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Marrying the macro- and microprudential dimensions of financial stability

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Bank for International Settlements
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Foreword

On 9-10 October 2000, the BIS hosted its annual autumn meeting of central bank economists. The topic of the meeting was "Marrying the macro- and microprudential dimensions of financial stability". With a view to stimulating debate on and study of this important topic, this volume makes available the papers discussed at the meeting. These papers address three broad policy questions:

(i) How do central banks monitor the risk of financial instability?

(ii) What mechanisms amplify or dampen financial cycles?

(iii) How should policymakers respond to developments that pose a threat to the stability of the financial system?

Recent years have seen central banks pay increased attention to monitoring the risk of financial instability. As the papers in this volume illustrate, the approaches adopted by various central banks have much in common, although there are certain important differences. Some central banks rely mainly on aggregate macroeconomic and prudential data, while others make extensive use of supervisory data on *individual* financial institutions. Moreover, some central banks rely heavily on models of the financial sector, while others use a more eclectic approach. Overall, the work on indicators of financial stability has led to a more focussed analysis and a greater understanding of the aggregate risks to the financial system, even if it has not led to the development of a simple indicator of financial stability.

A theme that pervades a number of the papers in the volume is the recurrence of financial cycles. These cycles are often characterised by rapid increases in credit and asset prices, and often end with some form of financial system stress. The papers discuss the factors driving these cycles, including the tendency for assessments of and attitudes to risk to be procyclical, incentive structures that encourage short-termism and the nature of regulatory arrangements. One important issue addressed in some of the papers is the tendency for bank provisioning to be backward looking. This tendency reflects both accounting rules and the methodologies that are used by banks to assess risk. Another important issue is the role of contagion in amplifying the downswing of the financial cycle.

The papers identify a number of policy options for dealing with the build up of systemic risk. The first is public discussion by the official sector of the nature of risks facing the financial system. The second is to use regulatory and supervisory policies in a countercyclical fashion or, less ambitiously, to make the financial system more robust to financial shocks. The third is to use monetary policy in an effort to constrain the development of financial imbalances that have the potential to cause financial and macroeconomic instability. The various papers discuss the advantages and disadvantages of each of these types of policies. One common consideration is the ability of policymakers to identify changes in risk sufficiently well to be able to respond. Another is the possible creation of moral hazard if the authorities systematically respond to changes in risk over time. A third important issue is the need to coordinate policy responses amongst authorities with different responsibilities.

Participants in the meeting

Australia:	Mr Christopher Kent Mr Keith Hall
Austria:	Mr Andreas Ittner Mr Markus Arpa
Belgium:	Mr Thierry Timmermans Ms Catherine Rigo
Canada:	Mr Sean O’Connor Ms Donna Howard
ECB:	Mr Jesper Berg Mr Mauro Grande
Finland:	Mr Kimmo Virolainen
France:	Ms Françoise Drumetz Mr Alain Duchâteau
Germany:	Mr Christian Upper Mr Andreas Worms
Hong Kong SAR:	Mr Guy Meredith Mr Eddie Yue
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United States:	Mr William Nelson Mr Wayne Passmore Mr Donald Morgan
BIS:	Mr William R White Mr Renato Filosa Mr Claudio Borio Mr Philip Lowe Mr Konstantinos Tsatsaronis

Procyclicality of the financial system and financial stability: issues and policy options

Claudio Borio, Craig Furfine and Philip Lowe[1]

1. Introduction

In recent decades, developments in the financial sector have played a major role in shaping macroeconomic outcomes in a wide range of countries. Financial developments have reinforced the momentum of underlying economic cycles, and in some cases have led to extreme swings in economic activity and a complete breakdown in the normal linkages between savers and investors. These experiences have led to concerns that the financial system is excessively procyclical, unnecessarily amplifying swings in the real economy. In turn, these concerns have prompted calls for changes in prudential regulation, accounting standards, risk measurement practices and the conduct of monetary policy in an attempt to enhance both financial system and macroeconomic stability.

In this paper, we examine these concerns and discuss possible options for policy responses. It is not our intention to formally model the complex interactions between the financial system, the macroeconomy and economic policy. Rather, we have the more modest goal of stimulating discussion on some of the key linkages between developments in the financial system and the business cycle. Our main focus is on the intrinsically difficult issues of how risk moves over the course of a business cycle and on how policymakers might respond to reduce the risk of financial instability, and attendant macroeconomic costs, that can arise from the financial system's procyclicality.

A common explanation for the procyclicality of the financial system has its roots in information asymmetries between borrowers and lenders. When economic conditions are depressed and collateral values are low, information asymmetries can mean that even borrowers with profitable projects find it difficult to obtain funding. When economic conditions improve and collateral values rise, these firms are able to gain access to external finance and this adds to the economic stimulus. This explanation of economic and financial cycles is often known as the "financial accelerator".[2]

While the financial accelerator presumably plays a role in all business cycles, it is not sufficient to generate the widespread financial instability that periodically leads to very large swings in economic activity. In this paper, we argue that an additional material source of financial procyclicality is the inappropriate responses by financial market participants to changes in risk over time.[3] These inappropriate responses are caused mainly by difficulties in measuring the time dimension of risk, but they also derive from market participants having incentives to react to risk, even if correctly measured, in ways that are socially suboptimal.

The measurement difficulties often lead to risk being underestimated in booms and overestimated in recessions. In a boom, this contributes to excessively rapid credit growth, to inflated collateral values, to artificially low lending spreads, and to financial institutions holding relatively low capital and provisions. In recessions, when risk and loan defaults are assessed to be high, the reverse tends to be the case. In some, although not all, business cycles these financial developments are powerful amplifying factors, playing perhaps the major role in extending the boom and increasing the severity and length of the downturn. We argue that the worst excesses of these financial cycles could be

[1] We would like to thank Joe Bisignano, Bill Coen, Renato Filosa, Stefan Gerlach, Bengt Mettinger, Bill White and, in particular, Kostas Tsatsaronis for their helpful comments. We are also grateful to the central banks that provided us with data and comments. Thanks are also due to Philippe Hainaut and Marc Klau for valuable research assistance. The views expressed are those of the authors and do not necessarily reflect those of the BIS.

[2] It has a long history, reaching back at least to Fisher (1933), and has recently been subject to extensive theoretical modelling by, amongst others, Bernanke and Gertler (1995) and Kiyotaki and Moore (1997). For a recent survey, see Bernanke et al (1999).

[3] In recent times, although from a somewhat different perspective, the role of financial excesses has been stressed by, amongst others, Kindleberger (1996) and (1995) and Minsky (1982).

mitigated by increased recognition of the *build up* of risk in economic booms and the recognition that the *materialisation* of bad loans in recessions need not imply an increase in risk.[4]

These measurement biases, which we argue go hand in hand with economic agents being better at measuring *relative* than *absolute* risk, can arise from a variety of sources. One such source is difficulties in forecasting overall economic activity and the link with credit losses; difficulties in assessing how *correlations* of credit losses across borrowers and, more generally, across institutions in the financial system change over time are part and parcel of the same problem. This tends to contribute to excessively *short horizons* and to an extrapolation of current conditions into the future. The short-term focus is also encouraged by incentive structures that reward short-term performance, and by certain aspects of accounting and regulatory arrangements. We argue that good risk management requires both a horizon for measuring risk that is longer than one year – the typical industry practice – and a consideration of system-wide developments. Not only would such an approach contribute to the soundness of individual institutions, it would also reduce the financial amplification of economic cycles.

Looking forward, proposed changes to the way in which bank capital is regulated are likely to increase the importance of accurately measuring changes in the absolute level of risk. The proposed changes are primarily designed to rectify current problems with *relative* capital charges. They represent a major step forward in aligning regulatory capital charges with the relative riskiness of banks' credit exposures (eg public sector versus private sector, high- versus low-risk corporates). As such, they significantly strengthen the soundness of individual institutions. At the same time, the proposed changes will naturally result in capital requirements on a *given* portfolio changing over time, as the assessed risk of that portfolio evolves. If risk is measured accurately, this has the potential to further enhance banks' soundness and reduce the procyclicality of the financial system. However, exploiting this additional potential arguably calls for improvements in current risk measurement practices and/or greater reliance on the supervisory review process. The New Basel Capital Accord, which proposes a strengthening of the supervisory review process, could provide a sounder basis for such increased reliance.

To the extent that procyclicality stems from inappropriate responses by financial system participants to changes in risk over time, we argue that there is a case for a public policy response. Four types of responses are possible. The first is the promotion of a *better understanding of risk*, through the publication of risk assessments by the authorities or through supervisory reviews of risk management practices. The second is the establishment of *supervisory rules* that, while not explicitly contingent on the cycle, promote better measurement of the time dimension of risk and make the financial system more robust to misperceptions of risk. Examples of such rules include requiring longer horizons for risk measurement, the use of stress testing and forward-looking provisioning. The third is the use of supervisory instruments in an explicitly *countercyclical* fashion in an effort to limit the development and consequences of serious financial imbalances. The common element of the two supervisory responses is that they directly or indirectly *encourage the building-up of a protective cushion in good times that can be drawn down in bad times.* The fourth response is to use *monetary policy* in an effort to contain the development of financial imbalances. We see scope for the application of all four types of policies, although we argue that *discretionary* countercyclical adjustments in either supervisory instruments or monetary policy aimed directly at addressing financial imbalances should only occur in those cycles in which financial overextension is playing a pre-eminent role.

Throughout the paper, we stress the endogeneity of the business cycle with respect to the collective decisions of financial institutions. In other words, misperceptions of the evolution of risk over time and inappropriate responses to it, as reflected in lending and financial investment decisions, serve materially to amplify economic fluctuations. At the same time, *it is important to emphasise that the appropriateness of the policy options we discuss does not hinge on this premise.* These options would still apply even if the course of the economy were completely unaffected by decisions in the financial sphere. Underestimating the risk of a downturn in economic activity and its impact on credit losses, as reflected in financial institutions' lending, provisioning and capital decisions, can be sufficient to generate financial instability. Policies designed to limit instability need to take this into account. *This is true regardless of whether that instability takes the form of financial distress at individual institutions,*

[4] See also Crockett (2000a) and (2000b) and Borio and Crockett (2000). This perspective is also emphasised in Kent and D'Arcy (2001).

typically the supervisors' concern, or of system-wide difficulties. Factoring in the financial amplification of economic fluctuations simply reinforces the argument for a policy response.

The remainder of the paper is structured as follows. Section 2 begins by setting out various definitions and concepts of risk. It distinguishes between relative and absolute risk and pays particular attention to the concept of systematic risk. It then discusses why the measurement of the evolution of risk over time – particularly its systematic component – is especially susceptable to error, and why, even if it were measured properly, financial market participants might still respond inappropriately. Section 3 briefly documents the procyclicality of the financial system. It provides a brief overview of the main stylised relationships between, on the one hand, business and financial cycles and, on the other, the performance of the banking industry and measures of financial system risk. In particular, it stresses how various measures suggest that assessed risk falls during upswings and increases during downswings. It also indicates that, at least in those countries that have experienced widespread financial difficulties, the capital cushion rose only after the bad loans materialised, and then started to decline when the economic upswing became firmly entrenched. Section 4 examines in more detail the risk measurement methodologies currently employed by banks, rating agencies and supervisors. It documents the focus on relative risk, the limited headway made in measuring correlations and, in most cases, the short-term horizon employed, all factors that can potentially promote misperceptions of risk. Section 5 focuses more specifically on capital and provisions and their relationship to risk. It lays out a normative framework against which their observed evolution can be assessed. It argues that capital and provisions should, in principle, rise as booms mature so as to act as an effective buffer once risk materialises in the downswing. It then considers factors that can help explain the observed cyclical patterns, focusing primarily on regulatory, accounting and tax elements, and briefly discusses the potential impact of the New Capital Accord. Section 6 examines the impact of practices and regulations concerning loan-to-value ratios and of the supervisory review process on procyclicality. Section 7 then discusses possible policy responses to cycles in systematic risk, and finally the Conclusion provides a brief summary of the main points of the paper.

2. Risk: concepts, measurement and incentives

"Risk" is a multifaceted concept. In order to understand better the themes developed in what follows, it is necessary to clarify various definitions and dimensions of risk. Of particular relevance are the distinctions between expected and unexpected losses (in the statistical sense), between relative and absolute risk, between idiosyncratic and systematic risk and between the risk of individual portfolios and that of the financial system as a whole. Armed with this classification, we then develop the basic thesis of the paper. In particular, we lay out the reasons why financial system participants may tend to misassess the evolution of risk over time, especially the systematic component associated with economic activity, and to respond to it in ways that may be socially suboptimal, thereby sowing the seeds of financial instability.

2.1 Basic terminology: definitions and dimensions of risk

One popular way of characterising risk is to describe it in terms of a probability distribution over future outcomes. In the case of credit risk – the focus of this paper – the term "risk" is normally used to refer to at least two quite distinct concepts, namely expected and unexpected losses, depending on which features of the distribution one focuses on.[5] "Expected losses" refer to the average or mean losses anticipated over a particular period, while "unexpected losses" refer to a measure of the dispersion, or degree of uncertainty that surrounds that outcome. This second notion of risk is closer in spirit to classical definitions of risk.

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[5] Of course, as amply demonstrated in the paper, credit risk and market risk are intimately related, as asset prices are a major cause of credit losses and as market gains on certain instruments, by generating market losses to counterparties, increase the likelihood of their default. The Asian and Russian crises were prime example of this. Box 1 addresses the relationship between credit risk and market risk, broadly defined as deriving from asset price movements generally. See eg Borio (2000) (and references therein) for a discussion of the relationship between market risk on marketable instruments and credit risk at times of stress, including the implications for market liquidity. Several of the policy lessons are analogous to those drawn in this paper for credit risk at business cycle frequencies.

To illustrate the two concepts, consider two banks of the same size. Bank A makes 100 loans for \$1 million each, while Bank B makes only one loan, but for \$100 million. Suppose that all loans have a 5% chance of default with no recovery in case of default, and that the correlation between defaults is zero. Both portfolios have expected credit losses of \$5 million, and therefore the two banks would be viewed as equally risky using the first concept of risk. However, using the second concept, Bank B is clearly more risky. It has a 5% chance of losing the entire \$100 million, while Bank A has virtually no chance (precisely $(0.05)^{100}$) of losing this amount. By virtue of Bank A's diversification, there is relatively little uncertainty about its future returns.

In the course of the paper, we use the term "risk" to refer to both the level of expected losses and the potential for large unexpected losses. When the analysis refers specifically to one or the other concept, we make this distinction clear.

Whether measuring the value of expected losses or the potential for large unexpected losses, it is important to distinguish between two dimensions of risk: relative and absolute risk.

Relative risk relates to the risk, in a cross section, of a particular financial instrument, portfolio or institution. This is the dimension involved in statements such as "Bond A is riskier than Bond B" or "Institution X is more risky than Institution Y".

Absolute risk relates to the specific value that the measure of risk takes at a particular point in time. Much of the paper relates to how the level of absolute risk varies over time. In what follows, we refer to this as the time dimension of (absolute) risk. For example, the statement "Portfolio X is more risky today than it was last year" concerns this time dimension of risk.

Focusing now on absolute risk, it is useful to distinguish between the risks of portfolios, institutions and groups of institutions (or "the system as a whole"). A bank, for instance, will be concerned with the credit risk associated with its portfolio of loans which, through the capital cushion, will map into the risk of default of the institution. This is also the risk with respect to which regulatory capital requirements are set. Crucially, the risk in the portfolio will depend on the correlation of the risk of default of the bank's counterparties. In much the same way, the risk of a group of institutions, or the system as a whole, will depend not just on the risk of the component institutions but, importantly, on the correlation between the risk of the individual institutions.

To bring out more clearly the relationship between the risk of individual institutions and that of the system as a whole, one can think of the financial system as a portfolio of securities, with each institution representing a security. The overall risk of the portfolio is not just the sum of the risk of individual institutions but depends fundamentally on the correlation between them. This distinction will play a key role in much of what follows. For instance, if capital requirements were to be set with a view to limiting the risk of the system as a whole, they might look rather different than if they simply focused on the risk of each institution separately, as is currently the case (see Section 5).[6]

Pursuing further the analogy with the portfolio of securities, the risk for each of these two types of "portfolios" can in turn be broken down into two components, the systematic and *non-systematic* (or *idiosyncratic*) component (Box 1).[7] The systematic component is, by definition, the one associated with the correlation between the component securities.[8] Conceptually, it can be thought of as arising from exposures to common factors, such as specific industries or the business cycle. There can, of course, be several such factors. In what follows, we will focus primarily, and somewhat loosely, on the systematic risk arising from exposure to the common factor associated with the business and financial

6 These points are elaborated in Crockett (2000b), where the supervisory perspectives that focus on individual institutions and the system as a whole are referred to as, respectively, "microprudential" and "macroprudential".

7 A useful exposition of these concepts as applied in portfolio theory can be found in standard finance textbooks, such as Elton and Gruber (1991).

8 This is also the component that cannot be diversified away simply by adding securities to the portfolio.

cycle.[9] In particular, we pay special attention to its time dimension. This can refer to the systematic risk in individual portfolios or banks or, depending on the context, to the system as a whole.[10]

2.2 The measurement of systematic risk: challenges and views

Measuring the time dimension of risk, especially its systematic component, is fundamentally difficult. For an individual institution it entails assessing not only how the riskiness of each individual borrower is changing over time, but also how the correlations between borrowers are changing. From the point of view of the system as a whole, a further complexity is the need to understand the correlations amongst individual financial institutions that arise from their exposure to common factors. In addition, while an individual institution might reasonably assume that the evolution of the economy is exogenous with respect to its actions, this is not true for the system as whole. The actions of individual institutions collectively affect the health of the economy, and the health of the economy affects the collective health of individual institutions.

Understanding the evolution over time of the systematic component of risk and hence the endogenous relationships between the financial sphere and the macroeconomy is central to the measurement of financial system risk. In particular, experience indicates that widespread financial system stress rarely arises from the contagion or domino effects associated with the failure of an individual institution owing to purely institution-specific factors. More often, financial system problems have their roots in financial institutions underestimating their exposure to a common factor, most notably the financial/business cycle in the economy as a whole.[11] This form of instability is also the more costly in terms of output forgone, with costs sometimes estimated to run well into double digits as a percentage of GDP.[12]

Despite this, there is no consensus as to how the overall level of risk in the financial system moves over the economic cycle. As Section 4 explores, many of the risk measurement methodologies used by banks, rating agencies and bank supervisors imply that risk falls during booms and periods of financial market stability and increases only during recessions and periods of financial turmoil. The view developed here is that it is better to think of risk as increasing in booms, not recessions, and that the increase in defaults in recessions simply reflects the materialisation of risk built up in the boom.

At its heart, the difference between these two views reflects a difference in opinion about the nature of economic processes that underlie the business cycle.

The view that regards risk as moving in line with current economic conditions is more consistent with the interpretation that the economy is best characterised by a series of frequent and small unpredictable developments, or shocks, that alter the economy's equilibrium, with the adjustment being smooth and rapid. As a result, by default, current conditions are seen as the best, if rather imprecise, guide to future conditions (Box 1). This view means that any observed cycles are mainly the result of the configuration of shocks, which by definition cannot be predicted ex ante.

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[9] By "financial cycle" we essentially mean the sequence of rapid expansion in credit and asset prices, often accompanied by a relaxation of price and non-price terms in access to external funding, that then moves into reverse and can ultimately be followed by financial distress. See Section 3.

[10] What is the difference between *systematic* risk for the system as a whole and *systemic* risk? One possible way of thinking about it is that systemic risk refers to the risk faced by the system as a whole, regardless of the source. For instance, systematic risk would not cover self-fulfilling crises driven by liquidity concerns (Diamond and Dybvig (1983)) or contagion from the failure of an institution due to purely idiosyncratic factors (eg gross mismanagement of operational risk) unless these causes are in turn thought of as separate common factors. In addition, from the viewpoint of the financial system in a *single country*, international diversification of system-wide risk is of course possible, so that a residual idiosyncratic component remains. For some related definitions and a survey on systemic risk, see De Bandt and Hartmann (1998).

[11] See Section 3. History suggests that even bank panics, or widespread bank runs, in the pre-safety net era bore a consistent relationship to the business cycle, tending to occur close after the peak (see Gorton (1988), for the United States, and Palgrave (1894), for the United Kingdom). Wood (1999) reviews this evidence critically.

[12] For a review of episodes and associated costs, see IMF (1998) and Hoggarth et al (2000).

Box 1

The basic hypotheses: a slightly more formal treatment

This box attempts to couch the basic hypotheses about the time dimension of risk that underpin our thinking in a factor analysis framework. In this framework, individual asset returns are assumed to have a systematic component which is a function of a number of stochastic risk factors common to all and an idiosyncratic component specific to the individual asset. For given stochastic properties of the factors, the sensitivities to each common risk factor are known as factor loadings and determine the correlation between any two assets' returns.

From this perspective, one can think of the basic hypotheses put forward in the paper as translating into statements about the stochastic properties of the risk factors and the factor loadings. In understanding this translation, it is important to realise that the main focus of the paper is on credit risk. Statements about credit risk require some mapping between asset returns and credit losses. The asymmetric nature of credit risk plays a significant role here. While the framework outlined above explains the fluctuation of asset prices in terms of the variation in the set of risk factors, credit risk relates to events that are realised in extreme negative states. Consider these points in turn.

The paper concentrates primarily on the behaviour of one specific factor, which for the moment can be thought of as overall economic activity. Other factors, such as the degree of sectoral diversification, are not explicitly considered, although they are obviously relevant for the assessment of systemic risk in the financial system. The basic claim made is that the stochastic process of the factor in question has some well defined time-varying properties. Specifically, it is argued that *movements in the factor are at least partially predictable and have a mean-reverting element.* This can be best thought of as representing the sequencing, not necessarily regular in timing, of upswing and downswing phases in economic activity. The obvious alternative would be to assume that the factor follows a random walk and is, in this sense, "unpredictable". The main text attempts to provide some economic justification for these different views.

One key implication of the mean reversion property is that if output is above trend, the (conditional) probability of a downswing increases with the forecast horizon. This implication underlies the bulk of the conclusions. And it holds regardless of whether financial mechanisms are a causal factor behind the cycle. As long as credit losses rise in a downswing, both expected and, under typical assumptions about their probability distribution,[1] unexpected losses would rise as the upswing proceeds.

The mapping between asset returns (as determined in the framework outlined above) and credit losses has some significant implications for the time properties of credit risk. These arise from the variables involved in the mapping, namely debt and the level of equity prices relative to the contractual value of debt, which can help in arriving at statements about the probability of default and loss given default, two key components of credit losses.

First, if asset returns are mean reverting, credit losses will also be mean-reverting. The time series pattern of the latter, however, is likely to exhibit greater "clustering", because in "good states", when equity prices are high relative to debt levels, defaults will be low, but they will be high in bad states. Likewise, it might be expected that, all else equal, loss given default would follow a similar pattern, at least for those credits backed by forms of collateral whose value is procyclical. One way of thinking of this is that in credit loss or default space the factor loading on (contemporaneous) business conditions is high in bad states and low in good states. This puts a premium on the need to rely on longer horizons.

[1] For example, the result follows automatically for binomial or Poisson distributions for the probability of default (Saunders (1999)) even disregarding correlation effects, which are discussed below.

Second, for *given* correlations of asset returns, correlations of credit losses will be higher, the higher is the probability of default.[2] The intuition is that the probability of one borrower defaulting conditional on another borrower doing the same is a decreasing function of its credit quality. That is, this probability is higher the closer the value of the borrower's assets is to that of its debt (ie the closer is the firm to its insolvency boundary). Thus, in contrast to asset returns, other things equal, higher expected losses also imply higher unexpected losses through this correlation effect. In addition, higher volatility of asset returns implies higher probabilities of default. This tightens the relationship between asset price volatility and default losses and correlations.

Third, in economic terms, there are a number of reasons why correlations of credit losses might be expected to rise in a downswing, more so than correlations of asset returns. During this phase, the actual incidence of defaults is more likely to reflect movements in the common factor than idiosyncratic elements specific to individual borrowers. For much the same reason, losses given default are likely to be more highly correlated. The changes in behavioural patterns that are typically associated with financial distress would contribute to heightening further these correlations and could lead to a stronger positive relationship between defaults and losses given default compared with normal times. In addition, credits have a strong "ageing effect",[3] whereby default rates peak three to four years after the credits have been granted. Since more new loans and bonds are issued as the upswing gathers pace, defaults would tend to bunch up with a lag. Any systematic misperceptions and underpricing of risk in the upswing would, of course, reinforce this phenomenon, by increasing vulnerabilities in balance sheets.

Here again, any mean-reverting, predictable element in the common factor plays a significant role. As a result of this property, lengthening the horizon would "telescope" the corresponding ex ante (conditional) correlations into the upswing phase. In other words, such (conditional) correlations would increase as the upswing proceeds.

Several empirical regularities regarding financial variables seem to be broadly consistent with the picture just described. The mean-reverting element over long horizons in asset returns, including equities, has been amply documented. The same is true of the relationship between these returns and business conditions, at least over periods spanning some of the shorter postwar cycles.[4] Measured asset correlations are known to rise, alongside volatility, during bear markets, peaking during periods of financial stress.[5] There is evidence of a negative relationship between credit quality, as proxied by credit ratings, and historical correlations of default. [6] And defaults of course tend to bunch up during recessions.[7]

[2] See Zhou (1997), Gersbach and Lipponer (2000) and Erlenmaier and Gersbach (2001).

[3] See, for instance, Saunders (1999) and references therein.

[4] For equities, see Fama and French (1988) and, in particular, Fama and French (1989), which also examines the relationship to business conditions and corporate spreads.

[5] For correlations, see Eng et al (1994), Solnik et al (1995) and Lin et al (1994), and for volatility, see eg Schwert (1989). There is a debate about how far the well documented increase in correlations during times high volatility, and hence possibly financial stress, reflects changes in underlying behavioural patterns or is purely a statistical property (eg Forbes and Rigobon (1999) and English and Loretan (1999)).

[6] See Lucas (1995).

[7] See also Carey (2000), who shows that simulated tail losses on portfolios, drawing randomly from "good" and "bad" years from a rating agency's database of loss experience on bonds, differ substantially. The author also notes that the difference does not capture the range of possible outcomes, since the period available (1970-98) does not include experience with a depression or with severe stress in many specific industries.

The view we prefer emphasises the relevance of sporadic but larger unpredictable developments, such as a clustering in technological innovations, and structural behavioural patterns that result in a cyclical response in the economy. Accordingly, the forces that lead to the upswing carry the seeds of the subsequent downswing. The financial cycle supported by credit expansion, asset price developments and their interaction with expenditure decisions, in particular capital accumulation, is a prime source of the cyclical pattern.[13] Such cycles cannot be predicted exactly. And their amplitude, length and characteristics will depend in part of the nature of the original unpredictable developments or triggers and the policy response.[14] But they are in the nature of economic processes. Moreover, there are observable factors that can be relied upon to help form useful conditional judgements about the likelihood and severity of recessions and financial system problems, although their timing may be close to impossible to establish with any precision (Box 1).[15] Such factors can be used as inputs into assessments of systematic risk.

The difference in the two views is not surprising given the experience of forecasters in predicting short-term macroeconomic developments. Despite recent research suggesting that a number of financial variables are useful in predicting recessions, macroeconomic forecasters have a poor record in predicting the exact timing of recessions or turning points in the business cycle.[16] This record has led some to eschew incorporating business cycle effects into risk measurement methodologies. To the extent that these methodologies focus on risk over a one-year horizon, this might be a reasonable approach. However, if longer horizons are used, as we argue should be the case, the approach is less justifiable. While a long-running business expansion might continue for another year, it is much less likely that it will continue for another five years. *Being able to predict the exact timing of a downturn is by no means necessary to design an appropriate response to it.* Using longer horizons would help lessen some of the emphasis on short-term forecasting, and promote a more thorough analysis of financial vulnerabilities associated with business and financial cycles. This would promote better assessments of systematic risk.

2.3 Factors underlying misperceptions of, and inappropriate responses to, risk

More generally, it is worth standing back and examining the set of factors that can result in either misperceptions of risk per se or inappropriate responses to it. Observationally, however, it is often hard to distinguish between the two.

The first set of possible factors includes the use of the "wrong" model of the economy to interpret developments. The economics profession is now accustomed to analysing economic processes on the assumption that agents understand what drives the economy and have sufficient information to infer, up to an unbiased error, where the economy is going (so-called "rational" or "model-consistent" expectations).[17] This assumption may be helpful in capturing the behaviour of agents in a very stable environment, where economic processes are characterised by regular, recurrent patterns.[18] It is less

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13 In this sense, this view has a long historical tradition. For example, the Austrian school, with its emphasis on waves of technological innovation and the role of credit in generating or supporting unsustainable booms, through their interaction with capital formation, is highly relevant here (eg von Mises (1912), Hayek (1933) and Schumpeter (1939)).

14 The potential amplitude of the financial cycle just described arguably depends on the set of institutional arrangements in the financial and monetary spheres. For example, during the period when high inflation coexisted with less liberalised financial markets, expansions would more naturally be brought to an end by contractionary monetary policy aimed at containing inflation. The scope for the financial cycle is likely to be greater when inflation is under control and markets are liberalised. See Crockett (2000a) and Borio and Crockett (2000) for an elaboration on these issues from a historical perspective and Gertler and Lown (2000) for evidence consistent with this hypothesis in the United States since the 1980s.

15 In the terminology of Box 1, output growth would be seen to follow a random walk, rather than having a mean-reverting component.

16 See, for instance, Andersen (1997), Artis (1996) and Granger (1996).

17 The formalisation of this very influential view goes back to Muth (1961) and Lucas (1976). After some resistance, it has become the prevailing paradigm, mainly because of the perceived intellectual ad hocery of alternative views and the difficulties of rigorously modelling looser notions involving rational learning. See also Lucas and Sargent (1979).

18 Even then, the fact that economic outcomes in turn depend on the beliefs themselves raises daunting identification problems. Ironically, it is precisely the endogeneity of beliefs with respect to the economic environment that has made rational expectations so influential and useful in analysing policy.

well suited, however, as a description of the evolution of beliefs in the real world. The observation of reality is generally not sufficient to adjudicate between alternative hypotheses in a definite way. Beliefs can reasonably differ, even substantially, without necessarily being contradicted by events, depending on the priors held by individuals and the weight that they attach to different observations.[19] An obvious example is the debate about the scope and implications of the so-called New Economy and the present wave of technological change.

This approximate "observational equivalence" of different paradigms can provide fertile ground for the formation of persistent misperceptions of risk. It can do so by failing to anchor expectations sufficiently tightly to the actual economic environment. The measurement of systematic, as opposed to idiosyncratic risk, is more likely to involve such misperceptions, not least owing to the dearth of observations available regarding business cycles in comparison with the relative default experience of borrowers and the conceptual difficulties involved, as discussed above.[20] Beliefs can therefore be more vulnerable to the attraction of short-cuts, such as the use of short-term horizons and extrapolative expectations, or to cognitive biases.

Two types of well-documented cognitive biases consistent with the misperceptions of risk stressed in this paper are "disaster myopia" and "cognitive dissonance".

Disaster myopia refers to the tendency to underestimate the likelihood of high-loss low-probability events.[21] This, in turn, derives from certain cognitive biases, confirmed by psychological controlled experiments, which indicate that individuals tend to put excessive weight on recent events and too little weight on those whose likelihood is regarded as "too" small.[22] Cognitive dissonance refers to the tendency to interpret information in a biased way, so that it reinforces the prevailing belief entertained by the economic agent.[23]

These cognitive biases could easily generate perceptions of risk that move procyclically. As the expansion proceeds, the memory of the materialisation of risk diminishes and incoming data are interpreted as reinforcing the view that the economy is moving along a sustainable higher expansion path. What are short-run cyclical movements are perceived as part of a new, longer run trend. This process then moves into reverse, as actual defaults and other incoming information unambiguously contradict the prevailing paradigm.

In addition to misperceptions of risk, complementary explanations of excessive procyclicality point to actions that, when taken in isolation, may appear reasonable, if not compelling, but that collectively add up to undesirable social outcomes. In other words, risk may be correctly perceived, but the response to it may not, in the aggregate, be appropriate. This outcome may result from a failure to internalise the consequences of the actions of others, the impossibility of coordinating responses or simply the fact that the costs would be borne by other groups in society.

Certain types of response may be reasonable when seen from the perspective of individual agents regardless of what the others do.[24] For instance, in a downturn, it may be compelling for an individual bank to tighten lending terms.[25] Others, faced with the similar situation, would have the incentive to do

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19 One version of this notion, known as "rational beliefs", has recently been formalised by Kurz (1997) and (1998), who also derives implications for the behaviour of financial markets generally and asset prices in particular.

20 In statistical terms, the problems of limited power that plague tests of the validity of estimates of the tails of probability distributions for market risk (Kupiec (1995)) are therefore compounded in the case of credit risk (eg Saunders (1999)). The problems are particularly acute in the case of estimates of parameters such as correlations of default (McCallister and Mingo (1996)).

21 See the original treatment by Guttentag and Herring (1984) and (1986). See also Herring (1999) for a discussion of disaster myopia in the context of recent techniques for the measurement and management of credit risk.

22 These are known, respectively, as "availability heuristic" and "threshold heuristic". On the former, see Tversky and Kahneman (1982); on the latter, see Simon (1978) and Slovic et al (1977). Kunreuther et al (1978) contains experimental evidence in favour of these hypotheses. See also Herring (1999).

23 The theory was developed by Festinger (1957).

24 This is known as the "prisoner's dilemma" or more correctly, in the case of many agents, the "tragedy of the commons".

25 This is almost certainly the case if others do not tighten. It also makes sense if others do tighten, since the action of any individual bank, taken in isolation, would not be such as to lead to a sufficient deterioration in the economic environment to make the bank worse off. The exception might be highly concentrated banking systems.

likewise. The result, however, would be a widespread reduction in the availability, and increase in the cost, of external funding, which would protract the slowdown. Analogous incentives might help lengthen the upswing. In the pursuit of long-term profits and out of fear of losing customers, lenders can face strong incentives to keep lending.[26] But if everyone does so, at some point overextension may result.

Other courses of action may appear reasonable from the perspective of individual institutions precisely as long as others do likewise. This can result in so-called "herding behaviour", where agents conform their behaviour to that of their peers.[27] Herding may relate to the use of information, in which case it could be a direct source of misperceptions of sustainable asset values and risk.[28] More generally, it can provide fuel for lending booms and contractions, amplifying the financial cycle. Arguably, the most common factor behind herding behaviour is reward structures that limit blame in the case of collective, as opposed to individual, failure. There may be, for instance, a strong tendency not to blame individual managers for the failure of their bank if failures are widespread. Collective failure would signal homogeneous managerial skills, pointing to realistically small gains from a change in management.[29] Moreover, the authorities might be perceived as more likely to support institutions in the event of widespread financial difficulties in an attempt to limit the severity of the crisis.[30] In such situations, the pressure to conform to the norm can be quite strong. Formal compensation schedules that emphasise relative performance can exacerbate this tendency.[31]

More generally, inappropriate responses to risk may derive from shortcomings in contractual arrangements.[32] Arrangements that stress short-term performance are one such example. If rewards are front-loaded in comparison with penalties, there is little incentive to take a longer-term view.[33] The problem is compounded if remuneration is not risk-adjusted. Such arrangements, in fact, are quite common. Obvious cases in point include the payment of fees up front and of bonuses related to unadjusted profitability or to the volume of business, such as to loans extended or funds under management.[34]

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26 For instance, in interviews following the Asian crisis, bankers noted that they were indeed cognisant that the spreads "dictated" by the market underpriced risks, but that they had strong incentives to keep lending (invest in securities) owing to longer-term considerations. See CGFS (1998).

27 Devenow and Welch (1996) provide a short review of rational theories of herding behaviour. Not all such herding behaviour need result in undesirable collective outcomes. Herding may also reflect cognitive biases and more deep-seated traits of human nature (eg Daniel et al (1998) and Prast and Herding (forthcoming)). Evidence of herding has been documented for institutional investors (Nofsinger and Sias (1999)), for investment newsletters (Graham (1999)), for stock prices (Avery and Zemsky (1998)) and for bank lending decisions (Jain and Gupta (1987)). Welch (2000) has also found evidence that herding in the advice of securities analysts based on the prevailing consensus is more likely to take place when the outcome later turns out to be wrong, pointing to undesirable collective outcomes.

28 The theory of so-called informational cascades is one such example. See, for instance, Bikhchandani et al (1992) and Barnejee (1992).

29 See, for instance, Rajan (1994).

30 Acharya (2000) shows formally how this can result in herding behaviour that is socially suboptimal, as systematic risk is increased excessively.

31 For example, formal assessment of performance in relation to the median is common in the asset management industry in the United Kingdom (Blake et al (1997)).

32 Note that what are referred to here as shortcomings in contractual arrangements may represent difficulties in reconciling fundamental differences in interests and perspective. For example, a diversified shareholder would not be concerned with the idiosyncratic risk associated with the share in an individual company/bank nor, given limited liability, would it care about the loss given failure, as a regulator would. The oft-heard complaint by managers or risk controllers that shareholders are demanding returns not commensurate with risk may reflect at least in part such differences in perspective, quite apart from any overly optimistic expectations about risk/return trade-offs.

33 Herring (1999), for instance, discusses the benefits of having risk-based compensation systems.

34 A common explanation for distorted incentives leading to increased likelihood of systemic distress is the moral hazard associated with mispriced implicit or explicit government guarantees, such as those associated with bailout expectations or deposit insurance schemes. This can indeed fuel lending booms, sowing the seeds for subsequent crises. At the same time, the value of the corresponding implicit subsidies would, if anything, move countercyclically alongside perceptions of risk, falling in booms and increasing in recessions.

The bottom line is that several, often related and mutually reinforcing factors provide fertile ground for misperceptions of risk, or inappropriate responses to it, that can lead to excessive procyclicality in behaviour. By the same token, they can also amplify the financial and business cycles. These factors are reflected in financial quantity and price indicators that behave as if risk was perceived to decline in the upswing and rise only once it materialised. Such excessive waves of apparent optimism and pessimism in turn heighten the risk of financial instability.

3. Financial and business cycles and financial indicators of risk

Empirical evidence is generally consistent with the view that the procyclicality[35] of the financial system can be at the root of financial instability and that measures of risk behave as if risk declined during the upswing phase and rose only close to the peak or as the downswing set in. While it is beyond the scope of this paper to present new evidence, it is helpful to document in stylised terms the highly cyclical nature of the financial sector and of measures of financial system risk.

The procyclicality of credit and asset prices has been amply documented and is summarised for a sample of industrial countries in Figures 1 and 2. Periods of robust economic growth tend to be associated with significant increases in the ratio of credit to GDP, and recessions with declines in this ratio. Likewise, episodes of strong credit growth tend to go hand in hand with large increases in equity and property prices, and, to varying degrees, these prices tend to decline as credit contracts in the downswing.[36] *Ex post*, a financial cycle is clearly apparent.

There are, of course, several possible reasons for such co-movements. And there is a debate regarding how far developments in the financial sphere cause, rather than reflect, the evolution of economic activity. This is true, in particular, for those changes in the cost and availability of external financing associated with imperfect substitutability between internal and external funding,[37] such as the easier extension of credit as the net worth and value of collateral held by borrowers increases. There are, however, good a priori grounds to believe that the process feeds on to itself. Moreover, it also stands to reason that the influence of financing constraints should become especially relevant as economic agents, suppliers and recipients of funds alike, face financial distress. In industrial countries, typical examples include the financial "headwinds" that appeared to inhibit the recovery following strains in the US banking system in the early 1990s and more recently, the serious difficulties faced by the Japanese economy following the banking crisis.[38] More generally, the recent record of financial crises, especially those in Latin America and Asia in the 1990s, amplified by boom and bust movements in international capital flows, has been interpreted as providing evidence of a sizable causal role of financial factors.[39]

Above all, experience suggests that overextension in the financial system, in the form of rapid credit expansion and unusually sharp increases in asset, especially property,[40] prices during the economy's

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35 To avoid confusion, in what follows the movement in a financial indicator is said to be "procyclical" if it tends to amplify business cycle fluctuations. According to this definition, for instance, provisions behave procyclically if they *fall* in economic upswings and *rise* in downswings.

36 Formal econometric evidence on credit/asset price cycles in industrial countries can be found in Borio et al (1994). Kent and D'Arcy (2001) examine four major credit and property price cycles and their relationship with financial stability in Australia since the 1870s.

37 This is the "financial accelerator" hypothesis, as articulated in detail by Bernanke et al (1999) in particular. Much of the formal statistical evidence testing this hypothesis relies on panel data and applies to the United States (Hubbarb (1998). More recently, the hypothesis has been tested with some success with time series macroeconomic data, with the spread between low- and high-quality corporate bonds being used as a proxy for the premium on external funding costs (Gertler and Lown (2000)).

38 See Gibson (1995) and Peek and Rosengren (1997) and (2000) for evidence that Japanese banking troubles had real effects. Hancock and Wilcox (1998) provide similar evidence for US banks.

39 See for example the papers in Gruen and Gower (1999).

40 Borio et al (1994), BIS (1993) and various issues of the BIS Annual Report document in detail the behaviour of residential and commercial real estate prices across countries. A classic reference on historical cycles in property prices in the United States is Hoyt (1933).

upswing, tends to sow the seeds for subsequent strains in the financial system, once the movements reverse. In the industrial world, this was the case, to varying degrees, in those countries that experienced banking system problems in the early 1990s, including the United States, Japan, the United Kingdom, Australia, Sweden, Norway and Finland. Similar evidence can be gleaned from the more virulent episodes of financial instability in emerging market countries in the 1980s and 1990s, where boom and bust cycles tend to be more pronounced.[41]

While the behaviour of credit and asset prices just described is broadly consistent with the view that assessments of risk are procyclical, more direct evidence can be obtained from the evolution of credit spreads on bonds traded in financial markets, credit ratings and bank provisions.[42]

Typically, bond spreads are negatively correlated with the business cycle, with spreads between corporate and government securities tending to narrow in booms and widen in recessions or in periods of financial turmoil. As an illustration, Figure 3 shows the evolution of credit spreads in the United States and Korea. In the United States, spreads generally narrowed in the run-up up to the recession that began in late 1990 and then widened during the recession.[43] Spreads also increased during late 1998, in the aftermath of the Russian debt default and the problems experienced by the hedge fund Long-Term Capital Management.[44] The data for Korea focus on this latter period and show that spreads did not widen before the crisis, but increased by nearly 600 basis points at the same time that the currency was depreciating dramatically.

The picture is not fundamentally different if the ratings from credit rating agencies are examined. For instance, Figure 4 shows the recent movement of sovereign credit ratings for Korea and Thailand assigned by the three largest credit rating agencies, Standard & Poor's, Moody's and Fitch IBCA. In both countries, ratings were stable during the period of rapid growth, and were only adjusted after the currencies depreciated dramatically; in Korea's case, repeated downgrades saw the country's rating fall from a AA credit to a junk rating in a matter of months. Then, as currencies strengthened, credit ratings were upgraded. More generally, the evidence suggests that credit rating agencies fail to predict changes in the probability of crises, with downgrades occurring during a crisis, rather than before.[45]

Bank provisions are even more strongly procyclical, being highly negatively correlated with the business cycle (Table 1). Figure 5 shows that provisions typically do not increase until after economic growth has slowed considerably and often not until the economy is clearly in recession. This pattern is clearest in Australia, Sweden, Norway and Spain. In each of these cases, provisions failed to increase substantially in the late 1980s, when credit and asset prices were growing rapidly and the financial imbalances were developing. In each case, the peak in provisions did not occur until at least one year after the economy had clearly slowed. In Japan, the picture is broadly similar, with the level of provisions increasing substantially only in the second half of the 1990s, long after the problems in the Japanese banking system had been widely recognised.[46]

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41 For instance, a review of the 1997 Asian crisis stressing these elements can be found in BIS (1997). The role of lending booms, possibly fuelled by financial liberalisation and increasing competition, is stressed, among others, by Gavin and Hausmann (1996), Honohan (1997), Kaminsky and Reinhart (1999), Gourinchas et al (1999) and Eichengreen and Arterta (2000). The dearth of data on property prices makes it hard to test formally for their significance, although their role has been widely recognised; see BIS (1997).

42 In addition, recently Lown et al (2000) have provided evidence for the United States on the procyclicality of non-price terms on lending.

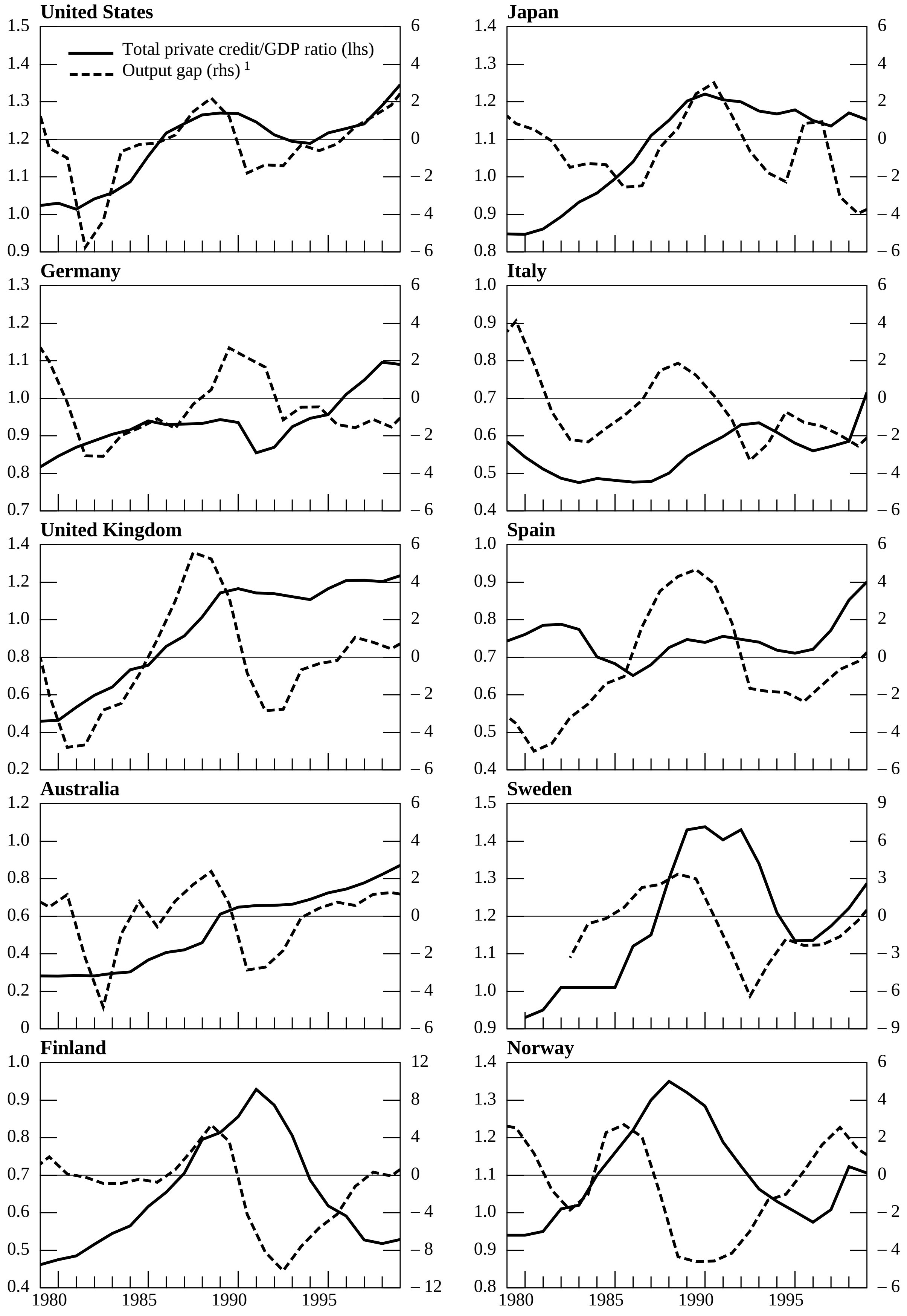
43 Gertler and Lown (2000) find that, in addition to moving contemporaneously with economic activity, the spread between low- and high-quality corporate bonds has some leading indicator properties at one-year horizons. See also Fama and French (1989) for a historical perspective on the relationship between the corporate yield spread and business cycles.

44 Formal econometric evidence of emerging market spreads consistent with this picture can be found in Cline and Barnes (1997), Eichengreen and Mody (2000a) and Kamin and von Kleist (1999). A similar analysis for spreads on syndicated loans can be found in Eichengreen and Mody (2000b).

45 For example, Haldane et al (2000) report that Moody's and Standard and Poor's downgrade sovereign ratings *prior* to a crisis in less than 25% of cases. In most instances, the downgrades occur during, or immediately after, the crisis.

46 The (low) positive correlation between provisions and the business cycle in the United states appears to be driven by the surge in provisions in the second half of the 1980s, which would seem to reflect mainly the delayed cleaning of balance sheets following the developing countries' debt crisis of the early 1980s.

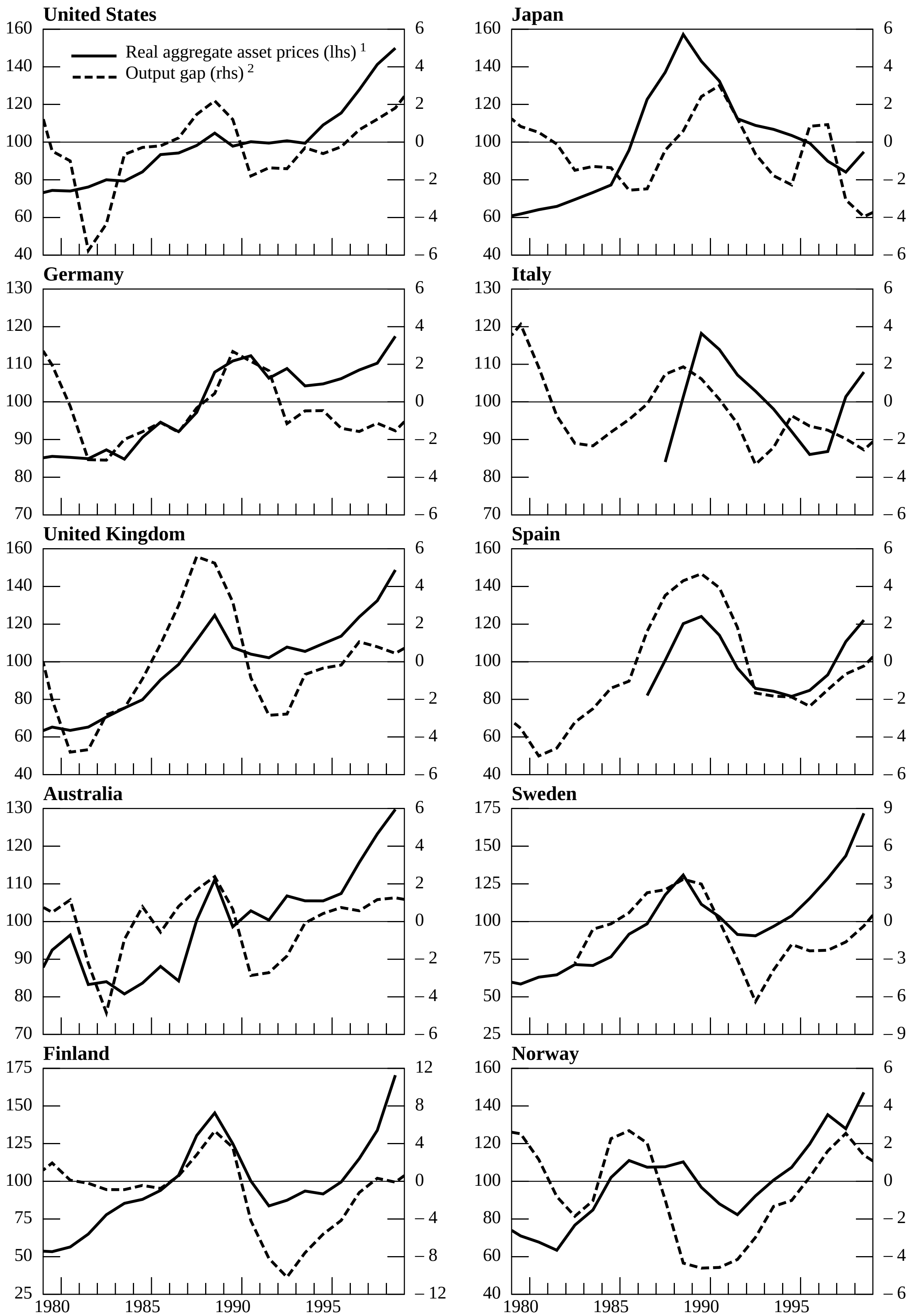
Figure 1: Total private credit



[1] As calculated by the OECD.

Sources: OECD Economic Outlook; national data.

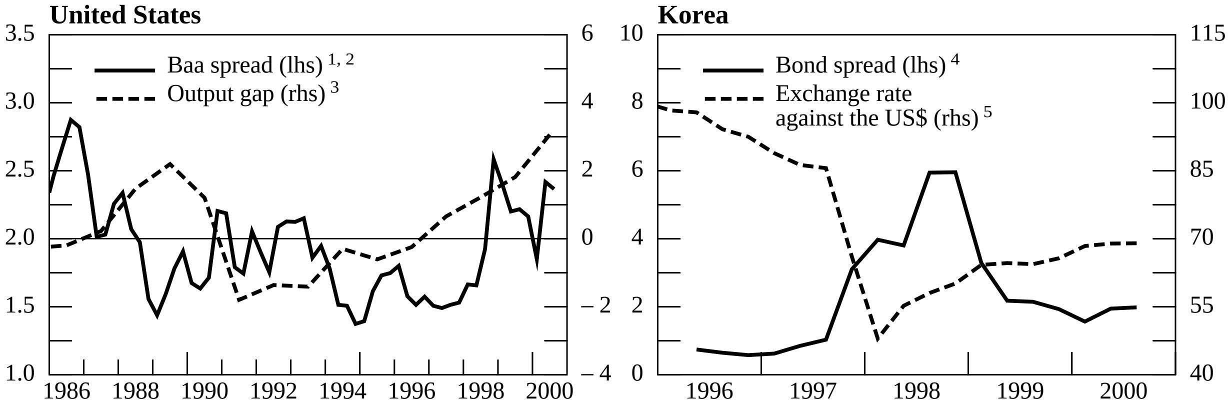
Figure 2: Real aggregate asset prices



[1] Indices, 1980-99 = 100 (for Italy, 1988-99; for Spain, 1987-99); weighted average of equity and residential and commercial real estate price indices deflated by consumer prices; the weights are based on the composition of private sector wealth.
[2] As calculated by the OECD.

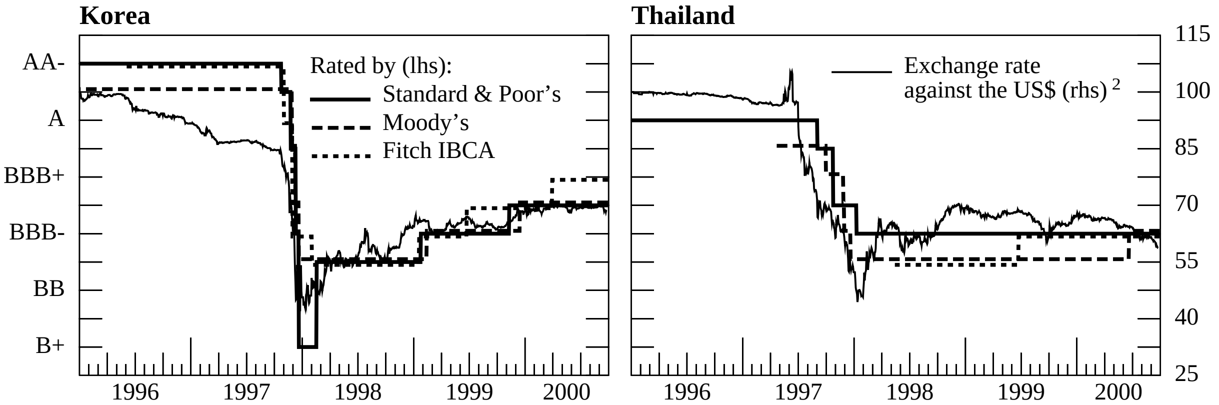
Sources: OECD Economic Outlook; BIS calculations.

Figure 3: Credit spreads



[1] In percentage points. [2] Spread between corporate and 10-year government bond yield. [3] As calculated by the OECD.
[4] Spread between US$ denominated sovereign bond and US Treasury bond. [5] Index end-1995 = 100.
Sources: Board of Governors of the Federal Reserve System; Datastream; Moody's; OECD Economic Outlook; national data.

Figure 4: Sovereign credit ratings [1]



[1] For long-term foreign currency debt; in the notation of Standard & Poor's methodology. [2] Index end-1995 = 100.
Sources: Datastream; Fitch IBCA; Moody's; Standard & Poor's.

Table 1

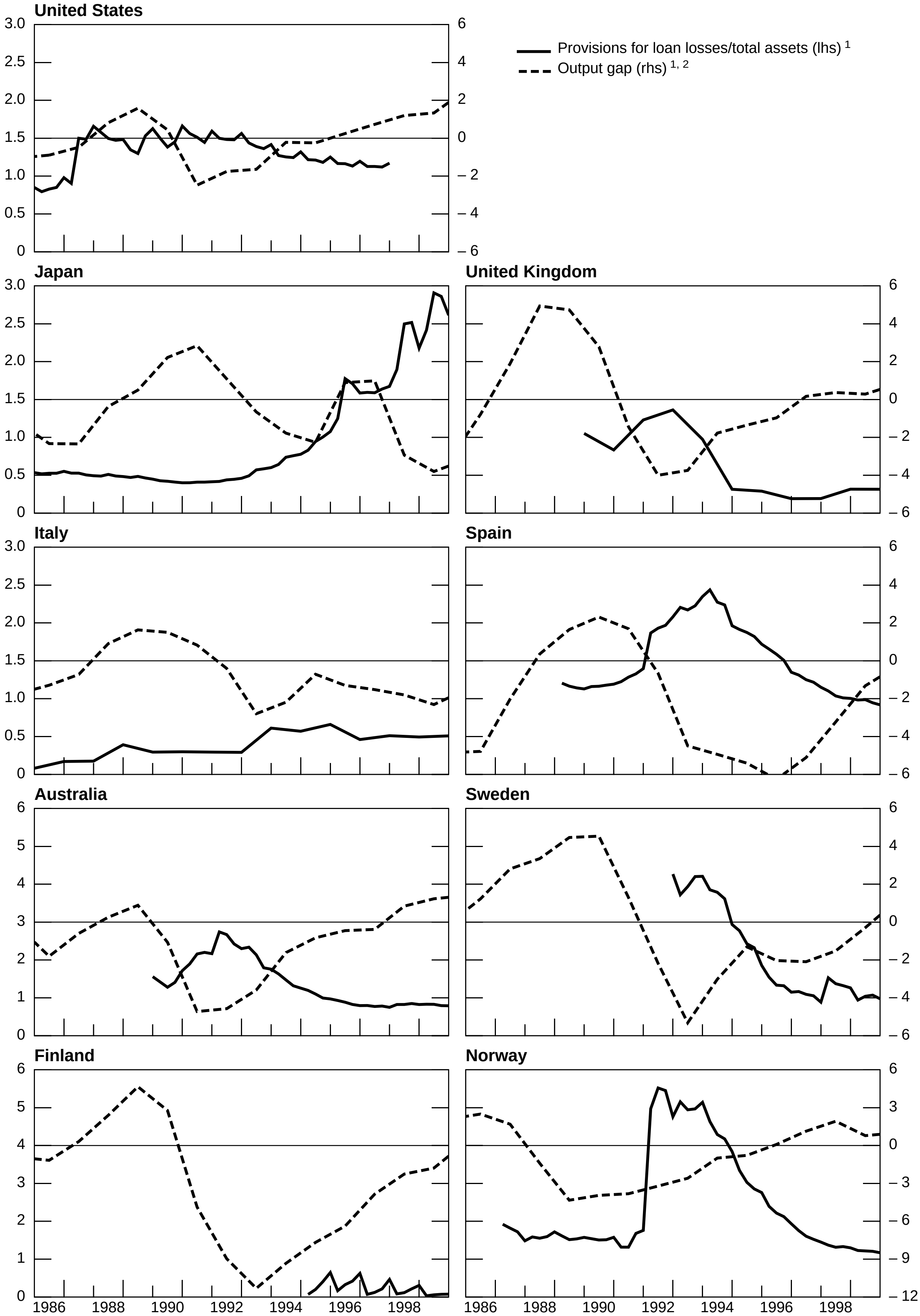
Correlations between the output gap and measures of banking system performance

	Correlation between current output gap and bank:			
	Provisions	**Profitability**	**Equity prices**	**Capital**
Australia	– 0.88	0.71	0.47	– 0.39
Finland	–	0.81	0.43	0.04
Germany	– 0.21	– 0.42	0.18	0.20
Italy	– 0.21	0.25	0.10	– 0.25
Japan	– 0.43	0.22	0.30	– 0.25
Norway	– 0.35	0.54	0.03	0.41
Spain	– 0.41	0.84	0.32	0.06
Sweden	– 0.83	0.60	0.26	– 0.16
United Kingdom	– 0.38	0.12	0.26	0.26
United States	0.14	0.24	0.12	– 0.04

Notes: 1. Profitability = gross profit/total assets; provisions = provisions for loan losses/total assets; capital = capital/total assets; equity prices = deviation of real equity prices (calculated with the CPI) from a log trend (using the HP filter). 2. Data periods vary across series. For most countries, equity prices from at least 1980 are used. For profitability, provisions and capital, data generally commence in the 1980s.

Sources: OECD; BIS survey; BIS calculations.

Figure 5: Bank provisioning



[1] In percentages. [2] As calculated by the OECD.

Sources: BIS survey; OECD Economic Outlook.

In large part, the behaviour of provisions translates into a clear procyclical pattern in bank profitability, which further encourages procyclical lending practices. This pattern appears to be strongest in those countries that experienced banking system problems in the 1990s (Table 1). German banks are the only exception to this procyclical behaviour, given their ability to smooth profits through hidden reserves. The procyclical nature of bank profits has arguably also contributed to bank equity prices being positively correlated with the business cycle, although the correlation is typically somewhat weaker than that for profitability, reflecting the forward-looking nature of the equity market.

The relationship between the business cycle and bank capital is less obvious (Table 1 and Figure 6). While it is clear that the level of bank is positively correlated with the economic cycle, there does not appear to be a robust relationship between measured capital ratios and the business cycle. To some extent, the task of detecting any relationship is made difficult by the introduction of the Capital Accord in 1988, which some have argued caused a structural change in capital ratios in some countries.[47] Analysis is also complicated by the fact that government support schemes have influenced capital ratios. Nevertheless, long-run historical time series do not suggest a strong business cycle effect, with the main stylised fact being a steady decline in capital ratios over the 20th century, before a slight increase over the past decade or so.

At the same time, there are two important qualifications to the conclusion that capital ratios tend to be acyclical. The first is that, to the extent that provisions underestimate expected losses in expansions, *measured* capital ratios overstate *true* capital ratios in expansions. This effect can be significant. For example, if the ratio of provisions to total assets is 1 percentage point below where it should be, then the measured capital ratio is likely to overstate the true capital ratio by at least 10%. If adjustments were made to capital for underprovisioning in economic booms, it is likely that, all else constant, measured capital ratios would fall during expansions and increase during downswings.

The second qualification is that there has been a pronounced cycle in aggregate capital ratios over the 1990s in those countries that experienced problems early in the decade. In the years immediately after the crisis, when conditions were still relatively depressed, banks made a concerted effort, not only to rebuild their capital ratios, but also to substantially increase them above previous levels. Then, starting in the middle of the decade, when economic expansions were firmly entrenched, some of the increase in capital ratios was unwound. This pattern is evident in Australia, Sweden and Norway, and to a lesser extent in Finland.[48]

Further, the cycle in the ratio of capital to risk-weighted assets was much more pronounced than the cycle in the ratio of capital to total assets. This reflects the fact that, in the aftermath of the banking crises, risk-weighted assets fell more strongly than total assets, as banks shifted their portfolios away from commercial lending (which has a relatively high risk weight) towards residential mortgages and public sector securities (both of which have relatively low risk weights).

Overall, these various indicators suggest that perceived risk in the financial system does not increase in business cycle expansions, and that it may actually decline during periods of robust economic growth. They also suggest that typically risk is assessed to have increased only when credit losses materialise, rather than when the problems that underlie the losses are building up.[49] These risk assessments sit uncomfortably alongside recent experiences, which suggest that business cycle expansions underpinned by rapid credit growth, large increases in asset, especially property, prices and high levels of investment (particularly in the property sector) can sow the seeds of subsequent financial system problems. While incorporating the lessons from these experiences into risk measurement systems is not straightforward, doing so would help improve the way in which risk is assessed to evolve over time.

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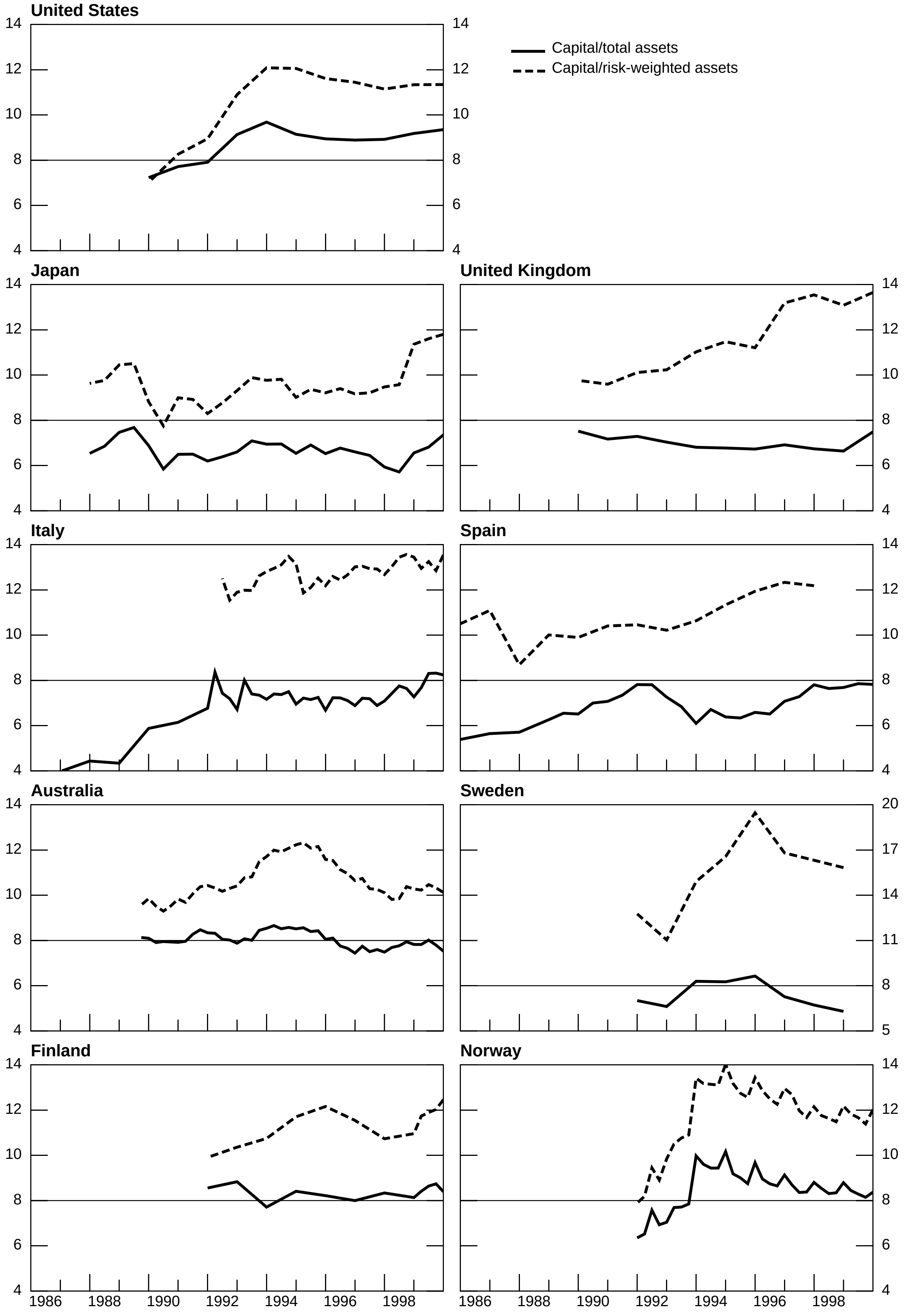
[47] For a survey of the impact of the Basel Capital Accord, see BCBS (1999a).

[48] In Section 5, we consider the reasons for this.

[49] One set of alternative explanations of analogous patterns in asset price behaviour seeks to explain them as reflecting changes in equilibrium required returns by risk averse investors. For instance, Fama and French (1989) document how corporate bond spreads and dividend-price ratios are comparatively high in weak business conditions and low in strong conditions and how these variables can help to forecast future corporate bond and equity returns. Low dividend yields or spreads tend to be followed by sup-par asset price performance. This is interpreted as reflecting comparatively low (high) required returns in good (bad) times. See Campbell et al (1999) for an overview of attempts to explain asset returns along these lines.

Figure 6: Capital-asset ratios [1]



[1] In percentages.

Sources: BIS survey; OECD Bank Profitability.

4. Risk measurement methodologies

As argued in Section 2, a number of factors could explain possible misperceptions of, and inappropriate responses to, risk and contribute to the observed procyclical behaviour in market indicators of risk documented in Section 3. Here, we review in more detail the main risk measurement methodologies actually employed in the financial system, including banks' internal rating systems, ratings by credit rating agencies, credit risk models and the approaches used by bank supervisors and other policymakers. We argue that while, in general, these methodologies are well suited to addressing relative risk, they have difficulty in measuring the systematic component of risk associated with financial and business cycles. This difficulty stems from the relatively short horizons that are often used to assess expected and unexpected losses and from insufficient attention being paid to the movement of correlations over time.

4.1 Commercial banks' internal rating systems

Many banks have recently increased the attention paid to the quantification of risk. This has typically involved the development and implementation of internal grading systems, which classify loans into specific risk categories or ratings.[50] These internal ratings are used as inputs into decisions regarding pricing, capital allocation and provisioning.[51]

Most internal rating systems have a "point-in-time" focus and use a one-year horizon for measuring risk. This means that the systems are designed around the idea of measuring the probability of default over the next year. The choice of a one-year horizon is driven by a variety of factors, including the availability of data, the internal budgeting cycle of the bank, and the interval in which new capital can be raised or loss mitigation action taken.[52]

The nature of the internal rating systems means that the average rating of a bank's loan portfolio is likely to change over the course of the business cycle. When economic conditions are strong, loans are likely to move up the rating scale (to lower-risk ratings) given that the probability of default in the next year is relatively low. Conversely, in an economic downturn the average rating is likely to decline, given the increased probability of default in the short run. As a result, measured risk, as revealed by average internal ratings, is likely to be negatively correlated with the economic cycle - that is, it falls in booms and increases in recessions.

The correlation issue is not relevant for simple rating schemes, although it is critical in assessments of overall portfolio risk; see Section 4.3.

4.2 External rating agencies

The approach used by most credit rating agencies attempts to rate borrowers "through the cycle". This means that ratings are less likely to move over the course of the business cycle, with borrowers being rated on their probability of defaulting in a constant hypothetical downside scenario.[53] Ratings will only change over time if the rating agency changes its assessment of the probability of default in the downside scenario, or changes the scenario itself.[54]

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50 For a recent survey of banks' internal rating systems, see BCBS (2000a).

51 For example, English and Nelson (1998) use survey information for United States banks to document the fact that lower-rated credits are charged a higher price (both in terms of interest rates and non-price terms of credit).

52 See the survey by the BCBS (2000a). The survey also notes that banks that use a longer horizon do so because their exposures are typically held to maturity and because of a lack of markets in which their credits can be traded.

53 For a comprehensive overview of the credit rating industry, its approach to measuring risk, and its successes and failures, see BCBS (2000b).

54 Carty and Fons (1994) report that during the period 1980-1993, 88% of all ratings remained unchanged over a one-year horizon. This number is lower than the 95% stability of ratings reported for the 1950-1980 period. Lucas and Lonski (1992) have also documented the volatility of ratings, reporting that 1% of issues rated AAA and 9% of issues rated Baa were downgraded to speculative grade within five years.

The through-the-cycle approach does not guarantee that the ratings will be acyclical. In particular, an economic downturn that is worse than expected is likely to lead to ratings being downgraded. Table 2 summarises evidence from a recent study that documents this empirical fact.[55] The authors' estimates show that the probability of being downgraded, particularly for bond issues at either end of the rating scale, rises during recessions and falls during booms. Despite this, it remains likely that these ratings are less procyclical than internal bank ratings (Box 2).

Historically, the agencies have been relatively successful at measuring the cross-sectional dimension of risk.[56] As discussed in Section 3, however, they have been less successful in downgrading ratings prior to a borrower defaulting.[57]

4.3 Quantitative credit risk models[58]

Given that the focus of internal and external ratings is on measuring the risk of individual instruments or borrowers, such systems do not explicitly consider the correlations between ratings and how these correlations change over time. Thus, such ratings by themselves cannot easily be used to address the credit risk of large and complicated portfolios. As a result, a number of financial institutions have recently developed, or purchased, quantitative credit risk models.

While the various models have different structures, most tend to extrapolate recent history in one way or another, so that good current economic conditions signal good future prospects.[59] Moreover, while the various approaches incorporate correlations, the treatment is often simplistic, with correlations either fixed or dependent on the recent history of financial markets.

One of the most commonly used approaches relies on equity price data and option pricing theory to construct measures of risk. In these "Merton-type" models, a rise in a firm's indebtedness, a fall in its equity price or an increase in the volatility of its equity price leads to an increase in the measured probability of default (all else constant) of the firm over the next year.[60] Even where estimates can be calculated over a multi-year horizon, the assumptions made result in simple extrapolations that effectively rule out business cycle effects. [61] The correlations between firms are derived on the basis of past movements in equity prices.

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55 See Nickell et al (2000).

56 See Moody's (2000). A more scientific documentation of the success that rating agencies have had in distinguishing the cross-sectional dimension of risk can be found in Brand and Bahar (1999) and Keenan (1999).

57 More generally, credit ratings are less successful at measuring the time dimension of risk. For instance, Cantor and Packer (1994) document that the default rates associated with each rating change significantly over time. For example, over the period 1970 to 1989, the five-year default rates associated with a BBB rating ranged anywhere from 0.8% to nearly 5%.

58 A review of the historical developments in credit risk modelling can be found in Altman and Saunders (1997). A summary of the most popular models currently in use can be found in Saunders (1999), which also contains an extensive bibliography on the measurement of credit risk. Crouhy et al (2000) and Gordy (2000) provide a more technical and detailed comparative analysis of the models.

59 While there are a number of papers that compare and contrast the different models, we know of no literature that compares how aggregate measures of risk generated by these models are likely to move over the course of the business cycle. Given the increasing importance of these models, this seems a useful area for future research.

60 The original papers on which this methodology is based are Merton (1973) and (1974).

61 One such model employing the Merton approach and allowing risk to be measured over different horizons has been developed by KMV. Since KMV forecasts equity price movements by essentially assuming that stock prices follow a random walk, increasing the horizon over which KMV forecasts expected default probabilities leads to a mechanical adjustment rather than to a thorough assessment of longer-term vulnerabilities. Moreover, the assuption fails to capture the mean reverting properties associated with equity returns over longer horizons (Box 1).

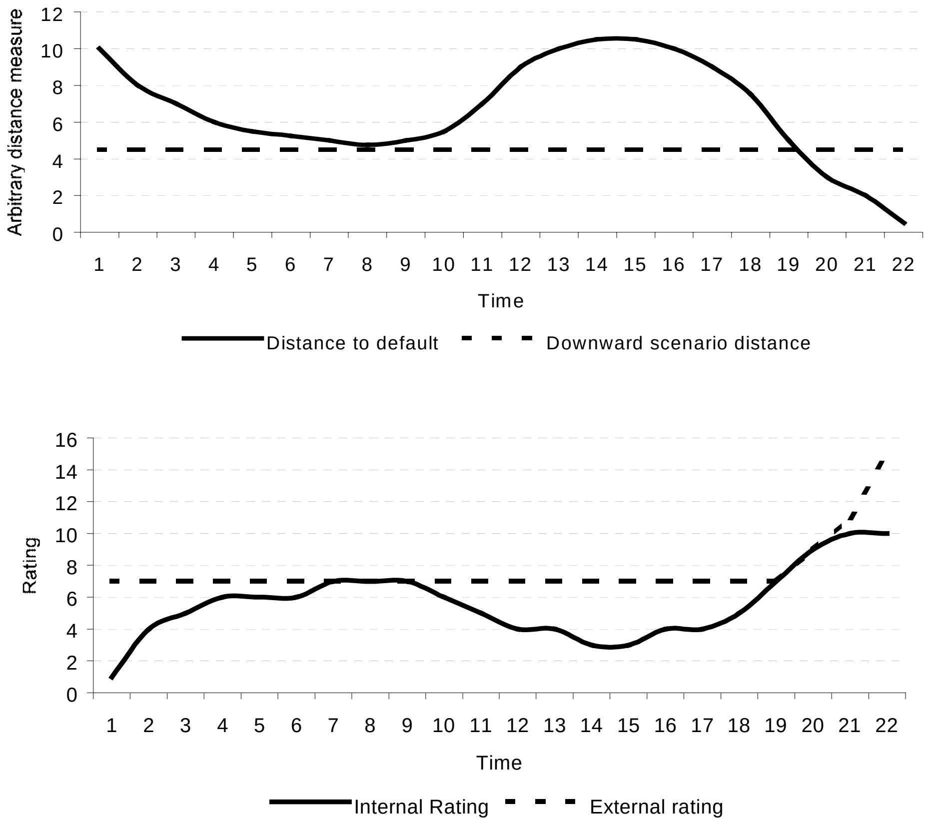
Box 2

Point-in-time and through-the-cycle measurement systems

Figure 1 depicts the behaviour of a point-in-time system and a through-the-cycle risk measurement system and has been adapted from Carey and Hrycay (2000).

The bold line in the top panel shows the distance to default. Initially, the borrower is very unlikely to default (indicated by a large distance to default), but over time the likelihood of default goes through a cycle, perhaps following the trend of the general macroeconomy. The dashed line in the top panel depicts the stress distance to default, here assumed to be 4.5, used by the external credit rating agency. When the actual distance to default falls below the stress distance of 4.5, the financial condition of the borrower has degraded beyond what the external rating agency had expected to occur in a downside scenario.

Figure 1: Point-in-time vs through-the-cycle



The bottom panel depicts how internal and external ratings would change over time. The point-in-time internal rating approach/system initially assigns the very best internal rating of 1 given the large distance to default. As the actual distance to default falls, the internal rating rises to reflect the greater risk. The external rating is, however, constant given that it was assigned based on what was perceived to be a reasonable distance during a downside stress scenario. As the figure is scaled, when the actual distance to default equals the downside scenario distance, the internal rating has adjusted to equal that given by the external rating. The other point to notice in the bottom panel is that as long as the actual distance to default remains above the stress distance, the borrower's external rating does not change. When the distance to default eventually falls below that assumed in the stress scenario, both internal and external ratings are downgraded accordingly.

Figure 1 leads to two generalisations about how external and internal ratings move over time. First, provided that rating agencies are not constantly re-evaluating the exposure of firms to the downside scenario, or the scenario itself, external ratings are likely to be more stable over time than bank internal ratings. Second, when re-evaluations occur, the time series pattern of both types of ratings will be similar, although it is possible that the rating agencies will move in larger steps.

Table 2
Downgrade probabilities (%) and business cycles

Initial rating	State of business cycle	
	Trough	Peak
Aaa	16.9	12.2
Aa	15.0	9.1
A	5.9	6.0
Baa	1.9	2.0
Ba	4.1	3.6
B	5.4	4.1
Caa	25.6	15.8
Ca/C	46.3	30.9

Source: Nickell et al (2000), Tables 6 and 7.

The procyclical nature of equity prices discussed in Section 3 suggests that Merton-type measures of credit risk may tend to fall during booms, unless debt rises sufficiently to actually increase the debt-to-market value ratios, and rise during recessions, as equity prices fall and debt takes time to be worked off.[62] More specifically, fundamental to these models' ability to measure changes in systematic risk is the requirement that the equity market reflect economic fundamentals.[63] If misperceptions of risk affect equity prices, then the implied probabilities of default are likely to themselves be distorted. Consider, for instance, the case in which misassessments of risk led to significant increases in equity prices. All else constant, this would imply a decline in the measured average probability of default, and perhaps also a decline in the corresponding correlations of default.[64] This would be so despite the fact that inflated equity values would be associated with overextension in the financial system, and thus increased risk. Thus, if the development of financial imbalances in the economy is often accompanied by overinflated stock markets, this may be a serious limitation of the methodology.

An alternative, and also widely used, approach is based on the credit rating transition matrices first developed by the external rating agencies.[65] In effect, this approach attempts to mark to market a bank's loan portfolio and then calculate the potential variability in the value of the portfolio due to changes in credit quality. It does this by assigning loans to particular ratings and then using the historical transition matrices and credit spreads to calculate the "value at risk". Correlations between individual credits are derived from equity prices in a similar fashion to that used by Merton-type models. This general approach is sometimes interpreted as being forward-looking, since a loan's current implicit price is a function of possible future events. However, these future events and their probabilities are determined mechanically by the transition matrix, and are not conditioned on any economic or financial variables. Moreover, the overall measure of risk generated by this approach depends heavily on the nature of the rating system. As we argued earlier, the rating systems themselves may well deliver procyclical measures of risk. Another source of procyclicality is the tendency for the credit spreads that are used to calculate implicit market prices to narrow in booms and widen in recessions.

62 Related to this is the fact that KMV estimates equity volatility using actual equity price movements. To the extent that volatility is greater in falling equity markets (Schwert (1998) and Hardouvelis et al (1997)), all else equal, the KMV methodology will yield lower measures of risk in upswings than in downswings (see Box 1). This, of course, is not to deny that equity prices do have some predictive power, as reflected in their widespread inclusion in leading indicators of economic activity.

63 This property is commonly referred to as "informational efficiency". Note, however, that in the presence of a time-varying risk premium, even if markets are efficient in the sense that returns in excess of equilibrium ones are unpredictable, biases may arise if the models do not take into account the mean-reverting properties of equity returns and their relationship to the business cycle. This would presumably tend to underestimate the probability of default in good times, at least over the longer horizons (see also Box 1).

64 For a given correlation in asset values, the higher the probability of default, the higher the correlation between default probabilities (see Box 1).

65 CreditMetrics is the best known example of this type of model.

Another approach focuses more narrowly on the risk of losses from defaults, ignoring the risk arising from changes in credit quality short of default.[66] A critical input to this “default-mode” approach is the bank’s internal loan gradings and their associated probabilities of default. The model’s ability to identify changes in systematic risk is thus inexorably linked to that of the rating system. Since a “point-in-time” rating system will tend to indicate less risk in economic booms, so too will this approach to credit risk measurement. Correlations between defaults are modelled as a function of a set of industries or country factors which are derived from historical experience.

Another approach to quantitative risk measurement explicitly incorporates the state of the macroeconomy.[67] In this approach, predicted default rates depend, amongst other things, upon forecasts of future macroeconomic variables. Since the forecasts are generated from simple time series models, the macro variables are, by construction, mean reverting processes, so that both good and bad times are not expected to last forever. The approach also allows default rates to be calculated over longer horizons using model-based forecasts for the macroeconomic variables. Like many default-mode models, the evolution of the default probability of individual credits is modelled as a function of factors, although in this case the factors are macroeconomic variables.

Although the methodologies employed by the various quantitative credit risk models vary, all models calculate the probability of individual credits either defaulting or changing quality. They further make some assumptions regarding the correlation between defaults/quality changes and between losses given default to calculate the full distribution of future losses. The main emphasis of the models is on a one-year horizon, with defaults rates or potential changes in credit quality over longer horizons being the result of mechanical adjustments that typically do not take into account business cycle effects. Whereas much effort has been devoted to forming accurate measurements of the probability of credit losses, the approach to assessing the relevant correlations remains quite simplistic. As the Basel Committee survey notes, “in virtually all credit risk models the only correlation effects considered at present are the correlations between defaults/rating migrations of different customers” (p 32). Further, most models relate these correlations to simple functions of equity prices, industrial sectors or macro variables. With regard to more sophisticated treatment of loss correlation, the “models generally assume zero correlation among the LGDs (loss given default) of different borrowers, and hence no systematic risk due to LGD volatility” (p 36). This is despite the fact that in downturns, asset prices tend to be falling, and losses on all defaults tend to be higher. More generally, it might be expected that correlations move over time (see below). In particular, during booms exposures to common factors are likely to increase, to be subsequently revealed in recessions in the form of more widespread actual defaults.

4.4 Bank supervisors

Bank supervisors also spend considerable resources on assessing risk. There is no standardised approach here, although a recent review of supervisory risk measurement practices in a number of G10 countries documented that, to varying degrees, supervisors tend to emphasise the cross-sectional or relative, as opposed to time, dimension of risk.[68]

Historically, perhaps the most common supervisory method of identifying risky financial institutions has been peer group analysis (for example, the BAKIS system used in Germany). By definition, this approach attempts to measure the cross-sectional dimension of risk and has limited, if any, ability to identify changes in systematic risk over time.

As a complement to peer group analysis, supervisors in a number of countries have developed rating systems that translate current financial information into a more scientific measure of default risk; the CAMELS and SEER approaches in the United States and the PATROL system in Italy are examples. These are point-in-time approaches and are meant either to reflect the financial condition of an institution when the rating is assigned or to forecast potential near-term distress. They are thus useful in allocating scarce supervisory resources to the most immediate problems. This focus necessitates a

[66] CreditRisk+ is the best known example of this approach.

[67] One such model of this type has been developed by McKinsey.

[68] See Van den Bergh and Sahajwala (2000) and the references therein for a more extensive discussion.

relatively short horizon that ultimately reduces the possibility of usefully incorporating assessments of systematic risk.[69] In these systems, a general decline in economic conditions would be expected to lower supervisory ratings and indicate an increase in risk in recessions. Similarly, such systems would most probably indicate a decline in risk during booms.

More recently, supervisors have developed more comprehensive assessments of the common risks facing financial institutions; the RATE system in the UK is an example. An explicit goal of this type of approach is to identify exposures to common factors across institutions and to discuss these exposures with bank management. By relying more strongly on the supervisor's qualitative assessment and beliefs about future prospects, comprehensive systems are potentially the most useful supervisory tool for effectively assessing changes in risk over time. This depends, however, on whether the supervisory horizon is sufficiently long and whether supervisory authorities can identify the important common factors that drive systematic risk.

Typically, the main focus of bank supervisors is the riskiness of individual institutions, rather than the riskiness of the financial system as a whole. In part, this reflects the fact that in most countries an important rationale for bank supervision is the protection of depositors in individual banks. While some supervisors view their mandates more broadly, their regulatory frameworks remain largely designed around their depositor protection responsibilities. As a result, historically they have not given a high priority to measuring correlations across institutions and system-wide financial vulnerabilities. Over the last few years, however, this has began to change. We now briefly consider the efforts being made in this direction.

4.5 Financial system stability policymakers

A recent focus of attention for a number of central banks and other authorities responsible for the stability of the financial system has been the identification, measurement and monitoring of *macroprudential indicators* of systematic risk.

This work has started from the proposition that macroeconomic and financial aggregates contain useful forward-looking information about vulnerabilities in the financial system. It has built on previous empirical studies that use past episodes of financial instability to uncover factors that help predict the occurrence of financial system problems.[70] These studies point to a number of variables, although the particular combination varies from paper to paper. Amongst the identified variables, exchange rate misalignments, credit booms and asset price booms seem particularly relevant.

This approach differs from the others discussed in this paper in that it is directly concerned with how risk moves over time for the system as a whole. To date, however, there has been little success in incorporating this type of analysis into quantitative indices of risk or into banks' credit risk models. Arguably, progress would call for greater and more selective attention to be paid to the recurrent features of financial cycles, including the distinction between cumulative and marginal processes and the *interaction* between different variables, as well as for a more careful treatment of relevant horizons.

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[69] Berger, Kyle and Scalise (2000) provide a useful review of the accuracy and timeliness of supervisory assessments in the United States. They note that many of the early studies concluded that supervisors did not have more timely information than market participants. More recent studies (eg Berger and Davies (1998) and Jordan (1999)), however, have suggested the opposite, with a number of papers finding that changes in regulatory ratings help predict changes in bank stock prices and yields on debentures. On the issue of accuracy, the recent research is mixed. For example, Berger, Davies and Flannery (2000) find that supervisory assessments in the United States are less accurate than those made by financial markets, with the exception that supervisors may be more accurate when inspections are recent. Berger, Davies and Flannery interpret their results as suggesting that supervisors have a tendency to be more concerned with assessing the *current* condition of the bank, rather than its *future* condition. The reason for this is that assessments of the current conditions can be used more effectively to exert pressure on institutions to resolve problems.

[70] IMF (1998) is a useful starting point for an examination of this burgeoning literature. See, for example, Kaminsky and Reinhart (1999), Sachs et al (1996), Frankel and Rose (1996), Edison (2000) and Hawkins and Klau (2000).

5. Provisions and capital

Any limitations in risk measurement methodologies discussed in the previous section would inevitably also be reflected in banks' decisions concerning provisions and capital. In turn, the procyclical behaviour in provisions and, possibly, in "true" capital reviewed in Section 3 can make banks more vulnerable to, and contribute to amplifying, financial and business cycles. Looking forward, any limitations in risk measurement methodologies are bound to have more significant implications once capital adequacy standards come to depend more closely on banks' own assessment of risk, as is proposed by the Basel Committee on Banking Supervision.[71] Likewise, policies geared to capital and provisioning are potentially key tools for addressing any excessive procyclicality in the financial system. In recent years, for instance, there have been calls for more forward-looking capital and provisioning decisions, although there is little consensus about the way in which this should be achieved.[72]

In this section, we examine these issues in more depth. We begin by setting out a simple conceptual framework for provisions and capital and for how they should vary over time. We pay particular attention to the time horizons over which risk should be measured, the impact of loan pricing on provisioning decisions, and how capital requirements designed to protect the stability of the financial system might differ from those designed to protect individual institutions. We then examine some possible reasons why actual practices differ from theoretical ideals and consider the possible implications of the recent proposals to modify the Capital Accord. This analysis forms the basis for the discussion of policy options in Section 7.

The main points are:

(i) Contrary to current practice, provisioning decisions should be based on the entire future profile of expected losses. While a shorter time horizon is relevant for capital calculations, the appropriate horizon is probably longer than one year.

(ii) Provisioning decisions should not be independent of the way in which loans are priced.

(iii) Capital and provisions should both rise during periods in which imbalances are developing in the financial system. Given that such episodes are likely to be characterised not just by an increase in the correlation of credit risk among borrowers in individual bank portfolios but also among bank portfolios themselves, higher capital ratios are particularly important from the perspective of the stability of the system as a whole. Such a rise is essential if capital and provisions are to perform as effective buffers in an economic downturn.

(iv) Accounting standards, and to a lesser extent taxation arrangements, stand in the way of proper economic provisioning. The standards contribute to artificial procyclical fluctuations in bank profitability and distort the measurement of true economic capital available to cover unexpected losses.

(v) The proposed changes to the Capital Accord will more closely align regulatory capital with measured risk. Whether or not the proposed changes increase or decrease the procyclicality of the financial system will depend, at least in part, on how well the time dimension of risk is measured. Arguably, improvements in risk measurement practices are required to reap the full benefits of the proposed changes.

5.1 Conceptual issues

As has now become widely accepted, it is best to think of the role of capital as that of providing protection against *unexpected* losses, and of the role of provisions as that of providing cover against *expected* losses.

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[71] For details of the Basel Committee's proposals see BCBS (2001).

[72] For example, the Governor of the Bank of France has recently argued that "one of the best ways of avoiding earnings volatility is to anticipate cyclical downturns by developing a system of provisioning based on new loan production" (Trichet (2000)). A similar point has been made by the Bank of Spain (Poveda (2000)). See also Crockett (2000b).

This distinction between capital and provisions is sometimes seen as artificial, since both provide the bank with similar protection against losses. It could be argued that all that matters is that the sum of capital and provisions is sufficient to cover expected and unexpected losses; if provisions are "too low", then the bank can simply hold additional capital to achieve its acceptable probability of failure.

The distinction, however, is important for at least two reasons. The first is that having provisions against expected losses (properly measured) is likely to lessen fluctuations in recorded bank profitability at business cycle frequencies even if it does not affect the solvency probability of the bank. Reducing this variability in profits could mean that bank behaviour becomes less sensitive to the economic cycle. The second is that if the balance sheet is to represent the true value of both the gross and net assets of the bank, then gross asset values need to be recorded net of expected losses. As we discuss below, given current accounting arrangements, this can only be done through the creation of provisions.

5.1.1 Provisions

In general, the value of a loan recorded on the balance sheet is equal to the bank's recorded investment (ie the amount outstanding or face value), less a provision for bad and doubtful debts. The need to create provisions arises because the loans are not recorded at market value, typically because imputed market values are either empirically difficult to obtain due to an absence of traded markets or they rely on judgemental assumptions.[73] For assets valued at market prices, as a first approximation all changes in value would be unexpected,[74] and there would be no need to create provisions against expected losses.

The *current value* of a loan *(V)* at time *t* can be thought of as being equal to *the present discounted value* of the expected future cash flows generated by the loan. That is:

$$V_t = \sum_j \frac{E(C_j)}{(1+r)^{j-t}} \qquad j = t,\ldots,T \tag{1}$$

where $E(C_j)$ is the expected cash flows generated by the loan in period *j*, *r* is the discount rate, which we take as the risk-free interest rate, and *T* is the point at which the loan matures.[75] If we assume that operating costs are zero, the expected cash flow in each period is given by the contracted interest and principal payments on the loan, *less* the expected value of losses from the non-repayment of the contracted amounts. Further, if *F* is the face value of the loan and the loan interest rate is equal to the risk-free rate plus a default premium to compensate the bank for the probability that the borrower will not repay the loan, we can rewrite the current value of the loan as:

$$V_t = F_t + \sum_j \frac{E(d_j)}{(1+r)^{j-t}} - \sum_j \frac{E(l_j)}{(1+r)^{j-t}} \tag{2}$$

where *d* is the *default premium* and $E(l)$ is the expected loss from non-repayment of contracted amounts. It is important to note that the fact that $E(l)$ is positive does not mean that the bank expects to incur an overall loss on the loan; the default premium also needs to be taken into account.

Given equation (2), the current value of the loan will only equal its face value if the present discounted value of expected default premiums is equal to the present discounted value of the expected losses.

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73 Obtaining reliable estimates of market value is empirically difficult when it is hard to find a traded asset with similar characteristics. The exercise is complicated for bank loans since one reason that loans are not traded is the existence of the private information that made the loan possible in the first place. This information is difficult to convey credibly to outsiders, and as a result the value to the issuing bank is likely to be greater than to potential buyers. See eg Berger et al (1991).

74 Strictly speaking, all changes in future asset values would be unexpected, other than those necessary to generate the equilibrium rate of return. In the following discussion, we implicitly assume that markets work efficiently. If markets were not efficient there would be predictable excess returns, and one could imagine, at least conceptually, financial accounts making allowances for these predictable returns.

75 The issue of what discount rate should be used to value assets is keenly debated by accounting authorities, although there is a broad consensus that if cash flow assumptions reflect certainty-equivalent cash flows (as is the case here), the discount rate should reflect the risk-free rate. An alternative approach would be to discount the contracted payments with an interest rate that incorporates a risk premium. If this risk premium exactly covers the default risk the two approaches are equivalent.

This condition is most likely to be satisfied at the time of origination, although this need not be the case if pricing decisions are distorted by competition or other factors. For example, the existence of a long-term multidimensional relationship with a borrower, or the need to build market share, may lead a bank knowingly to price a loan at a rate which does not cover expected losses. In this case, the current value of this loan would be less than its face value. Conversely, if a bank enjoys market power, the current value of the loan might exceed its face value.

If provisions are to equal the difference between the face and current values of a loan, equation (2) can be easily rearranged to show that provisions equal the difference between the present discounted value of expected losses and the present discounted value of the expected default premiums, that is:

$$\text{Provisions}_t = F_t - V_t = \sum_j \frac{E(l_j)}{(1+r)^{j-t}} - \sum_j \frac{E(d_j)}{(1+r)^{j-t}} \tag{3}$$

Two important points follow from this formulation. The first is that the *entire future profile* of expected losses and default premiums is relevant, not just the outcomes over the next year. This result is independent of the bank's ability to sell or liquidate assets over a particular horizon. This is because the current price of the loan will be affected by expected losses at any point in the future, irrespective of the time over which the bank can close out its exposure.

The second point is that if the default premium adequately compensates the bank for the expected non-repayment of principal and interest *there is no need to make a provision*. If this condition is met, the expected losses from non-repayment of the contracted amount will be exactly offset by the default premiums. If things work out as expected, the bank will not experience an overall loss. Losses worse than expected are by definition unexpected and would therefore need to be covered by the bank's capital. This point highlights the fact that provisions are needed only to cover *expected credit losses beyond those covered by the default premium built into the loan rate*.

It is sometimes claimed that a provision should be created even in cases in which overall expected losses are zero, due to the fact that a default could occur before the default premium has been earned.[76] However, while defaults can occur at any time, it cannot be the case that loans are expected to *systematically* default before the payment of interest. In expectation, the rate of default on a fairly priced loan portfolio should match the rate of accumulation of the default premiums. If this is not the case, then a provision is required.

To illustrate the implications of this approach to provisioning, consider two special cases (numerical examples are provided in Box 3):

Case 1 *Default premiums are correctly set when a loan is originated and cannot be changed over the life of the loan; at origination, the risk of default is expected to increase over time.* This case might be relevant in a period in which the bank expects economic conditions to deteriorate, and the loan rate (or at least the default premium) is fixed. Provided that the loan is priced appropriately, no provisions are required at origination. Early on, when economic conditions are good and default experience is low, the bank records strong net interest income and only a small expense for bad debts. In the profit and loss statement, however, this favourable outcome is offset by the creation of a provision to cover the fact that as time progresses the default premium built into the loan rate no longer covers the expected losses over the remaining term of the loan. This divergence arises because the default premium is fixed, while the present discounted value of losses increases over time as the expected deterioration in economic conditions gets closer. *When the deterioration eventually occurs, and defaults increase, the provisions built up in good times are drawn down, so that profits are not adversely affected in the period in which the risk actually materialises.* The end result is stability in bank profits despite the cycle in defaults.

Case 2 *Default premiums can be adjusted each period (say quarterly) and are set to cover the expected loss over the next period.* This case might capture floating rate loans in which margins are reviewed continuously. In this case, provisions are always zero, with the default premium always equal to expected losses. Any change in expected credit losses is immediately reflected in lending rates.

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76 This argument has recently been suggested by Jackson and Lodge (2000).

While this second case is a neat theoretical example, it is not very realistic. Not only might continuous re-evaluation of default premiums not be justified on cost grounds, it might also be counterproductive as it could make the probability of default endogenous, driven up by an increase in the borrower's interest burden. Moreover, there is an extensive literature that argues that increasing loan rates might actually decrease bank profitability by causing a deterioration in the quality of borrowers. A consequence of this is that, to some extent, default spreads are relatively sticky, with changes in risk reflected in adjustments to quantities, as well as lending rates.[77] Case 1 then represents the more realistic example. It suggests that if risk increases as economic booms mature, provisions should increase even if loans are being priced accurately.

As noted above, this approach to provisioning is likely to contribute to a reduction in cyclical fluctuations in published bank profitability. Provisions would rise when loan losses were low, and would be run down when loan losses were high. Such stability is sometimes pejoratively termed "profit smoothing", and is often frowned upon by accounting and taxation authorities (see below). In this example, however, there is nothing artificial about the stability of profits. To see this, note that if we were to use market value accounting, and if market values reflected present value as specified in the example,[78] the value of the bank would also be constant over time, since we assume that nothing unexpected occurs. As mentioned earlier, provisioning can be seen as a way of replicating, *in terms of logic though not necessarily in terms of inputs*, market value outcomes within the context of a book value accounting system.

In the above example, provisions became necessary as the time profile of risk evolved in the expected fashion; in addition, this approach would suggest that provisions be created in a number of other circumstances. The first is the case in which a bank underprices a loan for reasons of competition or in order to retain a customer relationship.[79] The second is when an unexpected deterioration in credit quality occurs and loan rates cannot be adjusted. The third is when market interest rates increase and loan rates are fixed. In each of these cases, a divergence between the present discounted value of default premiums and the present discounted value of expected losses creates the need for a provision. Given these various factors, one could imagine a bank's financial statements *disclosing both the change in the level of provisions and the various factors behind the change.*

Proposals for forward-looking provisioning have been subject to two quite different forms of criticism. The first relates to the room for discretion left to banks, the second to the implications of attempting to approximate market outcomes too closely.

The first concern is that forward-looking provisioning opens up the potential for banks to artificially smooth their profits, making it more difficult for investors to assess the true position of the bank.[80] This is a legitimate concern, as the estimation of expected losses is judgmental, and it may be difficult for outside investors to assess the appropriateness of the judgments made by the bank. However, this concern can be substantially alleviated through improved disclosure by banks regarding the methods and processes that they use to calculate provisions. Indeed, it is arguable that more comprehensive disclosure combined with forward-looking provisioning is likely to give investors a better view of the true state of the bank than is currently available. Moreover, discretion could be constrained by accountants, auditors or supervisors based on clear criteria (see Section 7).

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77 At the theoretical level, this point was first developed by Stiglitz and Weiss (1981). At the practical level, ECSC (1992) documents that in the interbank market, changes in the riskiness of banks are reflected mainly in a reduced willingness of other banks to provide funds, rather than in an increase in interest rates.

78 A situation in which market values reflect the present value of fully informed estimates of future outcomes is sometimes known as "informational efficiency".

79 If the amount of the provision is left entirely up to the bank, the bank should be underpricing the loan *knowingly*. Auditors and supervisors may, of course, have the power to question and influence the amount of the provision. Herring (1999) argues that banks often cite relationships as a motivation for making loans of dubious quality.

80 For example, Goldschmid (1999) sets out the US Security and Exchange Commission's concerns about the creation of provisions against losses from events that have not yet occurred.

Box 3

Provisions, expected losses and default premiums

We begin by assuming that the bank has a portfolio of two-period loans, with each loan having a face value of $100. Further, we assume that the banks understand the time profile of risk, that the discount rate is equal to 10%, and that operating costs and the equilibrium rate of return are zero.

In the first case, we assume that the economy is currently experiencing a boom so that the probability of default in period 1 is relatively low (1%). The strong current conditions are, however, not expected to continue, leading to a higher probability of default in period 2 (3%). As outlined in the text, it is assumed that the bank does not change the loan rate after the loan is established. As a result, when setting the loan rate it must look at the entire profile of expected losses, not just expected losses in the current period. To ensure that the present discounted value of expected cash flows covers the bank's cost of funds, it would need to charge a loan rate of 12.19%. In the first period, this means that the bank is earning default premiums which more than cover its bad loan expense, so that net interest income would be relatively high. However, in the profit and loss statement, this would be offset by the need to make a provision for the fact that at the end of the period the default premium no longer covered the expected losses. With the default premium fixed at 2.19% (discounted value of 1.99) and expected losses in period 2 equal to 3.37% (discounted value of 3.06), the current provision would equal 1.07%, so that profits would be zero. In period 2, the provisioning cushion built up in period 1 would be used to compensate for the fact that the interest margin did not cover the default losses.

In the second case, the bank can adjust the interest rate at any time. We begin by assuming that the bank expects the probability of default to be constant and low (1%) through time. Thus, in the first period, it will set a loan rate of 11.11%, with the default premium of 1.11% covering the expected losses from the non-repayment of principal (0.01 x $100) and interest (0.01 x $10) in that period. Provided things turn out as expected, the interest income earned through the default premium will exactly offset the credit losses, with the bank earning zero profit. Now, at the end of period one, we assume that unexpected adverse economic events lead the bank to increase its estimate of expected losses to 3%. In this case, the bank simply increases its loan rate to 13.40% to reflect the higher default probability. Again provided things turn out as expected, profits would be zero. Provisions are not required in either year.

	Case 1: default premium is fixed		**Case 2: default premium is variable**	
	Period 1	**Period 2**	**Period 1**	**Period 2**
Discount rate	10.00	10.00	10.00	10.00
Probability of default	1.00	3.00	1.00	3.00
Loan rate	12.19	12.19	11.11	13.40
Default premium	2.19	2.19	1.11	3.40
Profit and loss				
Contracted interest income	12.19	12.19	11.11	13.40
Other interest income[1]	–	0.11	–	–
Less interest expense	10.00	10.00	10.00	10.00
Less loan losses	1.12	3.37	1.11	3.40
Net interest income (after loan losses)	**1.07**	**– 1.07**	**0.00**	**0.00**
Less provisioning expense	1.07	– 1.07	0.00	0.00
Net Profit	**0.00**	**0.00**	**0.00**	**0.00**

[1] Generated on the net interest income earned in the first period (assuming funds are invested at the discount rate).

The second criticism is that, rather than leading to reduced volatility of bank profitability, a move to forward-looking provisioning (which depending upon how it is done could amount to the effective replication of *full fair value accounting*[81]) would lead to increased volatility in bank profits.[82] This concern arises partly because of the volatility in the market interest rates that might be used for discounting future cash flows on both the asset and liability sides of the balance sheet.[83] Regardless of the validity of this concern, the adoption of forward-looking provisioning does not necessarily need to be accompanied by a complete move to fair value accounting. In one sense, forward-looking provisioning could be seen as a reasonable intermediate step in which loan values are appropriately adjusted for expected credit losses, but movements in market interest rates are not instantaneously reflected in the value of non-traded assets and liabilities. This approach might deliver the profit stabilising effects that we argue would follow from appropriate economic provisioning, while avoiding the volatility that some fear would result from full market value accounting.

The bottom line is that, given our view that risk (expected losses) rises as the boom matures, in ideal conditions (ie if risk is correctly perceived) one should see provisions increase during this phase of the cycle, rather than only once losses materialise. Such forward-looking behaviour would also reduce the need to make large additional provisions when developments turn out worse than anticipated.

5.1.2 Capital at a point in time: the perspective of an individual bank

A common view on the appropriate level of capital for an individual bank is that it should be sufficient to reduce the *probability of failure* over a particular time horizon to some specified level. This applies both to the economic capital with which a bank would wish to operate and to the (minimum) regulatory capital determined by supervisors, although the corresponding probabilities of failure would presumably differ. Once this level is set, the amount of capital depends upon the *variability* of expected cash flows over the chosen horizon. This variability would, in turn, depend crucially on the *correlation* between exposures.

Unlike for provisions, the relevant time *horizon* is not the entire life of the loan, but rather depends upon the time taken for a bank to raise additional capital or to remove risks from its balance sheet.[84] At one extreme, suppose there is no possibility of raising capital in the future and that once a loan has been made, the exposure remains with the bank until maturity. In this case, the amount of capital required today depends upon the variability of the discounted cash flows in each and every future period until the loan's maturity. At the other extreme, suppose that capital can *always* be raised instantaneously. In this case, there is no need to hold any capital, with the bank simply making a call on its owners or outside shareholders whenever asset values fall. Similarly, if exposures can be quickly removed from the balance sheet, the horizon for capital calculations can be quite short, irrespective of the term of the loan and the bank's ability to raise new capital. For example, if the bank held a portfolio of 10-year commercial loans, the relevant horizon would be the time it would take to completely remove these loans from the balance sheet. This might be a matter of months, or it could be a matter of years depending upon the structure and liquidity of markets and the ability of the bank to change the structure of its assets through outright sales or hedging.

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81 The "fair value" is normally defined as the amount for which an asset could be exchanged between knowledgeable, willing parties in an arm's length transaction. In principle, fair value accounting tries to approximate as closely as possible the value that the asset would have if it were traded in the market. Some limited deviations may be allowed in practice, however. For example, the proposals by the Joint Working Group of Standard Setters (2000) envisage that, in some circumstances, "fair values" be calculated using banks' internal credit grading models.

82 Jackson and Lodge (2000) provide an overview of the debate on fair value accounting. The Joint Working Group of Standard Setters (2000) sets out the arguments in favour of fair value accounting, while the Joint Working Group of Banking Associations on Financial Instruments (1999) summarises the banking industry's objections.

83 Another concern, already discussed above, relates to the practical and conceptual difficulties in finding reliable market inputs for the measurement of value, given the different characteristics of traded and non-traded assets.

84 The different time horizons for capital and provisioning calculations reflect the fact that expected events beyond the holding period affect current asset values (and thus the appropriate level of provisions), while the *variability* of expected returns beyond the holding period does not affect the variability of returns during the holding period (and thus does not affect the appropriate level of capital). This result would need to be qualified if people were risk averse. In this case, an increase in the variability of future returns should also affect the current value of the asset.

In practice, it is difficult to raise capital during periods in which loan losses have been unexpectedly high, and it is often problematic to cleanse the balance sheet of risky loans at short notice, particularly if those loans are already performing poorly. This means that *optimal calculations of capital need to consider the variability of expected returns over relatively long time horizons, arguably considerably longer than one year*, which is the current practice.

5.1.3 Capital at a point in time: the perspective of the system as a whole

Bank capital regulation can be thought of as the regulator setting a floor on the probability of failure of an individual bank in order to protect the interests of depositors. An alternative approach would be for regulators to set the minimum level of bank capital with the explicit goal not of protecting depositors, but of protecting the stability of the financial system as a whole.[85] From this perspective, one could think of the amount of regulatory capital (as opposed to internal economic capital) being calibrated to ensure that the *probability of a systemic event* is acceptably low, where a systemic event was defined as stress in financial institutions on a sufficient scale to cause noticeable macroeconomic damage. In the terminology used in Section 2, this could be thought of as setting a threshold level for the loss in the "portfolio" made up of individual financial institutions.

The acceptable probability of a systemic event should arguably be lower than that of the failure of individual institutions, since the associated costs in terms of output are greater. This may well imply a higher overall level of capital in the system as a whole under most circumstances. Even so, as already noted, a key issue in determining the appropriate level of capital is the strength of the *correlations* between the performance of the individual institutions as well as their size. If institutions are small and the correlations between them are close to zero, then the overall capital requirement could be relatively low, as the probability of the simultaneous failure of a large number of institutions would be quite low. Conversely, and all else equal, if institutions were large and/or correlations high, a much higher level of capital would be required.[86]

Similarly, the *horizon* for calculating the capital cushion seen from the perspective of the system as a whole should arguably be longer than that seen from the perspective of an individual institution. The reason is that the difficulties in raising the necessary additional capital are likely to be greater when financial stress is widespread, as macroeconomic constraints would become binding.

5.1.4. Capital over time

Conceptually, there are two distinct reasons why capital should change over time. The first is to reflect the changing riskiness of the relevant portfolio (individual institution or system) so as to maintain constant the *target probability* of failure. The second relates to *intertemporal arbitrage*, so as to reduce the costs of raising capital under different conditions (for an individual institution or the system) and hence its impact on financial distress. To different degrees, both of these arguments suggest that capital should be raised in booms to be drawn upon as risk materialises.

A central thesis of this paper is that the potential for unexpected losses is likely to increase as a boom matures.[87] While this view is not universally accepted, we argue that it is a reasonable proposition that uncertainty about future returns and the direction of the economy tends to grow in the late stages of business cycle expansions, especially if the expansion is characterised by excesses in the financial system. The possible presence of such imbalances would naturally tend to increase the range of potential outcomes, especially the potential for unusually large losses. In addition, as argued above, expected losses also tend to increase. It can also be shown that as probabilities of default rise, so also does the correlation of defaults.[88] This would affect both the correlations in the portfolios of individual

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[85] See Crockett (2000b) for a further elaboration of this point. See also Acharya (2000) for a preliminary formalisation of some of its aspects.

[86] In part this will depend on the strength of factors other than the common exposures to the systematic cyclical factor(s), such as the risk of unwarranted contagion.

[87] See Kent and D'Arcy (2001) for a formalisation of the basic point from the perspective of an individual institution.

[88] See Box 1. On the basis of simulations and adopting a Merton-type approach, Gersbach and Lipponer (2000) actually argue that as much as half of the overall increase in credit risk associated with an increase in default probabilities could reflect this correlation effect. More generally, a positive relationship between expected and unexpected losses is consistent with the

institutions and those between institutions. More generally, correlations between the present discounted values of expected losses are likely to be higher in periods in which financial imbalances are developing, given the increased exposure to the common factor and the heightened possibility of adverse feedback effects on the macroeconomy. Arguably, these elements are more significant for the correlation across banks, given their greater vulnerability to contagion (see also Box 1).

Just as importantly, it is easier, and less costly, to raise capital in booms. An implicit assumption in the previous discussion was that if risk increased, the bank could simply raise new capital through either paying lower dividends or issuing more shares at no additional cost.[89] In practice, things are not so straightforward. Dividend policies are sometimes difficult to change and shareholders may be reluctant to contribute additional capital in periods in which risk has increased. The cost and difficulties are of course greater if distress is generalised. By holding *additional* capital over and above that needed to achieve the target probability of default at a particular point in time, each individual bank can smooth its cost of capital over time and increase its survival prospects. This is a critical insurance function. From the perspective of the system as a whole, raising capital in good times to be drawn upon in bad times has the additional benefit of limiting the amplification of the financial and business cycle, especially the headwinds that accompany periods of widespread bank retrenchment.

5.2. Actual practices

In practice, neither provisions nor capital behave as we suggest. In what follows, we examine possible reasons for this, paying particular attention to accounting and regulatory factors.

5.2.1 Provisioning: accounting and taxation rules

Provisioning policies tend to be backward looking.[90] There are two important reasons for this. One is the way in which risk is measured by financial institutions, as already discussed in previous sections. The second is the nature of accounting and taxation rules, which themselves tend emphasise realised losses instead of ex ante risk.

Accounting and taxation rules in most countries have as a basic principle that financial statements should reflect the outcomes of events that have *already* occurred and should not attempt to reflect events that have not yet happened.[91] This stands in stark contrast to the approach suggested above, in which provisions are created against events that have not yet occurred, but that have some probability of happening.[92] It also stands in contrast to the important role that expectations of future events play in determining the market's valuation of assets.

In most countries, the accounting standards distinguish between specific and general provisions.[93] Specific provisions are normally made for expected losses on individually assessed loans and can

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measurement approaches adopted by many banks. In particular, it is common practice to use distributions for loan losses in which the variance of losses is a function of the mean of the distribution (for example, Poisson and binominal).

89 More precisely, the implicit assumption was that differential costs/rationing prospects did not have an impact on the bank's decision about when to raise capital.

90 A useful overview of provisioning practices available in the public domain is provided in Beattie et al (1995).

91 See Wall and Koch (2000) for a useful summary of accounting concepts in the United States and their relationship with relevant economic concepts.

92 The tension between the two views is illustrated by the recent debate between the US Securities and Exchange Commission (SEC) and the Federal Reserve. A task force of the American Institute of Certified Public Accountants (AICPA), established to study the issue of provisioning, has recently agreed with the position put forward by the SEC that banks' provisions should only cover loans that have already been downgraded by the lender or have gone into default. In response, Federal Reserve Chairman Alan Greenspan has argued that the proposal would be "counterproductive to the safety and soundness of the banking system" and lead to "a very significantly sub-optimum degree of bank reserving". For a summary of the debate, see Garver (2000) and Anason (2000).

93 In a number of continental European countries, a Fund for General Banking Risks (FGBR) and/or hidden reserves are seen as a complement to general provisions. However, both the FGBR and hidden reserves are probably better thought of as elements of a bank's capital. Transfers to the FGBR must be made out of after-tax income, and sit on the liability side of the balance sheet, rather than representing a writedown of asset values, as is usually the case with provisions. While these reserves might serve as an additional buffer against unexpected losses, they do not serve the same purpose as provisions in insulating bank profitability from the cycle in expected default rates.

usually be made only when there is a strong expectation that a loss is “probable”. Often, the bank needs tangible grounds for believing that default is likely. In some cases, accounting standards go as far as to specify the nature of these events (for example, the failure by the borrower to make contractual payments for a specified period of time).

The range of practice with respect to general provisions is somewhat wider. In some countries, general provisions are analogous to specific provisions (in that a deterioration in credit quality must have already occurred before a provision can be created) but differ in the fact that the credit evaluation is done on the basis of a group, or portfolio, of loans, rather than on a loan by loan basis.[94] Often, this group evaluation is conducted on portfolios of small homogeneous retail loans, where credit assessment of individual loans is either too difficult or too costly. In other countries, general provisions are more forward looking in that they may be created for losses arising from events that have not yet occurred but that the bank can reasonably expect to occur. In some countries that use this broader concept, banks are permitted to use statistical models to estimate expected losses. This approach, which is often known as *ex ante*, or *dynamic provisioning*, is closer in spirit to the approach outlined above, although the time horizon used in the calculations is typically relatively short, business cycle effects are often ignored and consideration is not given to whether default premiums cover expected credit losses.

Taxation arrangements can also have a major influence on banks’ incentives to create provisions. In almost all countries, bad loans are ultimately tax-deductible, either at the point when a provision is made, or at the point when the loan write-off actually occurs. Arguably, allowing tax deductibility of provisions encourages earlier recognition of potential problems, and thus more forward-looking provisioning.

Taxation arrangements differ greatly around the world, although most countries permit specific provisioning expense as a tax deduction (although restrictions often apply). The major exception is the United States, where all provisions are essentially disregarded for tax purposes. In the United States, tax deductions are only available when loans are charged off, although this normally occurs earlier than in many other countries.

The situation with respect to general provisions is more varied. For example, in the United Kingdom, general provisions are not allowed as a tax deduction,[95] and in Germany, the tax deductibility of general provisioning expense is severely limited. In contrast, in a range of other countries, including Switzerland and Australia, general provisions are tax-deductible, although the taxation authorities are able to question the appropriateness of the deduction.

One country that has a long history of fairly liberal provisioning policies and full tax deductibility of provisions is Denmark. Arguably, this tradition helped insulate the Danish banking system from the worst of the problems that beset other Nordic banking systems in the early 1990s. Unfortunately, however, Denmark now finds itself under increasing pressure to more closely align its approach with that of other European countries, partly due to concerns that the more liberal approach gives a competitive advantage to Danish banks.

In principle, if the appropriate basis for taxation is the change in the current value of a bank’s net assets, then all provisioning expenses should be tax-deductible. From an economic point of view, whether or not the provision is created in response to an observed or an expected event is irrelevant. What is relevant is the change in the net value of the bank’s assets.

In sum, accounting and tax constraints, together with the methodologies used to measure risk, lead to provisions increasing in downturns, rather than being built up during periods of strong economic growth. More forward-looking provisioning requires the removal of these constraints. It also requires more forward-looking risk assessment, which involves not just a lengthening of time horizons but also an evaluation of vulnerabilities in the financial system.

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[94] In some countries, this type of portfolio provisioning might be included in specific provisions.

[95] An exception is made for homogeneous groups of small loans for which it is not practical to calculate a specific provision on a loan by loan basis.

5.2.2 Capital: regulation

Capital regulation can play an important role in the evolution of bank capital. A bank's capital ratio, as calculated by the regulatory formula, is often used by the market as an indicator of the strength of the bank. Moreover, individual banks may themselves wish to keep a capital buffer between their actual capital ratio and the regulatory minimum. The way in which the minimum standards are specified can also influence how banks think about and measure capital.

To date, the capital standards, embodied in the 1988 Capital Accord, have not had a strong cyclical component.[96] Indeed, under current arrangements, capital requirements change over time only if the structure of a bank's assets changes, for example through a switch out of residential mortgages and into corporate loans. Currently, capital requirements do not change with changes in the credit quality of a given portfolio, or with changes in the correlations between returns earned by individual banks.

In contrast, the proposed modifications to the Capital Accord have the potential to lead to larger changes in capital requirements over time.[97] While the proposals are aimed primarily at making *relative* capital requirements more sensitive to *relative* risk, a natural consequence of this is that the capital requirement for a given portfolio will change over time as the bank's assessment of the riskiness of that portfolio changes. Accordingly, if the average assessed credit quality of a given portfolio of loans deteriorates, the minimum amount of capital that the bank is required to hold will increase. As is the case now, the proposed modifications to the Capital Accord do not envisage capital requirements being a function of the correlations between institutions.

The modifications will significantly increase the importance of accurately measuring the time dimension of risk. If measured risk falls in economic booms and increases in recessions, then regulatory capital requirements might themselves fall in booms and increase in recessions. All else constant, this would obviously have implications for the robustness of individual institutions and the procyclicality of the financial system more generally.

The current proposals envisage risk being assessed either by external credit ratings or by internal ratings. Of these two approaches, the internal ratings approach could be more exposed to the possibility of procyclical risk assessments. There are at least two reasons for this. First, as discussed in Section 4, banks' internal measures of risk almost universally have a "point-in-time" focus and a one-year horizon, meaning that changes in current economic conditions are likely to generate a change in the measured riskiness of loans. Second, under the internal ratings approach, the capital charge will depend not only on the probability of default, but also on the loss given default, with the loss depending in part on the collateral that underpins the loan. If, in periods of strong economic growth, collateral values become inflated, required capital may well fall, when in fact the reverse should be the case.

Even so, external ratings, while arguably less sensitive to the cycle, are not immune from procyclical movements, with many more downgrades occurring in recessions than in booms. In addition, when downgrades happen, they may well occur in larger steps and only after the materialisation of risk. This might lead to larger discrete jumps in capital requirements than would be the case with internal ratings.[98]

In terms of reducing procyclicality, one possible advantage of both approaches (relative to current arrangements) is that they may lead to earlier recognition of problems by markets and supervisors. If more timely recognition leads to earlier corrective action, then the potential for problems to escalate is reduced. This issue is discussed in more detail in Section 6.

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96 A number of authors, however, have argued that existing capital regulation reinforces macroeconomic fluctuations by requiring banks to raise additional capital in economic downturns; see for example Blum and Hellwig (1995) and Goodhart (1995). Jackson et al (2000) provide an overview of the empirical evidence.

97 These changes to the Accord are motivated largely by the distortions that have arisen from the crude differentiation of risk embedded in the 1988 Accord. For a discussion of the distortions, see BCBS (1999b), Jones (2000) and Carey (2000).

98 Altman and Saunders (2001) argue that linking capital requirements to external ratings could increase financial instability due to the tendency for ratings downgrades to occur more frequently in recessions than in booms.

5.2.3 Capital: market pressures

Even if capital regulation is not procyclical, bank capital ratios might still fall in booms and increase in recessions owing to market-based pressures.

The experience of the countries that had banking system problems in the early 1990s is illustrative here (see Section 3). Soon after the problems were recognised, the management and in some cases the new owners of the banks made a concerted effort to establish quite high capital ratios. This was not so much driven by the requirements of the supervisors, although in some countries this did play a role, but rather by a belief that, after experiencing problems, the banks needed to demonstrate their financial strength and their commitment to better risk management. One way of doing so was to report a high capital ratio, even if this meant severely cutting back the size of the balance sheet and sacrificing long-term banking relationships.

One way of interpreting this experience is that the capital ratio demanded by the market is path-dependent. That is, the market requires a higher capital ratio for a bank that has experienced losses, relative to an identical bank without the history of losses. The market, however, does not demand the higher capital ratios indefinitely. Once the bank has regained the market's confidence and economic recovery has become entrenched, lower capital ratios are acceptable. Indeed, in the countries concerned, the market's focus shifted to the rate of return on equity, and the high capital ratios tended to be seen as an impediment to shareholder value. The result is a decline in capital ratios at the same time as strong economic growth is occurring.

6. Lending practices, loan-to-value ratios and supervisory review

While capital and provisions are key channels through which potential misassessments of risk can weaken banks' balance sheets and amplify the financial cycle, they are not the only ones. Two other mechanisms that can play a similar role, and by the same token can be a policy tool to address the problem, are the interaction of bank lending strategies with collateral valuation practices and regulatory restrictions, and the supervisory review process. If bank lending is highly dependent upon collateral values, and if the risks associated with collateral are misassessed, the scope for large credit cycles is increased. Similarly, the scope for credit cycles is also greater if the intensity of supervisory review also changes with the stage of the cycle. This section discusses these two issues.

6.1 Loan-to-value ratios

The interaction between practices concerning the valuation of collateral and loan-to-value ratios has potentially major implications for the procyclicality of bank lending. There are at least three relevant factors: valuation methodologies, average loan-to-value ratios and the cyclical behaviour of loan-to-value ratios.

Valuation methodologies that deliver collateral values that move closely with the cycle are likely to generate greater procyclicality. The combination of inflated property markets and *market* valuation of collateral is particularly problematic. Procyclicality is also likely to be greater, the higher the average loan-to-value ratio. The reason is that the higher the ratio, the higher is the marginal amount of new lending that can be granted for a given change in the value of the collateral.[99] Finally, if competition or mis-assessments of risk cause loan-to-value ratios to rise in booms, the potential for procyclicality is increased. The interaction of these three factors is especially important. Biases in the measurement, or response to risk can have an impact on any of the three elements, potentially leading to excessive procyclicality. The overall relevance of this channel will depend on the extent to which collateral is used as a risk mitigation device and on the ratio of the aggregate value of collateral to GDP.

Significant as the three factors are, there is comparatively little systematic information about actual practices or indeed empirical evidence on their implications for procyclicality. In what follows,

[99] Generally, if "x" is the loan-to-value ratio, then "x" also represents the change in the amount of the loan that can be supported by a given change in the valuation of the collateral.

therefore, we simply begin to put a picture together. We focus on real estate, by far the most important type of collateral in this context.

Approaches to the valuation of collateral have been classified into two broad and stylised categories: the *open market value* and the *mortgage lending value.*[100] The first approach focuses on the value of the asset if exchanged between a willing buyer and seller in an arm's length transaction after a period of proper marketing. The second approach, while still based on an arm's length transaction, is designed to arrive at an estimate of the realisable value of the property that is sustainable in the longer term.

How far these approaches are used in different countries is not entirely clear; moreover, in some cases combinations of the two are not uncommon. At the same time, available information indicates that the mortgage lending value is more prevalent in a number of continental European countries, notably Germany, Austria and Denmark; the open market value is more common elsewhere (Table 3).

Other things being equal, approaches to valuation that are very sensitive to market values or which extrapolate cash flows and other parameters on the basis of short-term horizons would tend to be more procyclical. On this basis, the open market concept would arguably induce a higher procyclicality in valuations than the mortgage lending methodology. The former places comparatively more emphasis on the current transaction value of property, short-term financing conditions and capital gains; the latter is based on an analysis of long-term market trends and discount factors and is designed to produce more stable valuations.[101] The counterargument is that long-term valuations can be used to avoid recognition of losses, with the effect of ultimately prolonging a recession by delaying the resolution of asset quality problems on banks' balance sheets.

Information on standard *loan-to-value ratios* is rather patchy. Practices seem to exhibit significant variation across countries (Table 3).[102] Typically, banks in English-speaking countries have been prepared to lend up to 85% (and sometimes 100% or more) of the value for residential mortgages. In contrast, banks in continental Europe have generally limited residential mortgages to 80% or less of the value of the property.

There is also limited information concerning the *behaviour of these ratios over the credit cycle*. On a priori grounds, there may be good reasons to believe that the ratios tend to remain constant over the cycle or, if they vary, to do so procyclically, along with other lending standards and pricing. There are, for instance, indications that practices were relaxed during the upswing in property prices in Japan[103] and the United Kingdom during the 1980s. To our knowledge, however, no systematic information has been put together on this issue. On the other hand, there is clear evidence that competitive pressures have tended to raise acceptable loan-to-value ratios, notably within Europe. Cross-border competition, for instance, has helped narrow cross-country differences in practices.[104] If competitive pressures increase in the upswing of a credit cycle, this could by itself be sufficient to lead to a relaxation of loan-to-value standards.

Aside from the supervisory review process, regulators and supervisors can in principle influence the procyclicality of bank practices by setting rules for the valuation of collateral, by establishing maximum loan-to-value ratios or by linking these ratios to other regulatory tools, such as capital requirements. A look at current practices suggests that, in general, the degree of influence actually exercised is not great, although it does vary considerably across types of instrument and countries (Table 3).

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[100] We follow the distinction made by the European Mortgage Federation (1998) and applied to methodologies in Europe. See also Dübel and Pfeiffer (1995).

[101] Dübel and Pfeiffer (1995) elaborate on the distinction between the two approaches and their cyclical properties. They argue that the mortgage lending value approach tends to prevail in countries where mortgage lending banks take the lion's share of the financing of property. In contrast, the open market value would be more likely to be used where non-leveraged institutional investors such as pension funds and insurance companies invest heavily in real estate.

[102] See European Central Bank (2000) for a brief overview of standard loan-to-value ratios in the European Union.

[103] Anecdotal evidence suggests that LTV ratios in excess of 100% were not uncommon.

[104] See European Central Bank (2000).

Table 3
Loan-to-value ratios in selected countries

	AU	BE	CA	CH	DE	ES	FI	FR	HK	JP	MX	NL	UK
Practice													
Valuation	OM	OM/ML	OM	ML	ML	OM	OM[1]	OM	OM	OM	OM	OM	OM
Typical LTV ratios							60-75						–
• Residential loans	..	..	..	75	..	70	..	..	60-71	..	..[2]	..	65-90
• Commercial loans	..	..	..	60	..	70	..	..	..	..	..[2]	..	
• Mortgage bonds/MBS	70	..	..	..	60	70	..	..	..	..	..	..	..
Restrictions (by whom)													
Valuation	Y(P)	N	N	Y(P)[3]	Y(P)[4]	N	N	Y(P)	N	Y(P)[5]	Y(P)[6]	N	N
LTV ratios													
• Authority	Y(P)	N	Y(L)[7]	Y(P)[8]	Y(L)[9]	N	Y(L)	Y(L)[10]	Y(P)	Y(P,L)[11]	N	Y(P)[12]	Y(P)[13]
• Maxima	N	N	Y	N[8]	N	N	Y	Y	Y	Y	N	N	N
Residential loans	N[14]	N	75[7]	N[8]	N	80[16]	75	80[10]	70/60[15]	80[11]	N	N	N[13]
Commercial loans	N	N	75[7]	N[8]	N	80[16]	75	60[10]	N	N	N	N	N
Mortgage bonds/MBS	N	N	75[7]	N[8]	60[9]	80[16]	60[17]	N	N	N	N	N	N
Capital adequacy risk weights	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	Y	Y[18]
• Residential	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	Y	Y[18]
• Commercial	N	Y	N	Y	Y	N	N	N	N	N	N	N	N
Other	N	N	N	N	N	Y[16]	N	N	N	N[11]	Y[6]	N	N

Key to symbols:

Y = yes; N = no; - = not applicable; .. = not available; OM = (variant of) open market value; ML = (variant of) mortgage lending value; P = prudential supervision; L = other legislation/regulation.

[1] Market value for residential property; discounted cash flow method for commercial and industrial property.

[2] Some evidence of loan-to-value ratios in the region of 90% in 1991. Should be lower now.

[3] No restrictions have been set by supervisors; the authority exists but is not used.

[4] Conservative and detailed valuation principles set out in the Mortgage Bank Act.

[5] Disposal value equal to 70% of market value.

[6] In general, for the purposes of provisioning (loan grading), a 50% discount is applied to the appraisal value. Provisions are lower for guaranteed portions.

[7] Bank Act for commercial property lending; Bank Act and Trust/Loan Act for residential property lending, but not applicable if guaranteed under Federal Government's National Housing Act. Such guaranteed mortgages can be securitised. Mortgage finance by finance companies ("sub-prime lending") is not subject to maximum LTVs.

[8] LTV ratios need to be approved by the Swiss Federal Banking Commission; approval is given on the basis of expert judgment.

[9] Mortgage bonds only, which have to be backed by first mortgages, to which the 60% LTV ratio applies.

[10] Since 1999, applicable only to specialised mortgage institutions, which were created in that year.

[11] The supervisors have the authority to restrict effective LTV ratios that they judge to be imprudent. This could involve higher provisioning requirements or reclassification of the loan. In addition, separate regulation sets a maximum LTV ratio of 80% for loans granted by the House Loan Corporation.

[12] For banks.

[13] The supervisory authority has the authority to, but does not, set limits to LTV ratios. Some restrictions apply, however, to Building Societies (eg. three-quarters of the residential loan book must be fully secured and there is a limit to the amount of lending with an LTV ratio of 90% or higher).

[14] Residential LTVs in excess of 80% require full insurance in order to meet the criteria for the 50 per cent preferential capital adequacy risk weight.

[15] Since 1994, 70% maximum LTV ratio for residential mortgages granted by authorised institutions; in 1997 the maximum LTV ratio was lowered to 60% for properties with values exceeding HK$12 million. No restrictions on specialised mortgage institutions, but the Hong Kong Mortgage Corporation Limited will only purchase mortgages with LTVs ratios of up to 70% (without insurance) and 85% (with insurance) respectively.

[16] Indirect ceiling established through more stringent loan loss provisions if LTV ratios exceed 80% if the loan becomes impaired (1% rather than 0.5%).

[17] For Mortgage Credit Banks. An additional loan may be granted up to 100% of the value of the collateral. The total of such additional loans should not exceed one-sixth of the total amount of mortgage loans granted according to the above conditions.

[18] For Building Societies only.

Key to symbols:

Y = yes; N = no; - = not applicable; .. = not available OM = (variant of) open market value; ML = (variant of) mortgage lending value; P = prudential supervision; L = other legislation/regulation.

Box 4

Arrangements linking loan-to-value ratios and capital adequacy standards

Australia (AU)	Residential: 50% risk weight subject to conditions, including insurance above an 80% LTV ratio. Commercial: None.
Belgium (BE)	Residential: 50% risk weight subject to the condition that the valuation of collateral does not exceed the prudently estimated pledge value. Commercial: 50% subject to the LTV ratio not exceeding 50% of open market value and 60% of the mortgage lending values.
Canada (CA)	Residential: 50% risk weight subject to maximum 75% LTV ratio but 0% if insured according to Federal government programmes. Commercial: None.
Switzerland (CH)	Residential: 50% risk weight when the LTV ratio does not exceed 66%. Commercial: 75% risk weight when the LTV ratio does not exceed 50%
Germany (DE)	Residential: 50% risk weight for first mortgages, which have a maximum LTV ratio of 60%. Commercial: 50% risk weight for first mortgages, which have a maximum LTV ratio of 60% (currently EU regulation only).
Spain (ES)	None.
Finland (FI)	Residential: 50% risk weight when the LTV rates does not exceed 70%. Commercial: None.
France (FR)	None.
Hong Kong (HK)	Residential: 50% risk weight for a first legal charge mortgage if the principal sum does not exceed 90% of the purchase price or the market value of the property at the time the mortgage was approved, whichever amount is the lower. Same LTV requirement also applies to the underlying properties of the MBSs. Commercial: None.
Japan (JP)	None.
Mexico (MX)	Residential: 100% risk weight. Residential with at least 50% guaranteed by government programmes: 50%. Commercial: None
Netherlands (NL)	Residential: 50% risk weight for that part of the loan up to the 75% LTV ratio. Commercial: None.
United Kingdom (UK)	Residential: (for Building Societies only) 60%, rather than 50%, risk weight for mortgages with an LTV ratio in excess of 90%.

Key to symbols:

Y = yes; N = no; - = not applicable; .. = not available; OM = (variant of) open market value; ML = (variant of) mortgage lending value;
P = prudential supervision; L = other legislation/regulation.

Supervisors typically do not set the parameters to be used in valuations.[105] In some countries, however, they do specify some inputs for the calculation of discounted present values, such as minimum discount factors, conservative principles for the calculation of rents and forecast horizons. For example, in Germany the Federal Supervisory Authority sets minimum discount factors that vary between residential and commercial property, requires rents to be valued at whichever is the lower of the comparative and the contractual value, and recommends a minimum forecast period. Denmark, too, has some less formal bank regulations on discount factors used in valuation. Likewise, in some cases supervisors set specific haircuts on market or appraised values, including, for instance, in Japan and Mexico. In others, the incentive to limit loan-to-value ratios is more indirect; for example, in Spain required provisions may depend upon the loan-to-value ratio.

While it is not necessarily beyond their authority, supervisors do not generally set maximum loan-to-value ratios. One notable exception is Hong Kong, where a "recommended" maximum loan-to-value ratio of 70% has been in place since the 1990s (see Section 7). At the same time, in other countries maximum loan-to-value ratios may be constrained in other ways. In particular, in several European countries the law establishes maximum loan-to-value ratios for those loans that are admissible as collateral for mortgage bonds. These limits can be uniform, such as in Germany, Austria and Finland, or differentiate between types of collateral, notably between residential and commercial real estate, such as in Italy, Norway and Sweden, or even more finely, as in Denmark. The maximum ratios range from as low as 60% (Germany, for Pfandbriefe) to 80-85% (Norway and Sweden). In some cases, however, it might be possible for mortgage banks to exceed the lending limits by granting lower-ranking loans provided that they are secured by the public authorities, credit institutions or insurance companies. Borrowers may also be free to go to a commercial bank for a top-up loan.

In a number of countries, loan-to-value ratios are also influenced by capital adequacy standards (Box 4). For example, in some European countries mortgage loans with a loan-to-value ratio below a certain level attract a preferential capital weighting of 50%. Differentiation based at least partly on loan-to-value ratios is also practised for some residential mortgages in the United States, Canada and Hong Kong.

Historically, restrictions on loan-to-value ratios and conservative valuation methods have probably helped to mitigate the amplitude of credit-asset price cycles or at least protected banking systems from their disruptive effects. Arguably, it is no coincidence that banking problems in real estate lending have been less evident in some of the countries using conservative approaches. Even so, attractive as the case may be on conceptual grounds, little systematic research has been done on these issues, not least owing to serious data limitations.[106] More definite conclusions about the economic significance of these factors will require further empirical work.

Looking forward, one key issue is the impact of an increasingly deregulated and competitive environment on the viability and ultimate effectiveness of restrictions such on loan-to-value ratios. In particular, in such an environment it becomes easier for borrowers to avoid regulations by obtaining top-up loans from other institutions. Since higher overall ratios increase the sensitivity of the availability of lending to collateral values and reduce the safety cushion of lenders, they heighten the need for reliance on proper valuation methodologies. As in the case of provisioning, methodologies should take due account of the evolution of systematic risk over time, and hence of the losses that could arise from sharp reversals in asset prices associated with the financial and business cycles.

6.2 Supervisory review

The response of supervisory agencies to changes in economic developments and bank profitability can also affect lending behaviour.[107] If supervisors make tougher assessments of banks following an

[105] The information for this and the next paragraph is drawn from a survey of central banks and regulatory authorities (as reflected in Table 3) and from Dübel and Pfeiffer (1995).

[106] For some very preliminary cross-country evidence on the role of collateral in amplifying the impact of monetary policy and the asset price-credit cycle, see BIS (1993) and Borio (1997). Data limitations are discussed in Borio et al (1994), Borio (1997) and, in particular, Dübel and Pfeiffer (1995).

[107] For example, the President of the Federal Reserve Bank of Boston argued that the effect of a shift in regulatory sentiment about New England banks in the early 1990s may have had a perverse effect on the economy as a whole (Syron (1991)).

increase in loan losses, banks might respond by restricting the supply of credit, ultimately creating a credit crunch. Similarly, if supervisors reduce their intensity of supervision in a boom, they might help fuel the boom and the development of imbalances in the financial system.

Supervisors might make tougher assessments and impose tougher standards after loan losses for a number of reasons. First, as discussed earlier, most supervisory risk measurement approaches indicate an increase in risk at the time of high loan losses. Second, supervisors might overreact to losses in the hope that by tightening standards, they can deflect criticism of their own performance by being seen to be "doing something". Third, in those countries where the rationale for supervision is the protection of depositors, supervisors might see it as in the interests of the depositors for each bank to have a less risky profile after an episode of higher than expected losses. This is despite the fact that tighter standards might be contrary to the collective interests of all depositors, for the reasons discussed in Section 2.[108]

In economic booms, the reverse process may be at work, with reduced supervisory attention contributing to lending booms. Even if supervisors do not lessen the intensity of their supervision, they might find that they have less authority to act in good times. When economic growth is strong and bank profitability is high, supervisors can find it difficult to gain the broad political support needed to impose tighter standards on institutions, particularly if banks and the general public see the strong current performance of the banking sector as evidence that risk is low. This could lead to a de facto reduction in supervisory oversight in booms, and a de facto tightening in recessions, even if supervisors do not change the basis on which risk assessments are made.

Evaluating the empirical validity of these concerns is difficult, as the intensity of supervision is generally not observable. Even so, a few recent studies have used data on supervisory assessments in the United States to provide some support for two propositions. The first is that supervisors have tended to make tougher assessments in recessions and easier assessments in booms. The second is that supervisory assessments do affect bank lending behaviour. At the same time, however, these studies suggest that the effect on overall bank lending is relatively small, and that changes in the toughness of supervisory review play only a relatively minor role in explaining the credit cycle.[109]

Looking forward, the proposal by the Basel Committee to make the process of supervisory review a core pillar of the revised capital adequacy framework has the potential to increase the impact of supervisory judgements on banks' actions. The current proposal, while recognising that risk management is primarily the responsibility of bank management, recommends that supervisors assess each bank's internal risk management processes. It also recommends that supervisors intervene at an early stage if there is a danger that the level of bank capital will fall below required minimum levels. In evaluating the level of capital, one factor that supervisors might consider is the exposure of a bank to the business cycle. The success of the supervisory review may depend, at least to some extent, on how supervisors assess this exposure and respond to business cycle effects.

7. Policy options

We now consider a range of policy options for dealing with the problems examined in the previous sections. In particular, we consider various alternatives that policymakers might have in dealing with the financial vulnerabilities and amplification of the business cycle caused by biased assessments of,

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[108] The Federal Reserve, for instance, has argued that the problems following the Latin American debt crisis of the early 1980s and the real estate-induced problems of the early 1990s would have been greater if the regulators' desire to see an improvement in the health of financial institutions had led to an aggressive tightening of lending standards.

[109] Peek and Rosengren (1995) find that banks in New England that were subject to supervisory enforcement actions in the early 1990s reduced lending by more than other banks in the region with the same capital adequacy ratio. Berger et al (2000) provide support for the view that supervisory "toughness" moves over the economic cycle and that this has a small effect on bank lending.

and inappropriate responses to, the time dimension of risk. We group the various options under the following broad headings:[110]

- the promotion of an improved understanding of risk;
- the discretionary use of supervisory instruments;
- regulatory, supervisory and accounting rules; and
- the use of monetary policy.

Before examining the various options, we discuss two issues that are relevant, to varying degrees, to all four options: the ability of the authorities to identify changes in system-wide risk; and the potential creation of moral hazard by the authorities responding to changes in their own assessments of risk.

Our main points can be summarised as follows:

(i) Policymakers need to be able to respond to the development of financial imbalances that have adverse implications for the business cycle and financial stability. The costs of not doing so can be very high.

(ii) There is no single instrument that can be assigned exclusively to this task.

(iii) To the extent that existing instruments need to be used, there is the potential for an apparent conflict between the financial stability objective and the instruments' primary objectives. This means that short-term compromises between objectives may need to be made. It also means that authorities with different responsibilities need to coordinate their responses.

(iv) While rule-based countercyclical changes in supervisory instruments have a number of attractions, designing robust rules is likely to be difficult. A more promising approach may therefore be to implement supervisory rules and encourage practices that can reduce procyclicality without leading to cycle-related frequent changes in supervisory requirements. Common to most of these rules is a lengthening of the time horizon for the assessment of risk.

(v) The prime example of this is provisioning rules. Supervisors could engage the accounting profession in a more active dialogue and encourage institutions to adopt longer time horizons in their assessments of risk. We also suggest that it might be useful in future to give further consideration to possible responses in areas such as loan-to-value ratios and capital requirements.

(vi) Discretionary adjustments in both supervisory instruments and monetary policy have a role to play in responding to changes in system-wide risk. Such policy responses, however, should probably occur only infrequently and only when major financial imbalances are developing.

7.1 Some common issues

7.1.1 The identification of changes in systemic risk

A common response to those who propose that policymakers react to the development of system-wide vulnerabilities is that these vulnerabilities cannot be identified ex ante, or at least cannot be identified any better by policymakers than by the market as a whole. As a result, the best that policymakers can do is to establish a regulatory framework that contributes to financial stability, and be prepared to act quickly whenever financial instability threatens the health of the macroeconomy.

[110] This list of options to address procyclocality is not exhaustive. For example, we do not consider tax policies and a range of possible more direct controls on lending (see eg McCauley et al (1999)). Likewise, we also exclude from consideration a number of aspects of the financial infrastructure that are crucial to ensuring well functioning financial markets and overall financial system stability. These include solid legal, accounting and disclosure regimes, a robust payment system, high-quality prudential supervision, well designed financial safety nets and sound macroeconomic policies. This is done, not because these elements are unimportant, but rather because they are not specifically addressed to the issue of financial system procyclicality. See eg Goldstein and Turner (1996) and Group of Ten (1997).

Whether or not policymakers can judge financial vulnerabilities any better than the market is difficult to determine. On the one hand, policymakers might be expected to have longer time horizons, access to a broader set of information and perhaps a more thorough understanding of the aggregate feedback effects between the financial sector and the real economy. This might allow them to more quickly and accurately identify changes in system-wide risk. On the other hand, in many cases the authorities have a poor record as regards outperforming the market in assessing likely future developments and predicting stresses in the financial system.

Less contentious is the proposition that policymakers' incentives and responsibilities are different from those of private sector participants. As a result, their response to financial system developments may well differ from those of market participants. For example, faced with signs of financial overextension, such as rapid credit growth and asset price increases, the authorities may judge it appropriate to increase capital requirements in order to safeguard system-wide stability, not least owing to higher exposures to common factors *across* financial institutions (see Section 5). In contrast, individual institutions are likely to have less of an incentive to take corrective action.

As in other areas of public policy, assessing the balance of risks is critically important in framing policy responses. In the above situation, if the authorities imposed higher capital ratios, the efficiency of the banking system might be impaired if it turned out that the credit and asset price increases were sustainable. Conversely, if higher capital ratios were *not* imposed, and asset prices subsequently fell significantly, financial distress might be the outcome. Determining the appropriate policy in a world of uncertainty requires balancing the costs of both Type I and Type II errors. In balancing these costs, public authorities would make different judgments to those of the private sector.

7.1.2 Moral hazard

Another recurrent issue is whether policy responses create moral hazard problems that ultimately lead to less careful risk management by financial institutions and thus an increase in aggregate risk.

To illustrate the possible problem, consider the scenario in which it becomes widely understood that the authorities have adopted a regime in which policy instruments are adjusted in a discretionary fashion on the basis of the authorities' own assessments of financial system risk. These policy instruments might include, amongst others, minimum capital ratios, maximum loan-to-value ratios, interest rates and "open-mouth operations" (see below). In this scenario, given the intrinsic difficulty of measuring risk, the private sector might condition its own assessments of risk on those of the public sector as revealed through changes in the policy instruments. If this was the case, then the absence of a policy change in response to some event (say a large increase in asset prices) might be taken by the market as a signal that the authorities were relatively relaxed about the level of risk in the system. Moreover, if the private sector thought that the authorities would take action to contain the overall level of risk in the financial system, they might be less careful in their own risk management. The end result might be an increase in risk-taking.

Another concern is that if the authorities' assessments ultimately turn out to be incorrect, their reputation will have been harmed and there could even be claims on the public sector for compensation for private losses incurred as the "result" of the policy error. The errors might also mean that authorities feel that they shoulder some of the blame, and thus they may be reluctant to take the necessary corrective action. This could lead to delay in addressing problems, and ultimately to problems that are larger and more difficult to solve. Another concern is that the supervisory authorities might be subject to political pressure to intervene, or not intervene, and that ultimately politically induced interventions would be destabilising and create additional pressure on the public sector to bail-out institutions.

While this general scenario may be extreme, it does highlight the concerns that are shared by many policymakers. There is general reluctance to adjust policy instruments in response to changes in assessments of financial system risk. This reflects concerns about moral hazard and the fact that responding in this way could put the authorities in the uncomfortable position of being the arbiters of the appropriate level of risk in the financial system.

While identifying system-wide risk and moral hazard are issues common to all policy options, the extent to which these are affected varies depending on their nature. For instance, the balance between Type I and Type II errors is arguably rather different in the case of monetary policy and supervisory instruments. Likewise, as we discuss below, moral hazard considerations have implications for the balance between rules and discretion and for the modes of intervention more generally. We now consider four specific policy options.

7.2 Specific options

7.2.1 The promotion of an improved understanding of risk

Given that a central theme of this paper has been that the time dimension of risk is difficult to assess, one approach would be for policymakers to promote an *improved understanding of risk* and its relationship with the business and financial cycles.

This could be done through a number of channels, including the publication of analysis and research on financial system issues, and speeches by senior officials discussing vulnerabilities in the economy and the financial system. Such an approach could be thought of as being analogous to the "open-mouth operations" that have sometimes been used by monetary authorities to influence expectations of inflation, interest rates or exchange rates. Supervisors could also suggest that banks undertake stress tests that are specifically designed to highlight the risks associated with current vulnerabilities in the financial system. These stress tests could then form the basis of a dialogue between the supervisory authorities and each of the banks.

The central banks in Norway, Sweden and the United Kingdom have already taken steps along this road with the publication of financial stability reports on a regular basis. In a number of cases, these reports have highlighted developments in credit and property markets and raised concerns about the sustainability of current trends. To date, this has been done in a way which has helped improve dialogue between the authorities and the private sector, and has avoided the central bank being seen as an arbiter of the actual or appropriate level of risk in the financial system.

One attraction of this approach is that it addresses an important *source* of financial procyclicality (ie the measurement of risk), rather than dealing with the consequences of mismeasurement. A second attraction is that, by comparison with some of the other policy options discussed below, the moral hazard problem is likely to be less severe, although if the authorities take strong positions and push their views aggressively, moral hazard may be created. Nevertheless, the private sector is free to ignore the comments of the authorities.

The approach will, however, only be successful if participants in the financial system take heed of the analysis of the authorities. Thus, its strength from the perspective of moral hazard is also arguably its main weakness. A system of supervisory sticks and carrots may play a useful complementary role in promoting a better understanding of risk (see below).

7.2.2 The discretionary use of supervisory instruments

The authorities could adjust their supervisory instruments, if and when required, in a *discretionary* fashion on the basis of their own views about the level of risk in the financial system.[111] This approach would be consistent with a strengthening of the macroprudential focus of financial regulation.

An example of this approach would be for supervisors to induce an increase in capital cushions during an economic boom in which they judged, based on overall available evidence, that risk was being misassessed by financial institutions. Another example would be an increase in capital requirements during a period of increased systemic risk due to, for example, an increase in the riskiness of international capital flows.

An increase in capital could be achieved by supervisors raising the required regulatory minimum for all banks, or by using the process of supervisory review to induce banks with the largest exposures to the domestic business cycle (or to foreign funding) to hold additional capital.[112] At least conceptually, one

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[111] Depending on the legal and institutional setup in each regulatory jurisdiction, this could be done by changing regulatory requirements or enforcing more stringent standards above those minima through the supervisory review process.

[112] Or, more generally, the economic cycle (common factor) to which they are exposed.

way of doing this would be to link capital requirements or cushions above the minima to the outcomes of stress tests. From a system stability perspective, supervisors might also raise regulatory capital ratios if they thought that the correlation between expected defaults by individual banks had increased due to common exposure to particular vulnerabilities in the financial system (for example due to an overextension of the commercial property market).

A complementary instrument would be the imposition of minimum provisioning rates, which could vary over time. Again, this could be done for the system as a whole, or on a bank by bank basis.

Another potential discretionary instrument is loan-to-value ratios. Whenever it is within their power, supervisors could change minimum ratios or the size of haircuts to collateral values in response to their evolving judgments of risk. The most obvious area in which this could be done is the loan-to-value ratios that apply to property lending. For instance, if supervisors were of the opinion that property price increases were excessive and that some correction was likely, the maximum loan-to-value ratio might be lowered. The ratio could then be increased after a downward adjustment in prices. Such an approach might reduce the amplitude of the property price cycle and at the same time cut the exposure that banks have to the cycle. To a limited extent, this approach was used in Hong Kong in the 1990s, although the authorities there do not view loan-to-value ratios as a countercyclical instrument.[113]

Whatever the conceptual attractiveness of using supervisory instruments in a countercyclical fashion, there are a number of practical problems. First, there is a measurement issue. To the extent that such adjustments should be calibrated with reference to the exposure to systematic risk, it is not obvious how regulatory minima might be adjusted for banks that operate across national boundaries or have different domestic exposures. For example, home supervisory authorities may wish to impose higher capital ratios on banks operating domestically because of a belief that the cycle is being amplified by banks' misassessment of risk. It might, however, find it difficult to justify imposing a higher capital ratio on a consolidated group of a bank with international operations, since domestic developments may have only a small effect on the bank's overall risk profile. This problem is likely to be less severe if the cycle in risk is being driven by developments in the world economy, as opposed to the domestic economy. In such cases, higher capital ratios might be appropriate globally. The difficult question then becomes how this might be achieved.

Second, imposing standards on regulated entities that are tougher than those demanded by the market might simply encourage innovative ways of avoiding them. For example, during the mid-1990s boom in Hong Kong, the 70% maximum loan-to-value ratio led some institutions to offer "top-up" loans, which ostensibly were for the purpose of decorating a new apartment, but in reality were part of a "package" designed to circumvent the regulation. It is also likely that the authorities' actions would push financing into unregulated sectors. If this were to occur on a large enough scale, the stability of the system as a whole might even by reduced by the regulators' actions, even if the stability of the regulated entities was improved.

Third, measurement difficulties and the possibility of circumventing requirements highlight potential level playing field concerns. Discretionary supervisory adjustments would be likely to meet with stiff opposition from the regulated entities unless they were seen to be based on objective criteria and justified by the financial situation.

Fourth, discretionary adjustments could create the possibility of regulatory forbearance. If capital ratios are increased in booms, they might need to be lowered in recessions. In some circumstances, supervisors might use the "financial system stability" argument to avoid taking necessary action against troubled banks, or lower capital ratios excessively. To some extent, this problem could be mitigated by placing constraints on the supervisors' discretion, perhaps through setting a floor below which capital ratios could not fall without specific action being undertaken. This floor would be constant through the cycle.

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[113] In 1991, the Hong Kong Monetary Authority (HKMA) recommended that banks adopt a maximum loan-to-value (LTV) ratio of 70% for property lending. In December 1996, in the face of a very strong property market, the recommended maximum LTV was reduced to 60% for properties with a value of over HK$ 12 million. After the decline in property prices in 1998, these ratios remained in place, although in March 1999 the HKMA introduced a mortgage guarantee scheme that enabled homebuyers to secure mortgage loans of up to 85% of the value of the property. This limit was subsequently increased to 90% in July 2000. For a fuller description, see Hong Kong Monetary Authority (1998a) and (1998b).

Finally, supervisors would need to be careful not to overstep the mark and become excessively involved in the management of risk in individual institutions. If changes in supervisory instruments occurred on a relatively regular basis, a bank's management might pay less attention to internal risk control. As discussed above, the result could be an increase in overall risk. In addition, if system-wide problems did develop the authorities might feel that they were partly to blame, and might thus be slow to take appropriate action.

Taken together, these practical problems probably mean that discretionary adjustments in supervisory instruments in response to changes in the business cycle or system-wide risk are difficult to implement and should not occur *on a regular basis*. This, however, does not mean that such adjustments should never be made. In particular, the use of discretionary supervisory instruments can play an important role in lessening the potential macroeconomic costs of financial overextension in situations where the authorities judge that, on balance, the business cycle is sustained or accompanied by serious financial imbalances. On the basis of past experience at least, such discretionary adjustments should be expected to take place only in some business cycles.

7.2.3 Regulatory, supervisory and accounting rules

The authorities could establish *rules* that help reduce the procyclicality of the financial system. Two types of rules are possible. The first are rules for the adjustment of supervisory instruments over time. The second are rules that reduce financial procyclicality but do not lead to cycle-related changes in supervisory requirements.

The first type of rules could be used in place of discretionary changes in supervisory requirements. For example, minimum capital ratios, provisioning rates or maximum loan-to-value ratios could be linked in a *mechanical* way to variables such as the rate of growth of credit, the length of an economic expansion, or changes in property prices. Such an approach has both advantages and disadvantages relative to discretionary changes.

One advantage is that rules can act as a precommitment device. This limits the ability of participants in the financial system to put pressure on the authorities to delay adjustments in policy instruments, and also reduces the ability of the authorities to engage in regulatory forbearance. A second advantage is that rule-based changes in requirements would reduce, although probably not eliminate, the moral hazard problem. While the authorities would need to justify the rule, they would not need to provide continuous commentary on their own views of the level of risk in the financial system.

The main disadvantage of rule-based adjustments in supervisory instruments is that rules are difficult to specify. Typically, it is the interaction of a variety of factors that leads to an increase in financial system risk. Modelling these interactions is very difficult, as it is problematic to assign time-invariant weights to the various factors and to capture the important multidimensional interactions. These difficulties are compounded in an environment in which the financial system is undergoing significant structural change. Another disadvantage of preannounced rules is that they are likely to increase the incentives for and ability of banks to develop ways around the regulation, and to heighten level playing field concerns.

The second type of rules avoids explicit changes in regulatory requirements over time. Instead, they focus on ensuring that the basic regulatory structure does not unnecessarily amplify the business cycle.

An obvious starting point is the rules that govern provisioning. As discussed in Section 5, the current arrangements are far from optimal and lead to distortions in the measurement of both bank profitability and bank capital. Supervisors could play a potentially important role in improving the situation in this area. In particular, they could enter into a more active dialogue with accounting authorities, pressing the point that provisions need to be forward-looking. As more banks use internal rating systems to explicitly measure expected losses, the tension between the accounting treatment of expected losses and the way that banks and regulators think about expected losses is likely to grow. If progress proves too slow or difficult, supervisors could require deductions from regulatory capital to offset underprovisioning.

A related option is for supervisors to require banks to use horizons longer than one year when calculating expected losses and the expected variability of losses. While most banks' information systems have been designed around the one-year horizon, this horizon is not immutable and could change, in time, under supervisory pressure. For example, as part of the process of approving the use of internal ratings for the purpose of calculating minimum capital requirements, supervisors could require institutions to move towards measuring risk over longer horizons and to use measurement methodologies that incorporate business cycle effects.

A third option is to establish more constraining supervisory rules to smooth the procyclical fluctuations of provisions, effectively increasing provisions in periods of historically low loan losses. Such an approach has recently been introduced in Spain.[114] Under new provisioning rules, banks are required to take a charge to their profit and loss for *statistical* provisions, where the charge is calculated using a long-term average of loss experiences. Then, provided the fund for statistical provisions is large enough, the charge for specific provisions will effectively be made from the statistical fund, rather than from the current year's profit and loss. The effect is to reduce the fluctuation in a bank's year-to-year profitability, with the provisioning charge being driven by average loss experiences rather than year-to-year loss experiences. This profit stabilising mechanism is, however, not unlimited. If loan defaults are high and unusually large specific provisions are required, the statistical fund could be exhausted, and specific provisions would need to be made directly from the current year's profit. Conversely, once the statistical provision fund has reached a certain level, no further charges to profit are required.[115]

This approach can be interpreted as forward-looking even though it does not require the banks or the supervisors to forecast future economic conditions or to evaluate financial vulnerabilities when making provisioning decisions. One attraction is that it lessens the potential moral hazard problem, as supervisors are not required to make constant judgments about the appropriate level of provisions. On the other hand, the ratio of provisions to total assets is likely to be relatively constant over time, and so may not track changes in actual expected losses very closely. This potential problem could be alleviated by allowing banks to use their internal models (as is ultimately envisaged in Spain), rather than supervisory guidelines, to estimate the statistical provision. This would of course require that the internal models not be subject to the biases that we discussed earlier.

A complementary option might be to require banks to use default probabilities calculated over an entire cycle, rather than at a point in time, when calculating minimum regulatory capital. As we argued earlier, the through-the-cycle approach is likely to be less cyclical than the point-in-time approach. Another possibility would be for supervisors to set target capital ratios as well as minimum capital ratios. In normal times, banks would then be expected to maintain their capital ratio above the target ratio, but would be permitted to go below the target when economic conditions were depressed. In such circumstances, supervisory action would only be taken when the capital ratio was below the minimum. This approach ensures an additional capital buffer is in place in good times while also addressing concerns about forbearance at times of financial distress.

A final area of potential policy action is minimum loan-to-value ratios. As discussed in Section 6, the *level* of the ratio acts as a kind of multiplier, as it determines the amount of additional lending that can be sustained by a given change in asset value. Moreover, low minimum loan-to-value ratios would reduce the likelihood that the value of the collateral would fall below that of the loan, limiting losses and hence headwinds during the downswing. One possibility would be to apply conservative valuation approaches, either by focusing on sustainable cash flows from the asset or by linking valuations to historical stress episodes of declines in prices. Another possibility would be to set low values for the minimum ratio itself. The potential to get round such regulations would of course limit their effectiveness, but strengthened supervisory review could help to restrain such circumvention.

7.2.4 Monetary policy

The authorities could use *monetary policy* to address imbalances in the financial system. This option has recently received increased attention in the debates about how monetary policy should respond to movements in asset prices.[116]

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[114] For a description of the Spanish approach, see Poveda (2000) and Fernández de Lis et al (2001).

[115] The accumulation of statistical provisions will cease when the statistical fund reaches three times the annual charge.

[116] See Crockett (2000a) and Borio and Crockett (2000) for a discussion of these issues within the broader context of the relationship between financial and monetary stability. See also BIS (1997), Chapter VIII. Three useful volumes devoted to the issue of monetary policy and asset prices are BIS (1998), CEPR/BIS (1998) and Federal Reserve Bank of Kansas City (1999).

One view is that financial stability considerations may, in certain circumstances, warrant an increase in interest rates larger than that justified in terms of short-term inflation control. The rationale for doing so is that by containing the development of financial imbalances today, the central bank might help avoid financial instability in the future. It may well be desirable for the central bank to deviate slightly from its inflation objective in the short run, if in so doing it is able to reduce the probability of serious financial problems and thus the expected variability of inflation in the future.[117]

For instance, given the important role of commercial property in generating banking system problems, the central bank might increase interest rates in response to an unsustainable commercial property lending and price boom, even if there were no short-term pressures on the prices of goods and services. One benefit, relative to increasing capital ratios on regulated entities, is that the higher interest rates would affect regulated and unregulated entities alike. Another is that a decision to increase interest rates is unlikely to generate criticism that the authorities are interfering in the management of individual firms.

The alternative, and more commonly encountered, view is that monetary policy should be directed exclusively at control of the inflation rate over the central bank's forecast horizon. Financial stability considerations are then only relevant to the extent that they bear on the expected inflation rate over that horizon. This view reflects, in part, an assessment that financial imbalances, and asset price misalignments in particular, are too difficult to identify and that systematically reacting to them might be destabilising.[118]

Those who take this position typically also argue that it is supervisory instruments that should be used to address financial imbalances. However, if at the same time supervisors were to argue that supervisory instruments should not be used to address system-wide vulnerabilities associated with macroeconomic developments, there would be a risk that financial imbalances could go unaddressed. Coordination between monetary and supervisory authorities is therefore particularly important. This is especially the case in those countries in which the supervisory responsibility does not lie with the central bank.

While there is a case for using monetary policy to address financial imbalances, such an approach confronts a number of problems in addition to that of identifying the imbalances.[119]

First, it might be difficult to explain convincingly to the public why interest rates are being *increased* for financial stability reasons if there are no immediate inflation pressures. This difficulty is likely to be compounded if, as is often the case, the very developments that the central bank views with concern are viewed by others as evidence that things are going well (booming equity or property prices might be one example). In contrast, central banks are likely to find it easier to explain why interest rates are being *reduced* for financial stability reasons. For example, the Federal Reserve Board in the United States appeared to have little trouble explaining the reductions in interest rates that followed the financial market turmoil around the time of the Russian default and Long-Term Capital Management's problems. This introduces the possibility of asymmetric responses, which in turn could induce excessive risk-taking behaviour, an insidious form of "moral hazard".

Second, if higher interest rates are successful in containing the build-up of financial risk, but at the cost of slower growth or a fall in asset prices, the central bank might come under heavy criticism for undermining what appeared to be a sustainable non-inflationary boom. This could ultimately be harmful to the central bank's reputation and its ability to pursue its price stability objectives.

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117 Kent and Lowe (1997) provide a rigorous theoretical justification of this view; Shiratsuka (2001) makes a similar point with reference to the notion of "sustainable" price stability. See also Borio et al (1994) and Cecchetti et al (2000) and, with reference to the recent Japanese experience, Okina et al (2000) for arguments in favour of raising interest rates on financial stability grounds. Goodhart (1995), drawing in part on the theoretical paper by Alchian and Klein (1973) on the correct measure of inflation, also highlights the need to take the behaviour of asset prices into account in the setting of monetary policy.

118 This argument has recently been made by Bernanke and Gertler (1999). See also Vickers (1999) and some of the views expressed in CEPR/BIS (1998).

119 For a vivid account of the dilemmas faced by the Bank of Japan at the time of the asset price bubble, and an elaboration of these considerations, see Yamaguchi (1999).

Third, relatively small changes in interest rates might have little effect on developments in the financial system. They might actually be counterproductive if they lead to greater confidence in the central bank anti-inflation commitment and hence boost asset prices and financial overextension further.[120] One implication of this is that large changes in interest rates might be needed to make a material difference. This is likely to be the case given that the environment in which monetary policy would be used in this way is probably one in which credit is growing very strongly, asset prices are rising rapidly and people are (excessively) optimistic about the future.

The impact of large increases in interest rates on asset markets and the economy is, however, difficult to quantify. Thus, one cost of using monetary policy, rather than supervisory instruments, might be that the results are more difficult to predict and the costs of getting things wrong might be higher. An increase in required capital ratios, when in reality none was necessary, may be less damaging than an inappropriate large increase in interest rates.

Despite these difficulties, just as there is a case for discretionary adjustments in supervisory instruments, there is a case for monetary policy to respond to financial system imbalances. Indeed, the central bank's financial and monetary stability responsibilities may both require it to do so, particularly if the imbalances are making the macroeconomy and financial system highly vulnerable to an episode of instability.[121] As with supervisory instruments, however, such monetary policy adjustments should probably not be made every business cycle.

8. Conclusions

Developments in the financial system can amplify swings in the macroeconomy and sow the seeds of widespread financial instability. In this paper, we have argued that an important source of this amplification is the inappropriate responses by financial market participants to changes in the time dimension of risk, especially in its systematic component. These responses primarily reflect the mismeasurement of changes in the absolute level of risk over time, but also the incentives that are faced by individuals and institutions. Moreover, even if they did not contribute to amplifying the business cycle, such responses would still be sufficient to undermine the soundness of financial institutions, by heightening their vulnerability to a downturn in economic activity.

The mismeasurement of risk arises partly from the short horizons that underlie most risk measurement methodologies and partly from insufficient attention being paid to the correlations across borrowers and institutions. Combined, these two shortcomings mean that changes in risk associated with the economic cycle tend to be misassessed. In particular, risk is often underestimated in booms and overestimated in recessions. Longer horizons and a greater appreciation of correlations would contribute to better risk measurement, both at the level of individual institutions and for the system as a whole.

One consequence of current measurement practices is that bank provisions and capital ratios fail to increase in economic booms. This contributes to the procyclicality of the financial system by increasing the cyclicality of bank profitability and creating additional pressure for banks to raise capital and, more generally, constrain lending in recessions.

We argue that financial stability would be enhanced by provisions and capital ratios increasing in economic booms. This would track risk better. As economic expansions mature, there are reasons to believe that the riskiness of *individual* borrowers tends to increase, as do the *correlation* in default risk *between individual borrowers* and the *correlation* of the probability of losses *across financial institutions* themselves. In addition, an increase in provisions and capital ratios in a boom would act as a built-in stabiliser. Capital is generally cheaper and easier to raise in booms than in recessions. By creating *additional cushion*s in good times that can be drawn down in bad times, higher capital ratios

[120] Yamaguchi (1999) stresses this point. Goodfriend (2000) highlights more generally the paradoxical risks that can stem from the credibility of the central bank's anti-inflation commitment.

[121] The case is made stronger if regulatory policy is unable to address the system-wide vulnerabilities.

and provisions could help to limit the exacerbation of financial instability through the financial system's amplification mechanisms.

We argue that public policy should, and could, respond to cycles in financial system risk that threaten financial stability or significantly amplify the business cycle. The policy options include: the promotion of improved measurement of risk; discretionary countercyclical adjustments in supervisory requirements; the establishment of supervisory rules that make the system more robust to misassessments of risk; and the use of monetary policy to contain the development of financial imbalances.

Each of these options has advantages and disadvantages, with the appropriate response depending very much on the particular circumstances. Given the current state of knowledge about financial and business cycles, we regard provisioning as the area deserving the most immediate attention and holding the greatest promise of progress. At the same time, we believe that it might be useful in future to give further consideration to possible responses in areas such as loan-to-value ratios and capital requirements. We also see scope for the use of both monetary policy and discretionary adjustments in supervisory requirements, although we argue that these policy instruments should be used infrequently, and then only when serious financial imbalances are developing.

A common factor underlying the policy responses proposed is a lengthening of the horizon over which risk is measured and managed. This is all the more important given our limited ability to predict turning points in the cycle and the timing of financial instability. This lengthening is explicit in the case of policy options for current provisioning and capital practices; it is implicit in the proposed shift in focus towards further reliance on stress testing, as a means of identifying vulnerabilities, and on less cyclically sensitive measures of value.

Addressing the risks to financial stability arising from excessive procyclicality highlights a number of coordination issues among policymakers. The task involves authorities with different perspectives and responsibilities. Indeed, some of the policy instruments lie in the hands of authorities whose main task is not to safeguard financial stability at all, even though their tools and decisions can have a significant impact on the outcome. For instance, more forward-looking economic provisioning clashes with accounting rules that require an event to have already occurred before a provision is created, and could meet with objections from securities and tax authorities. Similarly, it is frequently argued that the task of monetary policy is to focus exclusively on price stability narrowly defined and that prudential regulation and supervision should not be concerned with the financial cycle. In the absence of a consensus on diagnosis, remedies and allocation of responsibilities, there is a risk that the problem will remain unaddressed.

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Cyclical prudence - credit cycles in Australia

Christopher Kent and Patrick D'Arcy[1]

1. Introduction

Over the past 150 years, Australia has experienced four major cycles in credit - in the 1890s, 1930s, 1970s and 1990s. Each of these episodes combined cycles in the real economy with varying degrees of financial system instability. This association reflects the fact that the health of the financial system and the economy are inextricably linked. While the strength of economic activity influences the demand for credit, at the same time the health of the financial system affects the supply of credit, which in turn influences economic activity. However, of particular concern for policymakers is the potential for the behaviour of financial institutions and financial markets to amplify cycles in the real economy.

In this paper we suggest that the behaviour of lending institutions through the business cycle depends on their perceptions of risk and that periods of excess optimism can lead to amplification of the business cycle.[2] This implies the prudential regulator/supervisor needs to pay close attention to the state of the business cycle and lending institutions' attitudes to risk in order to avoid excessive risk building up in the financial system.

Careful management of banks' loan portfolios can help to ensure diversification of risks arising from the potential for individual borrowers to default. However, ultimately the financial system as a whole cannot avoid the risk implied by downturns in the economy. To understand how this risk changes through the business cycle, it is helpful to distinguish between the actual level of risk and the realisation of that risk.

The paper argues that risk tends to build up during the expansionary phase of the business cycle. That is, the potential for banks to experience substantial losses on their loan portfolios increases towards the peak of the expansionary phase of the cycle. Even so, towards the top of the cycle banks appear to be relatively healthy - that is, non-performing loans are low and profits are high, reflecting the fact that even the riskiest of borrowers tend to benefit from buoyant economic conditions. While the risk inherent in banks' lending portfolios peaks at the top of the cycle, this risk tends to be ***realised*** during the contractionary phase of the business cycle. At this time, banks' non-performing loans increase, profits decline and substantial losses to capital may become apparent. Eventually, the economy reaches a trough and turns towards a new expansionary phase, at which time the risk of future losses reaches a low point, even though banks may still appear relatively unhealthy at this stage in the cycle.

The way in which banks (and capital markets, more generally) perceive risk changing through the cycle is a key determinant of their prudential behaviour.[3] Banks may observe and respond to the pattern of risk described above. In this case, prudential behaviour will be procyclical - that is, provisions and capital ratios will tend to rise through the expansionary phase of the business cycle and fall during the contractionary phase in line with the pattern of actual risk. This will also imply that the risk premium charged to borrowers will be procyclical.

Alternatively, bank behaviour may be driven more by the realisation of risks than actual risk itself. This implies that banks are ***excessively optimistic*** during the expansionary phase of the cycle and ***excessively pessimistic*** during the contractionary phase. In this case, provisions and capital ratios

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1 We would like to thank Chay Fisher, Bryan Fitz-Gibbon, Marianne Gizycki, Keith Hall, Melissa Hope, John Laker, Philip Lowe, Graham Johnson, Murray Jones and Guy Eastwood for their helpful suggestions. *The views expressed are those of the authors and should not be attributed to the Reserve Bank of Australia.*

2 This paper is similar in many ways to Herring (1999), who examines the relevance of disaster myopia for financial stability.

3 Bank behaviour is, of course, driven in part by the behaviour of capital markets. We deal with the role of capital markets later in the paper.

would tend to be countercyclical, as would the risk premium. Also, the risk of bank failure would be greater at the top of the cycle than would be the case under procyclical prudential behaviour.

Moreover, countercyclical prudential behaviour could lead to amplification of the business cycle. This occurs because the relatively low price and high supply of credit implied by this type of behaviour can lead to a mutually reinforcing increase in credit, asset prices and output during the expansionary phase of the cycle. From this it follows that the eventual correction in output is also likely to be larger than would otherwise be the case. In addition, the financial system becomes more vulnerable to a downturn in activity. When economic activity turns down, financial institutions are likely to incur substantial losses, which in turn can create an environment of excessive pessimism. This causes banks to adopt relatively cautious lending policies, which can lead to second-round reductions in economic activity.

Typically, amplification is triggered during the expansionary phase of cycles. Uncertainty regarding the size and persistence of positive shocks to the economy, when combined with an environment of heightened competition within the financial sector, can lead to the problem of excessive optimism. In such an environment, capital ratios will tend to drift downwards as the result of two sources of pressure. First, banks aiming to maintain market shares will strive to keep the growth of lending high. Second, shareholders' demands for high returns to equity will push banks to economise on their holding of capital. While debt markets can provide discipline for banks that take on excessive risks (relative to other banks), these markets are also susceptible to excess optimism that clouds their appreciation of system-wide risks.

An objective of policymakers charged with responsibility for financial system stability is to ensure that disturbances in any part of the financial system do not threaten the health of the economy more broadly.[4] Monetary policy plays a crucial role in protecting financial stability by maintaining low and stable inflation, thereby discouraging asset speculation financed by borrowing.[5] At the same time, there is scope for prudential/supervisory policy to respond to changes in risk facing financial institutions through the business cycle.

The paper proceeds as follows. Section 2 draws out the role that bank behaviour can play in the amplification of cycles by examining the Australian experience of major credit cycles over the past 150 years. A comparison of these cycles suggests that banks' attitude to risk - which plays a key role in determining their prudential behaviour - depends, in part, on the competitive and regulatory environment. The experience of the 1890s and 1990s episodes suggests countercyclical prudential behaviour can amplify the business cycle and contribute to more severe problems for financial institutions during economic downturns. In contrast, the 1930s episode suggests procyclical prudential behaviour reduces the potential for financial system instability even in the face of a significant downturn in economic activity.

Section 3 of the paper presents a stylised model describing how banks' prudential behaviour responds to changes in risk implied by the business cycle. The model demonstrates that forward-looking banks acting on the basis of actual risk (rather than realised risk) would adopt procyclical prudential behaviour. The model also demonstrates how alternative perceptions of risk can lead banks to adopt countercyclical prudential behaviour. By appealing to models that link cycles in credit, asset prices and output, our framework shows how countercyclical prudential behaviour can lead to amplification of the business cycle.[6]

The paper concludes in Section 4 with a brief discussion of the scope for prudential/supervisory policies to avoid situations in which banks' behaviour leads to financial system instability and amplification of the business cycle.

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4 Policymakers also want to enhance the efficiency of the financial system. Excessive regulation of financial institutions, though potentially good for stability, could impede efficient intermediation and, therefore, be detrimental to long-term macroeconomic performance.

5 Kent and Lowe (1998) suggest that in the absence of active prudential policy, a central bank with the objective of targeting inflation may attempt to burst an asset price bubble in order to avoid the risk that such a bubble expands even further. Bursting the bubble early would help to avoid financial instability, which would jeopardise the inflation target.

6 Dow (2000) provides a recent review of some relevant models.

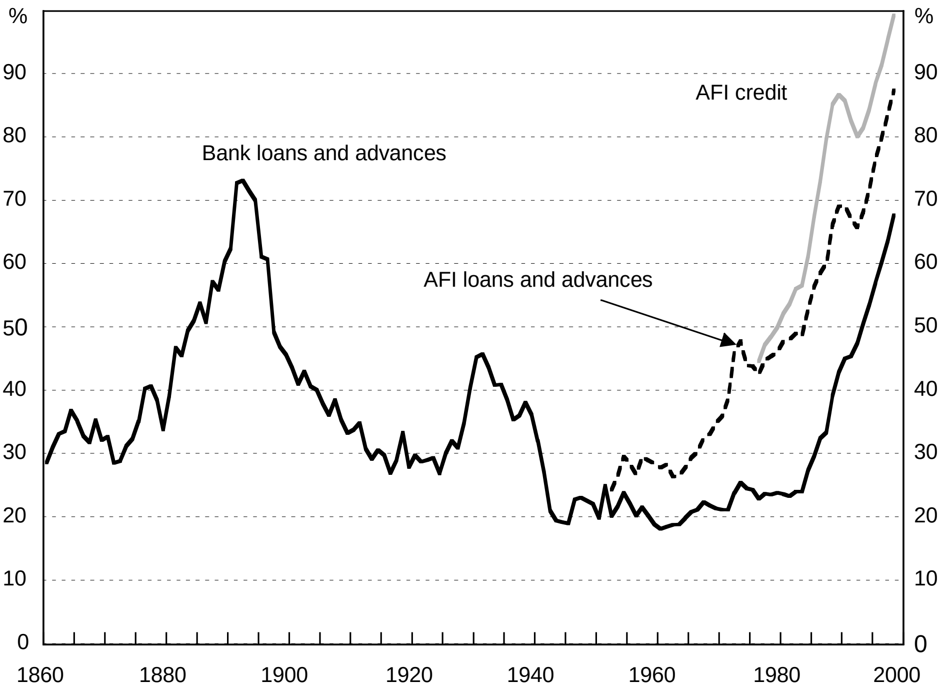
2. Four Australian credit cycles

Australia has experienced four major cycles in credit over the past 150 years, with turning points in credit during the depressions of the early 1890s and early 1930s and the recessions of the mid-1970s and early 1990s (Figure 1).[7] The four downturns in credit have also been associated with varying degrees of financial instability - across a number of measures, the 1890s and 1990s episodes were more severe than the 1930s and 1970s episodes. The experiences of these cycles are important for at least two reasons. First, the similarities between the episodes suggest there are a number of primary macro-indicators of financial system vulnerability - namely, rapid growth of output, credit and asset prices and increased concentration of investment/lending.

Figure 1

Credit in Australia

Per cent of nominal GDP



Note: AFI credit includes all banks and non-bank financial institutions.

Second, it is important to consider the role of prudential behaviour in driving these macroeconomic developments and determining the exposure of the financial system to the non-diversifiable risk inherent in the business cycle. Prudential behaviour during the 1890s and 1990s episodes is best characterised as having amplified the cycle in the real economy and exposed financial institutions to the risk of significant losses.[8] Capital ratios in the 1890s were clearly countercyclical, while they rose through the economic downturn of the 1990s episode. In contrast to these episodes, banks displayed relatively prudent behaviour during the lead-up to the 1930s depression - capital ratios were procyclical and banks suffered relatively minor losses during the depression. Further, we suggest that their lending behaviour did not exacerbate the downturn in the real economy. In the 1970s episode, mandated controls on banks' lending behaviour isolated the banking system from problems in the

7 Appendix B contains a detailed description of the data.

8 The paper does not discuss the period over the second half of the 1990s, which saw significant structural changes. These included strong growth in credit to households with more moderate growth of lending to business, a general improvement in risk management practices within institutions and, increasingly, a more sophisticated regulatory environment. For a recent discussion of these developments, see Gizycki and Lowe (2000).

general economy, but this was not without cost. Namely, tight controls on banks impeded efficient financial intermediation and pushed risky lending activities outside the regulated system.

This section of the paper draws extensively on the existing Australian literature regarding the four episodes. Kent and Fisher (2000) compare the experience of the 1890s with the 1930s episode using a broad range of macroeconomic and prudential indicators, while Kent and Lowe (1998) compare the 1970s and 1990s episodes with emphasis on the behaviour of credit and asset prices. Pope (1991) compares the impact of "deregulation" of the financial system prior to the 1890s with the deregulation of the 1980s; Merrett (1993), in comparing the impact of the 1890s financial collapse on bank policies in the 1920s, also makes reference to the 1980s experience.[9]

2.1 Similarities across four episodes - macroeconomic indicators

The periods leading up to each of the four episodes of financial distress share a number of common features (see Figure 2). With the exception of the 1920s, each of the peaks in credit was preceded by an extended period of high economic growth.[10] Strong growth reinforced confidence and fuelled the expansion phase of the credit cycles. Each of the four credit cycles was also closely linked with a significant cycle in property prices. Credit-fuelled investment booms concentrated in the building and property development sector, especially in the 1880s and 1980s, left the financial system vulnerable to the unwinding of asset price bubbles.

1890s

Prior to the 1890s depression, investment was concentrated in construction, representing the biggest building boom in Australia's history (Kent and Fisher (2000)). The enthusiasm for building activity, while primarily driven by urbanisation and rapid population growth, was also fuelled by rapid credit growth and the asset price bubble. Bank credit rose extremely rapidly (as did credit provided by non-bank financial institutions (NBFIs), although data on lending by NBFIs are not readily available). Property prices in Sydney and Melbourne (where the boom was concentrated) rose twofold between 1882 and their peak in 1891 and fell substantially thereafter.

1930s

The basic elements of the credit and property cycle were replicated in the 1920s and 1930s, though in many respects the cycle was more muted. The increase in the ratio of credit to GDP was more moderate and construction investment, though high, was lower as a share of GDP than it was in the 1880s. The cycle in commercial property prices was similar to that of the earlier episode, with property prices doubling between 1921 and 1930 before unwinding in the depression years.

1970s

Growth in credit in the late 1960s and early 1970s was also associated with the expansionary stage of a property price cycle. Commercial property prices more than trebled between 1968 and 1974. Much of the credit growth was driven by the rapid expansion of NBFIs. In addition, Daly (1982) highlights the increasing internationalisation of the Australian economy, the late 1960s mining boom, the development of Sydney as a major financial centre and generally positive business confidence as factors driving the property price boom. The property price cycle peaked in 1974, coinciding with a tightening in monetary policy and falling investment.

1990s

The cycle in property prices in the late 1980s and early 1990s shared many of the characteristics of earlier cycles. The ratio of credit to GDP grew rapidly over the second half of the 1980s, while

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9 See also Schedvin (1973), Merrett (1991), Crosby (1995), Grenville (1991) and Macfarlane (1989, 1990).

10 Real GDP grew by an average of at least 3% over the 10 years prior to the 1890s, 1970s and 1990s episodes. While GDP grew by an average of over 3% in the 1920s, this growth was concentrated in the first half of the decade with GDP remaining stagnant between 1925 and 1930.

commercial property prices doubled over the same period. Construction increased as a share of GDP throughout the 1980s, peaking at over 10% at the height of the asset price bubble in late 1989. The bubble burst with the recession of the early 1990s.

2.2 Banking behaviour - prudential indicators

Despite the many similarities between these four episodes, there were also a number of important differences, especially with regard to banking behaviour and the severity of financial system problems. Differences in the prudential behaviour of the banks across these four episodes were driven by regulatory developments and changes in market structure. The expansionary phases of the 1890s and 1990s cycles were characterised by heightened competitive pressures within the financial system and great optimism on the part of financial institutions - although in the 1880s, some older, more conservative banks had warned of the dangers of excessive lending. Competition between financial institutions was quite moderate through the 1920s and banks were relatively conservative. Competition within banking was moderated in the 1970s by restrictions on banks' activities, while competition was more vigorous within the unregulated non-bank financial sector.

2.2.1 Regulations and market structure

1890s

Prior to the banking crisis of 1893, the dominant banks were placed under increasing pressure by the emergence of a range of NBFIs, which grew quickly in tandem with the property price boom during the second half of the 1880s. In order to compete with the NBFIs, banks expanded the size of their branch networks, lowered their credit standards and became involved in speculative activities, including loans to the new land finance companies. These developments coincided with the relaxation of banking regulations, which had, amongst other things, prohibited property being taken as security against loans.

1930s

The structure of the financial system underwent considerable change over the period between the two depressions. The key changes were consolidation among the banks, the decline of NBFIs and the growing share of assets controlled by the conservative savings banks. Consolidation lessened competition in the banking sector at the same time as providing a vehicle for banks to diversify geographically. Merrett (1991) and Kent and Fisher (2000) provide evidence suggesting the experience of the 1890s crisis contributed to banks adopting more conservative prudential behaviour, lasting well into the 1920s.

1970s

After World War II, banks were heavily regulated. Constraints were placed on banks' deposit and lending interest rates and there were quantitative and qualitative restrictions on their lending activities (Grenville (1991)). Despite tentative steps in the early 1970s towards deregulation, banks remained heavily regulated with controls on interest rates and the structure of their balance sheets. While less heavily regulated NBFIs grew rapidly on the back of the property boom, the banks participated at arm's length through their ownership of NBFIs.

1990s

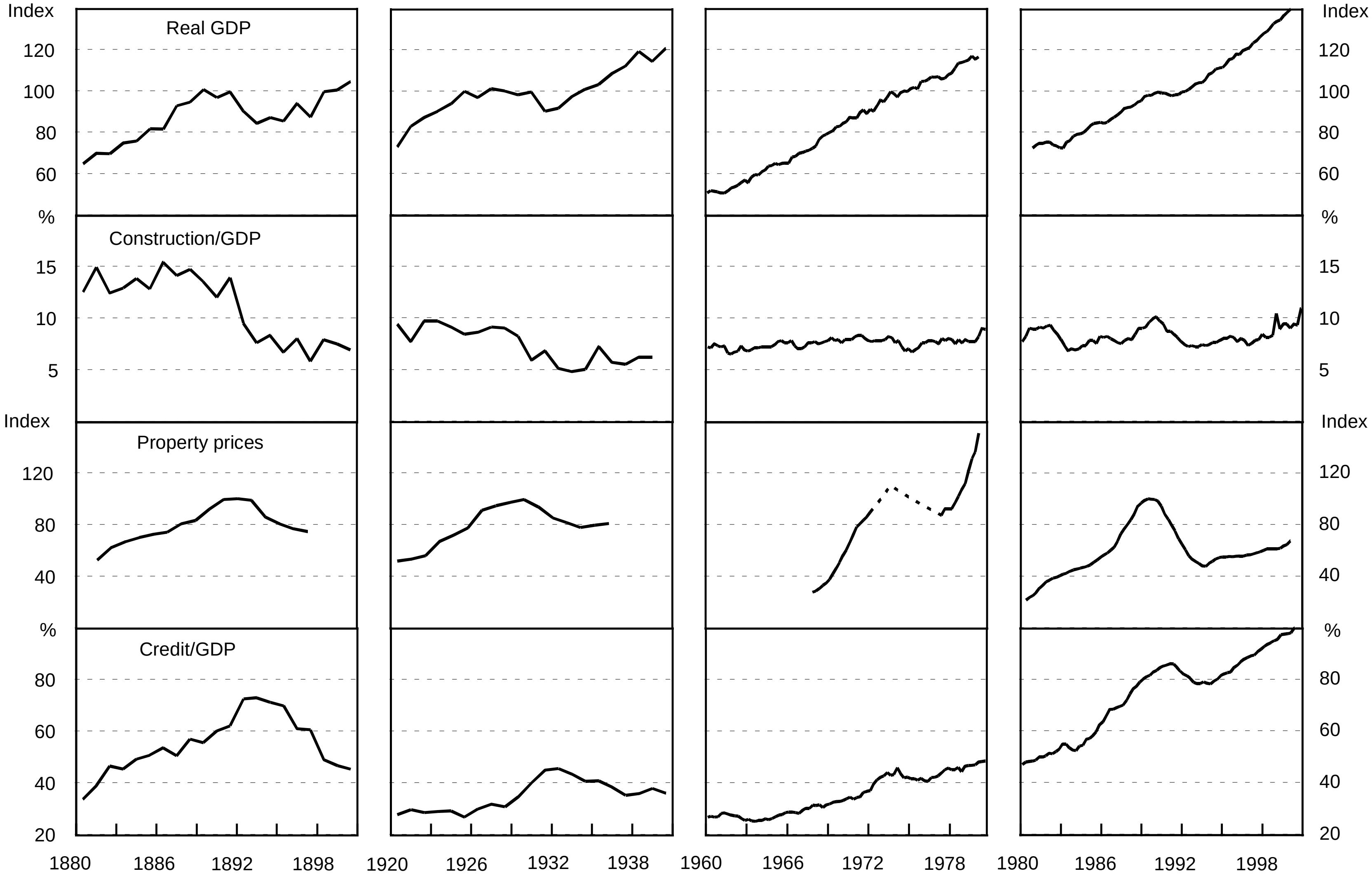
In many ways the 1990s episode was most like that of the 1890s - following an easing in regulatory controls in the early 1980s and faced with the threat of greater competition (this time from new foreign banks and new banks created from NBFIs), banks competed aggressively for market share. The rapid rise in credit was primarily driven by growth in lending to business. Increases in property prices were propelled by banks' appetite for property lending and the attractiveness of leveraged investments in the high-inflation environment.

2.2.2 Prudential behaviour

These differences in the competitive and regulatory environment contributed to variation in the prudential behaviour of banks as measured by a number of indicators.

Figure 2

Cycles in Australian output, construction, property prices and credit



1890s

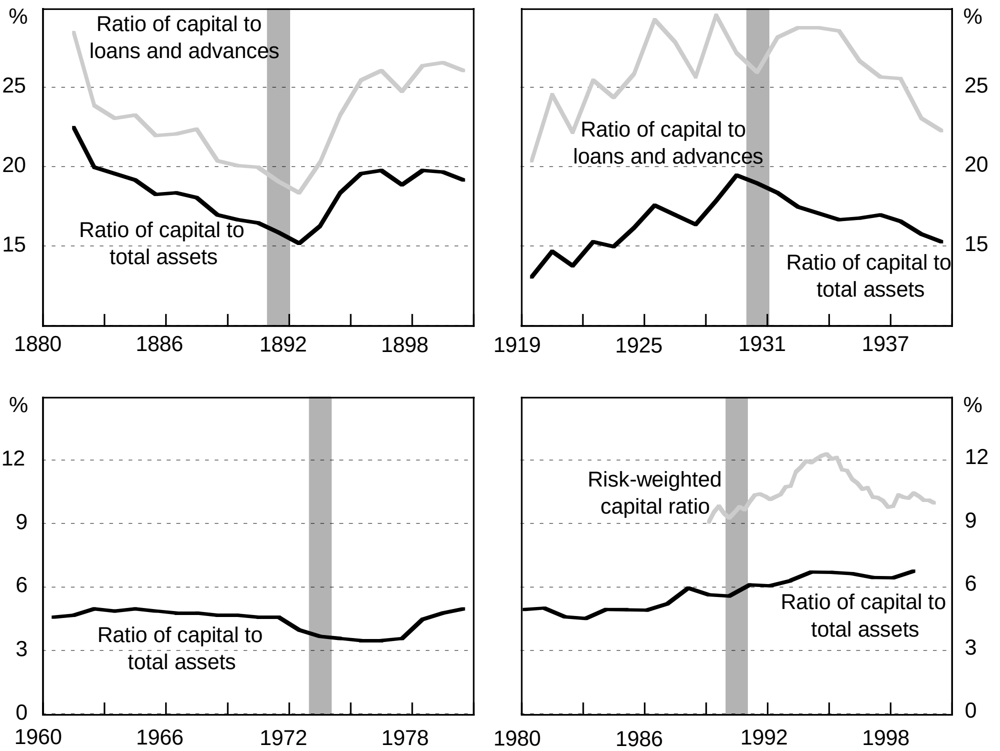
In response to greater competition in the 1880s, most banks reduced prudential standards and increased lending at a rapid rate. Declining prudential standards were in part inevitable as a result of the rapid increase in branch networks, which contributed to a loss of central control over lending policies. Banks built up many large exposures and permitted large insider loans (that is, loans to close business associates and even employees of the bank). They increased their reliance on short-term foreign liabilities at the same time as extending the maturity mismatch. Banks also allowed the rate of lending growth to outstrip the growth of capital. Figure 3 shows the decline in capital as a share of total assets and as a share of loans and advances (the latter ratio declining more rapidly). The combination of these factors left the banking system vulnerable to a downturn in the property sector, a loss of creditor confidence (especially among foreign creditors) and a general decline in the economy.

1930s

Prudential behaviour over the 1930s episode stands in stark contrast to that of the 1890s and 1990s episodes. Although banks allowed credit to grow quite rapidly towards the end of the 1920s, they maintained generally conservative lending policies; indeed, Merrett (1993) argues that banks may have been excessively cautious and, therefore, impeded the pace of industrialisation. Banks minimised their exposures to property, loans tended to be of relatively short maturity, and banks held a relatively high share of government securities. Another factor mitigating their overall risk profile was that banks held a net foreign asset position; however, falling liquidity became a significant problem towards the end of the 1920s. In addition to these factors, through the 1920s banks built up their capital positions; the ratio of shareholders' funds to total assets increased from under 15% in the early 1920s to nearly 20% in 1929 (Figure 3).

Figure 3

Capital ratios



Note: Shading indicates peaks in real GDP.

1970s

The ratio of shareholders' funds to total bank assets was lower during the 1960s and 1970s than during any of the other episodes (Figure 3). The ratio fell in the early 1970s at a time when credit was expanding quickly. While of itself this suggests prudential standards of the banking sector were low in the 1970s, heavy regulations placed on banks at the time, including on the structure of their balance sheets, enforced a considerable degree of conservatism. Of greater importance during this episode was the behaviour of NBFIs, including subsidiaries of banks, that were not subject to the same degree of regulation as the banks themselves.

1990s

Following deregulation, banks competed aggressively for market share prior to developing the internal credit controls necessary to control risk in a deregulated environment. The banking industry grew rapidly against the background of a boom economy and a business community where leveraged acquisitions of assets had become the orthodoxy (Macfarlane (1990)). Banks' exposure to property grew in tandem with the boom in this sector. Banks also entered the early 1990s with a high level of large exposures. The ratio of shareholders' funds to total assets rose slightly over the 1980s (Figure 3). This in part reflected an agreement between the banks and the Reserve Bank of Australia (the regulator at this time) to establish a minimum (unweighted) capital ratio. This minimum was subsequently raised and by the late 1980s the Australian banks complied with the minimum (risk-weighted) capital standards under the Basel Capital Accord (Reserve Bank of Australia (1989)). Following the turn in the credit and property price cycles, banks continued to increase their capital position in the early 1990s, especially as measured by the risk-weighted capital ratio, as they focused on repairing their balance sheets. This was driven, at least in part, by pressure from rating agencies and the capital markets more generally. Arguably this new-found conservatism, along with balance sheet repair in the non-financial corporate sector, contributed to the financial drag in the early stages of the economic recovery.

2.3 Severity of financial system problems

In this section of the paper we argue that differences in banks' behaviour during the growth phase of each episode helped to determine the relative severity of the financial system problems experienced during the downturn of each episode. A bank's own vulnerability depends on its prudential behaviour, while the behaviour of the financial system as a whole influences developments in, and the vulnerability of, the economy in general.

In short, financial system problems were mild in the 1970s episode, moderate during the 1930s (despite the severity of the depression), relatively severe during the 1990s and acute during the 1890s.

One way to gauge the severity of financial system problems is to compare the behaviour of credit as a share of nominal GDP (Figures 1 and 2). This measure supports the proposition that financial problems were acute during the 1890s, while those of the 1970s were relatively mild.[11] In contrast to the assertion above, the behaviour of credit suggests that the financial system problems of the 1930s were more severe than those of the 1990s. However, the interpretation of this measure (and other measures) of severity is clouded by the influence of demand side factors. That is, the decline in credit (as a share of GDP) partly reflects the effect of the downturn in the real economy (which was far greater in the 1930s) on financial system performance. Even so, other measures of severity confirm that the 1930s episode was in fact less severe than that of the 1990s.

2.3.1 Failures of banks

Another measure of severity is the number of financial institutions that failed or were forced to suspend payment. On this basis, the 1890s' financial problems clearly stand out as the most severe, with 13 of the 23 major banks forced to suspend payment in the first half of 1893.[12]

[11] Although the percentage point changes in the ratio of credit to GDP were larger in the 1990s cycle, the percentage change in the ratio was actually higher in the 1970s episode (Kent and Lowe (1998)).

[12] By August that year, 12 of these banks had reopened after a process of reconstruction which involved writing off capital, converting some deposits into equity and deferring the payment of the remainder of deposits.

Runs on banks during the 1930s were confined to smaller institutions; major banks survived the depression relatively unscathed. Only three smaller institutions suspended payment, the largest of which was the Government Savings Bank of NSW - although this was largely due to political influences which led to a run on deposits.

The financial problems of the mid-1970s eventually led to the failure of Bank of Adelaide in 1979 (due to losses incurred by its finance company subsidiary), which merged with ANZ Bank (one of the major Australian banks).

The 1990s saw the failure of two government-owned banks, the State Bank of South Australia and the State Bank of Victoria, which was the fifth largest bank in Australia at the time. Large losses at these institutions forced the injection of public funds by their respective state governments before they were eventually merged with other banks.

2.3.2 Losses incurred by banks

The performance of financial institutions provides a more comprehensive measure of financial system problems than failures of financial institutions. The poor performance of financial institutions during a period of financial system instability can be gauged in a number of ways. The most direct measure is the level of charges for bad and doubtful debts. A more general measure is the cumulative decline in profitability.

Accounting standards in the 1890s and 1930s make it difficult to separate out charges for bad and doubtful debts. Typically, when banks identified large losses on loans, these would lead to a writedown in shareholders' capital without first going through profit and loss statements (Royal Commission (1937)). From 1893 to 1909, these charges amounted to about 77% of the value of shareholders' funds at the outset of the depression. The Royal Commission identified no such losses for the 1930s. This may have reflected the fact that smaller losses could be "hidden" by reporting a lower level of profits. Banks did not incur substantial credit losses over the 1970s. Charges for bad and doubtful debt from 1990 to 1992 amounted to 82% of the value of shareholders' funds in 1989.[13]

An alternative to bad and doubtful debts is to cumulate the difference between profits during "normal" times and profits during periods of financial instability. For simplicity we choose "normal" profits based on the year prior to the first substantial fall in profits. (For the 1890s, we also add in separately identified charges for bad and doubtful debts in order to compare results with other episodes.) The results (Table 1) confirm that the financial crisis of the 1890s was the most severe with cumulative losses (from 1893 to 1904) of 108% of shareholders' funds in 1892.[14] For the 1930s, cumulative losses (from 1930 to 1936)[15] were moderate, amounting to only 19% of initial shareholders' funds. Losses for the 1970s were insignificant - amounting in 1974 to only 0.4% of shareholders' funds in the previous year. While banking losses were small during the 1970s, there were significant losses within the NBFI sector (see Section 2.3.4). Losses of the banking sector in the early 1990s were more in line with those of the 1890s than the 1930s - cumulated from 1990 to 1992 they amounted to 44% of initial shareholders' funds.

So, although the decline in general economic activity was far greater in the 1930s than the 1990s, the severity of financial system problems in the 1990s was significantly greater as measured by the decline in bank profitability.

2.3.3 Lending behaviour - impact on the economy

When measuring the severity of financial system problems, our primary interest is the extent to which the weakened financial system exacerbates the decline in the real economy.

[13] See Gizycki and Lowe (2000) for a more detailed discussion of these losses.

[14] The weakest banks made substantial calls on their shareholders in order to recapitalise (Kent and Fisher (2000)).

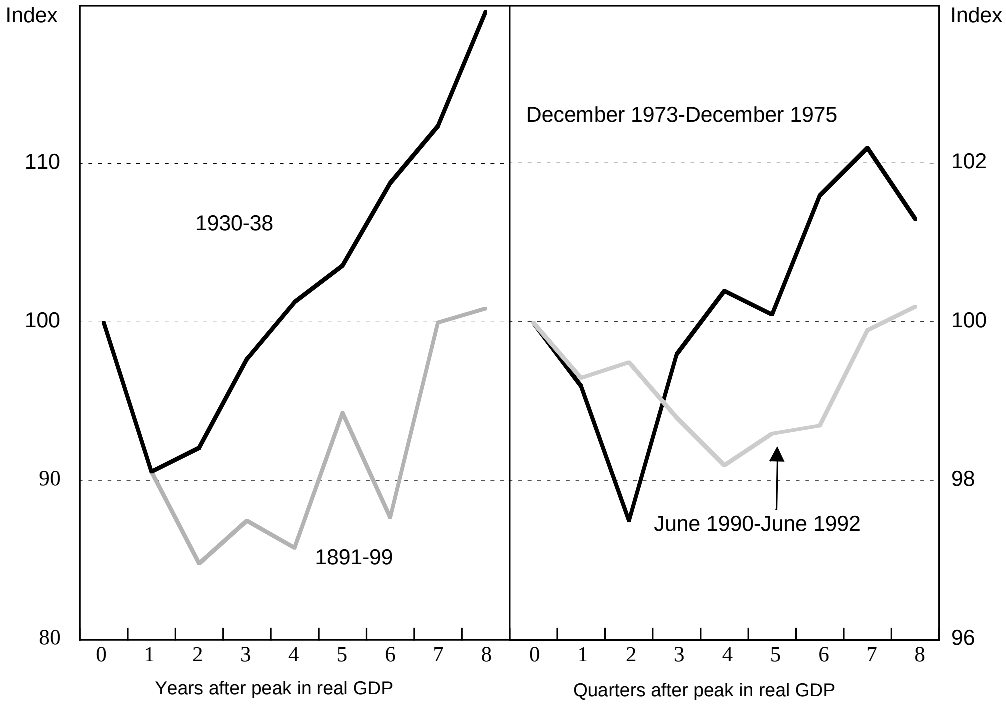
[15] Data on banks' profits are from Royal Commission (1937) and so do not extend beyond 1936.

Figure 4 compares the decline in output across the four episodes. Clearly, the depression of the 1890s was the most severe, the 1930s depression was relatively deep, while the 1970s recession was relatively mild. Finally, although the 1990s recession was also mild in comparison with Australia's depression experiences, actual output still remained below potential for a considerable period (Kent and Lowe (1998)).

It certainly appears that the severity of the 1890s banking crisis contributed to the depth and length of the decline in real output. Output fell by 10% in 1892. In 1893, when over half of the banking system collapsed, output fell by a further 7% and did not recover its earlier peak until the end of the decade. While output also fell by about 10% in the first year of the 1930s depression, it recovered thereafter - even though the decline in world output and that in the terms of trade were larger in the 1930s depression than the 1890s depression. This suggests the relative health of the financial system contributed to the 1930s depression being less severe than the 1890s depression.[16]

Figure 4

Australian real GDP during downturns



The relatively minor decline in output during the 1970s is consistent with the fact that losses of the financial system were also small. Kent and Lowe (1998) argue that the impact of the decline in the property sector through the mid-1970s was moderated by the fact that the general level of inflation was high. This meant the correction in real property prices was achieved via a moderate decline in nominal property prices (relative to the experience of the 1990s).

To emphasise the role of the property price correction in exacerbating the 1990s economic downturn, Kent and Lowe (1998) show that real GDP growth in Australia from June 1991 to December 1993 was significantly lower than growth as predicted by a model based on US GDP, Australian real interest rates and lags of Australian GDP growth.[17] This period of "unexplained" low GDP growth coincides

[16] Royal Commission (1937) describes the negative impact the financial problems in the 1890s had on the course of that depression. It also suggests that, although the banks were accused of adopting relatively tight lending policies through the 1930s episode, this had been true both before and after the depression. Kent and Fisher (2000) suggest differences in fiscal and monetary policies were not sufficient to explain the better performance of the banking system (and, indeed, the economy in general) in the 1930s compared with the 1890s.

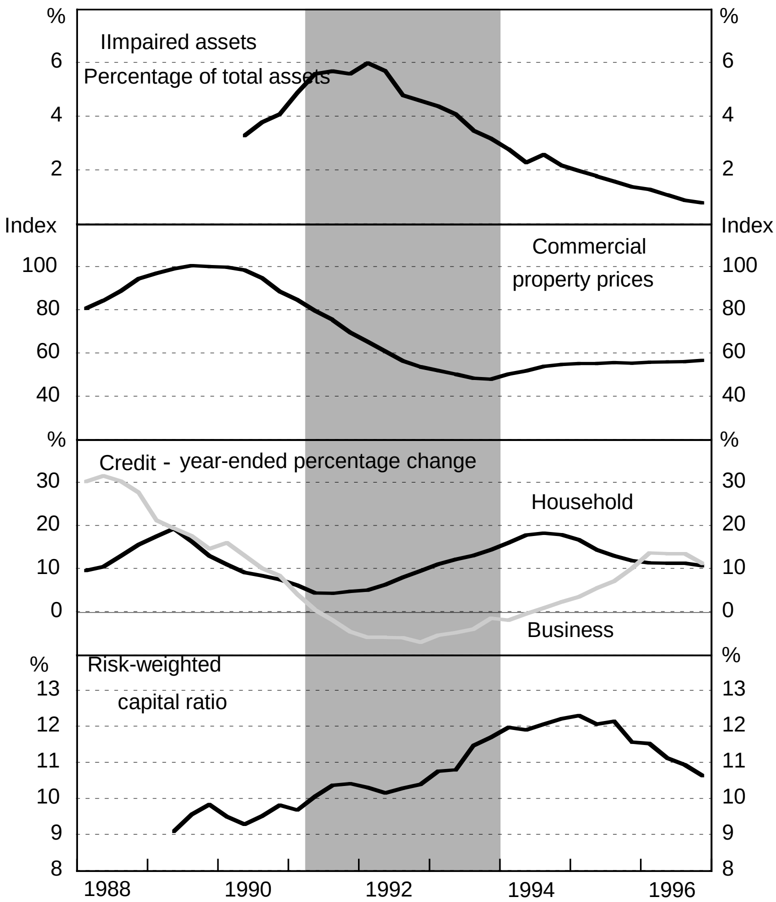
[17] Lack of quarterly data precludes this type of analysis for the 1890s and 1930s episodes.

with the period during which the banking system was very weak - non-performing assets were high, commercial property prices and business credit were falling and capital ratios were rising (Figure 5). This suggests the banking sector weakness explains the especially poor performance of the economy over this period.

Figure 5

Banking sector weakness - 1990s

Shading indicates period of unexplained low output growth



Finally, returning to the comparison across the four episodes, capital ratios provide a summary measure of the extent to which weakness in the banking system may have created a drag on the macroeconomy (Figure 3). In particular, if weakened banks seek to rebuild or even raise their capital ratios, this will tend to restrict the supply of credit with attendant effects on the macroeconomy.

In the early stages of the 1893 depression, banks were forced to raise new capital to replace that which had been written off as a result of substantial losses. Subsequently, in order to convince both shareholders and depositors of their new-found conservatism, the banks were forced to raise the ratio of shareholders' funds to assets (and shareholders' funds to loans and advances). The behaviour of the (risk-weighted) capital ratio through the 1990s was not too dissimilar. Despite earlier increases in the capital ratio following the move to the Basel capital standard, banks' capital ratios continued to rise through and beyond the recession.[18]

While the ratio of shareholders' funds to assets fell through the 1930s depression, the banking system did not lose capital over this period. The ratio of shareholders' funds to loans and advances, though

[18] This general pattern is robust to the exclusion of outlying banks which suffered the largest losses.

quite volatile, remained around pre-depression levels during the early years of the depression, but then fell consistently from 1934 onwards.

2.3.4 Problems at non-bank financial institutions (NBFIs)

In addition to problems in the banking sector, it is also worth comparing the severity of problems within NBFIs across episodes. However, data availability makes this problematic. The most comparable data are changes in the number and assets of NBFIs.

Over the 1890s episode, NBFIs grew rapidly during the expansionary phase of the cycle and suffered substantial losses during the depression. The assets of building societies and pastoral finance companies (the most significant non-bank lending institutions) rose by 80% in the five years to 1891 and fell by 45% over the 1890s. Between 1891 and 1893, 54 deposit-taking NBFIs closed their doors, 60% of them permanently (Pope (1991)).[19]

The market share of non-bank lending institutions remained low through the 1920s - their assets rising only 30% in the five years to 1930. Their assets fell by only around 6% from 1930 to 1933, roughly in line with the decline in the number of building societies over this period.

Daly (1982) describes the key role played by finance companies in the commercial property boom and bust of the 1970s. Almost half of the largest 20 finance companies failed following the collapse of the commercial property market in the mid-1970s. Even so, assets of NBFIs in general did not decline (in nominal terms) through this period.[20]

Gizycki and Lowe (2000) provide a brief account of the problems experienced by NBFIs through the early 1990s. There were runs on a number of institutions, some of which were forced to close or merge with stronger institutions. More generally, there was a significant decline in credit provided by NBFIs (as a share of nominal GDP).

In summary, although limited data make the comparison of these episodes difficult, in terms of the problems experienced by NBFIs it appears that the 1890s episode was the most severe, followed by the 1970s and then the 1990s and 1930s.

2.4 Overview of four credit cycles

The Australian experience of credit cycles (which is by no means unique) highlights three important results. First, there are a number of macroeconomic developments, which, ***in combination***, provide an indication of financial system instability - namely, an extended period of rapid growth of credit and asset prices (particularly of assets used for collateral) and increased concentration of investment and lending.

Second, while macroeconomic performance clearly impacts upon the health of financial institutions, there is also evidence that prudential behaviour of lending institutions is an important determinant of the course of the business cycle. In particular, countercyclical prudential behaviour during the 1890s and 1990s episodes amplified the business cycle. These episodes were also associated with severe cases of financial system instability. In contrast, generally procyclical prudential behaviour of banks over the 1930s episode meant their losses were relatively minimal and readily absorbed despite the depth of the cycle in output. Also, bank behaviour does not appear to have contributed to the depth of the 1930s downturn.

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[19] In the late 1880s, there were approximately 120 building societies in NSW and Victoria.

[20] In 1974, the NBFIs had assets of about $17 billion, of which finance companies accounted for almost $9 billion. This compares with bank assets of $27 billion. Many of the finance companies were owned by domestic or foreign banks and allowed banks to get around the strict controls on their lending activities.

Table 1

Summary of the severity of financial system problems

		Episode			
		1890s	**1930s**	**1970s**	**1990s**
Fall in real GDP	Relative ranking[1]	1	2	4	3
Failures of banks	Number of banks "failing"	13	3	1	2
Bank credit losses	Cumulative bad and doubtful debts (share of initial capital)	77%	na	na	82%
Performance of banks	Cumulative decline in profits (share of initial capital)[2]	108%	19%	0.4%	44%
Fall in ratio of credit to nominal GDP	Relative ranking[1]	1	2	4	3
Problems at NBFIs	Change in the number and assets of NBFIs (relative ranking)[1]	1	4	3	2

Note: Includes building societies and pastoral finance companies in the 1890s and 1930s.

[1] Ranking in declining order of severity from 1 (the most severe) to 4 (the least severe). [2] Cumulative difference between profit before tax relative to profit before tax in the year prior to the onset of financial system difficulties.

Third, underlying variation in the type of prudential behaviour across these episodes were differences in the competitive and regulatory environment facing banks. Deregulation heightened competitive pressures in the lead-up to the 1890s and 1990s, whereas competitive pressures were relatively moderate prior to the 1930s. Finally, the 1970s experience demonstrates that, although rigid regulatory controls on lending behaviour can isolate banks from the effects of declining economic activity and sharp falls in asset prices, much of the risk was pushed outside the regulated institutions.

3. Cyclical prudential standards for banks

In this section of the paper we use a stylised model of the economy to examine in more detail some of the themes raised in Section 2. Our primary interests are to describe the two-way relationship between the business cycle and banks' prudential behaviour and to consider the potential for banking behaviour to lead to amplification of the business cycle and financial system instability. In doing so, we examine how different assumptions regarding banks' perceptions of risk can lead to procyclical or countercyclical prudential policies.

Banks can vary their prudential standards across a number of dimensions. However, we focus on their decisions regarding the approval of loans, the interest rate on loans and levels of provisions and capital. In broad terms, banks' decisions regarding prudential standards have two important effects. First, they determine the level of credit risk held by banks. Second, by influencing the availability and price of credit, they influence developments in the general economy.

We assume that banks make these decisions in a way that is consistent with the standard capital allocation model.[21] We extend these models by recognising that the interest rates on loans and deposits and the capital ratio are determined endogenously. We then consider the impact of the business cycle on the distribution of potential credit losses and the impact of this on interest rates, credit and the risk of bank failure.

[21] See Herring (1999) and Jones and Mingo (1998) for a recent discussion of this framework.

3.1 Model overview

In the standard capital allocation model banks have a one-year planning horizon.[22] At the start of each year, banks make new loans, set loan rates, make provisions and raise capital and deposits. Losses on the loan portfolio are revealed at the end of the year and depend on the realisation of idiosyncratic and common factors that affect the ability of each borrower to service their debt. Loans are assumed to have an initial maturity of at least one year. Interest rates on loans are variable and determined in a competitive market. The demand for loans is assumed to be negatively related to the cost of loans and positively related to output.

For simplicity we assume that banks face no costs other than those that arise from the cost of raising deposits and equity to fund their loan portfolio. In our model deposits are best thought of as wholesale funds, which earn a premium over the risk-free interest rate to compensate depositors for the risk of the bank defaulting. We assume that shareholders are risk neutral, while depositors are averse to bank failure because the process of extracting their deposits from a failed bank is assumed to be costly. Deposits and equity are assumed to be supplied to the banks in any quantity so long as expected returns are sufficiently high (that is, the supply of deposits and of equity capital is infinitely elastic).

Banks' potential loan losses are described by a probability distribution function (PDF), defined over the whole loan portfolio. Hereafter, we normalise losses, provisions and capital by total loans. Hence a bank's PDF, $f(l)$, is defined over $l \in [0,1]$, the share of total loans ***including interest payments*** which borrowers fail to repay the bank at the end of the period.[23] The PDF summarises the likelihood of borrowers defaulting and the likely losses given default (see Appendix A for details).

Banks will provide loans so long as the interest rate on the loan is sufficient to cover the cost of deposits and expected loan losses, and to provide shareholders with the required return on the economic (risk) capital allocated to cover unexpected losses. The minimum required return on shareholders' economic capital, $\overline{ROE}$, is assumed to be determined in the equity market and taken as given by banks. In equilibrium, the expected return on equity must equal the required return on shareholders' funds.

In short, the model determines the equilibrium loan and deposit interest rates, capital, provisions and the probability of bank failure (for a given PDF, $\overline{ROE}$, risk-free interest rate and bankruptcy cost). The interest rate at which loans are supplied then determines the level of credit in the economy according to the demand for loans.

At the centre of the model is the relationship between the capital ratio and the average cost of funds, which must be fully reflected in the interest rate charged to borrowers. As a bank's capital ratio increases, there are two effects working in opposite directions. First, the cost of funds rises with the capital ratio because the required return on equity, $\overline{ROE}$, is above the risk-free interest rate, *r*. Working in the other direction, the premium paid to depositors (over and above the risk-free rate) falls rapidly from a relatively high level (at very low capital ratios) towards the risk-free rate as the capital ratio increases. This reduction in the risk premium paid to depositors reflects the decline in the probability of bank failure as the capital ratio rises. Combining these two effects implies that the curve mapping out the relation between the loan rate and capital is u-shaped (see Figure 6 in Section 3.2). Competition in the loan market will drive the equilibrium interest rate on loans towards the minimum point on this curve - the supply curve for loans is infinitely elastic at this interest rate, given our assumptions regarding the supply of equity and deposits. This solution is mapped out more formally in the next section, before we consider the impact of the cycle in Section 3.3.

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[22] This is consistent with evidence from US banks (Jones and Mingo (1998)).

[23] That is, loan losses at the end of the period are $l\,L\,(1+i_L)$ where *L* is total principal lent by the bank at the beginning of the period and i_L is the interest rate charged on loans. This means the PDF for losses is independent of the interest rate on loans, which simplifies the solution of the model.

3.2 Model solution

Banks fail if their losses are so large that assets are insufficient to cover non-equity liabilities (that is, if actual loan losses are greater than the sum of provisions and capital). The return on equity (*ROE*) reflects the limited liability of shareholders as follows:

$$ROE = \begin{cases} -1 & \text{if } l > \mu + c \\ \{ i_L - i_D(1-c) - l(1+i_L)\}/c & \text{if } l \le \mu + c \end{cases} \tag{1}$$

where μ is equal to provisions (which are defined more precisely below), i_L is the interest rate on loans, i_D is the interest rate on deposits and *c* is capital (per unit of loans). (Deposits per unit of loans are equal to $(1-c)$.) The expected return on equity is therefore:

$$E(ROE) = \frac{1}{c}\left\{(1-p)[i_L - (1-c)i_D] - (1+i_L)\int_0^{\mu+c} l\ f(l)\,dl\right\} - p \tag{2}$$

where $p \equiv \int_{\mu+c}^{1} f(l)\,dl$ is the probability of bank failure.

Banks will fund loans so long as the interest rate on loans is such that the expected return on equity is greater than or equal to $\overline{ROE}$. Competition in the loan market will drive down the interest rate on loans to the point at which the expected ROE is equal to $\overline{ROE}$. Combined with equation (2), this implies that in equilibrium:

$$i_L = \frac{c\,(\overline{ROE} + p) + (1-p)(1-c)\,i_D + \int_0^{\mu+c} l\ f(l)\,dl}{1 - p - \int_0^{\mu+c} l\ f(l)\,dl} \tag{3}$$

For a given interest rate on deposits, equation (3) describes the relationship between the capital ratio and the interest rate on loans - as the capital ratio increases, the interest rate on loans must rise to provide a constant expected rate of return. This reflects the relatively high cost of equity. However, in this model we assume that the interest rate on deposits is not constant - it depends on the potential for depositors to experience losses, which in turn depends on the capital ratio.

The return on deposits, *ROD*, depends on the extent of bank losses as follows:

$$ROD = \begin{cases} \dfrac{b(1-l)(1+i_L)}{1-c} - 1 & \text{if } l > \mu + c \\ i_D & \text{if } l \le \mu + c \end{cases} \tag{4}$$

where, if the bank fails, $b \in (0,1]$ is the share of any remaining bank assets available for distribution to depositors after allowing for the costs of bankruptcy. The expected return on deposits is, therefore:

$$E(ROD) = (1-p)\,i_D + \frac{b(1+i_L)}{1-c}\left[p - \int_{\mu+c}^{1} l\ f(l)\,dl\right] - p \tag{5}$$

We assume that depositors are willing to supply banks with funds so long as the expected return on deposits is equal to the risk-free interest rate (which is less than the minimum required return on equity, $\overline{ROE}$). This can be justified in one of two ways, either:

(a) depositors are risk neutral but are willing to accept a lower expected return than equity holders because deposits provide a unique service, say liquidity or payment services; or

(b) depositors are risk averse and therefore willing to accept lower expected returns than equity holders because of the relative security provided by deposits. This aversion to losses can be captured by the term (1-b)>0 which describes the losses arising from bankruptcy. This may reflect the actual monetary cost of bankruptcy proceedings. It may also reflect the monetary value of the disutility associated with bankruptcy due to the loss of liquidity and wealth.[24]

Given that, in equilibrium, the expected return on deposits is equal to the risk-free interest rate, from equation (5) it can be shown that:

$$i_D = \frac{(r+p)}{1-p} - \frac{b(1+i_L)}{(1-c)(1-p)} \left[p - \int_{\mu+c}^{1} l \ f(l)\, dl \right] \tag{6}$$

The loan rate curve describing the relation between the interest rate on loans and the capital ratio can now be obtained by substituting equation (6) into equation (3):

$$i_L = \frac{c\,\overline{ROE} + (1-c)\,r + (1-b)\left[p - \int_{0}^{\mu+c} l \ f(l)\, dl \right] + E(l)}{1-(1-b)\left[p - \int_{0}^{\mu+c} l \ f(l)\, dl \right] - E(l)} \tag{7}$$

The two square-bracketed terms in equation (7) represent the effect of the premium that must be paid to depositors to compensate for the potential costs of bankruptcy. If there were no bankruptcy costs (that is, b equal to one), equation (7) would be greatly simplified. The expected return on the average loan, $i_L(1-E(l))$, would equal the cost of funds plus expected losses per loan, $c\overline{ROE} + (1-c)r + E(l)$. In this case, there would be a positive linear relationship between the loan rate and the capital ratio. In equilibrium the banks would fund all of their loans with deposits, which are cheaper than equity.

With b non-zero, the loan rate reflects not only the expected losses on the loan portfolio, but also compensation for depositors who face the potential costs associated with bankruptcy. At sufficiently high capital ratios (for well-behaved PDFs), the probability of bank failure is very low. At this point, the two square-bracketed terms in equation (7) tend to zero and the interest rate on deposits is close to the risk-free interest rate. It is only when capital is low to moderate and the probability of bank failure not insignificant that these terms become important.

To illustrate the main features of the model we provide a numerical solution based on a specific PDF and a set of parameters.[25] However, before solving the model we need to be more explicit about the conditions under which banks fail. We assume that a bank will fail if its assets at the end of the year are less than its debt liabilities, that is, if:

[24] The utility function implied by equation (4) is unsatisfactory to the extent that, conditional on bank failure, the depositor is then risk neutral with respect to losses. A more comprehensive form of risk aversion could be specified but this would complicate the solution without altering the main result - that is, that depositors are more averse to losses than equity holders and are willing to accept lower expected returns in exchange for greater security and/or liquidity. Moreover, depositors must be duly compensated when the probability of bank failure is relatively high (Figure 6).

[25] The parameters are: $r = 0.06$; $\overline{ROE} = 0.15$; $b = 0.9$; and the PDF is a Chi-squared distribution with three degrees of freedom defined over 50l (which has a mean of 0.0305). To derive the numerical solution we search over values of l from zero to one, increasing in increments equal to 0.001. The numerical solution should not be interpreted as approximation of reality; rather it serves to demonstrate the main features of the model.

$$(1-l)(1+i_L) < (1+i_D)(1-c) \tag{8}$$

$$\Leftrightarrow \qquad l > c + \mu \text{ where } \quad \mu \equiv \frac{(1-c)(i_L - i_D)}{1+i_L}$$

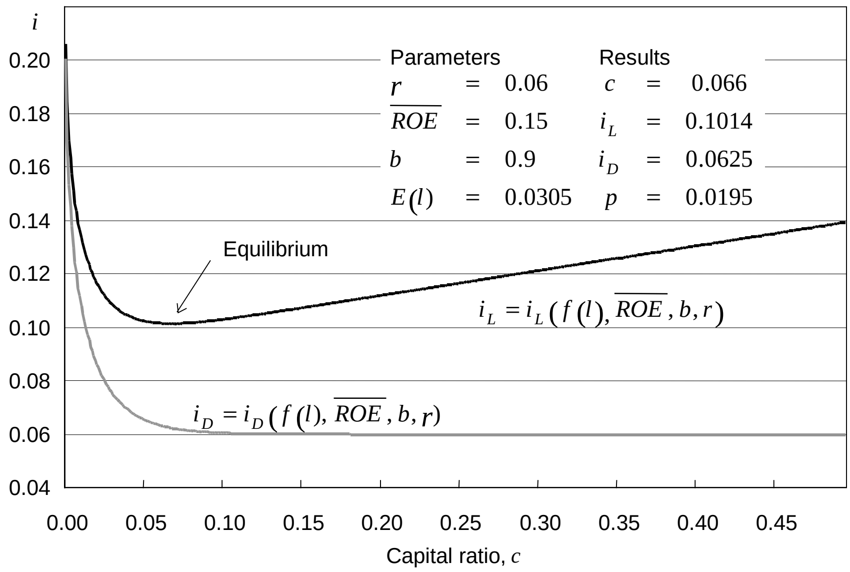
This defines the level of provisions, μ, which act as a buffer against losses. This buffer increases the greater is the differential between interest rates on loans and deposits.

The solution of the model is made more difficult by the fact that the failure condition depends on the interest rate on loans and deposits. This is because equations (6) and (7) both involve integrals with boundaries that depend on the endogenous interest rate variables. This requires us to solve the model using an iterative process whereby in the first instance we assume μ is constant (and equal to the expected value of *l*).[26] We then solve equations (6) and (7) for i_L and i_D and use these values to compute a new series for μ according to equation (8). This series is then used to find a new solution for i_L and i_D and so on until convergence.[27]

The numerical solution is summarised in Figure 6, which illustrates the relationship between the deposit rate and the capital ratio, and between the loan rate and the capital ratio (that is, equations (6) and (7) respectively). Banks can satisfy both the debt and equity markets by choosing any point along the (black) loan rate curve - however, competition in the market for loans will drive banks to the point at which the interest rates on loans is minimised. If capital ratios were to rise above this point, pressure to maintain the required return on equity would require a higher interest rate on loans. At lower capital ratios, the higher probability of bank failure requires banks to pay higher interest rates on deposits; this cost must be passed on to borrowers to maintain the required return on equity. Given the equilibrium capital ratio, the interest rate on deposits is given by the (grey) deposit rate curve.

Figure 6

Numerical solution of the model



[26] This assumption is relatively accurate around the equilibrium.

[27] We used 60 iterations of this process, which was more than sufficient for convergence.

3.3 Impact of the cycle on losses

In this section we consider the impact of the state of the business cycle on the distribution of losses on a bank's loan portfolio and examine how this affects capital ratios, interest rates, the probability of bank failure and aggregate lending.

We start by assuming that the ability of each borrower to service their debt depends on the state of the real economy. We characterise output as cycling around a trend - which can be thought of as potential output. Although uncertain, output is assumed to have a predictable component and while shocks to the ***growth rate*** of output are persistent, output has a tendency to return to potential over time. Figure 7 indicates our stylised version of the business cycle. One way to derive this type of behaviour is to assume that output growth follows a Markov-switching process - switching from above average to below average growth rates (relative to potential growth).[28] Shocks to growth rates are persistent, but as output moves beyond potential, the probability of a reversal in economic fortunes increases. This means that bad times are more likely to follow an extended period of good times and vice versa.

The risk of losses in the loan portfolio increases through the expansionary phase of the business cycle for a number of reasons:

i. as output moves further away from potential, the probability of switching to a contractionary phase increases. This implies an increasing risk that borrowers will face difficulty in generating income sufficient to service their debts. In addition to the increased incidence of default during a contractionary phase, the loss given default will also tend to be higher at this time;

ii. while in the early stages of the expansion there is a large pool of investment opportunities, resource constraints in the economy (including the finance sector) prevent all of these opportunities being pursued at once. Entrepreneurs tend to pursue the high-return and low-risk projects first. As the expansion progresses and the capital stock grows, remaining investment opportunities and new additions to the capital stock become increasingly marginal, making the financing of these projects increasingly risky for banks;

iii. further, as interest rates rise through the expansionary phase of the cycle, the problem of adverse selection increases (Mishkin (1997)). This has the effect of biasing banks' potential customers to those with larger downside risk;

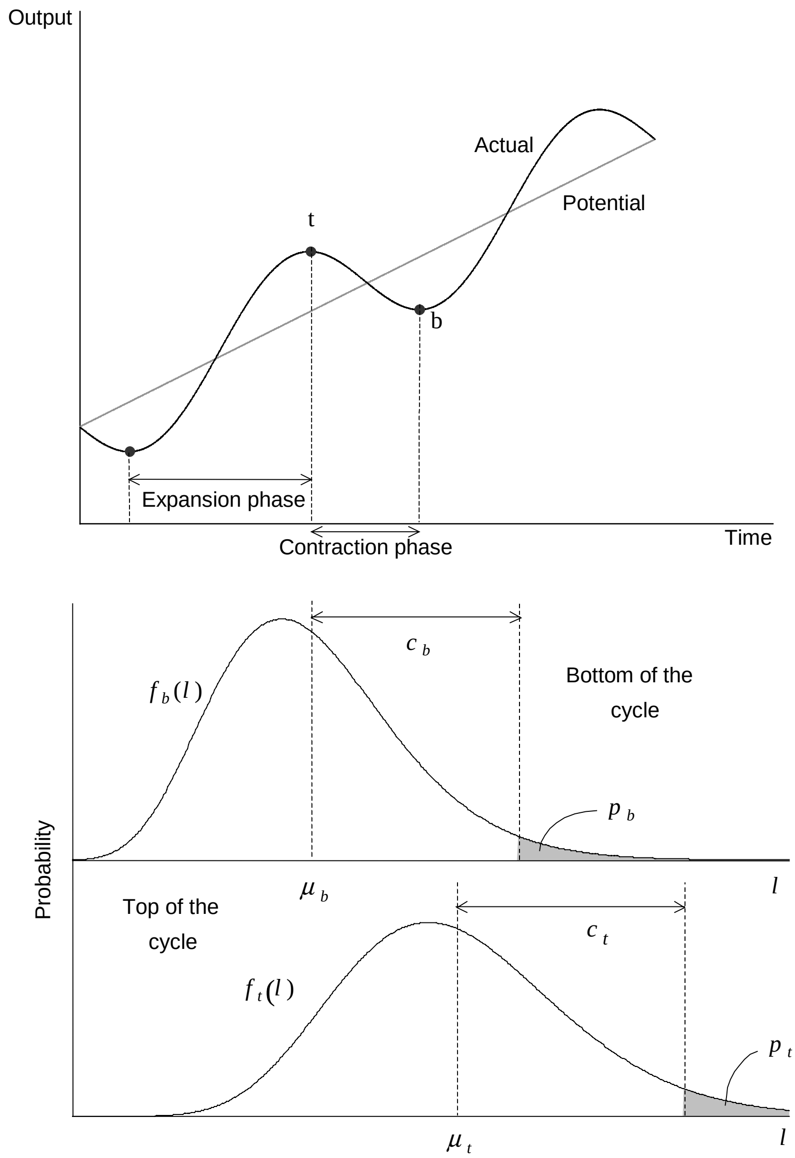
iv. there is also evidence that loan default rates have a distinct time profile, with default rates peaking when loans are a few years old (Carey (2000)). This suggests there is a build-up of risk during the upswing stage of the business cycle, when banks are writing a large number of new loans.

To simplify the analysis of the business cycle, consider two extreme points in the cycle: the top point of the cycle, state *t*; and the bottom point of the cycle, state *b*. Given the assumptions regarding the predictability of the cycle and the implications of the cycle for likely future loan losses, we can say something about the PDF for future losses at points *t* and *b*. Namely, $f_t(l)$ will imply greater expected losses than $f_b(l)$. In addition it seems reasonable to assume that the bad-tail of the loss distribution $f_t(l)$ also lies further from its respective mean than is the case for $f_b(l)$. Figure 7 illustrates these two points.

[28] The seminal paper to use Markov-switching processes to describe the business cycle is Hamilton (1989). For a recent discussion of this literature, see Kontolemis (1999).

Figure 7

The business cycle and PDF for losses



These assumptions are consistent with the findings in Carey (2000), who provides empirical evidence regarding bad-tail loss rates using Moody's bond-default database from 1970 to 1998. He shows that bad-tail events in bond portfolios are more likely to occur during times of general economic distress and that to protect against losses at the 99th percentile, capital ratios in bad years must be about 175% of those needed in good years. Further discussion of the relevance of the cycle for the loss distribution is provided in Appendix A.

Given the partly predictable nature of the cycle and the implied changes in the loss distribution, it makes sense for banks to condition their expectations regarding future losses according to the current state of the cycle. In this way, banks can adjust prudential standards in the light of changes in risk over their planning horizon. It is not necessary for banks to be able to predict the course of the cycle with a high degree of accuracy, only that they respond appropriately to the increasing probability of a downturn in the business cycle, even if this probability remains small.

In summary, the risk of large losses is greatest at the extreme peak of the cycle, whereas risk at the bottom stage of the cycle is relatively moderate. So long as the cycle is at least partly predictable, it makes sense for banks to use conditional PDFs when setting their prudential standards.

3.4 Solution based on conditional PDFs - Case 1

To illustrate how banks should respond to changes in risk through the cycle, we compare differences in their behaviour across the extreme points in the cycle. In this section we assume that banks perceive actual risk as implied by the PDFs conditional on the state of the cycle.

The PDF $f_t(l)$ implies higher expected loan portfolio losses than $f_b(l)$. By itself this implies a vertical shift in the loan rate curve, without altering the level of capital at which the interest rate is minimised. However, the PDF $f_t(l)$ also has a more prominent bad-tail than $f_b(l)$. This means that at each level of capital, banks must pay depositors a higher interest rate to compensate for increased probability of bank failure. This has the effect of shifting the loan rate curve up and to the right. In other words, the equilibrium interest rate on loans and the capital ratio are both higher at the top of the cycle. This is demonstrated by the numerical examples shown in Figure 8. The parameters and the results for the two equilibria are summarised in Table 2.

Figure 8
Equilibrium based on conditional PDFs

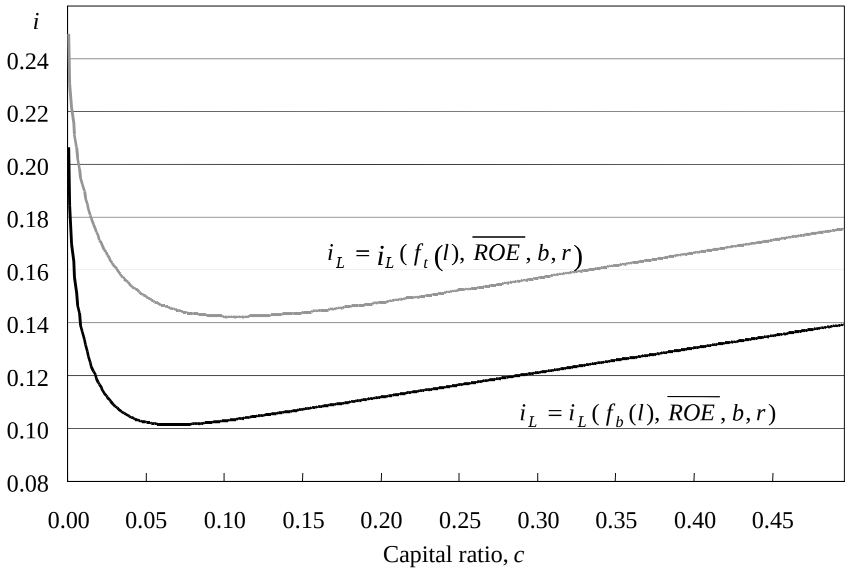


Table 2
Summary of equilibria for the conditional PDFs

		$f_b(l)$	$f_t(l)$
Capital ratio	c	0.066	0.107
Interest rate on loans	i_L	0.101	0.142
Interest rate on deposits	i_D	0.063	0.066
Probability of bank failure	p	0.020	0.040
Provisions	μ	0.033	0.060

Note: The PDFs, $f_b(l)$ and $f_t(l)$ are Chi-squared distributions defined over 50*l* and 100*l* respectively (with means of 0.0305 and 0.0605), both with 3 degrees of freedom. Underlying parameters are $b = 0.9, r = 0.6,$ and $\overline{ROE} = 0.15$.

These results also show that provisions and the probability of bank failure are both higher at the top of the cycle than at the bottom of the cycle. That is, depositors share some of the additional risk at the top of the cycle (though they are duly compensated for this risk through higher deposit rates). It is optimal for depositors and shareholders to share (albeit unevenly) this increased risk.

Because of the problem of adverse selection, banks may be reluctant to raise interest rates too much towards the top of the cycle. Instead, they may choose to reduce their exposure to borrowers by lowering the loan-to-valuation ratio or requiring a greater level of collateral. In either case, the impact on the demand for loans will be similar to a rise in the interest premium.

In summary, we have suggested the risk of borrower default and loss given default rises towards the top of the business cycle and falls at the bottom of the cycle. If the cycle is at least partly predictable, forward-looking behaviour by banks will lead them to increase capital ratios at the top of the business cycle and allow capital ratios to fall as they move to the bottom of the cycle. In equilibrium, interest rates will also be higher at the top of the cycle relative to the bottom of the cycle, as will the probability of bank failure.

3.5 Amplification of the cycle

In this section of the paper we investigate a number of reasons why banks might deviate from the type of behaviour described in Case 1 and the consequences for financial system stability of these alternative behaviours. Our primary interest is in the potential for banking behaviour to lead to amplification of the business cycle, both in terms of the amplitude of output cycles around potential and the duration of cycles.

In order to account for the potential for banks' lending decisions to influence the state of the cycle we need to make explicit the link between the supply of credit and the business cycle. A number of models do this by recognising that the health of borrowers will determine banks' willingness to lend, which in turn affects borrowers' ability to invest and consume and, therefore, the state of the general economy. The influence of the state of the economy on the health of borrowers completes the circular link between all of these factors.[29]

Other things equal, banks are more willing to lend to borrowers that can provide sufficient collateral or indicate more generally their willingness and ability to repay loans and avoid excessive risk-taking. Borrowers have to indicate to banks their financial strength in order to alleviate the problems of adverse selection and moral hazard, which arise due to asymmetric information. Collateral helps to protect the bank against loss and provides borrowers with some incentive to avoid excessive risk. The ***willingness*** and ***ability*** of firms to repay their debts and avoid excessive risk can also be indicated by a relatively high share of equity in total liabilities and by high profitability relative to the cost of debt servicing.

Suppose that at any point in the cycle the banking system as a whole were to ease lending conditions, leading to a fall in the interest premium and a rise in the level of credit. This should lead to some increase in output as borrowers take advantage of cheaper credit to undertake greater consumption and/or investment expenditure. The price of assets will also rise, as some of the additional credit is channelled into asset markets. An improvement in the economic outlook will be reflected in the value of firms' collateral, their share prices and profitability. Because these developments improve the financial position of firms, they can lead to a further easing of credit conditions.

Of course, the same amplification mechanism between output, credit and asset prices will also work in the opposite direction. For example, a negative shock to asset prices will reduce the willingness of banks to lend, which will impair the ability of borrowers to invest and consume. This in turn will have a negative influence on output and asset prices, further reducing banks' willingness to lend.

[29] One relevant model is that of Kiyotaki and Moore (1997), who describe the relationship between cycles in output, credit and asset prices and emphasise the role of collateral. Suarez and Sussman (1997) outline a model of financially driven business cycles. They imply the possibility of financial frictions amplifying the effect of external shocks in an unbounded manner. Holmstrom and Tirole (1997) present a model based on the lending channel, in which the health of banks' balance sheets determines the availability of intermediated finance for firms. See Dow (2000) for a recent review of these and other relevant models. Bernanke et al (1998) provide a survey of the literature on amplification arising through the financial sector.

3.5.1 Banks ignore the cycle - Case 2

The first alternative to Case 1 we consider is that banks (and the capital markets) are unable to predict the likely course of the business cycle and, therefore, base their lending decisions on the unconditional PDF $\bar{f}(l)$, rather than the conditional PDFs, $f_t(l)$ and $f_b(l)$.

If banks base their decisions on the unconditional PDF, they have no reason to vary their prudential standards through the cycle. If we ignore amplification effects for a moment, then under Case 2 provisions, capital and interest rates will all be constant through the cycle at levels between the extremes implied by $f_t(l)$ and $f_b(l)$. Banks will not have an incentive to deviate from this equilibrium since expectations regarding the return on equity and the return on deposits are constant through the cycle. However, while the banks (and markets) perceive the probability of failure to be constant throughout the cycle, the probability of failure will actually be higher at the top of the cycle and lower at the bottom of the cycle (reflecting differences in the actual PDF across the cycle).

In Case 2, banks are undercapitalised at the top of the cycle and interest rates are "too low" to account for the true level of risk implied by $f_t(l)$; the opposite is true at the bottom of the cycle. This also means the supply of credit is too great at the top of the cycle and too low at the bottom of the cycle compared to Case 1.

If we now attempt to account for amplification effects described above, the fact that interest rates are too low at the top of the cycle under Case 2 (relative to Case 1) implies an expansion in credit and hence an expansion in output (and asset prices). Again, the opposite is true at the bottom of the cycle. In other words, the cycle will display greater amplitude (and longer expansions and contractions) under Case 2 than Case 1. This amplification will also increase the risk of bank failure at the top of the cycle through its second-round impact on the conditional PDF, $f_t(l)$ - that is, the further output is above potential, the more likely it is that the economy will switch to a (long) contractionary phase. In this way, risk is accentuated by the interaction of the banks' beliefs and the amplification mechanism linking credit and output.

3.5.2 Excessive optimism - Case 3

The third case we consider is an extension of Case 2. Suppose banks perceive that risk is low (or even falling) during the expansionary stage of the cycle - that is, they are excessively optimistic relative to the true state of the world.

This behaviour can be explained as a form of myopia whereby the banks' (and the capital market's) expectations are driven by their more recent experiences[30] - that is, they base their assessment of risk on the (recent) realisation of risk. This means that during the expansionary phase of the cycle, when losses tend to be low, banks assume risk going forward is also low. Similarly, during the contractionary phase of the cycle, when losses tend to be high, banks assume that risk going forward is high (see Section 3.5.3).

Another possibility is that excessive optimism could arise because of uncertainty regarding potential output. Structural change can lead to a period during which potential (and actual) output is rising more rapidly than it has in the past. Ordinarily, above average growth rates for actual output cannot be sustained without leading to increasing risk of an economic downturn sometime in the near term. However, when potential output is also rising faster than average, this is no longer true. This implies that the conditional PDF for losses will not be shifting right to the same extent (if at all).

The risk, however, is that banks are excessively optimistic regarding how long this structural change will last and/or the extent to which potential output growth has increased. So long as they perceive risk to be relatively low they will increase lending and hold less capital than would have been the case in the absence of structural change. However, if the rate of growth of potential output slows (after structural change runs its course), then the risks will be rising over time to the extent that actual output is still growing strongly.

[30] Herring (1999) provides a detailed discussion of myopia and its relevance for financial stability.

The relative increase in risk will depend on the extent of banks' optimism. At the extreme, banks may believe actual output is likely to continue to rise at a rapid rate well into the future, in which case they might base their decisions on a conditional PDF that is close to a distribution like $f_b(l)$, while the truth is much closer to a distribution like $f_t(l)$. In this case, there will be greater amplification of the cycle than for Case 2 and an even greater build-up of risk during the expansionary phase of the cycle. Such a scenario is made more likely by the fact that excessive optimism can be self-sustaining. Banks may interpret the fact that growth is continuing at a fast pace (in part, because of amplification) as indicative of the strong growth in potential output.

Rapid growth of asset prices (particularly those that form the basis of collateral) has been an important element in many financial crises - both in Australia and elsewhere. Like output, asset prices can also be driven up by structural change. Excessive optimism with regard to future performance of the economy can drive asset prices well above their "fundamental" level. Banks lending on the basis of rapid rises in the value of borrowers' collateral are exposed to the risk of a reversal in market sentiment, which leads to a rapid decline in asset prices. This would then imply greater losses for banks in the event of borrowers defaulting.

This direct link between asset prices and banks' risk could be captured more explicitly within our framework by allowing the PDF for losses to be conditioned on asset prices. For example, rapid growth of asset prices above some threshold level would suggest larger losses are more likely (the PDF shifts right).

Excessive optimism will be more likely in a climate of relatively intense competitive pressure within the financial system, during which banks and other financial institutions compete aggressively for market share. Although excessive lending (driven in part by undercutting competitors' prices) will increase the risk of failure over the longer term, in the short term, during an expansionary phase, it may appear to be a profitable strategy. In part, this reflects the fact that default rates peak when loans are a few years old (Carey (2000)).

It may also be difficult for a single bank to deviate from other banks by displaying more conservative behaviour. If the capital market is subject to the problem of herding, the lone conservative bank may be unduly penalised.[31] That is, when markets care about relative returns, it may be hard for a bank to convince the market of the value of a conservative strategy when all other banks are lending aggressively. This is especially true if the market is focused on realised risk (as reflected in reported profits) rather than actual risk.

These arguments are certainly consistent with the Australian evidence. Indeed, the financial deregulation of the 1980s which led to increased competitive pressures was arguably also a factor leading to an improved outlook for the economy - that is, the end of financial repression led to financial deepening and, presumably, an improvement in the ability of financial institutions to direct funds to the most productive uses. The difficult question at the time was: how much and how rapidly could the economy absorb an increase in credit without a sharp rise in risk? Ex post, the pace was clearly too great, though it was still nothing like the experience of 100 years earlier.

3.5.3 Excessive pessimism - Case 4

Setting a minimum regulatory capital ratio that is invariant to the business cycle may be problematic for at least two reasons.

First, a fixed minimum capital ratio has to be set relatively high in order to protect (uninformed) depositors from very bad outcomes that are more likely during extreme economic distress. In the context of the model, this means capital would need to be set according to the PDF for losses, $f_t(l)$. However, this implies inefficient use of capital at the bottom of the cycle, when capital should be lower, according to $f_b(l)$. In this respect, Case 4 is similar to Case 2, which also had a fixed level of capital throughout the cycle.

[31] Devenow and Welch (1996) provide a brief summary of the literature on regarding rational herding models.

Second, when the economy experiences a very sharp downturn, banks are likely to lose a substantial amount of capital. The rigid minimum capital ratio forces banks to recapitalise to a relatively high level. As Hellwig and Blum (1995) show, the rigidity implied by a fixed minimum capital ratio can lead to amplification of large negative shocks to the banking system.

So far, our model has implicitly assumed that after experiencing a loss of capital, a bank is able to recapitalise - this follows from the assumption that banks view the one-year planning horizon as sufficiently long. However, following a sharp downturn in the economy, the capital market may well become excessively pessimistic. Having suffered significant (unexpected) losses, banks may find that the equity market is unwilling to provide additional funds under the same conditions as previously. This could be captured in the context of our model as a rise in the required return on equity, leading to an increase in the capital ratio and interest rates on loans.

Similarly, debt markets may become less willing to fund banks that experience significant losses. This could be captured in the context of our model as a rise in the required return on equity, leading to a fall in the capital ratio and higher interest rates on loans.

In our model, we have implicitly assumed that so long as the expected ROE and the interest rate on deposits are sufficiently high then equity and deposits will be supplied in whatever quantities the banks demand. However, in the real world, when banks suffer large losses, capital markets may be reluctant to fund banks, even at very high expected rates of return. If banks face limited access to funding, they will be forced to restrict lending, or even liquidate assets, in order to increase capital ratios. This will have a detrimental impact on output, credit and asset prices, leading to amplification of the cycle during its downturn phase.

If we allow for the possibility of pessimism, large losses at, or even the failure of, one bank can have a detrimental impact on the health of other banks. This follows from the negative impact of such losses on asset prices and the confidence of capital markets more generally. The difficulties created by these effects will be compounded if a number of institutions experience difficulties at the same time. Such an outcome is clearly more likely to occur during a downturn in the macroeconomy - especially if banks enter the downturn undercapitalised. This suggests the risk of a bank running into difficulties will depend not only on its own behaviour and the state of the business cycle, but also on the behaviour of other banks.

However, while it seems plausible that banks act according to a PDF conditional on the state of the business cycle, it is unlikely they will account for the condition of other banks. Essentially this implies there is a market failure causing banks to take on too much risk at the top of the business cycle. In a way the problem is one of liquidity for the system as a whole - that is, markets can cope with one bank failing during good times but fail to anticipate the failure of many institutions during bad times.

3.5.4 Backward-looking provisions - Case 5

It is a principle of sound prudential behaviour for banks to provide for ***expected*** losses in a forward-looking manner. In our model, banks (implicitly) make provisions according to their expectations of future loan losses. In theory, the key is not that banks make provisions, but rather that they charge an interest rate on loans sufficient to cover the cost of deposits as well as expected future losses on the loan portfolio. Having done this, making provisions is only important to the extent that the timing of interest payments and the revelation of loan losses may not be coincident. However, unless the bank has appropriately priced its lending it will be unable to make sufficient provisions and still satisfy the demands of the equity market.

In practice, loans may be priced on the basis that the current loan rate only needs to cover the current provisioning charge. However, this may be problematic if current provisioning levels are being set in a backward-looking fashion so as to cover the losses that are currently in the process of being realised. In this case, at the top of the cycle when current losses tend to be low, the charge to profits for provisions will be low at a time when credit risk is actually high (according to the conditional PDF at the top of the cycle, which implies relatively high expected losses going forward). This is problematic because the bank is likely to have to increase provisions in the future at a time when its interest income will be insufficient to cover expected losses. In practice, backward-looking provisioning may arise because the accounting standards and tax laws under which banks operate dictate their provisioning. Accounting standards (and bank supervisors) usually require banks to make specific provisions against non-performing loans that have been identified (that is, against losses in the process of being realised).[32] This means the charge to profit and loss for specific provisions would be too low at the top of the cycle when the realisation of non-performing loans is low - and too high at the bottom of the cycle when the realisation of non-performing loans is high. This may also be reflected in banks' decisions regarding loan rates.

Ideally, banks would make general provisions in a forward-looking way so as to compensate for the countercyclical path of specific provisions. General provisions would be built up during the expansionary phase of the business cycle when future expected losses are increasing and charged against during the downturn when the losses are realised. Presumably interest rates on loans would also vary to reflect these changes in provisioning. However, the accounting standards require that general provisions be made against non-performing loans not specifically identified, but which the bank believes to be present in the balance sheet at the balance date. Thus, strictly interpreted, general provisions will not be forward-looking. In practice, there is some scope for general provisions to be forward-looking because of the subjective nature of the decision to determine the level of non-performing loans not yet identified. In Australia and some other countries, general provisions are not tax-deductible, which also acts to discourage banks from being forward-looking when making general provisions. Nevertheless, major Australian banks have adopted a dynamic-provisioning methodology which attempts to set general provisions in a forward-looking manner.

If, during the expansion, general provisions and specific provisions are less than actual expected losses, then banks will be underprovisioned. With no compensating increase in capital, this means the likelihood of failure is also too high, as is profitability - banks are not pricing loans in such a way that they can afford to set aside sufficient revenue to cover expected losses. Debt markets may provide the discipline that forces banks to hold additional capital to compensate for the shortfall in provisions. However, if the debt markets suffer from excessive optimism, there may be a role for supervisors to ensure adequate capital is held to offset the problem of backward-looking provisions.

4. Policy implications

The results of Sections 2 and 3 of the paper suggest that countercyclical prudential behaviour of banks can lead to the build-up of excessive risk during the expansionary phase of the business cycle. Furthermore, this behaviour can amplify the business cycle and reduce financial system stability. The build-up of excessive system-wide risk through the expansionary phase of the business cycle is indicated by a combination of developments, including: rapid and sustained growth in credit and asset prices; increased concentration of investment and lending; declining capital ratios; and a downward drift in risk premia. This countercyclical prudential behaviour may indicate the presence of excess optimism among banks and within capital markets.

The paper also suggests, however, that countercyclical prudential behaviour is by no means inevitable, as demonstrated by Australia's experience over the 1920s and 1930s. In this case, procyclical prudential behaviour meant that, even when faced with a sharp decline in economic activity, banks' losses were relatively minor and readily absorbed.

These results have at least two important implications for policymakers concerned about the failure of financial institutions and the stability of the financial system more generally:

1. supervisory authorities need to play close attention to macroeconomic developments; and
2. supervisory authorities need to ensure that lending institutions' prudential behaviour responds appropriately to changes in risk through the business cycle.

[32] This is driven by accounting standards that seek to remove subjective elements from the banks' accounts by preventing banks from incorporating forecasts into their reported provisions.

Cyclical capital ratios

Perhaps the most obvious policy for supervisors to adopt is to ensure that lending institutions adjust capital ratios through the cycle - raising the ratio as risk increases through the expansionary stage of the cycle and then allowing the ratio to decline as risk dissipates through the contractionary phase of the cycle.[33]

One possibility is for the supervisor to make informal recommendations on an institution-by-institution basis regarding changes in the margin between actual capital and the regulatory minimum through the cycle.[34] The wholesale funding market may assist the supervisor in determining the margin of capital that banks hold over and above the minimum - in particular, the market plays an important role in determining the relative position of individual banks above the regulatory minimum.[35]

While such a system of informal (one-on-one) recommendations may cope with moderate business cycles, it may be less effective during more extreme periods characterised by very rapid growth of credit and asset prices. In these circumstances, financial institutions and markets are susceptible to excessive optimism and, therefore, may not appreciate, and may even be contributing to, the build-up of risk across the system. At the same time, informal recommendations by the supervisor may lack credibility and transparency. In contrast, a more formal system of announced adjustments to system-wide capital requirements would make the supervisor more accountable and provide a clear signal of the supervisor's assessment of risk in the system.

While this paper has argued that prudential standards should vary over the course of the cycle to account for changes in risk implied by the business cycle, this does not mean that prudential policy should be used to dampen the course of an "average" business cycle. Rather, it should seek to ensure developments within lending institutions do not amplify the business cycle and reduce financial system stability.

Uncertainty

Perhaps the most significant difficulty associated with a cyclical policy of this type is the uncertainty regarding the business cycle on the part of the supervisor. Uncertainty on the part of the lending institutions may lead to excessive risk at the top of the business cycle in the first place. It is not clear that the policymaker would have significantly better information than financial institutions. An ill-informed supervisor runs the risk of adjusting regulatory policy by the wrong amount, in the wrong direction or at the wrong time, thereby impeding efficiency and, worse still, amplifying the cycle itself.

Despite these problems, one advantage the supervisor has over financial institutions is immunity to the competitive pressures which can lead to excessive optimism. In addition, the supervisor is in a position to consider the system-wide implications for risk of individual banks' prudential behaviour.

With regard to the difficulties raised by uncertainty, it is also worth drawing a parallel with monetary policy, which faces many of the same problems. Uncertainty regarding the state of the cycle, the impact of structural changes and the effectiveness of interest rate changes suggests that monetary policy needs to be discretionary (rather than rules-based). In order to be effective, discretionary monetary policy needs to have the features of transparency and clear accountability. A cyclical regulatory policy framework would also need to incorporate these features. Like monetary policy, cyclical regulatory policy would also have to be forward-looking given the time it takes to adjust capital ratios (that is, to raise capital or adjust asset portfolios).

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33 During the downturn phase of the cycle the capital market's attitude to risk may force institutions to hold a higher level of capital than the supervisor believes to be necessary (as suggested in Section 3.5.3).

34 This is consistent with guidelines proposed by the Basel Committee on Banking Supervision (1999).

35 There is a debate regarding the ability of ratings agencies to act in a forward-looking manner. For a brief summary of this debate, see Jackson and Perraudin (1999).

Current research regarding financial system stability suggests there is no single set of indicators or a satisfactory model to guide prudential policy in a mechanistic way (Davis (1999)).[36] However, the history of financial crises demonstrates that risks in the financial system are greatest when a period of rapid economic growth is combined with strong credit growth on the back of rapid inflation of asset prices. These developments are of even greater concern during a period of heightened competition or a period of structural change in the economy, since in this environment financial institutions and markets are more susceptible to excessive optimism.

Central banks' involvement in financial markets and their macroeconomic responsibilities give them a broad system-wide perspective. Therefore, where the supervisory authority is separate from the central bank (as is the case in Australia and many other countries) it is important to ensure strong links exist between the two institutions. This has been guaranteed in Australia by the fact that the Governor and another senior executive of the Reserve Bank of Australia are on the Board of the Australian Prudential Regulation Authority, while the Chief Executive Officer of APRA is on the Payments System Board of the Reserve Bank. In addition, there are less formal links between the two institutions. For example, a high-level joint Coordination Committee meets on a monthly basis to oversee the day-to-day relationship between the RBA and APRA.

This level of formal communication with the central bank can help to provide the supervisory authority with a sound assessment of the current state of the business cycle, enabling it to more accurately assess the level of system-wide risk going forward so that policies can be determined accordingly.

[36] Though monetary policy is arguably more developed in this regard, it is still subject to model uncertainty and data problems.

Appendix A

Micro foundations for the PDF for losses

In Section 3.3 of the paper we assumed that $f_t(l)$ will imply greater expected loan losses than $f_b(l)$ ***and*** that the bad-tail of the loss distribution $f_t(l)$ lies further from its respective mean than is the case for $f_b(l)$, that is, the variability of potential losses would be greater for $f_t(l)$ than for $f_b(l)$. In this appendix we demonstrate how this type of behaviour regarding the PDF for losses on a bank's lending portfolio can be generated from independent binomial distributions. These describe the likelihood of default of an individual loan and the distribution of the loss given default.

An increase in either the probability of default on individual loans, or the probability of a large loss given default, shifts the PDF for losses on a bank's portfolio to the right, increasing both the expected loss and the variability of losses. This supports our assumption in Section 3.3 that the PDF shifts to the right at the top of the business cycle. The greater probability of default during the downswing stage of the business cycle may be thought of as representing the effect of slack demand on firms' profitability and the impact of higher unemployment on households' financial position. The higher probability of a larger loss given default may be thought of as a simple attempt to capture the effects of falling asset prices during the downswing stage of the business cycle on value of bank collateral. During benign economic conditions banks will be able to recover more of the value of defaulting loans than during a macroeconomic downturn.

We start by defining the average loss on a portfolio of *n* loans:

$$l = \frac{1}{n}\sum_{i}^{n} l_i$$

where l_i is the loss on loan *i* (expressed as a share of the value of the loan, including contracted interest payments).[37] We assume that loss on a loan is conditional on default - that is, there are no "restructured loans" in our model. The loss on an individual loan is described by a binominal distribution,

$$l_i = \begin{cases} 0 & \text{with probability} \quad (1-d) \\ \lambda & \text{with probability} \quad d \end{cases}$$

where λ is the loss-given default and $d \in (0,1)$ is the probability of default (which is constant across borrowers). We assume that default probabilities for individual loans are independent; we briefly discuss the implications of this simplifying assumption below. The loss given default, λ, is also assumed to be described by a binomial distribution,

$$l_i = \begin{cases} 0.5 & \text{with probability} \quad (1-g) \\ 1 & \text{with probability} \quad g \end{cases}$$

where $g \in (0,1)$ is the probability that, given default, the bank recovers nothing from the loan. The case where $\lambda = 0.5$ represents a situation where the bank is able to retrieve half of the principal (plus interest) because the loan is partly collateralised.

Table A1 and Figure A1 show the results of Monte Carlo simulations using three different combinations of *d* and *g*. Each portfolio contained 100 loans and PDFs for the portfolio were generated by repeating the simulation 10,000 times.

[37] If we allow the size of loan portfolios to increase over the expansionary phase of the cycle, this will reduce the variability of the PDF for the average loss on the portfolio. However, so long as the increase in the size of the economy (that is, the number of borrowers) is not too large, this effect will not offset the impact of the increased probability of default and loss given default at the top of the cycle.

Figure A1

Simulated PDFs for losses

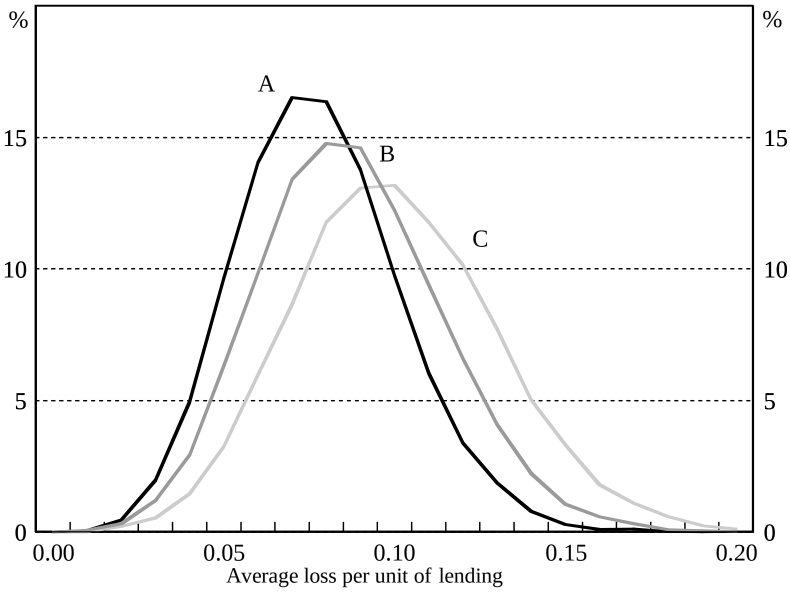

Table A1

Simulated PDF characteristics

PDF	A	B	C
Parameters	$d = 0.1$ $g = 0.5$	$d = 0.1$ $g = 0.8$	$d = 0.15$ $g = 0.5$
$E(l)$	0.075	0.090	0.1125
"Required capital"	0.060	0.070	0.067

Note: Required capital is defined such that the probability of losses greater than the sum of expected losses and required capital is 2.5%.

The results show that increasing either the probability of default (moving from A to B) or the probability of larger losses given default (moving from A to C) increases both the expected loss on the portfolio and the variability of potential losses. This means that both the level of provisions required to cover expected loss and the level of capital required to cover unexpected loss will increase in both cases.

So far we have assumed that the default probabilities for individual borrowers are independent. This is likely to be an unrealistic assumption as it does not take account of the interdependence between firms (and households) in the real economy. The failure of one firm is likely to have knock-on effects for other firms - increasing the probability that they also default on their loan. This will increase the correlation in defaults among the individual borrowers in a bank's loan portfolio. While incorporating these effects would change the shape of the PDFs - shifting more mass into the bad-tail - it would not alter the key results. Increasing the probability of default and loss given default for individual borrowers would still increase the expected loss and the capital required to cover unexpected losses on the bank's loan portfolio.

Appendix B
Data

Figure 1: Credit in Australia

Bank loans and advances: 1861-1945 sum of trading bank advances, Occasional Paper 4A, Table 1 and savings bank mortgage loans, Occasional Paper 4A, Table 53(i); trading bank data include the Commonwealth Bank from 1913 onwards; trading banks included in this series are the banks of note issue; 1946-52 sum of trading bank loans and advances and savings bank loans and advances, Pope, 1986; for 1953-76 total bank loans and advances, Occasional Paper 8, Table 3.2; 1977-99 total bank loans and advances, *Bulletin*, Table D2.

AFI loans and advances: 1953-99 sum of bank loans and advances and NBFI loans and advances; 1953-76 NBFI loans and advances are taken from Occasional Paper 8, Table 3.2; 1977-99 NBFI loans and advances, *Bulletin*, Table D2.

AFI credit: 1977-99 sum of AFI loans and advances and bank bills on issue, *Bulletin*, Table D2.

Nominal output: 1861-1900 GDP at market prices from Butlin, N G (1962), "*Australian domestic product, investment and foreign borrowing, 1861-1938/9"* (ADP), Table 1, p 6, col 2; 1901-59 from Vamplew, W (ed), "*Australian historical statistics"* (AHS), Table ANA 129; 1960-99, GDP(E) current prices, ABS 5206, Table 13.

Figure 2: Cycles in Australian output, construction, property prices and credit

Real GDP: 1880-99 and 1920-39 nominal output is deflated by the GDP price deflator index in AHS, Table PC 79 and indexed to equal 100 in the peak output years of 1891 and 1930; 1960-79 and 1980-99 real GDP(E) chain-linked, ABS Cat 5206, Table 5, indexed to equal 100 in the peak output quarters of December 1973 and June 1990.

Construction to nominal GDP: 1880-99 and 1920-39 output of the construction industry is taken from ADP, Table 2; 1960-79 and 1980-99 construction output is taken as the sum of private gross fixed capital investment - dwellings and private gross fixed capital - other buildings and structures, ABS Cat 5206, Table 13.

Property prices: 1882-97 and 1921-36 average of the capital value of rateable property in Melbourne and Sydney, indexed to 100 in 1891 and 1930, Kent and Fisher (2000); March 1968-June 1980 capital value indicator for Sydney CBD property indexed to 100 in March 1973, Jones Lang Wootton (JLW); September 1980-June 1999 spliced series indexed to 100 in 1989/1990; September 1980-June 1985 capital value indicator for Sydney CBD property and September 1985-June 1999 weighted average capital value indicator for capital city CBD property, JLW.

Credit to GDP: 1880-99 and 1920-39 as in Figure 1; 1960-79 and 1980-99 ratio of AFI credit to nominal output as in Figure 1.

Figure 3: Capital ratios

Capital: 1881-1900 and 1921-39 the sum of trading bank shareholders' funds and "reserves" as reported on banks' balance sheets, Occasional Paper 4A, Table 3 (prior to 1893 paid-up capital consists of paid-up ordinary capital, from 1893 paid-up capital is the sum of ordinary capital and preference capital); 1960-79 and 1980-99 capital is total shareholders' funds from banks' balance sheets, *Bank Annual Reports*.

Bank loans and advances: 1881-1900 and 1921-39 as in Figure 1.

Total assets: 1881-1900 and 1921-39 total assets of trading banks, Occasional Paper 4A, Table 1; 1960-79 and 1980-99 total assets from banks' balance sheets, *Bank Annual Reports*.

Risk-weighted capital ratio: ratio of regulatory capital base to total risk-weighted assets of locally incorporated banks, APRA.

Figure 4: Australian real GDP during downturns

Real GDP: as in Figure 2.

Figure 5: Banking sector weakness - 1990s

Impaired assets as a percentage of total assets: pre-September 1994 impaired assets included non-accrual items and accrual items greater than 90 days, APRA; post-September 1994 impaired assets include non-accrual items, restructured items and real estate and other items acquired through security enforcement. Past due items include housing loans and other items past due for 90 days or more which are well secured and portfolio facilities past due for 90-180 days, APRA. Total assets is total consolidated on-balance sheet assets (including assets of foreign bank branches), APRA.

Commercial property prices: as in Figure 2.

Credit growth: break-adjusted year-ended percentage change in AFI credit to the household and business sectors. Breaks include securitisation, entry/exit of institutions and changes in reporting by institutions (RBA calculations).

Risk-weighted capital ratio: as in Figure 3.

Table 1: Summary of severity of financial system problems

Bank credit losses: calculated as described in text; 1890s and 1930s data are from Royal Commission (1937); 1990s data are the charge for bad and doubtful debts from banks' profit and loss statements and capital from banks' balance sheets, *Bank Annual Reports*.

Performance of banks: calculated as described in text. For 1990s data are profit or loss from banks' profit and loss statements and capital from banks' balance sheets, *Bank Annual Reports*.

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The influence of macroeconomic developments on Austrian banks: implications for banking supervision

Markus Arpa, Irene Giulini, Andreas Ittner, Franz Pauer[1]

This paper aims to assess the effects of macroeconomic developments on risk provisions and earnings of Austrian banks for the 1990s. It seeks to detect economic indicators of potential instability in the banking system. The underlying theory is that bank earnings are to some extent directly (eg via interest rates) and indirectly (eg via their customers) dependent on the state of the economy.

The main findings for the 1990s in Austria are as follows. Austrian banks increase risk provisions in times of falling real GDP growth rates and in times of rising bank operating income or operating results. Net interest income appears to be uncorrelated with real GDP growth and interest rate developments, with the exception that at very low interest rate levels net interest income shrinks. For the Austrian banking sector as a whole, falling short-term and long-term interest rates, along with rising real estate prices and/or inflation, push up bank operating income, and vice versa, which is in line with expectations. When breaking down the Austrian banking sector by peer groups, the explanatory power of short-term interest rates becomes notably lower for most of the individual peer groups of the Austrian banking industry. The operating result of Austrian banks can be explained by and large by the same variables that explain their bank operating income. However, short-term interest rate developments are insignificant for the operating result, which suggests that - at least as far as direct implications are concerned - monetary policy has been of minor significance for Austrian banks during the last decade.

Overall, some macroeconomic variables such as interest rates, real estate and consumer prices can be used to explain the income side, profitability and financial stability of Austrian banks. Structural changes, such as increased competition, joining the single market and the opening up of eastern European markets, have certainly also had a strong impact on Austrian banks. Furthermore, we draw the conclusion that microeconomics, especially sound and prudent bank management - at least during normal (bank) business cycles - probably plays *the* major role in banking and supervision.

1.1 Motivation

During the past two decades, many countries have experienced severe banking crises. Episodes of profound banking system distress have occurred not only in emerging and transition countries, but also in advanced industrialised economies, such as the United States, the Nordic countries and more recently Japan.[2] In all cases, banking sector calamities have resulted in large losses of wealth and led to disturbances in the credit supply to the economy. Resolving the crises has frequently imposed a large burden on public funds.

The serious consequences mentioned above underline the value of indicators that signal a rising probability of banking sector problems before such problems actually occur. They would provide a useful service for the purpose of banking supervision and financial market surveillance.

It is obvious that indicators relating directly to the soundness of the banking system are ideal for the prediction of banking crises. Items from banks' balance sheets or profit and loss accounts should make sufficiently clear when problems are becoming increasingly likely. There is no doubt that banks' earnings performance and the probability of banking system distress mainly depend on the conduct of business within banks, ie on micro factors. Inadequate accounting and auditing practices, insufficient internal controls and poor management are the main causes for bank problems. In other words, bank crises are mainly the result of bad banking. Adverse macroeconomic developments should not cause severe banking problems if the bank management acts farsightedly and reflects the cyclical nature of

[1] The authors are at the Oesterreichische Nationalbank. We thank J Brockmeijer and W Waschiczek for valuable written comments as well as those colleagues at the Oesterreichische Nationalbank who commented in an internal discussion forum.

[2] Austria has not experienced any systemic banking crises since the end of World War II.

the economy in its decisions. As this is not always the case, and because cyclical fluctuations are sometimes unexpectedly extreme, macroeconomic variables might well deliver good indicators for the likelihood of mounting stress within the banking system.

1.2 How do macroeconomic developments influence the stability of the banking system?

Although banking crises are mainly caused by microeconomic factors, disturbances anywhere in the economy are likely to have repercussions on the banking system. Due to the nature of their business, banks are exposed to many potential sources of distress rooted in cyclical developments. The most dangerous characteristics in this respect are banks' above average reliance on creditors' funds (ie deposits) and their low capital ratio when compared to the corporate sector, their risky claims on different sectors of the economy, and the fact that their assets are in effect longer-term and less liquid than their liabilities. Banks' health reflects to a large extent the health of their borrowers, which in turn reflects the health of the economy as a whole.

A useful way to analyse the macroeconomic determinants of banks' health is to look at the main risks of banks: market risk (risk that values of underlying assets will decline), interest rate risk, exchange rate risk, default or credit risk (risk that debtors will be unable to repay their debts) and liquidity risk. All these risks are, at least partly, influenced by macroeconomic developments and policies.

An additional argument in favour of monitoring macroeconomic indicators for macroprudential purposes is the fact that the probability of systemic crises is greater when unsoundness is due to cyclical factors, because all banks are more or less exposed to the same conditions.

The evidence of past crises shows that certain macroeconomic variables typically display a distinctive pattern (boom and bust pattern) both before a banking crisis emerges and while it is unfolding. In general, the pattern is that of a rapid end to a boom: after rising rapidly, real GDP and domestic demand decline; an acceleration in inflation is suddenly reversed; credit from the banking system to the private sector builds up rapidly, peaks, and then contracts; real interest rates increase steadily, etc.

1.3 Development of production and domestic demand (cyclical indicators)

Overall macroeconomic data on production and domestic demand provide information about the state of the business cycle. The position of the cycle determines the earnings power of the public and private sectors and hence influences their debt servicing capability. When nourished by excessive borrowing, buoyant production and demand growth can turn out to be the first phase of a boom-bust cycle, whose second phase is a sharp downturn which often causes debt servicing problems for borrowers. In the boom phase, debt servicing problems are comparatively rare due to the exceptional earnings quality which tempts loan officers and bank managements to underestimate the riskiness of their business and reduce the margins of safety. Buoyant economic growth in combination with declining interest rate spreads gives a strong hint that such risky (mis)behaviour is widespread.

A swift and sharp decline in production, investment and consumption growth weakens the debt servicing capability of borrowers due to the declining financial surpluses of firms and reduced income growth of households. In addition, the value of collateral (equity and real estate) usually falls considerably in an economic slump, thus diminishing borrowers' secondary means of servicing their debt. The accompanying fall in the value of collateral may aggravate the problems of adverse selection and moral hazard.[3]

Indicators selected

- Rate of growth in real GDP
  - Exceptional growth rates may indicate a boom preceding a bust (indicator with a long lead).

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[3] Borrowers with low net worth constitute greater moral hazard to lenders, as they have less to lose at default. The less a borrower has to lose, the more he is inclined to engage in risky investments financed by bank loans.

- Sharply decelerating or negative growth rates point to an increased likelihood of approaching debt servicing problems.

- Rate of growth in nominal GDP
  - As price developments often play a prominent or even dominant role in economic excesses, changes in nominal GDP can provide additional information about changes in real GDP.
- Rate of growth in real domestic demand
  - Exceptional growth rates may indicate a boom (overinvestment and overconsumption) preceding a burst of the investment bubble and the consumption euphoria.
  - Sharply decelerating or negative growth rates may point to beginning debt servicing problems for companies and households.
- Rate of growth in nominal domestic demand

In this analysis we worked with real GDP and real domestic demand growth rates. Since the microeconomic bank data in our analysis are always relative data (eg operating income relative to total assets or risk provisions relative to total outstanding loans), we did not use nominal cyclical indicators.

1.4 Debt burden and leverage (financial fragility indicators)

The soundness of the banking system crucially depends on the sustainability of the level of corporate and personal debt. If the private sector accumulates debt relative to assets beyond a critical level and shifts from borrowing adequately covered by cash flow to borrowing not covered, its debt servicing capacity is likely to be impaired under worsening economic conditions. In addition to the increased likelihood of debt servicing problems, declining net worth of borrowers is also regarded (under the theory of asymmetric information) as an incentive to moral hazard and adverse selection.

Whether and when borrowers with a high debt burden run into debt servicing problems essentially depends on the development of both interest payments and income. An increase in income gearing (interest payments as a proportion of income) caused either by declining earnings or rising interest payments (due to rising interest rates and/or growing debt ratios) reduces the borrowers' scope to service their debt.

Indicators selected

This type of indicator is not incorporated in this paper, since it is only available on an annual basis in Austria.

1.5 Excessive asset price developments

Prices of certain assets can be very volatile, which makes the financing of their purchase or production a risky business, sometimes involving heavy losses. The main reasons for the high volatility of certain asset prices are strong cyclical demand fluctuations (eg commodities), hog cycles due to long gestation periods (eg real estate) and speculative activity (eg shares). Inflated asset prices often lead banks to make lending decisions based on asset values which are unsustainable in the long run. In addition, prudent creditors are likely to be driven into herding behaviour under such circumstances, as they are undercut by those market participants disregarding the long-term risk involved in the loan financing of such assets.

Asset price slumps following excessive price hikes affect banks in various ways: first, they increase borrowers' indebtedness relative to their assets. This enhances the danger that borrowers may default on their payment obligations. Second, they reduce the value of banks' own securities and real estate portfolios, which leads to capital losses. Third, due to negative wealth effects, the demand from households and corporates may decline and hence accelerate the economic downturn.

Indicators selected

- Austrian and European share price indices
- Vienna real estate price index
  - Due to myopic behaviour of (some) investors, a strong increase in real estate prices attracts much more investment in new buildings than will be demanded at this high price once the bulk of the new property enters the market. This overinvestment tends to cause the price bubble to burst at some point and (all) real estate assets to decline in value, potentially leading to negative net worth of the property and debt servicing problems.

1.6 Monetary and financial conditions

Banking soundness to an important extent depends on the general monetary and financial conditions. Experience shows that banking crises often tend to be systemic when they are caused by deteriorating monetary and financial conditions. The increase in (real) short-term interest rates has proved to be a major source of systemic banking problems.

Indicators selected

- Monetary aggregates (M1 and M3)
  - Accelerating money supply growth points to a potential overheating of the economy, while sharply decelerating money supply growth can be, amongst other things, triggered by a recession and perhaps by deflationary effects in the economy, and/or it can be the result of a restrictive monetary policy stance.
- Nominal and real short-term interest rates (three-month money market rate)
  - High and rising short-term interest rates point to restrictive monetary policies, motivated perhaps by an attempt to bring inflation under control. This imposes higher funding costs, while interest income cannot be increased equivalently as the interest rate for the stock of loans is usually fixed for a longer period. Furthermore, high short-term interest rates are likely to hurt banks even if they can be passed on to borrowers in the form of high lending rates. The reason is the tendency for adverse selection, which can increase the proportion of non-performing loans in the medium and long run.
- Nominal and real long-term interest rates (five-year benchmark government bond)
  - Investment project decisions depend on the long-term interest rate. Normally, an internal rate of return is used to test whether investment projects are worth undertaking. Rising long-term interest rates may push projects with an initial positive value towards a negative value on account of the new internal rate of return.
  - Besides the credit risk, the long-term interest rate affects the return on bank securities, and therefore it also imposes a market risk on the sector.
- Overall interest rate margin (average interest rate on banks' assets minus average interest rate on banks' liabilities)
  - Competition may cause banks to make inadequate provisions for detrimental events such as asset price collapses or cyclical downturns, because banks that make adequate provisions are undercut by those disregarding such possibilities for reasons of ignorance or competitive advantage.
- Rate of inflation (consumer price index)
  - High inflation rates usually go hand in hand with high nominal interest rates and will eventually lead to high real interest rates, which reduce the profitability of credit-financed investment projects and increases income gearing in real terms. However, rising inflation may temporarily reduce the real value of (fixed) interest payments by firms, thus increasing profitability for a certain period of time. Generally, a high and volatile nominal interest rate associated with high inflation makes it difficult for banks to perform maturity

transformation. High rates of inflation may proxy for macroeconomic mismanagement, which adversely affects the economy and the banking sector through various channels.

1.7 Bank data

The micro bank data used for this paper are taken from the monthly raw balance sheet and the quarterly income statement which Austrian banks have to report to the supervisory authority and the central bank. These data are delivered on an unconsolidated basis, ie including domestic branch offices and branch offices abroad, but excluding bank and other subsidiaries.

Risk provisions are calculated as total provisions for loans granted to banks and non-banks as a percentage of total loans plus total provisions for loans. This ratio is not taken from audited financial statements (which are available only on an annual basis), since this would not have generated enough observations for our statistical analysis. Therefore, these figures are taken from the monthly raw balance sheets. This implies, as the name already suggests, that the extent of provisions as audited by external auditors at the end of the year might deviate from the figures used for this analysis.

As regards income figures, we based our analysis on the following breakdown:

	Interest income
–	Interest expense
=	NET INTEREST INCOME
+	income from securities
+	net income from fees and commissions
+	net profit (loss) on financial operations
+	other operating income
=	OPERATING INCOME
–	operating expenses
=	OPERATING RESULT
–	RISK PROVISIONS
–	taxes
+/–	extraordinary items
=	PROFIT

Income from securities includes income from shares and other variable yield securities, income from participating interests and income from shares in affiliated companies.

Operating expenses include personnel and other administrative expenses, value adjustments on intangible and tangible fixed assets (such as land and buildings), but *exclude* value adjustments for loans and securities. Therefore, both operating income and the operating result do not include provisions for loan losses or for losses on securities.

Our analysis is based on net quarterly data, ie data on the second quarter do not include data from the first quarter in any given year.

For the purpose of supervisory analysis, Austrian banks are grouped into ***peer groups***, according to the structure of their assets. Some banks, due to their special status, had to be classified in special groups heuristically (ie by conceptual assumption) a priori.

– All large banks with total assets exceeding EUR 2 billion were placed in Peer Group 1. The total assets of this peer group amount to nearly three quarters of the total assets of all Austrian banks.

– All foreign banks (foreign assets of more than 30% of total assets) that do not come under the group of large banks constitute Peer Group 2.

– All specialised banks (those of the special purpose bank sector, including building and loan associations, etc) were grouped into Peer Group 3.

– The remaining banks were classified according to their balance sheet structure. The liabilities side of the balance sheet proved too blunt an instrument for differentiation; notably because savings deposits tend to correlate strongly with the balance sheet total, this breakdown would have been too close to the total asset criterion. Therefore, it was decided to use the assets side as a grouping criterion. Except for off-balance sheet business, the assets side reflects a bank's risk potential fairly accurately. The relation between domestic interbank claims (DIC) and claims on domestic non-banks (CDNB) was used as a group membership criterion. This parameter covers approximately 85% of the balance sheet volume.

Table 1

Peer groups

Peer group	Designation	Number of banks		Definition
		1999	2000	
1	Large banks	30	30	Total assets > €2 billion
2	Foreign banks	37	41	Foreign assets as a % of total assets> 30%
3	Specialised banks	91	90	
4	*"Retail banks"*	22	31	CDNB – 2* DIC > 60%
5		186	204	CDNB – 2* DIC > 35%
6		216	188	CDNB – 2* DIC > 15%
7		142	127	CDNB – 2* DIC > 0%
8		172	167	CDNB – 2* DIC > - 30%
9	*"Interbanking banks"*	74	72	CDNB – 2* DIC <= - 30%
Total	**Banks, total**	**970**	**950**	

Source: Oesterreichische Nationalbank.

CDNB: Claims on domestic non-banks as a % of total assets.
DIC: Domestic interbank claims as a % of total assets.
The multiplication factor 2 in the above table for domestic interbank claims (DIC) was introduced as a weighting factor to offset size-related differences against claims on domestic non-banks (CDNB).
From the data contained in the December monthly return, group membership is recalculated annually for the next following year.

1.8. General remarks on the macro and micro data used

Since the bank data required are not available before 1990, the econometric models are based on only half an interest rate cycle, ie falling rates between 1990 and 1999. We use quarterly data from 1990 Q1 to 1999 Q4. These data were transformed into annual growth rates, ie the logarithms and seasonal differences of the original quarterly time series. Data were sourced from the Austrian National Bank, the OECD, WIFO and Datastream.

2.1 When do Austrian banks form risk provisions?

Economic theory provides several lines of explanation which are partly contradictory:

First hypothesis:

Banks form provisions when their debtors show signs of financial strain. In our macroeconomic approach, this means that banks would increase their provisions during economic downturns and recessions, while economic upswings and booms should lead to reduced provisioning.

The underlying theory is that banks act under uncertainty and in particular are not able to ascertain whether a macroeconomic shock (positive or negative) is temporary or fundamental.

According to this view, banks behave ***procyclically***.

Second hypothesis:

Banks increase, or at least do not reduce, risk provisioning in times of high real GDP growth rates, because they are well aware that the economy behaves cyclically and that a boom is usually followed by a downturn. Farsighted banks even take into consideration that their debtors tend to stretch themselves somewhat during an upswing, which might become problematic during an economic downswing.

As a consequence, banks behave ***anticyclically***.

Third hypothesis:

Banks increase risk provisions when they engage in riskier business. This might well be correlated with higher returns, ie increased operating income for banks, since riskier business should lead to higher returns on average.

Fourth hypothesis:

Banks increase risk provisions in times of rising operating returns. This behaviour is partly connected to the behaviour described under hypothesis three, since operating return is defined as operating income minus operating expenses and therefore depends to some extent on returns.

Another argument for this type of behaviour is the attempt of banks to reduce the income tax burden by evening out profits and losses over time. Another, somewhat similar, reasoning is that banks want to produce a constant income stream, perhaps in order to generate trust among the public. Therefore, banks generally aim to reduce the volatility of their net income.

However, some banks might increase risk provisions simply when they can "afford" to do so, depending amongst other things on accounting standards and supervisory rules.

Econometric models:

We tested different multiple regression models to assess which of the above-mentioned explanations comes closest to the behaviour of Austrian banks.

In our models, risk provisions are defined as a percentage of total outstanding loans. For 1995 Q4-1996 Q3, a dummy variable (D96) has been used, due to a change in the definition of risk provisions in per cent of total outstanding loans by December 1995.

Test of the first hypothesis:

First, we formulated a multiple regression model in the form of (all variables in log and seasonally adjusted)

Provisions = c + b1 * GDP(r) + b2 * RealEstateLag2Q + b3 * RealInterestRate3M + b4 * D96.

Changes in risk provisions relative to total loans depend on ***real GDP*** growth rates, ***real estate price*** developments (lagged by two quarters), the development of ***real interest rates*** (three-month money market rate minus annual inflation rate) and the dummy variable. Asset prices, like ***real estate prices***, obviously play a role in risk provisions, since the underlying assets are often used as mortgage. Since real estate price developments and their possible implications for loan provisioning become visible only with a certain time lag, we lagged this time series by two quarters.

This model delivers a good proxy. All variables are highly significant, the explanatory power of the model is very high (adjusted R^2 of 0.92), and we experience only low positive autocorrelation (Durbin-Watson: 1.6). According to this model, ***risk provisions rise when real GDP growth declines (procyclical behaviour), they rise when real estate prices rise (anticyclical behaviour), and they rise when real interest rates fall*** (see Table A1.1[4]).

Since risk provisions of all Austrian banks significantly depend negatively on real GDP growth, ***Austrian banks behave procyclically*** when it comes to forming risk provisions.

The sign of the first independent variable (real GDP growth) ***confirms the first hypothesis*** mentioned above, but the sign of the second independent variable, ***real estate prices***, is questionable. When real estate prices rise, banks should be relieved as the value of mortgages rises, because this should reduce the likelihood of loan losses and therefore provisioning for real estate loans. Conversely, declining real estate prices should set bells ringing at banks, as the value of their mortgages declines and the chance that they may suffer a loss in the case of debt service problems of borrowers rises. However, it cannot be ruled out - even though we regard it as less likely - that banks behave "anticyclically" when it comes to real estate developments. In general, we are somewhat hesitant to accept that the Vienna real estate price index should have such a significant influence on risk provisions.

[4] Table numbers prefixed by an A can be found in the Appendix.

Rising ***real interest rates*** should indicate growing financial strains in an economy. Rising real interest rates tend to increase financial fragility via an increase in the interest service burden for debtors, which should be reflected in banks' risk provisions. On the other hand, rising real interest rates are typical for times of (prolonged) strong economic growth, while falling real interest rates are typical for the early stages of an economic trough and during recessions.

When we replace the three-month real interest rate with the ***consumer price index***, our ***model delivers a nearly perfect fit*** (adjusted R^2 of 0.94) with very high significance levels and no autocorrelation (Durbin-Watson test of 2.0). The results are shown in Table 2. According to this model, ***risk provisions rise when real GDP growth rates decline***, ***and they rise when real estate prices (lagged by two quarters) along with inflation increase***. Rising inflation usually increases risks and uncertainties for market participants in general, which in turn might lead to higher risk provisions. Even though this result is in line with expectations, we would like to add a word of caution, since the inflation rate in Austria never exceeded 4% during the 1990s, and the very significant regression results for inflation on risk provisioning might be somewhat overstated for reasons we do not yet know. (An "AR model" can be found in Table A1.2; since we experience some, albeit statistically insignificant, autocorrelation at a lag of four quarters, the AR (4) model even delivers slightly better results, which however do not change the picture described above.)

Table 2

Risk Provisions

Dependent variable: ProvisionsGlobalD4L
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficent	Std error	t-statistic	Prob
Constant	–0.032094	0.035585	0.901893	0.3745
GDPREALD4L	–2.580486	0.769412	–3.353841	0.0022
RESTATELAG2QD4L	0.463379	0.180112	2.572724	0.0155
CPID4L	5.472041	1.185861	4.614405	0.0001
D96	–0.357705	0.012099	–29.56426	0.0000
R-squared	0.943623	Mean dependent var		0.010556
Adjusted R-squared	0.935847	SD dependent var		0.173110
SE of regression	0.043846	Akaike info criterion		–3.281210
Sum squared resid	0.055752	Schwarz criterion		–3.056745
Log likelihood	60.78056	F-statistic		121.3489
Durbin-Watson stat	2.030604	Prob (F-statistic)		0.000000

Test of the second hypothesis:

The test of hypothesis one indicates that hypothesis two, ie provisions rise when real GDP rises, can be rejected (null hypothesis).

Test of the third hypothesis:

In the next step, we assess whether risk provisions might be influenced by bank earnings, ie we test hypothesis three.

In this model, risk provisions are explained by ***operating income*** (and the dummy variable) (see Table A1.3). We get a ***highly significant positive regression***, ie risk provisions rise when operating income rises. This is in line with our reasoning that higher returns are based on higher risks, which in turn lead to higher risk provisions.

A note of caution: R^2 is high with 0.76, but we experience autocorrelation. In fact, this simple model underestimates risk provisions in the early 1990s and overestimates them in the late 1990s.

Test of the fourth hypothesis:

Now we explain risk provisions by ***operating result*** (see Table A1.4). Again, we find a ***significant positive link***. Since the operating result is defined as operating income minus operating expenses, it is not surprising that the significant positive link of operating income with risk provisions is also found in this model.

Because the explanatory power of the operating result is somewhat less significant (and autocorrelation even higher), we are inclined to argue that risk provisions can be explained better by operating income than by the operating result. However, it cannot be ruled out that banks tend to increase their risk provisions in “good times”, ie because the bank operating result is high. Whether this type of behaviour is mainly triggered by tax or by confidence considerations, or perhaps something else, is difficult to assess.

To ***summarise*** these results, Austrian banks appear to behave procyclically, ie they increase risk provisions in times of declining real GDP growth rates. In addition, Austrian banks form risk provisions when their operating income rises. It cannot be ruled out that banks form risk provisions because the operating result rises. The model also delivers the result that rising inflation and rising real estate prices lead to higher risk provisions. While the first result is in line with expectations, even though it is somewhat astonishing that relatively moderate inflation rates have such a significant impact on risk provisioning, the latter result is not in line with expectations.

Putting the above findings in a single model delivers the expected result; see Table 3 and Figure 1. The statistical tests highlight that the explanatory power of this model with an adjusted R^2 of 0.95 and very high significance levels is exceptionally high (see table and corresponding Figure below). (The Durbin-Watson statistic indicates autocorrelation; however a close analysis of the residuals comes to the conclusion that the autocorrelation of the residuals is statistically not significant (probability values ≥ 0.15) and therefore does not pose a problem. Nevertheless, for an AR(4) model which deals with this insignificant autocorrelation, see Table A1.5.)

2.2 What determines net interest income?

Austrian banks’ operating income (still) very much depends on net interest income. This is also confirmed by a simple regression analysis, where operating income is very well explained by net interest income (see Table A2.1).

According to our multiple regression analysis, net interest income is not well explained by market ***short- and long-term interest rate*** developments and appears to be uncorrelated with ***real GDP*** growth (see Table A2.2; very much the same holds if net interest income is lagged by one year versus interest rate developments). However, we cannot rule out that net interest income reacts to interest rate developments with a very long time lag of perhaps three or four years. Since our data cover only 10 years, a time lag of that magnitude leads to serious econometric problems and could not be tested by us.

Anecdotal evidence as well as a graphic analysis of recent net interest developments in Austria lead us to the conclusion that ***the level of interest rates most likely has some influence on net interest income*** (see Figure 2). When short-term interest rates (three-month money market rates) hovered around or below 3.5%, and long-term interest rates (five-year government bonds) fell below 5%, net interest income started to fall (with a certain time lag). This might be explained by the fact that interest rates for customer deposits reached a point where they could not fall much further (eg in the case of retail overnight deposits), and/or customers started to move to other, higher-yield forms of investment (eg mutual funds). In the latter case, banks had to refinance themselves in other, usually more expensive ways (eg via money markets and bonds). On the other side of the balance sheet, interest rates for loans still had room to go down further and low rates were attractive for debtors. This caused the spread between active and passive interest rates to narrow.

Table 3

Risk Provisions

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.022176	0.031594	–0.701901	0.4885
IncomeGlobalD4L	0.351733	0.109022	3.226241	0.0032
GDPREALD4L	–1.887156	0.635363	–2.970202	0.0060
RESTATELAG2QD4L	0.406306	0.155008	2.621185	0.0140
CPID4L	4.773383	1.080456	4.417935	0.0001
D96	–0.368167	0.009352	–39.36569	0.0000
R-squared	0.956389	Mean dependent var		0.010556
Adjusted R-squared	0.948602	SD dependent var		0.173110
SE of regression	0.039246	Akaike info criterion		–3.479142
Sum squared resid	0.043127	Schwarz criterion		–3.209784
Log likelihood	65.14542	F-statistic		122.8089
Durbin-Watson stat	1.427442	Prob (F-statistic)		0.000000

2.3 Which macroeconomic developments influence Austrian banks' operating income?

Short- and long-term interest rates

First, the explanatory power of changes in nominal interest rates is tested, by applying the following model (reminder: all data are annual growth rates, ie in log and seasonal differences):

Operating income = c + b1 * InterestRate3Month + b2 * InterestRate5Years.

The variance of operating income of all Austrian banks is not significantly explained by the movement of short-term interest rates and just significantly explained by the movement of long-term interest rates. ***Falling long-term interest rates lead significantly to higher operating income and vice versa***. Short-term rates have the same sign as long-term rates, but are not significant. The Durbin-Watson statistic indicates some positive autocorrelation (see Table A3.1).

Short-, long-term interest rates and the volume of loans

When the above model is extended by the volume of loans, its explanatory power rises, even though short-term interest rates remain just below the significance level of 5%; changes in the volume of loans and long-term rates are significant. The results are in line with expectations: ***operating income rises significantly with the volume of loans and significantly when long-term interest rates fall*** (see Table A3.3).

Figure 1

Risk Provisions

(annual growth rates; rhs)

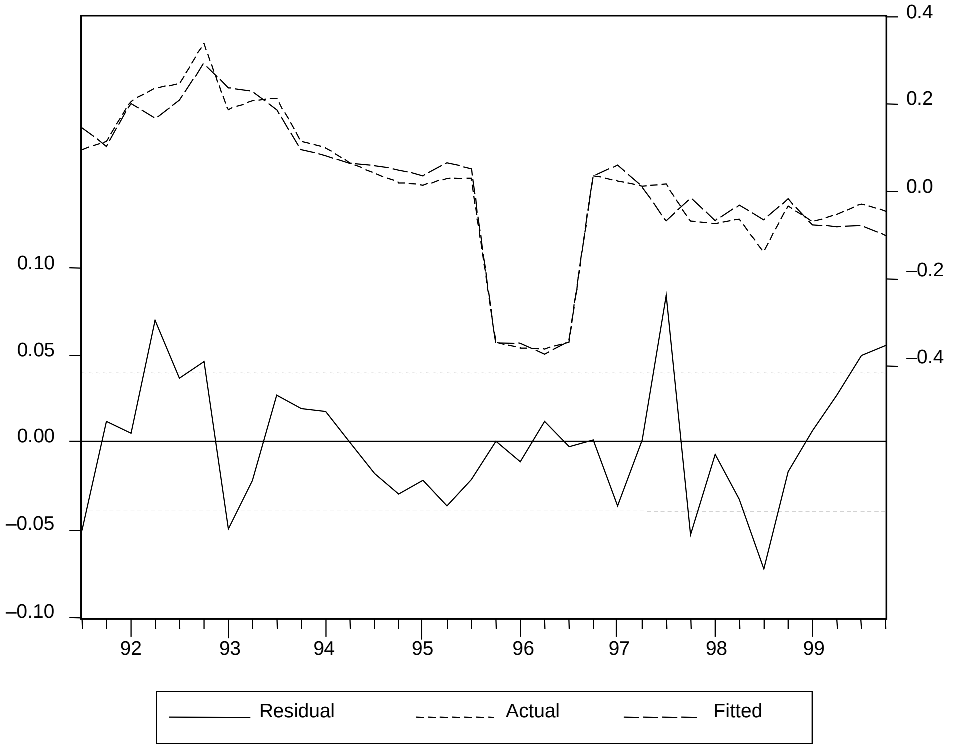
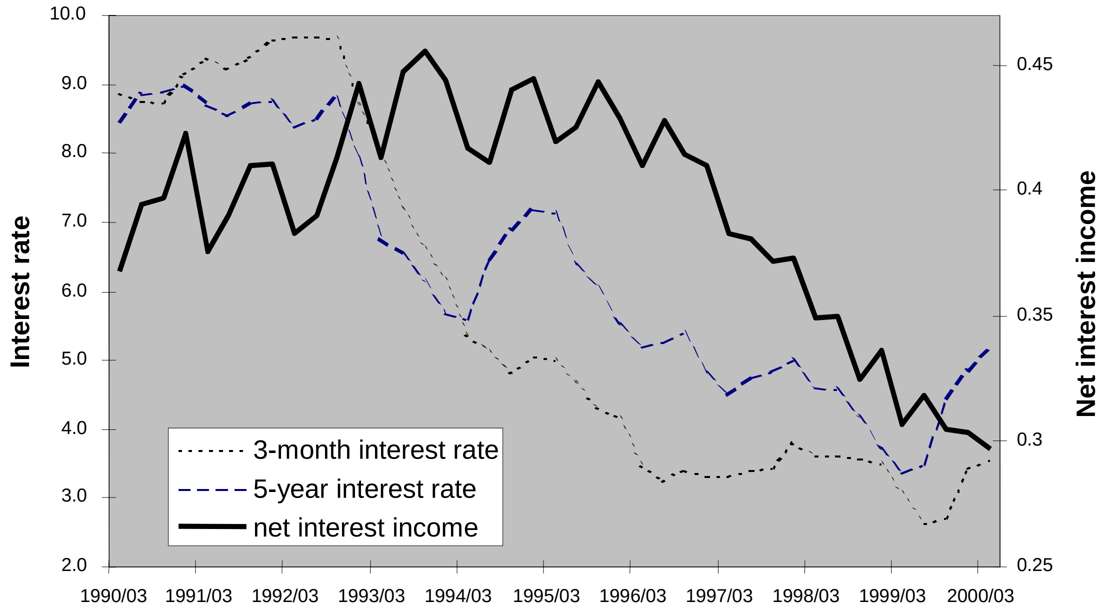


Figure 2

Net interest income in % of total assets and interest rates



Short-, long-term interest rates and real estate prices

In this model we use real estate prices in Vienna, lagged by two quarters, as one of the explanatory variables. A lag of two quarters is introduced, since it certainly takes time before real estate price developments and their effects on customers (loans, etc) show up in bank income. Lagging this real estate index by four quarters leads to similar but somewhat less significant results.

According to this model specification, operating income is significantly explained by short- and long-term interest rates, as well as real estate prices. ***Operating income rises when short- and long-term interest rates fall and real estate prices increase*** (we are not confronted with autocorrelation; see Table 4 and Figure 3).

Table 4

Operating income

Dependent variable: IncomeGlobalD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.063169	0.010388	–6.080930	0.0000
IRATE3MD4L	–0.166282	0.058541	–2.840465	0.0080
IRATE5YD4L	–0.125043	0.058192	–2.148786	0.0398
RESTATELAG2QD4L	0.587049	0.183582	3.197747	0.0033
R-squared	0.459964	Mean dependent var		–0.013839
Adjusted R-squared	0.405961	SD dependent var		0.070250
SE of regression	0.054145	Akaike info criterion		–2.884188
Sum squared resid	0.087949	Schwarz criterion		–2.704617
Log likelihood	53.03120	F-statistic		8.517298
Durbin-Watson stat	2.024644	Prob (F-statistic)		0.000305

This type of behaviour is ***in line with expectations***. Banks in general seem to refinance themselves short-term, while they tend to invest long-term (this holds not only for investment banking, but also for investments in eg equipment, real estate and human capital). In an environment of falling (short- and long-term) interest rates, operating income rises, and vice versa. Rising real estate prices are positive for operating income, since banks' profits from their own real estate transactions rise and the business of their real estate subsidiaries becomes more profitable, thus influencing operating income. In addition, rising real estate prices should lead to higher demand for mortgage-backed debt, which in turn increases the volume of fees, etc and probably increases margins.

Short-, long-term interest rates and the consumer price index

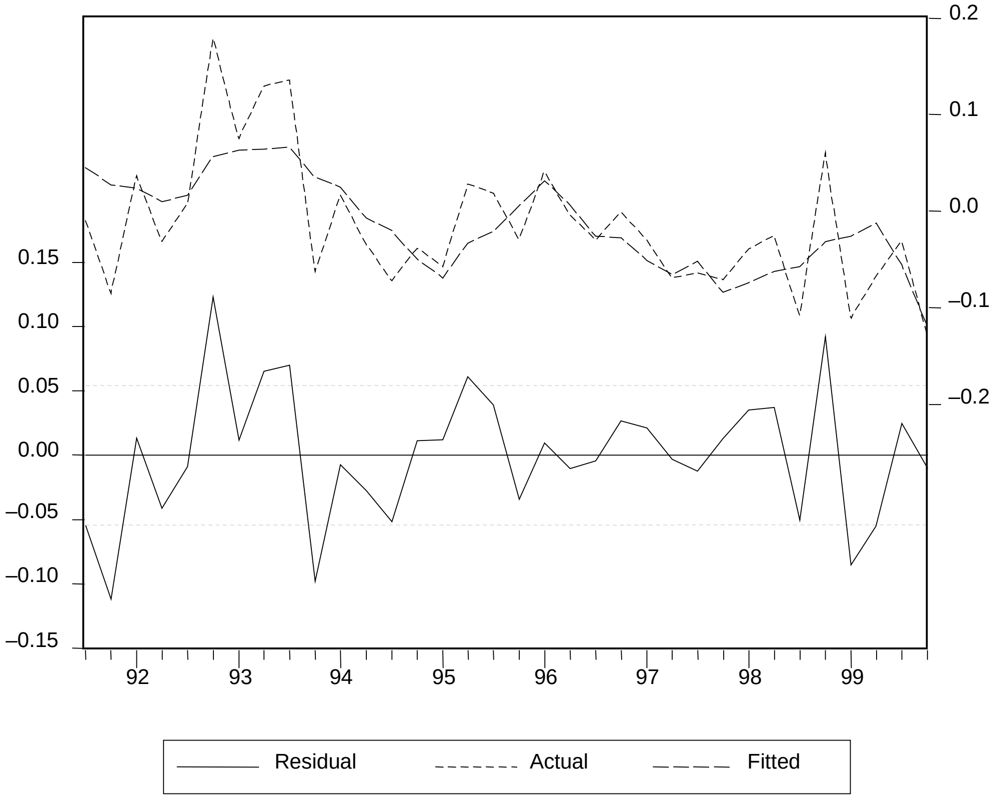
Using the consumer price index (CPI) along with short- and long-term interest rates to explain banks' operating income, we obtain a large extent the same - econometrically - good results (R^2 = 0.36: Durbin-Watson = 2.1).[5] ***Operating income rises significantly with inflation and increases significantly when long-term interest rates fall*** (and not significantly when short-term interest rates fall; see Table A3.4).

[5] Since we use nominal interest rates and the CPI in one multiple regression model, some multi-collinearity can not be ruled out, even though we have econometric evidence that this should not pose too much of a problem. Multiple regressions which do not use nominal interest rates and the CPI in one model confirm the explanatory power of nominal interest rates respectively the CPI.

Figure 3

Operating income

(annual growth rates; rhs)



In relation to bank operating income in Austria during the 1990s, the CPI might well be used as an indicator for structural changes in the Austrian economy during this period. Rising inflation rates can be - amongst other things - an indicator for inefficiency and protected or fragmented markets. Falling inflation rates can go along with increased competition. In this respect, falling inflation rates would hint at rising competition in the economy in general and amongst banks in particular. The latter is very much in line with developments in Austria during the 1990s, especially after joining the European Economic Area with its single market in 1994 and the European Union in 1995.

Real short- and long-term interest rates

Using real interest rates instead of nominal rates and the CPI, the result is that ***falling real long-term interest rates***[6] ***significantly lead to rising operating income, while falling real short-term rates have an insignificant effect*** on operating income (see Table A3.5).

The same analysis for ***different sectors of the Austrian banking system*** as a whole leads to different results (for different peer group definitions of Austrian banks, please see pages 6 and 7):

Large banks

The development of operating income of large Austrian banks can be explained by a similar model to that for the banking industry as a whole. ***Operating income of large banks depends significantly and negatively on long-term interest rate developments and significantly and positively on real estate price developments in Vienna*** (lagged by two quarters). The difference compared to the model for the banking industry as a whole is that short-term interest rates become totally insignificant

6 For practical reasons, real long-term interest rates are defined as the yield of five-year government benchmark bonds minus the annual inflation rate in the corresponding quarter.

(see Table A4.1). Nevertheless, the explanatory power of this model remains high (adjusted R^2: 0.44; Durbin-Watson test: 2.1). Viennese real estate prices become even more significant, which fits well with expectations. The largest Austrian banks are based in Vienna and are usually very active in the Viennese real estate sector.

Substituting the CPI for real estate prices brings, to some extent, the same results: The operating income of large banks ***depends significantly and negatively on long-term interest rate developments and significantly and positively on CPI developments*** (R^2: 0.28; no autocorrelation; see Table A4.2). Short-term interest rate developments fall slightly short of being significant, ie remain slightly above the probability level of 5%, but, unlike the results so far, correlate positively with operating income.

Using real interest rates instead of nominal rates and the CPI, the result is that ***falling real long-term interest rates significantly lead to rising operating income***, while rising real short-term rates have an insignificant effect on operating income.

Retail banks (peer group 4 and 5)

Applying the model with ***interest rates and real estate prices*** as the explanatory variables to "peer groups 4 and 5", ie retail banks, ***does not explain operating income*** developments (see Table A5.1). Neither interest rate nor real estate price developments in Vienna have a significant influence on the operating income of retail banks. This is not surprising, since small retail banks are mainly involved in the customer deposits and lending business, which is in general, according to our analysis of net interest income, not well explained by interest rate developments. The fact that real estate price developments in Vienna do not explain the operating income of small retail banks is reasonable. Small retail banks are usually not based in Vienna and in general do not have significant real estate operations in Vienna.

Substituting the CPI for real estate prices leads to very much the same results. ***Consumer price developments*** and - according to our interpretation of CPI developments during the 1990s - increased competition ***appear to have no significant effect*** on the operating income of small retail banks (see Table A5.2).

Banks specialising in interbank business

The operating income of - relatively small - banks operating mainly in the interbank area (peer group 8 and 9) cannot be explained by interest rates and real estate prices. Changes in ***real estate prices and long-term interest rates do not have any explanatory power; moreover, short-term interest rates are insignificantly (negatively) correlated with operating income****.* Inflation does not significantly explain the operating income of this banking sector, either (see Tables A6.1 and A6.2).

Foreign banks

Foreign banks' operating income, ie the operating income of relatively small Austrian banks with sizeable operations abroad, ***does not have any significant regressions*** with real estate developments in Vienna and with interest rates, which is by and large in line with expectations. CPI developments in Austria have no significant effect on the operating income of small Austrian banks operating abroad, either (see Table A7.1).

In ***conclusion***, for the banking industry as a whole, developments in short-term interest rates and long-term interest rates, along with real estate and/or the inflation rate, appear to have a significant influence on operating income. But this can be traced mainly to the behaviour of large banks, even though the influence of short-term interest rates on the operating income of large banks becomes insignificant or difficult to interpret. Small retail banks, (smaller) foreign banks and (smaller) banks in the interbank business seem to be unaffected not only by real estate price developments in Vienna (which is in line with expectations), but also by consumer prices and interest rate developments.

2.4 Real fundamentals, monetary aggregates and financial market data

Real GDP

In a simple regression model, ***real GDP growth rates correlate significantly negatively with the operating income*** of both the Austrian banking sector as a whole and that of most peer groups, which is contrary to expectations (see Table A3.2). However, in multiple regression models real GDP growth rates usually do not explain operating income significantly.

These results are even more astonishing, as we found strong seasonal patterns in operating income, similar to the ones for GDP; ie the first quarter - in absolute terms - is usually the weakest, and the fourth quarter usually the strongest of the year. The latter might have to do with the fact that banks tend to charge their annual service fees, interest due, etc at the end of the year, ie in the fourth quarter.

Real domestic demand

Real domestic demand growth as an explanatory variable for operating income of Austrian banks leads very much to the same results as for real GDP.

M3 and loans

We found some ***positive correlations*** between M3 growth or loan growth with operating income, which are usually ***not significant*** (apart from Table A3.3). The positive relationship is in line with expectations, since growing monetary aggregates should lead to higher income volumes and probably higher margins.

Stock markets

Stock market developments seem to have ***no significant explanatory power*** for the operating income of Austrian banks.[7] This is in line with expectations, since stocks play only a minor role in the Austrian economy. Austrian investors and Austrian banks are not known to be - relative to their size - big players on stock markets (with the exception of eastern European stock markets).

Yield curve

Apart from using short- and long-term interest rates, we also tested how the dynamics of the yield curve might explain operating income. In general, ***no convincing regressions*** were found.

2.5 Banks' operating result and macroeconomic developments

The ***operating result*** is ***operating income minus operating expenses***. Operating expenses are mainly influenced by microeconomic-related costs. Given this definition of the operating result, one might expect models similar to those which explain the operating income to also explain, to some extent, the operating result of Austrian banks.

Short-, long-term interest rates and real estate prices

First, we explain the operating result of the global Austrian banking industry by short- and long-term interest rates, as well as by the Viennese real estate price index lagged by two quarters; see Table 5. The results are largely in line with those achieved with the model for operating income. ***Falling long-term interest rates and rising real estate prices lagged by two quarters significantly lead to a rising operating result***, while short-term interest rates insignificantly explain the operating result.

Short-, long-term interest rates and the consumer price index

Substituting the consumer price index for the real estate price index decreases the explanatory value of the model somewhat; see Table 6. ***Long-term interest rates are highly significant, and the CPI falls slightly short of being significant in explaining the operating result***, while short-term interest rates are totally insignificant. Falling long-term interest rates lead to a higher operating result.

Real short- and long-term interest rates

Using real short- and long-term interest rates instead of nominal interest rates and the CPI leads to the following result: ***real long-term interest rates have a significant negative correlation with the operating result***, while real short-term interest rates have no explanatory power (see Table A8.1).

From the above results, we draw the ***conclusion*** that short-term interest rates, or ***monetary policy, had a minor influence on bank's operating results*** during the 1990s.

[7] We used the Austrian Traded Index (ATX) and Datastream's EU Market Index.

Table 5

Operating result

Dependent variable: ResultGLOBD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.136654	0.033295	–4.104305	0.0003
IRATE3MD4L	–0.263644	0.185031	–1.424861	0.1645
IRATE5YD4L	–0.588541	0.175562	–3.352321	0.0022
RESTATELAG2QD4L	1.260533	0.477319	2.640861	0.0130
R-squared	0.447993	Mean dependent var		–0.013362
Adjusted R-squared	0.392792	SD dependent var		0.197551
SE of regression	0.153939	Akaike info criterion		–0.794395
Sum squared resid	0.710913	Schwarz criterion		–0.614823
Log likelihood	17.50472	F-statistic		8.115714
Durbin-Watson stat	2.109950	Prob (F-statistic)		0.000419

Table 6

Operating result

Dependent variable: ResultGLOBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.200163	0.065995	–3.033002	0.0048
IRATE3MD4L	–0.013460	0.166792	–0.080699	0.9362
IRATE5YD4L	–0.661658	0.181228	–3.650971	0.0009
CPID4L	5.357209	2.829680	1.893221	0.0674
R-squared	0.377612	Mean dependent var		–0.017712
Adjusted R-squared	0.319263	SD dependent var		0.197986
SE of regression	0.163352	Akaike info criterion		–0.681380
Sum squared resid	0.853883	Schwarz criterion		–0.505434
Log likelihood	16.26485	F-statistic		6.471614
Durbin-Watson stat	2.079175	Prob (F-statistic)		0.001506

3. Summary and conclusions

We aimed to assess the effects of macroeconomic developments on the risk provisions and earnings of Austrian banks for the 1990s, by seeking to detect economic indicators with a potentially disturbing effect on the stability of the banking system. The underlying theory is that banks' earnings are to some extent directly and indirectly dependent on the state of the economy.

Since the bank data required are not available before 1990, the econometric models are based on only interest rate half cycles, ie falling rates between 1990 and 1999. This, and the structural changes which occurred in the Austrian banking industry and economy during the 1990s, must be kept in mind for any conclusions for the future.

The main findings

Risk provisions

We found evidence that Austrian banks behave procyclically, ie ***banks increase their risk provisions in times of declining real GDP growth rates. They also raise their risk provisions when their operating income increases***. It cannot be ruled out that banks form risk provisions because their operating result rises, with the aim of smoothing their operating results over time, perhaps due to credibility and/or tax considerations.

That banks should increase their risk provisioning in times of rising operating income is in the interest of supervisors, because ***higher return or income goes with higher risks***, for which risk provisions should be expanded accordingly. However, if banks increase their risk provisions because of a rising operating result, several questions arise. Is this behaviour triggered by the aim of evening out the operating result (and thereby profits) over time, in order to generate trust among the public? has it something to do with ***tax considerations***? or do some individual banks increase risk provisions simply when they can afford to do so?

The model also delivers the unexpected and somewhat curious result that rising real estate prices lead to higher risk provisions. Generally in line with expectations is the result that falling inflation depresses risk provisions.

Net interest income

Net interest income appears to be uncorrelated with ***real GDP*** growth. Difficult to interpret is the behaviour of ***net interest income*** in relation to short- and long-term interest rate developments. It appears that net interest income is by and large uncorrelated with interest rate developments, even though we cannot yet rule out that net interest income reacts to interest rate developments with very long time lags of perhaps up to four years.

However, we believe that ***very low interest rate levels lead to declining net interest income***. At very low interest rate levels, interest rates for retail deposits reach a point where they cannot fall much further (eg in the case of overnight deposits), and/or customers start to move to other, higher-yield forms of investment (eg mutual funds), while interest rates on loans still have room left to decline and become even more attractive for debtors.

Bank operating income

When it comes to explaining the development of the ***operating income*** of the Austrian banking industry as a whole, short- and long-term interest rates as well as real estate and/or inflation have a significant influence. ***Falling interest rates and rising real estate prices, as well as rising inflation, lead to higher operating income and vice versa***.

In an environment of falling ***interest rates***, operating income rises and vice versa. This type of behaviour is in line with expectations. Banks in general appear to refinance themselves short-term, while they invest long-term (this holds not only for investment banking, but also for investments in eg equipment, real estate and human capital).

Rising ***real estate prices*** have a positive impact on the operating income of banks, since their own real estate transactions and those of their real estate subsidiaries become more profitable. In addition, rising real estate prices should lead to higher demand for mortgage-backed debt, which in turn increases the volume of commissions, fees, etc and probably margins.

In relation to bank operating income, the ***consumer price index*** might well be used as an indicator for structural changes and especially for competition during the 1990s in Austria. High inflation or rising inflation rates could - amongst other things - be an indicator for inefficiency and protected or fragmented markets. Low inflation or falling inflation rates could be associated with increased competition. The latter is very much in line with developments in Austria during the 1990s, especially after accession to the European Economic Area, and shortly afterwards to the European Union in 1995.

When ***the Austrian banking sector is broken down into peer groups***, the individual peer group results deviate from the overall conclusion: The influence of real estate and the CPI on the operating income of the whole banking sector can be traced solely to large banks. (Small) retail banks, (small) foreign banks and (small) banks specialising in interbank business appear to be unaffected not only by the CPI and real estate price developments in Vienna, but also by short- and long-term interest rate developments. Along with the inflation rate and/or retail prices, long-term interest rates appear to be significant for the development of the operating income of ***large banks***, which represent nearly three quarters of all Austrian banks in terms of total assets. The influence of short-term interest rates on the operating income of large banks becomes insignificant or difficult to interpret.

Depending on the model specification, ***real GDP*** growth appears to have no significant explanatory value for the income development of the Austrian banking sector. This result is somewhat astonishing, as we have found strong seasonal patterns in operating income, similar to the ones for GDP or domestic demand; ie the first quarter is - in absolute terms - the weakest, the fourth quarter usually the strongest.

Bank operating result

By and large, similar conclusions to those for bank operating income can be drawn for the development of the ***operating result*** of Austrian banks. In particular, declining real estate, but also declining inflation, ie rising competition in Austria during the 1990s, appears to have a negative impact on the operating result of Austrian banks. However, short-term interest rates seem to have no significant influence on banks' operating results.

Real long-term interest rates have a significant negative correlation with the operating result, real short-term interest rate are completely insignificant.

The fact that short-term interest rates had no significant influence on banks' operating results during the 1990s leads us to the conclusion that ***monetary policy appears to have played a minor role in explaining the operating result of the Austrian banking industry***.

Possible implications for banking supervision and some general, tentative conclusions

Austrian banks seem to behave procyclically, ie they increase ***risk provisions*** in times of declining real GDP growth rates. In addition, they form risk provisions when operating income rises. It cannot be ruled out that banks form risk provisions because their operating result rises. From a supervisor's point of view, a ***less procyclical stance***, ie the forming of risk provisions in economic "good times" (rising or high real GDP growth rates), should be encouraged; the expected loan losses should include expected losses due to the business cycle. From a ***European perspective***, further harmonisation efforts in the area of accounting standards, provisioning and taxation should possibly be envisaged to achieve a level playing field.

Overall, some ***macroeconomic variables*** like interest rates, real estate and consumer prices, but not real GDP or domestic demand growth rates, can be used to explain the risk provisions, operating income and operating results of Austrian banks during the 1990s.[8] Consequently, the macroeconomic dimension must not be neglected by supervisory authorities. However, macroeconomic developments alone cannot explain the development of microeconomic bank data in a sufficient way. Other factors apart from macroeconomics obviously play a major role in banking.

Microeconomics, especially sound and prudent bank management - at least during normal (bank) business cycles - probably ***plays the major role for individual banks***. For supervisors, the "bottom up" approach, ie ***standard banking supervision, remains most relevant***.

Structural changes, such as increased competition, accession to the single market and the opening up of eastern European markets, have certainly also been influencing Austrian banks strongly and must be monitored by market participants and the relevant authorities.

[8] However, we regard it as likely that more pronounced business cycles than Austria has experienced during the 1990s might have an impact on bank data.

Appendix

Table A1.1

Risk provisions (of all Austrian banks) explained by real GDP growth, the real estate price index lagged by two quarters, the real three-month interest rate and a dummy variable (D96)

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.063477	0.021137	3.003051	0.0055
GDPREALD4L	–2.680895	0.907689	–2.953540	0.0062
RESTATELAG2QD4L	1.194800	0.155739	7.671790	0.0000
REALIRATE3MD4L	–0.098680	0.024024	–4.107562	0.0003
D96	–0.369404	0.012471	–29.62151	0.0000
R-squared	0.930840	Mean dependent var		0.010556
Adjusted R-squared	0.921301	SD dependent var		0.173110
SE of regression	0.048563	Akaike info criterion		–3.076845
Sum squared resid	0.068393	Schwarz criterion		–2.852381
Log likelihood	57.30637	F-statistic		97.57939
Durbin-Watson stat	1.555400	Prob (F-statistic)		0.000000

Table A1.2

Risk provisions explained by an AR model (lag four quarters) using real GDP, real estate lagged by two quarters, the CPI and a dummy variable

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1992:3, 1999:4
Included observations: 30 after adjusting endpoints
Convergence achieved after 11 iterations
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.017004	0.026877	–0.632658	0.5329
GDPREALD4L	–3.077624	0.990161	–3.108205	0.0048
RESTATELAG2QD4L	0.605490	0.162714	3.721204	0.0011
CPID4L	5.019448	0.742043	6.764364	0.0000
D96	–0.357067	0.014583	–24.48497	0.0000
AR(4)	–0.577672	0.156050	–3.701843	0.0011
R-squared	0.959855	Mean dependent var		–0.009767
Adjusted R-squared	0.951492	SD dependent var		0.173154
SE of regression	0.038137	Akaike info criterion		–3.518430
Sum squared resid	0.034906	Schwarz criterion		–3.238191
Log likelihood	58.77645	F-statistic		114.7668
Durbin-Watson stat	1.990391	Prob (F-statistic)		0.000000

Table A1.3

Risk provisions explained by operating income and a dummy variable

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.078750	0.014963	5.262981	0.0000
IncomeGLOBD4L	1.006263	0.200560	5.017257	0.0000
D96	–0.425653	0.043801	–9.717924	0.0000
R-squared	0.776917	Mean dependent var		0.015853
Adjusted R-squared	0.763397	SD dependent var		0.169573
SE of regression	0.082484	Akaike info criterion		–2.072780
Sum squared resid	0.224517	Schwarz criterion		–1.940820
Log likelihood	40.31004	F-statistic		57.46349
Durbin-Watson stat	0.622433	Prob (F-statistic)		0.000000

Table A1.4

Risk provisions explained by operating result and a dummy variable

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.067594	0.016941	3.989960	0.0003
ResultGLOBD4L	0.264865	0.081501	3.249841	0.0027
D96	–0.423443	0.050626	–8.364081	0.0000
R-squared	0.702090	Mean dependent var		0.015853
Adjusted R-squared	0.684035	SD dependent var		0.169573
SE of regression	0.095318	Akaike info criterion		–1.783534
Sum squared resid	0.299824	Schwarz criterion		–1.651574
Log likelihood	35.10361	F-statistic		38.88593
Durbin-Watson stat	0.334897	Prob (F-statistic)		0.000000

Table A1.5

Risk provisions explained by an AR model (lag four quarters) using operating results, real GDP, real estate lagged by two quarters, the CPI and a dummy variable

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1992:3, 1999:4
Included observations: 30 after adjusting endpoints
Convergence achieved after 14 iterations
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.010389	0.026717	–0.388865	0.7010
IncomeGLOBD4L	0.372042	0.152837	2.434233	0.0231
BIPREALD4L	–2.150079	0.916814	–2.345164	0.0280
RESTATELAG2QD4L	0.537019	0.144434	3.718088	0.0011
CPID4L	4.229359	0.862626	4.902887	0.0001
D96	–0.365138	0.014292	–25.54842	0.0000
AR(4)	–0.451055	0.151922	–2.968994	0.0069
R-squared	0.966697	Mean dependent var		–0.009767
Adjusted R-squared	0.958010	SD dependent var		0.173154
SE of regression	0.035482	Akaike info criterion		–3.638619
Sum squared resid	0.028956	Schwarz criterion		–3.311673
Log likelihood	61.57929	F-statistic		111.2722
Durbin-Watson stat	1.735501	Prob (F-statistic)		0.000000

Table A2.1

Operating income of all Austrian banks explained by net interest income

Dependent variable: IncomeGlobalD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.005177	0.009619	0.538202	0.5939
NetInterestIncomeD4L	0.749191	0.130168	5.755593	0.0000
R-squared	0.521344	Mean dependent var		–0.015505
Adjusted R-squared	0.507266	SD dependent var		0.069608
SE of regression	0.048861	Akaike info criterion		–3.145721
Sum squared resid	0.081172	Schwarz criterion		–3.057748
Log likelihood	58.62298	F-statistic		37.03220
Durbin-Watson stat	1.864855	Prob (F-statistic)		0.000001

Table A2.2

Net interest income of all banks explained by real GDP growth and short- and long-term interest rates

Dependent variable: NetInterestIncomeD4L
Method: least squares
Date: 30 November 2000 Time: 15:40
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.014571	0.031056	–0.469173	0.6421
BIPREALD4L	–1.097277	1.200252	–0.914206	0.3674
IRATE3MD4L	–0.100834	0.067323	–1.497765	0.1440
IRATE5YD4L	0.040665	0.072035	0.564519	0.5763

R-squared	0.097386	Mean dependent var	–0.027605
Adjusted R-squared	0.012766	SD dependent var	0.067085
SE of regression	0.066655	Akaike info criterion	–2.474120
Sum squared resid	0.142174	Schwarz criterion	–2.298174
Log likelihood	48.53417	F-statistic	1.150859
Durbin-Watson stat	0.451051	Prob (F-statistic)	0.343647

Table A3.1

Operating income of all Austrian banks explained by short- and long-term interest rates

Dependent variable: IncomeGlobalD4L
Method: least squares
Date: 24 November 2000 Time: 14:58
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.035499	0.011167	–3.179029	0.0032
IRATE3MD4L	–0.065340	0.052391	–1.247140	0.2211
IRATE5YD4L	–0.136139	0.068295	–1.993385	0.0545

R-squared	0.169034	Mean dependent var	–0.015505
Adjusted R-squared	0.118672	SD dependent var	0.069608
SE of regression	0.065347	Akaike info criterion	–2.538559
Sum squared resid	0.140917	Schwarz criterion	–2.406599
Log likelihood	48.69406	F-statistic	3.356402
Durbin-Watson stat	1.510052	Prob (F-statistic)	0.047111

Table A3.2

Operating income of all banks explained by real GDP growth

Dependent variable: IncomeGLOBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.034065	0.029198	1.166699	0.2515
BIPREALD4L	–2.493492	1.140224	–2.186844	0.0357

R-squared	0.165788	Mean dependent var	–0.015505
Adjusted R-squared	0.141252	SD dependent var	0.069608
SE of regression	0.064504	Akaike info criterion	–2.590216
Sum squared resid	0.141468	Schwarz criterion	–2.502243
Log likelihood	48.62389	F-statistic	6.757031
Durbin-Watson stat	1.877332	Prob (F-statistic)	0.013715

Table A3.3

Operating income of all banks explained by loan growth and short- and long-term interest rates

Dependent variable:
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.094401	0.027634	–3.416156	0.0017
IRATE3MD4L	–0.092329	0.050389	–1.832336	0.0762
IRATE5YD4L	–0.141305	0.065733	–2.149682	0.0392
DIRECTLOANSD4L	1.060479	0.541573	1.958145	0.0590
R-squared	0.240422	Mean dependent var		–0.015505
Adjusted R-squared	0.169212	SD dependent var		0.069608
SE of regression	0.063446	Akaike info criterion		–2.572829
Sum squared resid	0.128811	Schwarz criterion		–2.396883
Log likelihood	50.31093	F-statistic		3.376218
Durbin-Watson stat	1.655521	Prob (F-statistic)		0.030204

Table A3.4

Operating income of all banks explained by short- and long-term interest rates and the inflation rate (CPI)

Dependent variable: IncomeGlobalBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.102726	0.021613	–4.753041	0.0000
IRATE3MD4L	–0.047934	0.052286	–0.916769	0.3661
IRATE5YD4L	–0.159694	0.062268	–2.564602	0.0152
CPID4L	2.941452	0.926918	3.173369	0.0033
R-squared	0.418139	Mean dependent var		–0.015505
Adjusted R-squared	0.363589	SD dependent var		0.069608
SE of regression	0.055530	Akaike info criterion		–2.839360
Sum squared resid	0.098673	Schwarz criterion		–2.663414
Log likelihood	55.10849	F-statistic		7.665310
Durbin-Watson stat	2.102175	Prob (F-statistic)		0.000536

Table A3.5

Operating income of all banks explained by real short- and long-term interest rates

Dependent variable: ERTRAGGLOBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.023019	0.009359	–2.459532	–2.459532
REALIRATE3MD4L	–0.026220	0.020029	–1.309118	–1.309118
REALIRATE5YD4L	–0.095183	0.039199	–2.428205	–2.428205
R-squared	0.249775	Mean dependent var		–0.015505
Adjusted R-squared	0.204307	SD dependent var		0.069608
SE of regression	0.062091	Akaike info criterion		–2.640775
Sum squared resid	0.127225	Schwarz criterion		–2.508815
Log likelihood	50.53396	F-statistic		5.493415
Durbin-Watson stat	1.802876	Prob (F-statistic)		0.008723

Table A4.1

Operating income of large banks explained by interest rates and real estate

Dependent variable: IncomeLargeD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.062080	0.015208	–4.081982	0.0003
IRATE3MD4L	–0.004138	0.079477	–0.052061	0.9588
IRATE5YD4L	–0.222081	0.083920	–2.646357	0.0128
RESTATELAG2QD4L	0.886387	0.204974	4.324389	0.0002

R-squared	0.493222	Mean dependent var	–0.017344
Adjusted R-squared	0.442545	SD dependent var	0.097072
SE of regression	0.072477	Akaike info criterion	–2.300978
Sum squared resid	0.157585	Schwarz criterion	–2.121406
Log likelihood	43.11662	F-statistic	9.732522
Durbin-Watson stat	2.140879	Prob (F-statistic)	0.000121

Table A4.2

Operating income of large banks explained by interest rates and the CPI

Dependent variable: IncomeLargeD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.102195	0.029315	–3.486153	0.0014
IRATE3MD4L	0.178662	0.088885	2.010036	0.0529
IRATE5YD4L	–0.269259	0.093603	–2.876607	0.0071
CPID4L	3.680551	1.227093	2.999406	0.0052

R-squared	0.338785	Mean dependent var	–0.016194
Adjusted R-squared	0.276796	SD dependent var	0.097023
SE of regression	0.082510	Akaike info criterion	–2.047366
Sum squared resid	0.217850	Schwarz criterion	–1.871420
Log likelihood	40.85259	F-statistic	5.465247
Durbin-Watson stat	1.980203	Prob (F-statistic)	0.003785

Table A5.1

Operating income of peer groups 4 and 5, retail banks, explained by interest rates and real estate

Dependent variable: IncomePG45D4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.034131	0.033081	1.031750	0.3104
IRATE3MD4L	0.145402	0.129408	1.123599	0.2701
IRATE5YD4L	–0.038197	0.177246	–0.215501	0.8308
RESTATELAG2QD4L	0.193000	0.209572	0.920926	0.3644

R-squared	0.069771	Mean dependent var	0.023466
Adjusted R-squared	–0.023252	SD dependent var	0.114444
SE of regression	0.115767	Akaike info criterion	–1.364341
Sum squared resid	0.402061	Schwarz criterion	–1.184769
Log likelihood	27.19380	F-statistic	0.750037
Durbin-Watson stat	0.806937	Prob (F-statistic)	0.530930

Table A5.2

Operating income of peer groups 4 and 5, retail banks, explained by interest rates and the CPI

Dependent variable: IncomePG45D4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.034384	0.039689	0.866332	0.3928
IRATE3MD4L	0.170521	0.115617	1.474883	0.1500
IRATE5YD4L	–0.044146	0.176110	–0.250675	0.8037
CPID4L	0.269673	1.028666	0.262158	0.7949
R-squared	0.055160	Mean dependent var		0.023539
Adjusted R-squared	–0.033419	SD dependent var		0.111152
SE of regression	0.112994	Akaike info criterion		–1.418520
Sum squared resid	0.408566	Schwarz criterion		–1.242574
Log likelihood	29.53337	F-statistic		0.622722
Durbin-Watson stat	0.795228	Prob (F-statistic)		0.605506

Table A6.1

Operating income of peer groups 8 and 9, banks in the interbank business, explained by interest rates and real estate

Dependent variable: IncomePG89D4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.042172	0.047567	–0.886573	0.3824
IRATE3MD4L	–0.166970	0.208208	–0.801935	0.4289
IRATE5YD4L	–0.007988	0.103242	–0.077376	0.9388
RESTATELAG2QD4L	0.012593	0.299057	0.042109	0.9667
R-squared	0.053570	Mean dependent var		–0.018884
Adjusted R-squared	–0.041073	SD dependent var		0.120722
SE of regression	0.123176	Akaike info criterion		–1.240269
Sum squared resid	0.455172	Schwarz criterion		–1.060697
Log likelihood	25.08457	F-statistic		0.566022
Durbin-Watson stat	2.200606	Prob (F-statistic)		0.641663

Table A6.2

Operating income of peer groups 8 and 9, banks in the interbank business, explained by interest rates and the CPI

Dependent variable: IncomePG89D4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.070415	0.072175	–0.975606	0.3366
IRATE3MD4L	–0.176617	0.136126	–1.297451	0.2038
IRATE5YD4L	–0.021942	0.094445	–0.232324	0.8178
CPID4L	1.010476	2.014571	0.501584	0.6194
R-squared	0.079505	Mean dependent var		–0.023720
Adjusted R-squared	–0.006792	SD dependent var		0.119538
SE of regression	0.119943	Akaike info criterion		–1.299159
Sum squared resid	0.460363	Schwarz criterion		–1.123212
Log likelihood	27.38486	F-statistic		0.921299
Durbin-Watson stat	2.156738	Prob (F-statistic)		0.441657

Table A7.1

Operating income of peer group "foreign banks" explained by interest rates and the CPI

Dependent variable: IncomeFOREIGND4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.028314	0.134467	0.210565	0.8346
IRATE3MD4L	–0.002192	0.315491	–0.006948	0.9945
IRATE5YD4L	0.228094	0.507387	0.449546	0.6561
CPID4L	1.573079	4.007207	0.392562	0.6972
R-squared	0.026777	Mean dependent var		0.044486
Adjusted R-squared	–0.064463	SD dependent var		0.259783
SE of regression	0.268025	Akaike info criterion		0.308967
Sum squared resid	2.298798	Schwarz criterion		0.484913
Log likelihood	–1.561405	F-statistic		0.293478
Durbin-Watson stat	1.091311	Prob (F-statistic)		0.829792

Table 8.1

Operating results of all banks explained by short- and long-term real interest rates

Dependent variable: ResultGLOBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.034995	0.026227	–1.334322	0.1912
REALIRATE3MD4L	0.027982	0.055066	0.508144	0.6147
REALIRATE5YD4L	–0.377049	0.095164	–3.962083	0.0004
R-squared	0.311869	Mean dependent var		–0.017712
Adjusted R-squared	0.270164	SD dependent var		0.197986
SE of regression	0.169140	Akaike info criterion		–0.636521
Sum squared resid	0.944078	Schwarz criterion		–0.504561
Log likelihood	14.45738	F-statistic		7.477999
Durbin-Watson stat	2.056598	Prob (F-statistic)		0.002097

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Monitoring the macroeconomic determinants of banking system stability

Thierry Timmermans

Over the past few years, prudential authorities and, more specifically, central banks have focused increasing attention on the macroeconomic determinants of the stability of the banking system. Banks' vulnerability to changes in the economic environment, the many structural changes within the financial markets, and the banking crises which have recently hit a number of countries (including industrialised economies) are among the main factors underlying this enhanced interest. This paper examines the ways in which these macroprudential analyses are dealt with in Belgium.

These ways are partly conditioned by both the structural and the institutional environments in which the Belgian financial system operates. This general framework is examined in the first section of this paper. Notwithstanding these special national features, the theoretical foundations used for analysing the macroeconomic determinants of the stability of the banking system apply to the entire financial market. Those foundations are reviewed in the second section, which gives a brief overview of the economic literature devoted to the determinants of financial crises.

The third section deals with credit and interest rate risks, which are both highlighted by these theoretical analyses and considered as the most traditional components of the risks run by credit institutions.

The fourth section examines risks of a more structural nature which are also created by the interaction between the banking sector and the financial and real spheres of the economy. Banks do in fact run strategic risks in so far as they have to modify their lines of behaviour and activity in order to cope with changes in the economic and financial environment in which they operate. Furthermore, a number of recent changes, such as disintermediation and the development of new financial products, have enabled the banks to transfer part of their traditional credit or market risks to other economic agents, thereby possibly exposing the banks to other hazards, such as a weakening of the global financial resilience of customers or even reputational risks. The last section concludes.

1. Institutional and structural framework

In Belgium, the NBB does not have any specific brief in connection with bank supervision. It is not, of course, the only one in such a situation, since within the European Union prudential monitoring is the responsibility of the central bank only in six countries, namely Italy, Spain, the Netherlands, Portugal, Ireland and Greece. However, in four of the six other member states (Germany, France, Austria and Finland) the central bank does have to play an important role, either by providing the chairman of the banking supervisory body or by making staff available to that body, or again by carrying out certain assignments on its behalf. Belgium, together with Luxembourg, is the EU member country in which the demarcation between the central bank and the prudential authority is most clear-cut.

Despite this absence of direct responsibility, the NBB does however have various links with the body entrusted in Belgium with the supervision of banks and investment undertakings, the Banking and Finance Commission (BFC). It is thus laid down that a member of the NBB is an ex officio member of the BFC's decision-making body. The Bank is also consulted when changes are made in the prudential regulations and the accounting principles governing the presentation of the accounts of credit institutions. Lastly, the financial information and accounts provided by the banks in order to enable the BFC to carry out its off-site analysis are communicated to the BFC via the NBB, which carries out verifications and performs validation tests in advance. This procedure enables the Bank to maintain regular contacts with the banks and the BFC, and gives it direct access to statistical data which are particularly useful for macroprudential analyses.

The NBB's relatively limited involvement in the monitoring of the banking system is also attributable to more structural causes. Since the end of World War II, the Belgian banking system has displayed a fairly high degree of soundness, in contrast with the developments observed in many other countries. According to Lindgren et al (1996), who carried out a fairly extensive survey of banking problems recorded between 1980 and 1996, 140 countries, including 24 OECD member states, have encountered such difficulties. Belgium is one of only five OECD members not to appear on this list.

This favourable development is attributable to a significant extent to the very structure of the activities of the Belgian banking sector. Owing to the high level of general government borrowing, public debt securities represent a very large proportion of the assets of credit institutions. Thus, about 40% of the Belgian banks' claims on resident sectors have general government as their counterparty; the corresponding average percentage for Germany, France, the United Kingdom and the Netherlands is only 11%. Conversely, the claims vis-à-vis companies and individuals, which carry higher risks, represent 58% in these four countries, against 39% in Belgium.

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Table 1

Breakdown of assets of credit institutions by resident sector

(outstanding amounts at end-1997, percentages of total assets vis-à-vis resident counterparties)

	Belgium	**Germany**	**France**	**Netherlands**	**United Kingdom**	**Average of the 4 latter countries**[1]
Individuals	18.9	30.1	20.3	40.3	41.4	33.0
Companies	20.5	20,0	24.5	35.7	19.8	25.0
General government	40.9	16.7	10.2	15.3	2.9	11.3
Credit institutions	19.7	33.2	44.9	8.7	35.8	30.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

[1] Unweighted average.

Sources: ECB; NBB.

Intermediation of the abundant financial savings of households in order to finance general government therefore still constitutes one of the major traditional functions of Belgian banks. They have been able to play this role by succeeding, through active use of their distribution network, in placing their own bonds with individuals at the expense of direct subscriptions for public securities.

This favourable structure must not of course be used as an excuse for an attitude of benign neglect to problems of a macroprudential nature. Moreover, the pressure of events is making itself clearly felt at this level. The challenges faced by the banking sector do not spare Belgian banks, nor are these sheltered from the contagious effect on their domestic market of accidents originating in other countries.

The management of the many banking crises which have occurred in recent years has, furthermore, focused attention again on the essential contributions which central banks can make, whatever their role in the microprudential field, to containing systemic risks.

The first is the adoption of a clearly defined objective of price stability, which is the best guarantee of financial stability, since such an environment reduces uncertainties and eliminates one of the fundamental causes of distortion in financial choices.

The second is the devising of reliable and efficient payment mechanisms. Such mechanisms ensure rapid and transparent transmission of monetary policy, but also make it possible to prevent the breakdown of a payment system or the default of one of the participants from bringing about a disruption of all the financial markets.

A third role which central banks may have to play in the event of the outbreak of a financial crisis is that of lender of last resort. Owing to the many types of interaction which take place nowadays between markets, the possible causes of systemic risks have become more numerous and the potential consequences of individual incidents more unpredictable.

In this context, the concepts of individual problems and temporary liquidity difficulties are no longer sufficient, on their own, to mark out with certainty the limits to the last-resort interventions of central banks. It is therefore vital for the latter to carry out regular analyses and adequate monitoring of the overall stability of the financial system.

In this field, the NBB is in a rather privileged position, owing to the very important role which it plays in the collection, analysis and dissemination of statistics in Belgium. In addition to its intervention, mentioned earlier, in the processing of the financial accounts submitted by the banks, the NBB is also charged with the administration of the Central Register for Credits to Enterprises and to Individuals and of the Central Balance Sheet Office, which collects the standardised accounting statements which have to be filed by all Belgian non-financial enterprises. It also conducts business surveys and is responsible for the balance of payments and foreign trade statistics. Lastly, it is the Bank that draws up, on behalf of the National Accounts Institute, the national accounts data, not only for the financial part but also for the real economy.

These various sources of information enable the Bank to supplement the analyses made by the BFC. While the latter adopts a kind of bottom up approach by grouping together the data concerning the individual banks to obtain an overall view of the entire banking sector, the NBB takes a top down view by examining the implications of major macroeconomic developments for the operation of the financial markets in general and the stability of the banking system in particular.

The spectacular expansion in the volume of financial transactions compared with that of real activity has, moreover, led the Bank to examine the link between these two spheres of the economy from a new angle. While it is of course still essential for a central bank to carry out a very close examination of the effects which changes in financial conditions produce on the real part of the economy, largely via the process of transmission of monetary policy, the financial system has, conversely, become more vulnerable to developments in the real sphere. This trend therefore makes it necessary to reverse the direction of the analyses by studying to what extent macroeconomic developments of a real nature can affect the stability of the financial system.

2. Theoretical outline of the determinants of financial crises

Problems of a systemic nature, which can affect the whole of the banking sector, have been the subject of various theoretical analyses. Attempting to clarify the mechanisms of development of such risks, these analyses seek to draw lessons on the warning signs of financial crises. A first subsection deals with the more traditional approaches, namely the purely empirical works, demand-based explanations and monetarist-type analyses. A second subsection presents the more recent theory of asymmetric information, which places the emphasis more on the specific situation of credit institutions.

2.1 The traditional approaches

In the absence of strict definitions of the concept of financial crises, many analyses covering this phenomenon adopt an essentially empirical approach based on circumstantial data and episodes (for instance, Kindleberger (1978)). This viewpoint has several deficiencies. By concentrating on the actual crises, it fails to account for risks which, while potentially destabilising, have been successfully confined by preventive action. Furthermore, empirical studies often lead to the attribution of any excessive volatility on financial markets to a systemic problem. They may thus lead to the choice of an excessively wide range of indicators. Conversely, by ignoring the logical links between the various constituent elements of a financial crisis, they may fail to take account of phenomena which, though unspectacular, nevertheless play a central role in the way a crisis develops.

Two rather different theoretical approaches, the Keynesian and monetarist lines of argument, have tried to lessen the shortcomings of empirical analysis. The former attributes the origin of financial crises to a decrease in demand. According to this school of thought, the assessment of financial risks should therefore take account mainly of the development of the components of aggregate demand, measured either directly or, preferably, via indicators which are more readily available.

While the course of the business cycle certainly does exert an influence on the stability of the financial system, not every recession phase is accompanied by a systemic crisis. Conversely, a worsening of systemic risks is not always preceded by a slackening of activity, but may on the contrary trigger a cyclical turnaround.

The monetarists, for their part, attach only moderate importance to the cyclical variables, because they tend to analyse the economy from the angle of monetary developments. Thus, they trace the starting point of the financial crisis of the 1930s back to the rise in interest rates triggered at the end of 1928 by the Federal Reserve. The 1930 banking crisis, which in their opinion is the central element of the propagation mechanism of this crisis, is thus regarded as an essentially monetary phenomenon, because it was reflected in a cumulative decrease in the monetary multiplier. In the absence of a sufficiently expansionist monetary policy, the money supply therefore decreased rapidly, leading to recession.

By reducing the elements explaining financial crises to monetary factors alone, some monetarists go so far, at the extreme, as to deny the existence of a systemic risk applying exclusively to banks. Kaufman (1986), for instance, claims that the latter are not intrinsically more fragile than non-bank enterprises, and that the risk of contagion resulting from a possible bankruptcy is not greater. This approach obviously greatly narrows the scope of the argument, even though it has the indisputable advantage of giving prominence to the role of monetary stability in maintaining financial system soundness.

Table 2

Synoptic table of the main approaches to financial crises

Approach	Source of financial crises	Main advantages of the approach	Main drawbacks of the approach	Preferred indicators
Essentially empirical approaches	Sources identified in an ad hoc manner, often by reference to the depression of the 1930s	Simplicity. Episodes close to on-the-ground reality. Recreate the historical and the socio-economic environment	Concentrates on crises which have actually occurred, failing to consider potential crises	Very wide-ranging sets of indicators
Keynesian approach	Insufficient global demand	Stress on the cyclical factors which constitute a major determinant of financial crises	Neglects the non-cyclical causes of financial crises	Aggregate demand and its components, or more rapidly available indicators
Monetarist approach	Financial crises always have a monetary origin (inadequate development of monetary aggregates or inappropriate interest rates)	Emphasis on the importance of monetary stability	Neglects the intrinsic causes of fragility of banks. Financial crises too restrictively defined	Interest rates, monetary aggregates, interbank market liquidity, etc
Asymmetric information models	Problems of adverse selection (poor choice of co-contractors) and moral hazard (harmful behaviour of co-contractors) The main factors aggravating the moral hazard or adverse selection are the deterioration of repayment capacities, the rise in real interest rates and the volatility of asset prices	Strict definition of financial crises Very structured theoretical foundations, well suited to the banks' intermediation activity	Approach essentially centred on market and credit risks Fails to consider the crisis factors which do not intensify the asymmetric information problems	Solvency and liquidity of companies, households and banks Nominal and real interest rates Inflation rates Share and bond prices and exchange rates (affecting guarantees)

Source: NBB, Economic Review, May 2000.

2.2 The asymmetric information models

The aim of the asymmetric information models is to remedy the shortcomings of the traditional economic approaches. Contrary to empirical analysis and, to a lesser extent, to the demand-based approach, which is more cyclical in essence, these models in fact propose a strict definition of the phenomenon of a financial crisis. Moreover, their analysis framework is considerably less restricted than that of the monetarist approach.

The asymmetric information approach furthermore draws attention to phenomena of discontinuity in intermediation activity, whereas traditional economic theory is characterised by its marginalist line of argument and by the concept of equilibrium.

Ultimately, the management of the credit risk associated with information asymmetries is central to the banks' intermediation activity, while the knowledge which they accumulate concerning the profile of their borrowers constitutes their main comparative advantage with respect to the securities market.

Information asymmetry may take two forms which are often referred to in insurance theory, namely adverse selection and moral hazard. Very briefly, adverse selection refers to perverse mechanisms of choice of co-contractors or partners which lead to a biased risk structure. A moral hazard exists when an inadequate incentive structure induces a contractor to involve himself, after the conclusion of the contract, in activities which are liable to impede the successful progress of that contract.

Economists such as Mankiw (1986) and Mishkin (1991) have put forward the concept of asymmetric information to explain the occurrence of financial crises. In their view, moral hazard and adverse selection may, beyond a certain level, lead to a break in the intermediation channels, as these two phenomena may greatly obscure the information available to the banks on the quality of debtors. This may lead to a veritable rationing of credit, which may be damaging to the most solvent debtors even when they are willing to put up with interest rate conditions which are profitable for credit institutions. This is, moreover, the kind of situation which Mishkin (1991) refers to in his definition of a financial crisis: "financial crisis is a disruption to financial markets in which adverse selection and moral hazard problems become much worse, so that financial markets are unable to efficiently channel funds to those who have the most productive investment opportunities".

By analysing the anatomy of various US financial crises, Mishkin draws attention to three categories of indicators which have often coincided at the beginning of a financial crisis. These are the worsening of the ability to repay loans, the rise in real interest rates and the volatility of asset prices.

The first factor fits directly into the framework of the banking profession. Owing to the special relationships which they maintain with their customers and thanks to their accumulated expertise, credit institutions have a decisive comparative advantage as regards credit risk management, which enables them to lessen the problems of asymmetric information. This advantage may, however, lessen if the environment becomes more unstable.

A rise in real interest rates constitutes the second factor of financial instability identified by Mishkin. This fundamental determinant operates at two levels. On the one hand, higher real interest rates can be borne only by borrowers whose investment projects are sufficiently profitable. This substantial degree of profitability is generally coupled with an increased risk profile. On the other hand, the most reliable borrowers are the victims of obvious discrimination when the banks, as a result of their inability to evaluate individual risk profiles, impose uniform borrowing conditions on their customers. By exacerbating this discrimination, a rise in the real rate will induce the most solvent operators to leave the market.

The third indicator, namely an increase in the volatility of asset prices, is more akin to market risks. Its influence is exerted via loan guarantees, the existence of which makes it possible to lessen the problems of moral hazard and adverse selection. An erosion of the value of guarantees, which constitute the penalty associated with default, becomes less of a deterrent when this guarantee loses some of its value. Furthermore, it reduces the protection enjoyed by banks against credit risks.

The banks are not only potential victims of moral hazard and adverse selection. They can also derive an advantage from these mechanisms. In the event of difficulties due to a deterioration in their customers' repayment capacities or a fall in the market value of their securities portfolio, some banks may be tempted to engage in riskier activities in a sort of "gamble for survival".

Similarly, the banks' perception of the existence of an implicit guarantee owing, for instance, to the principle of "too big to fail", or possibly an excessively generous deposit guarantee system, might induce some credit institutions to give preference to excessively risky investments.

Lastly, identical mechanisms of moral hazard and adverse selection are liable to extend the problems originally created by individual institutions to the entire banking sector. Firstly, depositors, who are generally unable to differentiate between credit institutions according to their solvency, will be induced to make massive withdrawals of their deposits, even from sound banks, for fear of being the victims of adverse selection. Secondly, the existence of chains of claims and debts between financial institutions might accentuate the moral hazard if it strengthens, within the banking sector, the assumption of an intervention by the lender of last resort.

3. Credit and interest rate risks

3.1 General framework

As indicated by the review of the economic literature in Section 2, theoretical analysis of the determinants of financial crises took a long time to free itself from its close links with traditional macroeconomic analysis, whether Keynesian or monetarist in spirit. The great merit of the asymmetric information approach is the focus on the factors that set credit institutions apart from other sectors of activity.

This indisputable progress in the theoretical approach has not perhaps been sufficiently accompanied as yet by parallel progress in empirical measuring instruments. This dichotomy might have a number of different explanations. Firstly, financial statistics remain in several respects less developed and less harmonised than real statistics, especially as regards data on outstanding amounts. Financial flows are often difficult to trace and are subject to sharp fluctuations. While the annual flows of real transactions vary within narrow limits, changes in stocks measured by the financial accounts are liable to jump suddenly from strongly positive balances to strongly negative ones.

This situation leads to a second difficulty. Capital movements are more difficult to predict and model. While there are a number of global and integrated real models, financial models are often more restricted in scope. They are generally confined to the transactions which are most directly relevant for the transmission channels of monetary policy and only very rarely apply to the problems of the stability of the financial sector.

Lastly, macroprudential analysis probably requires certain changes in perspective. On the one hand, as already indicated above, the traditional analyses which examine the impact of financial developments on the real sphere must be coupled with an approach which studies the implications of real developments for the soundness of the financial sector. On the other hand, the developments to be detected are no longer exposed just to gradual changes but may also reflect sharp deteriorations, since systemic crises are characterised by a discontinuity in intermediation activity.

In this context, sophisticated instruments such as financial stability models or composite indices are not as yet widely available. Macroprudential studies are still largely based either on balance sheet analysis techniques applied to the accounts of credit institutions or on the macroeconomic indicators which are most directly connected with banking activity.

Belgium is no exception and still relies on this traditional approach. The risk indicators presented below are eclectic and limited. They do not aim to lead to an overall assessment of the stability of the Belgian banking sector, which is not the subject of this paper. They confine themselves to briefly illustrating some advantages and limitations connected with the use of a few indicators by dealing successively with the risks connected with credits to enterprises, credits to individuals and interest rate positions. The emphasis is on the macroeconomic data which can supplement the data derived from the financial accounts of credit institutions.

3.2 Risks on credits to enterprises

The risks run by banks on their credits to enterprises will depend, on the one hand, on the development of the outstanding amounts of these credits on the assets side of the balance sheet and, on the other, on the lesser or greater probability of their suffering losses on these assets.

However, the rates of change in bank credits to companies, as they appear in the statements of account of credit institutions, provide only a very sketchy picture of the development of companies' financing requirements. As is shown by the data of the Central Balance Sheet Office, bank credits represent less than 20% of the financing sources of Belgian enterprises. This is not, incidentally, a situation unique to Belgium. It is much the same in the other EU countries, as can be seen from the

BACH file in which the European Commission groups together the data concerning the annual accounts of enterprises in nine member states.

The fact that this proportion is small is not attributable, in Belgium any more than in the other countries of the Community, to a large growth in issues of fixed interest securities, the outstanding amount of which is still very small in Europe for non-financial companies. The share of equity capital has increased in a favourable stock market climate, but the main point to be noted is that over 40% of financing resources come from other (intragroup, commercial, payroll, tax, etc) debts.

An analysis and follow-up of the financing transactions carried out between enterprises in the form of intragroup credits or commercial credits is thus seen to be a necessary supplement for the monitoring of banking or market financing transactions. How do the big multinational groups manage their financial flows and spread their risks? What are the payment periods granted by or imposed on enterprises? Do these periods change over time according to the size of the enterprises or depending on the business cycle?

An analysis of the probabilities of default or of the risks of losses carried out on the basis of the banks' accounting data will have to rely chiefly on the development of provisions, supplemented where appropriate by an examination of risk concentrations. However, these data are not always easy to aggregate and often necessitate an individual approach.

In particular, provisions are generally formed by banks on a case by case basis when objective signals appear or as a result of specific events which point clearly to a worsening of the risk on a particular credit. They are rarely envisaged as a regular charge to be covered in advance according to expected losses. This conception deprives the provisions indicator of much of its predictive value.

The development of credit risk management techniques should lead to major developments in this field. It is also a sphere in which the use of macroeconomic data, particularly those of the Central Balance Sheet Office, might contribute not only to a better analysis of macroprudential stability but also to an improvement of the risk provision procedures advocated by the microprudential authorities.

Another statistical source, the Central Register for Credits, makes it possible to produce a sectoral breakdown of bank lending to enterprises, which is not generally possible on the basis of the banks' financial accounts.

This sectoral breakdown is, for Belgian banks, fairly close to that of the sectors' shares in total value added. This distribution of risks by types of activity is accompanied by a high degree of spread among enterprises. As the Belgian economy consists chiefly of SMEs, the average amounts of the bank loans contracted by enterprises do not reach an outstanding amount of 1 million euros in any sector.

The Central Register for Credits also provides an item of information which is at first sight less reassuring. The coverage ratio of interest charges (net operating result plus financial proceeds in relation to financial charges) is low, indeed less than unity in several sectors. This situation reflects the tendency of a large number of enterprises, particularly SMEs, to close their accounts near to break-even for tax reasons.

This behaviour is illustrated by the percentage of enterprises which have suffered losses, independently of the size of these negative results. This percentage has fluctuated between 35 and 45% since 1990.

While this indicator throws little light on the average profitability of Belgian enterprises (this is more appropriately measured by the profitability of equity capital), it does highlight the problems of data quality. The data of the Central Balance Sheet Office constitute a useful supplement to those of the banks' financial accounts, but they are also much less reliable.

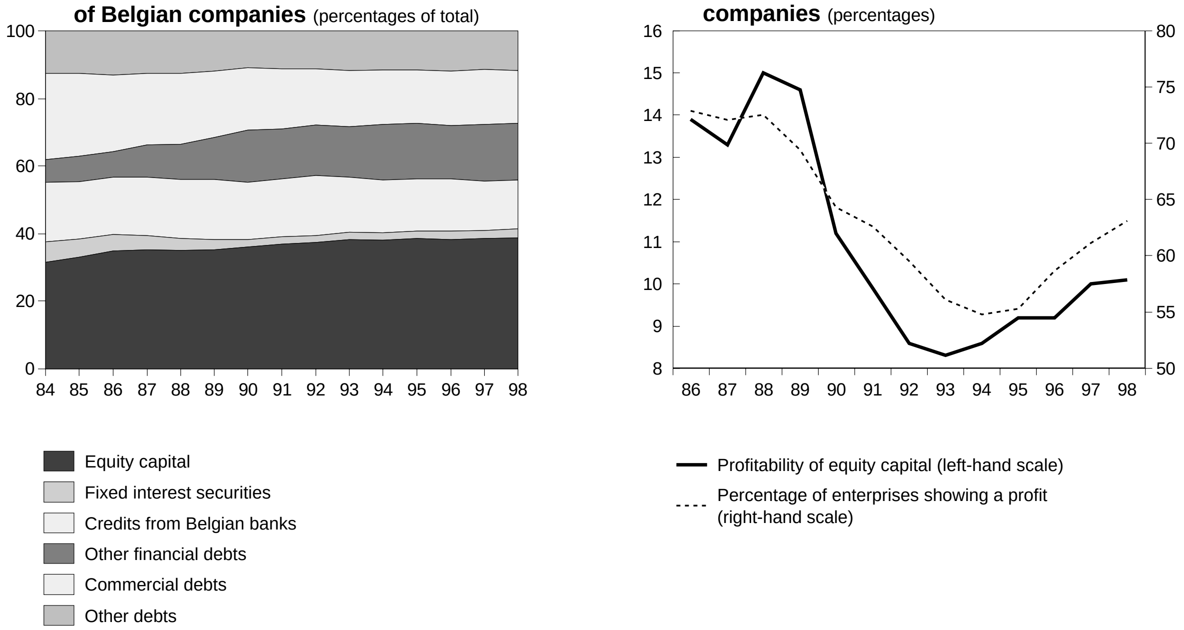
The gaps and weaknesses still displayed by the accounts published by many non-financial companies continue to be one of the major sources of asymmetric information between borrowing enterprises and their lenders. The banks, owing to their special relationships and their bilateral contacts, endeavour to reduce this asymmetry, but obviously without being able to eliminate it entirely.

Figure 1

Indicators of financial soundness of companies

1.1 Development of the financing structure of Belgian companies (percentages of total)

1.2 Indicators of the profitability of Belgian companies (percentages)



1.3 Analysis of the sectoral breakdown of bank credits to Belgian companies at end-1999

	Loans contracted as percentage of total credits	Value added as percentage of total	Average amount of loans contracted in thousands of euros	Coverage ratio of interest charges
Agriculture	4.2	1.6	104.1	0.6
Industry	24.6	25.9	947.0	2.9
Building	5.1	5.7	200.8	1.4
Trade	23.2	14.1	265.2	1.3
Hotels and catering	2.4	1.9	138.8	1.3
Transport and communication	7.0	8.5	629.6	1.6
Real estate	9.4	10.0	535.5	0.8
Other services to enterprises	14.3	14.1	379.3	0.8
Other services to households	9.8	18.2	171.0	2.4
Total	100.0	100.0	312.3	1.8

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Sources: Gerling Namur; NAI; NBB.

3.3 Risks on credits to individuals

The risks connected with the granting of credits to individuals are, in a number of respects, different in nature from those resulting from loans granted to enterprises.

Firstly, the average amount of credits per borrower is much smaller. The distribution of total credits over a larger number of debtors leads to greater diversification of risks and, furthermore, a very large proportion of the outstanding amount of borrowings is covered by mortgage guarantees. Secondly, the management of the risks connected with credits to individuals can be standardised to a greater extent, since the uncertainty factors liable to undermine the situation of this category of debtors are less numerous than in the case of credits to enterprises. Thirdly, losses on credits in the event of an economic recession do not generally take place at the same time for loans to individuals and those to enterprises, since the latter are the first to suffer the financial consequences of economic difficulties, whereas individuals are affected by them only at a later stage, as a result of losses of income due to redundancies, bankruptcies, etc.

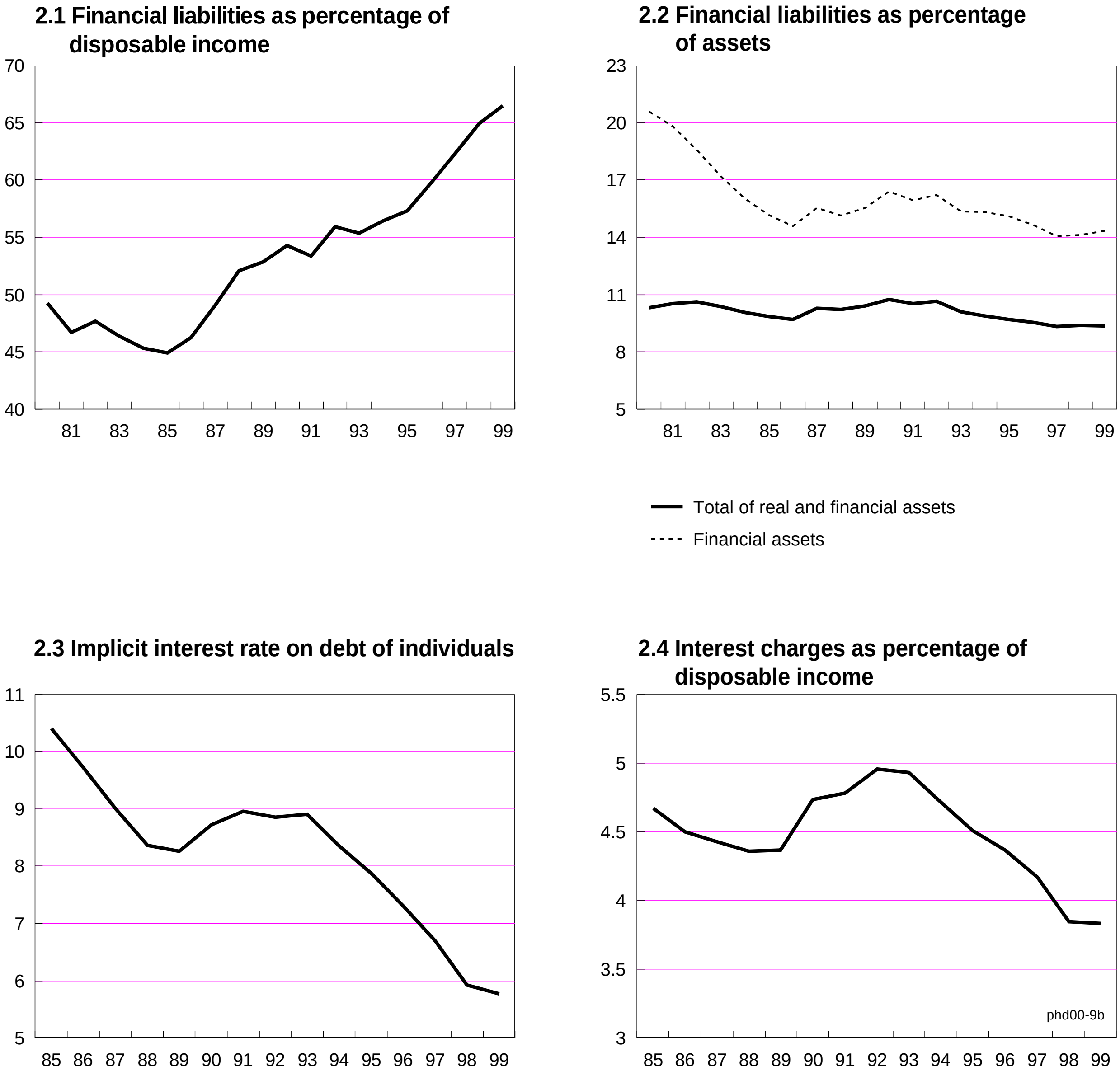
Unlike enterprises, individuals depend almost exclusively on the banks for their financing, and therefore the accounting data of credit institutions give a very good indication of the development of the liabilities of individuals.

On the other hand, individuals' investments are much more diversified, so that recourse to a wider set of statistics (the financial part of the national accounts) is required in order to obtain correct information on this other component of the financial situation of individuals.

As has been the case in many other countries, the steady growth in the liabilities of individuals as a percentage of their disposable income has been accompanied in Belgium by a similar increase in financial assets. Consequently, debts expressed as a percentage of total assets have remained very stable.

Figure 2

Indicators of financial soundness of individuals

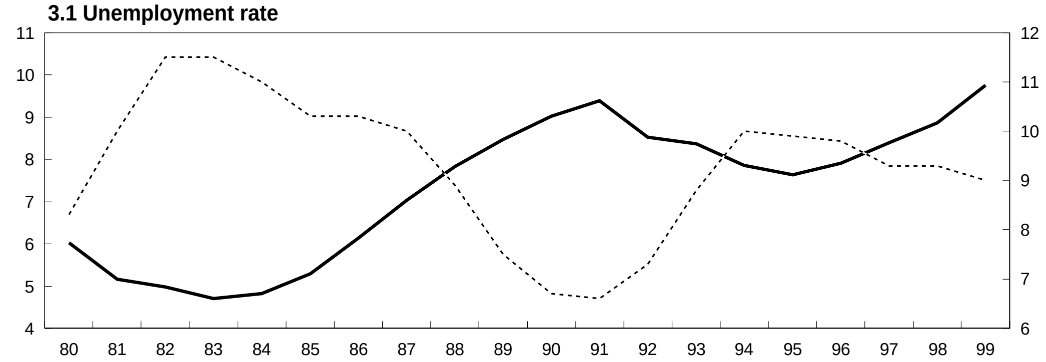


Sources: NAI; NBB.

Figure 3

Determinants of the development of credits to individuals

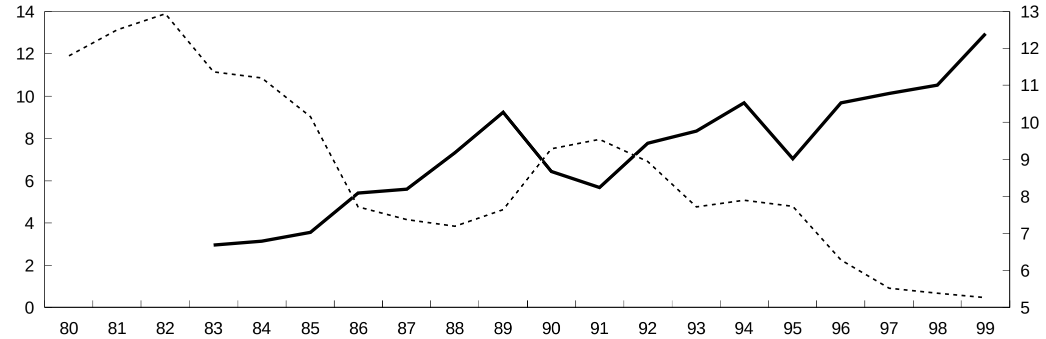
3.1 Unemployment rate



Outstanding amount of consumer credit in billions of constant 1999 euros, end-of-year data (left-hand scale)

Unemployment rate, annual average (right-hand scale)

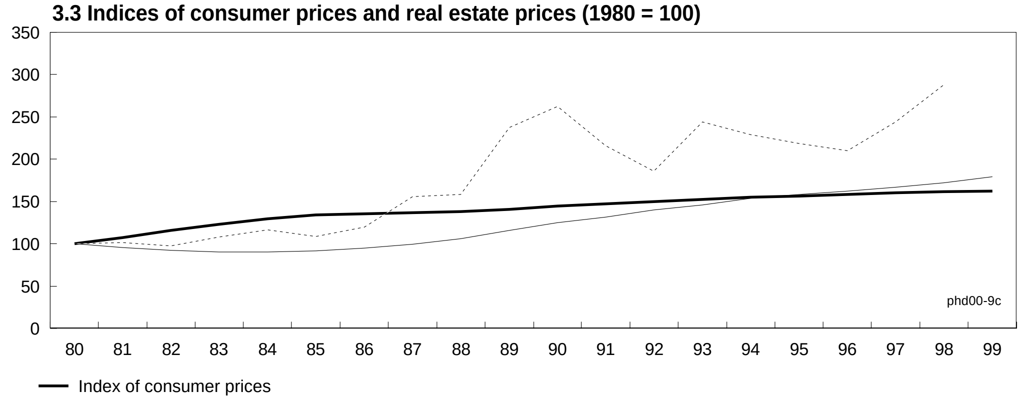
3.2 Interest rates



Amount of credits granted annually, billions of 1999 euros (left-hand scale)

Nominal interest rate on mortgage loans (right-hand scale)

3.3 Indices of consumer prices and real estate prices (1980 = 100)



Index of consumer prices

Index of residential real estate prices

Index of commercial real estate prices

Sources: NSI; Ministry of Economic Affairs; Ministry of Employment; Fortis Bank; NBB.

This is of course only an aggregate situation. The individuals who have increased their indebtedness are not necessarily those who have increased their holdings of assets. Furthermore, these assets may have become riskier or more sensitive to changes in prices (we shall return to this point in Section 4).

The financial situation of households is also very sensitive to the movement of interest rates, owing to the large amount of interest in the total charges on mortgage loans, especially during the first repayment years. A great number of borrowers have taken the advantage of the fall in interest rates to refinance their credits, which has helped to reduce total interest charges as a percentage of disposable income.

Two other macroeconomic components to be taken into account are the general development of economic activity (especially the labour market situation) and the development of real estate prices.

In Belgium, consumer credits display a fairly marked anticyclical character. They move clearly in the opposite direction to the unemployment rate, and this inverse correlation is thought to be due to the fact that consumer credit is largely intended to finance the purchase of durable consumer goods, the movement of which follows the course of the economic cycle fairly closely.

This inverse relationship, which at first sight appears to reduce the risks run by banks in the event of a cyclical downturn, is hardly confirmed for mortgage loans. The course of the annual amounts of new credits granted in this form appears to be chiefly dictated by the movement of interest rates.

In Belgium, the price of residential real estate has not undergone any speculative rises. Taking into account a catching-up movement after the stagnation of prices observed in the early 1980s, they have, over these 20 years as a whole, risen at more or less the same rate as the consumer price index. This is in contrast to the movements observed in several other countries, or even in Belgium itself, with the much more pronounced changes which have taken place on the market for buildings for commercial use.

3.4 Interest rate risks

Maturity transformation is one of the main activities of credit institutions. The annexes to the financial accounts submitted by Belgian banks provide particularly useful information in this field. They break down the banks' assets, liabilities and off-balance sheet items into 10 different periods to the next adjustment of interest rates.

An aggregate position is shown as an example in Table 3, in which the data are expressed as a percentage of equity capital. Some characteristics emerge clearly.

Table 3

Position in euros of Belgian banks classified according to period to next interest rate adjustment

(data as percentage of equity capital at end-September 1999)

Periods	Assets	Liabilities	Net balance sheet positions	Net off-balance sheet positions	Total net positions
Indeterminate	351	655	- 303	- 5	- 308
Up to 8 days	255	651	- 397	53	- 344
More than 8 days, up to 1 month	153	234	- 81	66	- 15
More than 1 month, up to 3 months	264	251	12	- 13	- 1
More than 3 months, up to 6 months	240	180	60	9	68
More than 6 months, up to 1 year	276	156	120	- 53	68
More than 1 year, up to 2 years	164	102	62	- 17	45
More than 2 years, up to 5 years	357	143	214	- 31	183
More than 5 years, up to 10 years	283	42	241	- 49	191
More than 10 years	96	5	91	15	106

Source: NBB.

First of all, net very short-term liabilities serve to finance net assets at over three months and, furthermore, the positive differential between medium- and long-term assets and liabilities appears to be proportionately greater the more distant the maturity date. Secondly, Belgian banks make active use of off-balance sheet transactions to manage their interest rate positions, but despite this recourse to derivatives the total net positions remain substantial, especially at the two ends of the maturity range. Lastly, a significant proportion of the transactions included in the balance sheets of Belgian credit institutions are for an indeterminate period (current account advances and fixed assets on the assets side, equity capital, provisions and, above all, savings deposits on the liabilities side). The choice of the duration to be applied to these items is thus one of the key variables of the banks' asset and liability management.

While these statistics obviously fall far short of the much more finely differentiated data used by the banks for managing their individual interest rate risks, they do provide a relatively detailed overall breakdown by term, especially as these data are also available by major balance sheet item (interbank, claims and debts vis-à-vis customers, investment and borrowings in the form of securities, etc).

At the microeconomic level, the BFC uses these data to highlight, by means of comparisons with reference groups, any individual lines of behaviour which diverge greatly from the average. At the macroeconomic level, these data can be used to evaluate the effects of a constraint which affects the whole of the banking sector, for example through scenario analysis aimed at assessing the overall effect, for the banks, of a given variation in the interest rate structure.

The overall position of Belgian banks is in fact partly dependent on the timing choices made by all economic agents, even if the field of this constraint has widened from the Belgian franc area to the euro area. The permanent achievement of an overall balance for the whole sector, apart from depriving the banks of their income from maturity conversion, might entail enormous fluctuations in interest rates.

These interest rate positions, which largely relate to securities, make Belgian banks very sensitive to the capital gains or losses recorded upon the realisation of part of their securities portfolio. Between 1995 and 1998, in a context of falling rates, the capital gains made by Belgian banks on these transactions represented, on average, 11% of bank earnings (the latter figure corresponding to the net interest results plus other net income). Owing to the rise in rates, this figure amounted to only 6% in 1999.

4. Structural risks

4.1 Strategic risks

An examination of the stability of the Belgian banking sector confined to credit and market risks presents an incomplete picture. While these risks do at present appear to be fairly well under control, this is largely due, as has been indicated above, to a concentration of claims on low-risk debtors (general government).

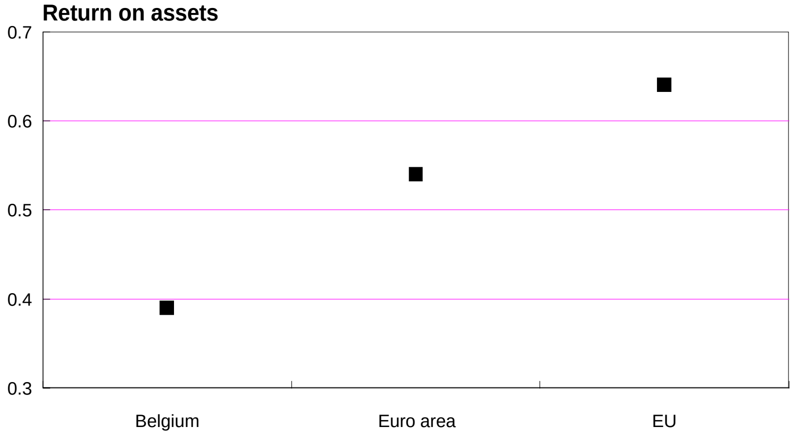
This situation is not without its counterpart. It is accompanied by a fairly traditional activity structure and relatively modest profitability, at least when the latter is measured in relation to assets; the yield on assets of Belgian banks having, on average over the period 1995 to 1998, amounted to only 0.39% against 0.64% for the European Union as a whole. The extent of their claims on general government does however allow the Belgian banks to meet the solvency ratio requirements while contenting themselves with a proportionately more limited level of equity capital. By making more use of the leverage effect, Belgian banks thus succeed in obtaining a return on equity very close to that of the other banks in the European Union.

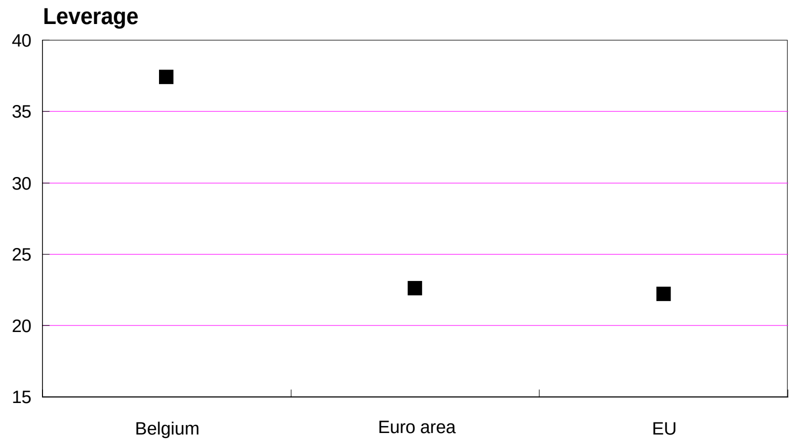
This overall structure is, however, the result of widely differing individual situations, as the variation between credit institutions is very great. In 1999, around 30% of Belgian banks recorded a profitability figure of less than 4%, whereas 13% of banks achieved a return on equity of more than 20%.

Figure 4

Indicators of bank profitability

(average percentage for years 1995 to 1998)





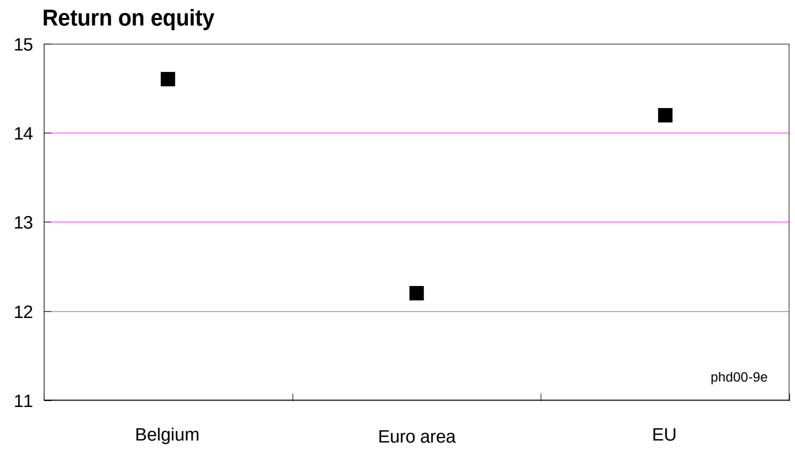
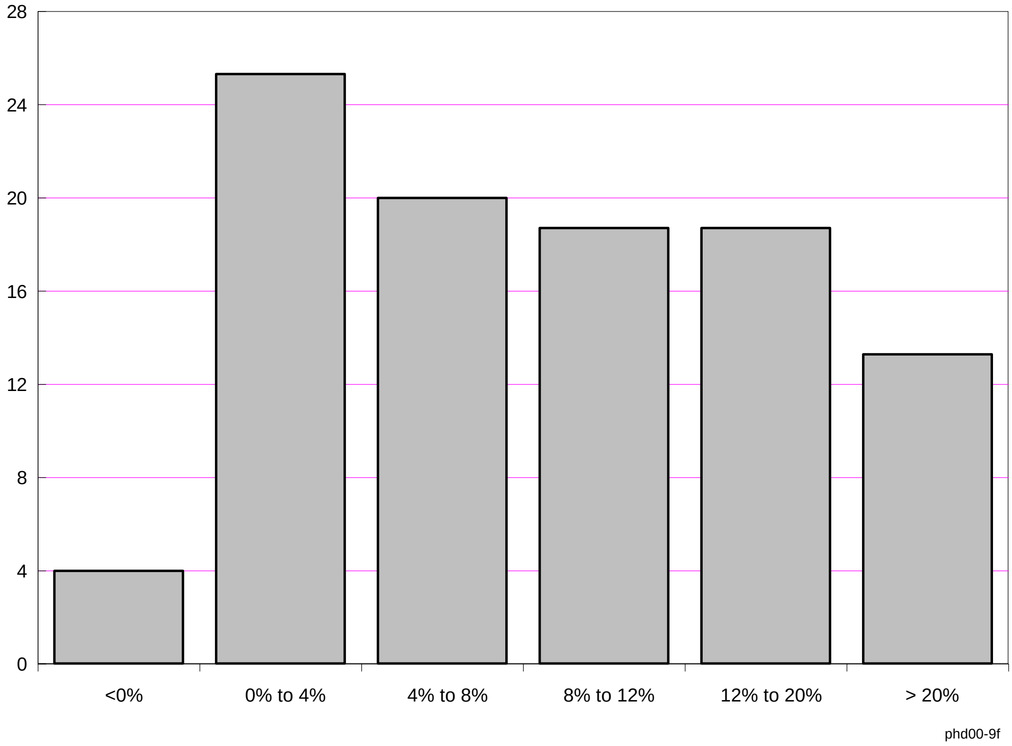


Figure 5

Spread of yields on equity capital of credit institutions governed by Belgian law

(data for 1999, as percentage of total, on a corporate basis)



Source: NBB.

The inadequate profitability of many Belgian banks coupled with a generally rather low capitalisation rate, limits their scope for development of operations with a private clientele requiring a greater degree of capital cover. It also makes external growth through acquisition of other financial institutions more difficult. Furthermore, the possibilities for undertaking capital increases are limited owing to the high yield requirements of shareholders and the importance attached to shareholder value.

Against this background, there is a temptation to increase profitability by taking greater risks. This is true not only for Belgian credit institutions but also for the international banking sector as a whole. In other countries, too, shareholders' requirements have to be satisfied in an environment in which disintermediation and increased competition among institutions exert downward pressure on margins.

The potential dangers of these shifts towards higher "risk-yield" couplings may not materialise immediately if the business situation is favourable. However, in such a scenario, the adverse consequences for banks of a cyclical downturn are greatly increased.

It can thus be seen that an examination of the exposure of banks to the business cycle cannot be made without undertaking a parallel analysis of the structural developments affecting the banking sector. The cyclical and structural components interact with each other, and this explains why banks are not affected in the same way during each recession.

In many banking crises, the driving force appears to be a change in the structural environment, which is reflected in the adoption of unsuitable lines of behaviour. The cyclical downturn then merely brings a latent crisis to the surface.

These interactions can be analysed with reference to the "structure-behaviour-performance" paradigm taken from the theoretical framework of industrial economy: the structure of the market leads to certain lines of behaviour which, in turn, have an effect on performance.

This paradigm can be used to analyse the banking crises which have affected several industrialised economies (for instance the United States, Japan and the Nordic countries) during the last 15 years. These crises have been greater in number and more pronounced than those observed during the

1970s and in the early 1980s, even though the latter period was marked by the two deep recessions caused by the double oil shock.

These divergences are very probably attributable to the differences in the regulatory environment. Between these two periods, most banking systems moved from a fairly rigid structure marked by controls on prices and/or volumes of activity to a more flexible structure, most of the regulatory constraints having been lifted. Many banks sought to exploit this margin for manoeuvre by changing from a fairly conservative approach of relying on situation rents to more aggressive lines of behaviour in which they took greater risks in order to increase market share.

The deregulation of banking systems has now largely taken place, at least in the industrialised countries. However, another phase of structural changes is currently under way. The deregulation within national frontiers during the 1980s has been followed by an international liberalisation marked by a removal of frontiers, both between national financial markets and between types of activity (credit institutions, investment service companies, institutional investors).

In Europe especially, the creation of the single market and the entry into force of EMU have allowed the formation of genuinely transnational financial groups and facilitated the removal of the partitions between the categories of financial services (the creation of combined bancassurance groups is a good example of this).

Table 4

Application of the paradigm structure - behaviour - performance to the conditions of operation of the banking system

	Structure	Behaviour	Performance
Prior to deregulation	**Regulation** • Ceilings on debit or credit interest rates • In several cases, control of volumes or activities (segmentation of markets)	**Conservative approach** • Specialisation of institutions • Limited risk-taking Long-term relationship based on proximity of customer	**High gross margin** • Little pressure on costs • Expansion in capacities (branch network)
Following the deregulation of the 1980s	**Liberalisation** • Interest rates aligned on market rates • Abolition of credit rationing measures • Lifting of constraints on banking activities • Freeing of international capital movements	**Aggressiveness** • Competition for market shares with increase in volume of credits and in balance sheet total • Development of new products and approach to new markets • Higher risk profile	**Small gross margin** • Loss of situation rents • Excessive costs inherited from the past Deterioration in profitability and solvency • Poor risk management Excessive concentration on certain sectors
Following the disappearance of geographical and sectoral frontiers	**Elimination of frontiers** • Creation of the single financial markets within the EU • Creation of EMU • Removal of partitions between banking activities and investment and insurance services • Use of remote access technologies	**Emphasis on expansion** • Effort to achieve economies of scale (mergers and acquisitions leading to consolidation in the financial sector) • Diversification of activities (especially of financial flows) • Disintermediation of financial flows	**High but fragile profitability** • Strict control of capital requirements to satisfy shareholders (shareholder value) • Need to produce high profits in order to position themselves in the mergers and acquisitions game **Appearance of new risks** • Development of new products and off-balance sheet activities in order to reduce credit risks and capital requirements but ... • Strategic risks, operational risks, reputational risks

Source: NBB, *Economic Review*, August 2000.

These two phases - deregulation and the disappearance of geographical and sectoral frontiers - have been based on two successive waves of innovation. Whereas the progress made in the field of information technology enabled credit institutions substantially to increase the speed and efficiency of processing of their transactions during the 1970s and early 1980s, the new communication products developed during the 1990s are now facilitating the entry of new players and remote access to financial services.

With regard to risks, the first phase was characterised by a strategy of increasing market share on the traditional markets, if necessary by seeking riskier borrowers. At present, the banks are endeavouring rather to extend their activities to other segments of financial services or other geographical areas, so that the risks seem to be linked more with the mastering of new and therefore less well known activities.

4.2 Transfer of risks and reputational risks

Strategic risk obviously applies not only to credit institutions but also to all enterprises faced with a problem of adaptation or of diversification of their activities in a context of increased competition.

Placing the emphasis on strategic risk would thus apparently mean departing from the philosophy underlying the approach based on asymmetric information, which on the contrary sought to underline what constitutes the basis of the banks' intermediation function.

It is, however, the very existence of such information asymmetries that offers banks scope for reacting to structural changes in ways which are not accessible to most other branches of activity. As pointed out earlier, they can respond to a fall in their profitability by running greater risks. This strategy is justifiable if these additional risks are correctly valued and appropriately monitored. Failing this, the result will be, after a certain time lag, a deterioration of the financial soundness of the credit institution. It is this lag which will induce some banks to "gamble for survival".

The need for an appropriate valuation of risks also applies to the other major segment of financial services, the insurance sector. Two main techniques are used for this purpose by that sector.

The first is a fairly far-reaching quantification of the risks, even though this is easier to achieve in some fields (for instance life insurance) than in others (such as large industrial exposures). In the banking field, many efforts have been made in recent years to achieve a more finely graded risk assessment. This problem is, in particular, central to the discussions currently taking place in the Basel Committee.

The second major technique to which the insurance sector resorts is that of reinsurance, which enables part of the risks to be transferred to other companies. Here, too, new instruments have been developed by credit institutions for improving risk-spreading mechanisms. A more recent addition to the derivatives based on interest rates, exchange rates or stock market prices are derivatives based on credits. Those techniques facilitate risk transfers between professionals, although they involve a counterparty risk.

On a more general level, the disintermediation phenomenon also has the effect of transferring some of the banks' risks to their customers. This development can be highlighted by examining the changes which have taken place in recent years in the structure of investments by individuals.

The share of low-risk investments, in the form of deposits and banknotes, decreased from 41% in 1980 to 22% in 1999. As this fall was accompanied by a reduction in holdings of securities issued by credit institutions, the decline in banking intermediation - from 60 to 30% - was even more pronounced.

This reduction was mainly compensated for by an increase in investments in equities. The proportion of directly held shares rose from 18 to 31% of the portfolio, but this figure is greatly affected by the high proportion of unlisted shares in Belgium representing capital invested directly by individual entrepreneurs in their SMEs. In this connection, the increase in investments with institutional investors is much more significant. Growth has been especially pronounced in the case of CIUs: while they were virtually non-existent on the Belgian market in 1980, at the end of 1999 they were receiving nearly 15% of the financial assets of individuals; about two thirds of these investments are made with funds whose yields are, directly or indirectly, connected with the movement of stock market indices.

Risk transfers are not confined to investors but can also affect borrowers. In Europe, the diversification of enterprises' financing sources is probably less advanced than the diversification of individuals' investment instruments. Non-financial companies still issue relatively few fixed interest securities.

Table 5

Structure of financial assets of Belgian individuals

(percentage of total)

	1980	1990	1999
With credit institutions	60.1	49.3	30.5
Deposits and notes	41.3	30.8	21.6
Fixed interest securities	18.8	18.5	8.9
Direct holding of securities	32.1	37.5	43.5
Shares	18.1	22.2	30.8
Fixed interest securities	14.0	15.3	12.7
With institutional investors	7.8	13.2	26.0
CIU's	0.5	5.3	14.6
Insurance companies	6.2	6.9	9.6
Pension funds	1.1	1.0	1.9
Total	**100.0**	**100.0**	**100.0**

Source: NBB.

However, an increase in such recourse to the capital markets at the expense of bank credit might expose enterprises to a funding risk because, in the event of a sudden reversal in market expectations, opportunities for issuing securities might dry up, creating a difficult situation for companies which have failed to retain an alternative source of finance with credit institutions.

Disintermediation is a new form of competition for banks but it also offers opportunities. In particular, it enables them to react to the reduction in intermediation margins by developing new sources of income.

This development is revealed by an examination of the structure of the banks' profit and loss accounts. The intermediation margin, measured by the ratio between net interest incomes and total assets, is showing a downward trend in the European Union as a whole. While this decline seems less pronounced in Belgium, the margin is also smaller there in absolute terms. This reflects the relative importance, in the Belgian banks' transactions, of lending to general government. The latter consideration confirms that an analysis of the intermediation margin cannot be made without taking account of the risk component.

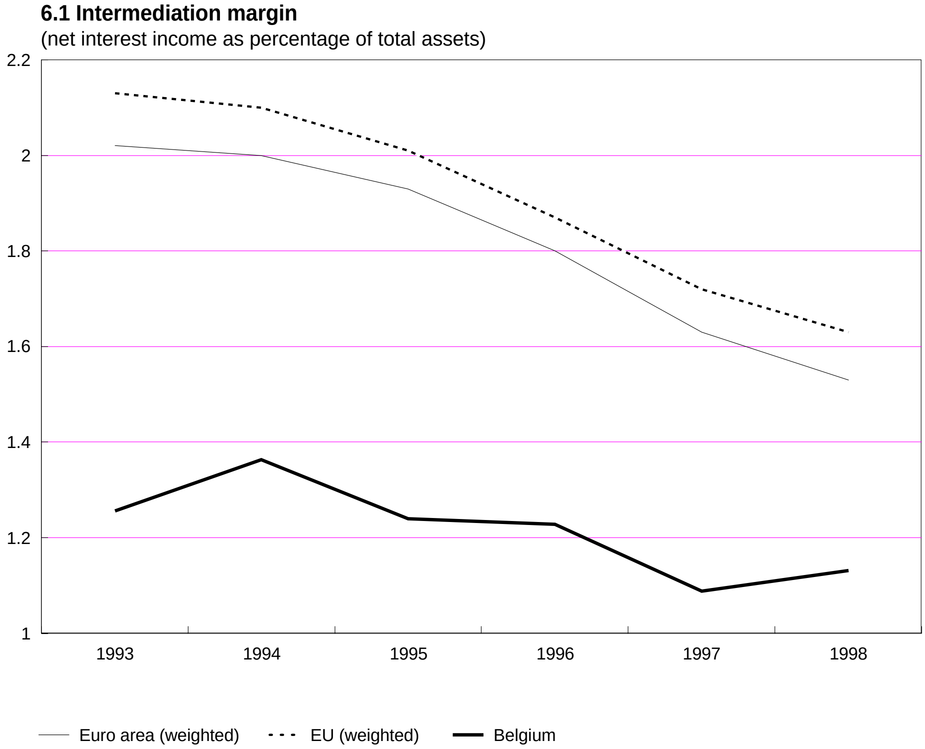
In response to this trend, credit institutions have endeavoured to increase non-interest, especially commission, income. In 1998, this other income represented about 40% of the total income of European banks.

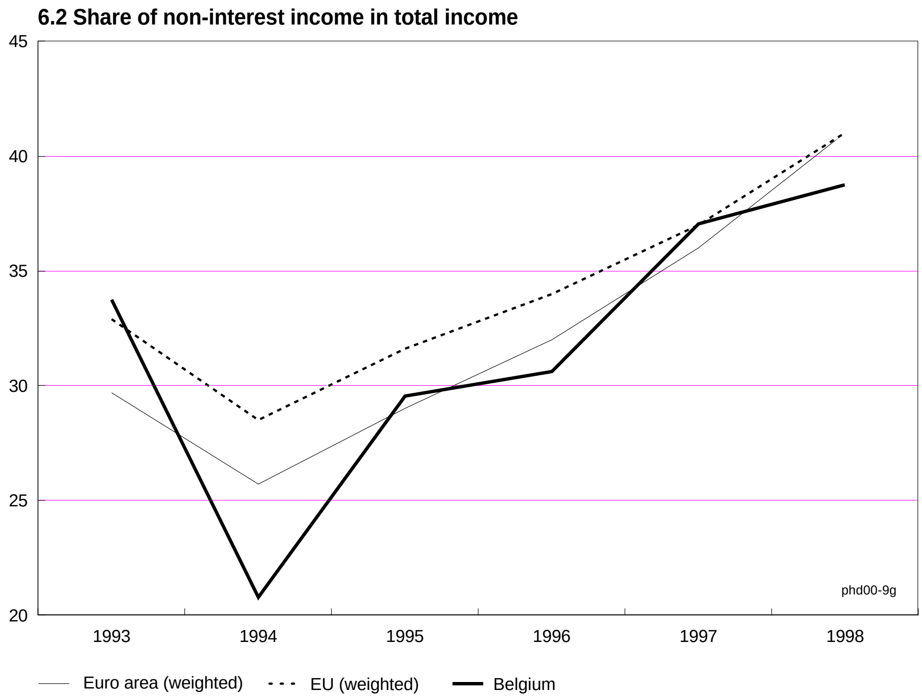
In Belgium, a large proportion of these commissions is levied on the sale of units of CIUs, which, as has been seen above, has increased very substantially during the last two decades. This market is largely dominated by banks, which themselves generate, manage and sell to the public most of the funds marketed in Belgium.

Disintermediation does not have implications only for the banks' sources of income. The increased recourse to the market is coupled with greater requirements regarding transparency and dissemination of data, a trend which limits the relative importance of the exclusive information which the banks traditionally have concerning their customers. In other words, the transfer of credit and market risks is accompanied by developments which tend to reduce the comparative advantage enjoyed by the banks in the management of these risks.

Furthermore, disintermediation, while it does contribute to reducing the credit and market risks run by banks, could give rise to other types of risks.

Figure 6





Sources: ECB; NBB.

On the one hand, it increases the vulnerability of the economic agents to whom the credit and market risks are transferred. The financial incomes of individuals become subject to sharper fluctuations; the financing sources of enterprises are less regular. These developments have macroeconomic consequences (one of the best known examples is the possibility of a wealth effect). They may also have macroprudential repercussions, by weakening bank customers' soundness, since the possibility of mobilising financial or real assets is one of the major components of the capacity to repay loans.

On the other hand, disintermediation induces the banks to establish with their customers relationships in which the sharing of responsibility and risk-spreading procedures present themselves in terms which are often more complex than in classical bank intermediation. Thus, the sale of units of CIUs and, generally, asset management presupposes a good knowledge of the customer's requirements. The same products cannot be sold in the same way to professionals and to inexperienced customers. Consumer protection requirements will have to be met. Conduct-of-business rules will have to be defined in order to ensure good provision of information, proper settlement of conflicts of interest and, more generally, integrity in the treatment of transactions. Banks will become exposed to reputational risks in the event of shortcomings in their organisational structures or internal audit mechanism, which might lead to lawsuits and actions for damages.

In principle, these new activities entail, for the banks, an obligation regarding means but not regarding results. Nevertheless, the reputational risk will not be totally independent of the performance achieved by banks. Asset management, or the provision of investment banking services to enterprises, are sophisticated products with a high value added. Customers therefore not only expect to have the benefit of good organisation. They will also want to obtain good results in terms of yield or costs. This also means that the banks must preserve a reputation for professionalism and efficiency, failing which their volume of activity is liable to undergo sharp changes.

5. Conclusions

The banking crises which have occurred in recent years in many countries have again highlighted the contributions which can be made by central banks, at a macroprudential level, to containing systemic risks. The devising of reliable and efficient payment mechanisms is directly in line with this. The work devoted to the conditions of granting of last-resort loans or to the synergies which exist between price stability and financial stability is another example of this. These various lines of action need to be supported by regular analyses and proper monitoring of the factors which are liable to affect the overall soundness of the financial system.

The nature of these factors has been the subject of various theoretical studies. Endeavouring to explain the mechanisms whereby such risks develop, these studies attempt to draw lessons concerning the warning signs of financial crises.

These analyses have long been based on the traditional macroeconomic models, whether Keynesian, with the emphasis on demand, or monetarist, paying greater attention to monetary factors. More recently, new models have been developed which seek to focus on what is the specific feature of the banks' intermediation activity.

The concept of asymmetric information has thus been put forward. These asymmetries will give rise to phenomena of adverse selection or moral hazard, which, beyond a certain threshold, will lead to a break in the intermediation channels. The approach via asymmetric information thus makes it possible to explain discontinuity processes in intermediation activity, whereas traditional economic theory is characterised by its marginalist line of argument and the concept of equilibrium.

These analyses reveal three categories of indicators which are often present together at the beginning of a financial crisis. These are the deterioration of the ability to repay loans, the rise in real interest rates and the volatility of asset prices; these indicators relate directly to the credit and market risks inherent in the banks' activity.

The progress made in theoretical analysis has not perhaps been sufficiently accompanied by parallel progress in empirical measurement instruments. This situation may be attributed to various factors. Financial statistics are still in many respects less developed and less harmonised than real statistics, especially as regards data concerning outstanding amounts. These figures, being subject to sharp fluctuations, are more difficult to extrapolate or model.

In this context, sophisticated instruments such as financial stability models or composite indices are still not very widely available. Macroprudential studies are largely based on two categories of instruments, namely the balance sheet analysis techniques applied to the accounts of credit institutions and the macroeconomic indicators relating most directly to banking activity. In Belgium, the BFC gives preference to the former category and starts from the individual data, working upwards to obtain an overall view of the whole banking sector. The Bank resorts more to the second category and examines, based mainly on a top down approach, the implications of the major macroeconomic developments for the functioning of the financial markets in general and the stability of the banking system in particular.

For this purpose, the Bank has a large number of databases, owing to the important role which it plays in the collection, analysis and dissemination of statistics in Belgium. For instance, the Central Balance Sheet Office makes it possible to obtain a complete overview of the financial structure of companies, while the Central Register for Credits enables sectoral breakdowns to be made. The financial accounts give information on the development of total assets, an important factor for judging the repayment capacity of economic agents. Direct access to the financial accounts submitted by the banks and to their various annexes enables a fairly detailed breakdown to be made of the banks' interest rate positions.

Credit and market risks are largely dependent on the movement of the business cycle and are a manifestation of the vulnerability of the banking sector to the development of economic activity. However, the banks are not affected in an identical manner upon each reversal of the cyclical trend. In many banking crises, the driving force appears to be a change in the structural environment. This forces banks to change their behaviour, but is sometimes reflected in a choice of unsuitable strategies. Many credit institutions may also be induced to run greater risks in order to preserve their profitability in the face of keener competition, so that economic recessions may merely bring latent crises to the surface.

Admittedly, these strategic risks are not peculiar to banks, because they relate to all enterprises confronted with diversification or changes in activity. Nevertheless, the specific character of intermediation activity - whose function is to manage and reduce information asymmetries between borrowers and lenders - offers banks opportunities to choose between different "risk-yield" couplings which are not accessible to most other branches of activity.

Various recent developments are changing the context in which the problems of information asymmetry are addressed. The development of derivatives on market instruments and on credits, or even disintermediation, enable the banks to transfer some of their risks to other economic agents. These developments are accompanied by greater requirements in terms of transparency and dissemination of data, which tend to limit the comparative advantage enjoyed by banks in the management of information asymmetries.

The possibility of transferring part of credit and market risks represents a positive factor for the stability of the banking sector. However, these operations create some problems which might also be systemic in nature. On the one hand, they increase the vulnerability of the economic agents to which risks are transferred, which could reduce the financial resilience of banks' customers. On the other hand, the terms and conditions of the relationships and the sharing of responsibility with customers are becoming more difficult to determine precisely, a factor which is liable to expose credit institutions to reputational risks.

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Assessing financial system stability, efficiency and structure at the Bank of England

Andrew G Haldane, Glenn Hoggarth and Victoria Saporta[1]

1. Introduction

Financial stability is concerned with an economy's saving-investment nexus. Deviations from the optimal saving-investment plan generate a welfare cost. These deviations may arise from *inefficiencies* in the functioning of the financial system or from *instabilities* in this system in the face of shocks. These welfare frictions are behaviourally distinct, though they are closely interlinked. There may also at times be a trade-off between the two. For example, an increase in competitiveness may accentuate the financial system's vulnerability to shocks, while conversely guarantees to the safety of the system as a whole may reduce its efficiency. An extreme version of the latter was witnessed in the financial systems of eastern Europe and the former Soviet Union during the command economy period. Any potential trade-off between financial stability and efficiency may be reduced, however, by having in place an adequate financial infrastructure for intermediating flows of funds or settling payments, and for regulating the financial system.

These frictions in the financial system are a potential public policy concern. They may justify public policy oversight and/or intervention and have, as a result, long been reflected in the mandate of central banks. For example, the Federal Reserve System was set up in 1914 "to furnish an elastic currency" - act as lender of last resort - against a backdrop of 14 separate episodes of banking panic between 1793 and 1914. Through extended periods over the last two centuries, financial stability has clearly been the primary concern of central banks around the world. The Bank of England is no exception.

The welfare costs of financial instability are often closely associated with monetary instabilities. Monetary instability may give rise to both *inefficiencies* and *instabilities* in the financial system. The Great Depression is a classic example of extreme financial *instability* that was, in part at least, induced by monetary instability. At the end of 1933, the number of banks in the United States was half the number that existed in 1929 (Bernanke (1983)), during which time money income had fallen by 53% and real income by 36% from their 1929 peak (Wood (1999)).

The link between monetary stability and financial *inefficiencies* is harder to pinpoint. But recent work by English (1999) offers some interesting insights. English's analysis starts from the observation that financial sectors increase markedly in size in economies undergoing high inflation or hyperinflation. He quotes the example of Germany in the 1920s, where the number of bank employees doubled between 1920 and 1923, at the peak of the hyperinflation, before returning to their earlier levels in 1924 as inflation subsided.[2] The reason for this is that agents switch out of (non-interest bearing) money balances to make greater use of banking services as inflation rises. But this is a socially wasteful switch, because financial services resources could otherwise be put to more productive uses. At high rates of inflation, the financial sector is above its socially efficient level. English estimates that a 10 percentage point rise in inflation has a welfare cost equal to around 1¼% of GDP working through this financial sector channel. This is a non-trivial cost. It is an example of monetary instabilities generating well-defined welfare inefficiencies from a financial system perspective.

There have been few (if any) studies evaluating precisely the *direct* welfare costs associated with financial instability and financial inefficiency. There has been recent work, however, quantifying some of the costs of financial instability and inefficiency in terms of foregone output. One strand of the literature has quantified the costs of recent banking and currency crises. Crises are, almost by definition, episodic and extreme instances of financial instability. As evidence on the output costs of

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[1] Bank of England, Threadneedle Street, London, EC2R 8AH. We are grateful to Alastair Clark, Paul Tucker, Simon Buckle, Patricia Jackson and Ian Michael for comments. However, views expressed are not necessarily those of the Bank of England.

[2] Other examples would include Eastern Europe in the 1920s and Israel in the 1980s.

financial instability more broadly, they are therefore limited and partial. To draw an analogy with monetary stability, they are equivalent to quantifying the output costs of hyperinflation - extreme monetary events. Nonetheless, the studies are illuminating and there have been enough recent crisis episodes to reach some fairly robust conclusions. The World Bank (Caprio and Klingebiel (1996,1999)) for example, document 69 instances of “systemic” crises since the late 1970s.

What broad conclusions can we draw from these studies? First, it is clear that banking crises are associated with periods of low output relative to various measures of pre-crisis trend levels. Using various measures of output loss, Hoggarth, Reis and Saporta (2001) estimate average output losses of 15-20% of annual GDP for a sample of 43 banking crises. Second, banking crises are not confined to developing economies. Twelve out of the 54 global banking crises documented by the IMF in an interesting study (World Economic Outlook, 1998) occurred in industrial countries. Moreover, banking crises in high-income countries have tended to last longer and, on some estimates, have been associated with greater cumulative output losses than crises in middle and low-income countries. According to the same IMF study, the average crisis length in the sample industrial countries is 4.1 years compared to 2.8 years in the sample emerging economies. Using a different sample of crises, Hoggarth et al (2001) confirm the IMF finding and report cumulative output losses of 24% and 14% of annual GDP, on average, in high and medium/low income countries respectively. Third, “twin crisis” episodes (when banking instability and sharp pressures on a country’s exchange rate occur at the same time) are associated with considerably higher output losses than “single” banking crises - between three and five times as large according to Hoggarth et al’s (2001) estimates. Similarly, estimates of the fiscal costs of banking crisis resolution are much larger when there is a twin crisis (Aziz, Camarazza and Salgado (2000), Hoggarth et al (2001)), especially when the exchange rate was previously fixed. This is consistent with the notion that the macroeconomic consequences of banking sector fragility are amplified when banking sector problems are intertwined with or, as some of the recent literature on the causes of the Asian crisis suggests, cause exchange rate vulnerability.[3]

A second strand of literature has looked at the effects of financial *inefficiencies*, and in particular the effects of financial development, on growth. Though empirical work on this issue began 30 years ago (Goldsmith (1969), McKinnon (1973)), the most compelling evidence is recent work looking across a broader cross section of countries (see Levine and King (1993) and Levine (1997)). This finds a statistically significant, behaviourally important and seemingly causal link between various measures of financial development and growth, even after controlling for other factors. These financial development measures usually include the proportion of credit allocated to the private versus the public sector and the size of financial intermediaries in relation to the economy as a whole. To give an idea of magnitudes, Levine (1997) offers the example of Bolivia. Had Bolivia’s financial depth been equal to the mean for all developing countries in 1960, this would have boosted its growth rate by 0.6% per year thereafter. This is a huge gain when accumulated over time.

There is also strong evidence of faster-growing countries being associated with larger non-bank financial sectors and larger stock market capitalisation, though it is more difficult to tell causal stories about these relations. There is likewise no clear-cut evidence on the relationship between financial structure - or example, bank versus capital market-based financing - and economic growth. That awaits further research. But in general this cross-sectional evidence is strongly supportive of financial development enhancing growth and productivity, and in non-trivial magnitudes.

There is relatively little, if any, literature that weaves together these two strands: the welfare costs of financial instability on the one hand; the welfare benefits of financial efficiency on the other. There is, however, some work exploring the trade-off between the two in the context of financial liberalisation. For example, Demirguc-Kunt and Detragiache (1998a) consider these relationships across a panel of countries from the 1980s onwards. They reach three intriguing conclusions. First, there is evidence that financial liberalisation - here identified to be the removal of interest rate controls - materially increases the estimated probability of banking crisis, by a factor of around four. Second, there is evidence of liberalisation reducing financial sector inefficiencies, for example, by lowering the return on equity in the banking sector and reducing its concentration ratio. But third, the effect of liberalisation on

[3] Examples include the work on the so-called “third generation” models of crisis. The most well cited example, perhaps, is the theoretical work of Chang and Velasco (1999). This shows that foreign exchange illiquidity alone can result in bank runs which would then lead to the collapse of the currency regime (see also Section 4 below). In the empirical literature, Kaminsky and Reinhart (1999) have found that banking crises are a leading indicator of currency crises which is consistent with (but not conclusive evidence of) the former causing the latter.

the probability of banking crisis is mitigated if the institutional infrastructure is robust - for example, if contracts are enforceable, there is high quality supervision, an absence of corruption etc.

Taking these three findings together, there appears to be some evidence of an important trade-off between financial efficiency and financial stability.[4] This trade-off can be improved, however, by improvements in the infrastructure of the financial system, including its prudential oversight by the authorities. This type of analytical framework, linking together financial efficiency and stability with the system's infrastructure, warrants further theoretical analysis.

In the following sections we discuss all three pieces of the financial stability jigsaw. In Section 2 we discuss some of the techniques the Bank of England uses in the course of its surveillance of financial stability risks. A key issue here is aggregation: how to measure aggregate system-wide financial stability risks from individual institutions' data. Section 3 discusses the efficiency versus macrostability trade-off in the context of the revised Basel accord. Section 4 discusses the implications of liquidity crises for macroprudential analysis and policy, thereby touching on both the aggregation and stability/efficiency issues. Section 5 briefly concludes by outlining some areas of future research at the Bank of England.

2. Monitoring the risk of financial distress

The Bank of England publishes a six-monthly *Financial Stability Review* (FSR) which contains a summary assessment of current and prospective risks to financial stability in the United Kingdom and internationally. These risks can take a variety of forms - credit risk, market risk, liquidity risk etc. The FSR uses a variety of techniques to identify and evaluate these risks.

This section describes three methods for evaluating credit risk in three distinct sectors: the UK banking system, the UK corporate sector and the international economy. Two of the methods use market-based measures of credit risk, as embodied in equity prices, bond prices and agencies' credit ratings. The third uses individual company account data to look at the cross-sectional distribution of credit risk. The techniques are illustrative of the types of approach used by the Bank for assessing aggregate credit risks, including in the FSR.

(a) Assessing risks to the UK banking system using the Merton model

In a famous paper, Merton (1974) derives analytically the value of risky debt by exploring the insight that company value may be thought of as the price of a call option written on a company's underlying assets with its liabilities acting as a strike price. The reason for this is that at expiry date (when liabilities become due) equity-holders will only exercise the option (pay off company debt) if the value of the company's underlying assets is not less than the value of its liabilities. Otherwise, due to limited liability, they are better off defaulting. Similarly, the value of a company's risky debt can be thought of as the value of a portfolio long in a risk-free asset (which at maturity pays an amount equal to the outstanding value of its liabilities) and short of a put option on the company's assets with a strike price equal to its liabilities.

Merton's insight can be readily applied to extract estimates of the default probability of a sample of firms using equity price data on quoted companies and balance sheet data on liabilities. This boils down to two steps. The first step involves the estimation of the distribution of company value. In practice, this can be done by employing simple parametric assumptions about the evolution of the company's assets and liabilities, using Monte Carlo simulations, or through non-parametric techniques which do not impose any distributional assumptions on assets and liabilities. The second step involves computing the (left tail) probability that the value of the company will be less than the value of its debt (in which case the equity-holders' option is worthless and debt-holders get less than the amount they were owed).

[4] This trade-off also arises in the context of a number of other financial stability issues, such as the design of payment systems.

It is also worth noting that Merton's original result is derived under various simplifying assumptions, a number of which have been modified or relaxed in subsequent research. In the original Merton framework, for instance, both default and bankruptcy occur at the point in time when an auditor happens to ascertain that the firm's assets are less than its liabilities. But in practice, the concept of default is distinct from the concept of bankruptcy. Black and Cox (1976) provide a more realistic default condition by introducing an exogenously determined level of assets below which default and bankruptcy are triggered. Merton (1977) and Jones, Mason and Rosenfield (1984) incorporate callable liabilities into the original framework.[5] These are useful modifications, particularly when one wishes to apply the framework to assessing the default probabilities of banks, but typically come at the cost of added complexity.[6]

Using time-series data on market capitalisation and liabilities of large UK banks, analysts in the Bank of England have estimated probabilities of bank insolvency for each of these banks, applying a number of variants of "Merton-type" or "equity-based" credit risk models. An example of their output is reproduced in the top part of Table 1 below (Nickell and Perraudin (2001)). The table gives estimates of default probabilities over two, five and 10 years for eight large banks. It assumes that the initial asset/liability ratio is equal to that observed at the end of the sample period (30 January 1991 and 23 September 1998) and that insolvency is triggered when assets are equal to liabilities.

The results suggest that the likelihood of default for all banks is small over a two-year horizon, but over a 10-year horizon it rises to between 2% and 5% for most banks and to 12% and 24% for two institutions. As discussed in more detail below, the estimates of the level of default probability should be treated with caution - more information is likely to be extracted from the changes in the levels of these estimates than from the levels *per se*. The estimate for at least one institution (Standard Chartered (ST)) is likely to be exaggerated since, over the relatively short sample period, the bank was particularly exposed to the 1998 turbulence in emerging markets. The last three rows of the table list various ratings assigned to each bank by FitchIBCA. FitchIBCA ratings are unique in that they provide a publicly available indication of the likelihood that the bank will receive support in the event of default ("support rating")[7] and an assessment of its ability to fulfil its debt obligations on its own ("individual rating") as well as the standard agency "long-term rating". Interestingly, the ranking of relative bank risk on the basis of individual ratings is different from that on the basis of long-term ratings. It is also better correlated with the ranking produced using the equity-based model.

It is also possible to use equity-based models to assess the probability of a systemic banking crisis. This requires a precise definition of "systemic crisis". Nickell and Perraudin (2001) define a crisis as the simultaneous deterioration in the finances of several banks. This allows them to use their variant of the Merton-type of model to compute the probability of two, three or more banks failing within a 10-year horizon. As the authors point out, their results appear to be sample-dependent. The presence of the two relatively riskier banks (Standard Chartered (ST) and Schroders (SC)) in conjunction with their crisis definition implies that when two or more banks fail they include these banks with high probability. In order to provide an indication of how the probability of crisis varies with the levels of capital in the system, Nickell and Perraudin (2001) repeat their experiment under different assumptions about the level of capital held by the banks in their sample. Unsurprisingly, perhaps, their results suggest that the probability of crisis is significantly reduced by increasing the capital in the system.

The definition of "systemic crisis" used by Nickell and Perraudin (2001) may not be appropriate for surveillance purposes.[8] One could argue, for instance, that a better definition would involve the loss of

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[5] When debt is callable, a company's equity value can be thought of as a "down and out" barrier option, ie an option that becomes worthless if the value of the firm's assets falls below the value of its liabilities *at any time* during the life of the firm.

[6] Other important extensions include the extension of the model to floating rate debt (Longstaff and Schwartz (1995)) and deviations from the strict priority rule in the event of bankruptcy (eg Longstaff and Schwartz (1995), Mella-Barral and Perraudin (1996)).

[7] FitchIBCA's support rating assesses the likelihood that the bank will receive official support from the authorities in the event of default. In cases where banks are owned by a stronger parent then the support rating will also include an assessment of the likelihood of parent support.

[8] The problem of devising an acceptable definition of crisis is a much more generic one and seems to have plagued much of the recent empirical literature on banking crises (see Frydl (1999) and Vila (2000) for an exposition of the seriousness of this problem in different contexts).

a significant fraction of the system's total capital rather than the simultaneous failure of a number of banks, and the research is being extended to examine this. More generally, the Bank's work with equity-based models of credit risk has highlighted a number of considerations one should keep in mind when interpreting their output.

Table 1

Probabilities of default (%) and ratings for 8 UK banks

Bank	AN	BA	BS	LL	NW	ST	SC	RS
2 years PD[1]	0.03	0.14	0.01	0.02	0.04	5.66	0.60	0.10
5 years PD	0.52	0.06	0.32	0.52	0.51	16.21	5.26	1.87
10 years PD	1.70	4.60	1.53	2.29	1.75	23.65	12.25	4.68
Long-term rating[2]	A	AA+	AA	AA	AA+	A+	A	AA
Support rating[3]	2	1	2	2	2	4	4	2
Individual rating[4]	A/B	B	B	A/B	B	B	B	B

[1] Probability of default. [2] Long-term ratings are comparable to standard agency bond ratings. [3] Support ratings indicate the likelihood of support on a scale from 1 (very likely) to 5 (very unlikely). [4] Individual ratings grade bank soundness on a scale of A to E where A is the most sound leaving out the assessment of the likelihood of support.

First, individual bank default probability estimates are sensitive to estimates of the volatility of the asset/liability ratio which, in turn, are sensitive to estimates of the volatility of bank equity. This means that if a bank's equity market volatility had been unusually high (low) relative to equilibrium, the probability of default would be biased upwards (downwards). More importantly, if equity market volatility during the sample period is excessive relative to the volatility implied by economic fundamentals - there is "excess volatility" - then all estimates of probability of default will be biased upwards.[9] Table 1 offers some support for this interpretation. Default probabilities implied by banks' credit ratings, at around 3bp per year, are, on average, well below the implied equity price derived default probabilities.

Second, the standard way of modelling the stochastic behaviour of assets and liabilities may not be appropriate for banks which, unlike non-banks, are subject to depositor runs. For example, anecdotal evidence suggests that large market counterparties in the swap market and the interbank market would restrict their exposure to a large bank in the event of a seemingly small deterioration in their credit quality, say a rating agency downgrade from A to A-. The occurrence of this event - although far from being equivalent to a default event - may actually precipitate it. The reason for this is that a number of large banks rely on these markets to manage their balance sheet. An initial decrease in credit quality would signal a decrease in the bank's ability to manage its risks and a greater increase in underlying bank riskiness, which, in turn, would further increase the bank's cost of funding. This could then lead to a further downgrade and so on, until the bank's eventual demise.[10] In the absence of a strong safety net, bank depositors would anticipate this chain of events and run on the bank before the effects of the initial credit quality deterioration have filtered through. In such a world, it would not be appropriate to model the stochastic process followed by the asset/liability ratio as a standard geometric process (the standard assumption used in option pricing theory and in most Bank research). A possible solution would be to model the liabilities as jump processes with a positive probability of a jump when the asset/liability ratio hits a trigger that is higher than the default trigger. But such a solution comes at the cost of added complexity.

A third issue is related to measurement error. As mentioned above, the data inputs are market capitalisation and bank liabilities. Whereas the former are forward-looking and reflect the market's assessment of expected profits, the latter are backward-looking and are based on historical cost accounting. To the extent that historical cost accounting does not capture the fair value of liabilities, this will be reflected in misestimates of default probabilities.

[9] Some authors have claimed that equity prices are characterised by systematic excess volatility (see Le Roy and Porter (1981) and Shiller (1981)).

[10] Anecdotal evidence, for instance, suggests that swap counterparties would refuse to deal with sub-investment grade firms.

A final issue is the treatment of interdependencies when measuring risks to the banking system as a whole - an aggregation problem. Covariances among individual bank equity prices may give some indication of these spillovers. These covariances can be taken into account when computing implied *joint* probability densities for bank valuations and implied default probabilities. But interdependencies are likely to be greater at times of stress - for example, during a bank run - than during tranquil periods. If that is the case, then equity price and other market-based measures are likely to be an underestimate of systemic banking risk; they may understate covariances. So while individual bank default probabilities may be biased upwards, measures of system-wide default could easily be biased downwards when based on the historical covariance matrix of banks' equity prices.

Taken together, these considerations point towards a cautious interpretation of the *levels* of default probability produced by standard "Merton-type" equity-based models. Some (but not all) of these considerations lessen if one focuses on the *changes* rather than the *levels* of default probabilities. These changes should in any case be interpreted in conjunction with other market indicators of credit risk, such as default probabilities implied by ratings and subordinated spreads.

(b) Ranking international risks to UK financial stability

Assessing international risks to UK financial stability is a key task at the Bank of England, since overseas exposures account for more than half of the balance sheet of UK-located banks. But carrying out this evaluation consistently and objectively across a potentially large number of countries is not straightforward. The Bank has recently begun to employ some simple techniques that allow a rough ranking of the key international risks to UK financial stability.

One technique is based on a calculation of "expected default loss" to UK-owned banks.[11] It is calculated simply as the product of UK banks' credit exposure to a country and an estimate of the credit risk (probability of default and recovery rate) attached to that exposure. Two measures of credit risk have typically been used in the Bank's work, both based on private sector assessments of credit risk: secondary market bond yield spreads over a safe asset (typically US Treasuries); and credit ratings. The latter measure of credit risk is in turn based on ex post realised default rates on bonds of different ratings, and can be split into different ratings for public sector, private sector bank and non-bank exposures. The two measures of credit risk - ratings and spreads - exhibit a high correlation in terms of default probability rankings, at least for the emerging markets.

Table 2 shows a league table of international risks to UK-owned banks based on proxies of expected default loss (EDL), as calculated above. It uses a ratings-based measure of credit risk and covers credit exposures to both developed and emerging markets. Also shown are the two components of the EDL calculation, credit exposure and default probability. Number one in the league table, by some margin, is the United States. This in part reflects the very large aggregate exposure of UK banks to the United States - over three times that to Germany and more than one and a half times that to all the emerging markets put together. But it also reflects the fact that much of this US exposure is to the (relatively riskier) US corporate sector, rather than to the public sector or banks.

The next three EDLs in Table 2 come from the emerging markets - Argentina, Brazil and Indonesia - two of which have experienced a crisis in the last few years. The higher risk reflects a combination of non-trivial credit exposures and significant implied credit risk. Indeed, it is striking that six of the top 15 risks in Table 2 come from emerging rather than developed markets. Germany is well down the United Kingdom's risk ranking, largely because most of the UK banks' exposures are to (higher-rated) banks rather than corporates.

Table 3 carries out the same exercise only now looking at the exposures of the entire BIS area banking system. This gives a better indication of international systemic risks. Unsurprisingly, the United States still tops the table, with an aggregate expected default loss of almost $10bn. The next three highest risks are, however, from the emerging markets - Brazil, Russia and Argentina. Russia now ranks higher in the risk table because BIS system-wide exposures - especially among German banks - are much higher than UK banks' exposures. Germany itself also now ranks higher, on account of the larger direct exposure of BIS banks to German banks and non-banks.

[11] See Buckle, Cunningham and Davis (2000) for details.

Table 2

EDL ranking of all economies, end-Dec 1999: risks to the UK system

	Expected default loss ($m pa)	Exposure ($m)	Credit risk (%pa)
1 United States	1,018	95,208	1.1
2 Argentina	288	6,444	4.5
3 Brazil	235	4,577	5.1
4 Indonesia	211	3,203	6.6
5 Australia	199	17,383	1.1
6 Canada	146	15,145	1.0
7 France	126	28,852	0.4
8 Japan	119	21,318	0.6
9 Netherlands	112	16,893	0.7
10 Germany	102	29,772	0.3
11 Mexico	87	5,303	1.6
12 Turkey	84	1,881	4.5
13 Venezuela	68	1,332	5.1
14 Ireland	68	9,175	0.7
15 Switzerland	63	7,693	0.8
Memo: euro area	*584*	*148,100*	*0.4*

These estimates should clearly carry a great many health warnings as they are based on some strong assumptions (see Buckle et al (2000)). Some of these problems are technical - for example, ratings and spreads are, for different reasons, likely to give (upwards) biased estimates of credit risk. The measures of exposure are also partial in that they ignore off-balance sheet and non-bank financial institutions' exposures. We have looked at the importance of the second effect using data from the IMF's one-off Co-ordinated Portfolio Investment Survey. This provides data on the portfolio claims of all UK financial institutions at the end of 1997. The cross-border pattern of portfolio claims appears from this survey to be fairly similar between banks and all financial institutions - for example, the correlation between the two measures is 0.96 for the 53 emerging markets for which data exist. This suggests that the inclusion of non-bank financial institutions may not materially alter the league tables of risk exposure.

Table 3

EDL ranking of all economies, end-Dec 1999: risks to the international system

	Expected default loss ($m pa)	Exposure ($m)	Credit risk (%pa)
1 United States	9,860	1,029,740	0.96
2 Brazil	3,180	61,840	5.13
3 Russia	3,170	48,090	6.58
4 Argentina	3,000	67,000	4.48
5 Germany	2,840	601,420	0.47
6 Indonesia	2,680	40,690	6.58
7 Japan	2,210	264,210	0.84
8 Netherlands	2,060	240,440	0.86
9 France	1,198	394,410	0.50
10 Italy	1,920	401,200	0.48
11 BLEU	1,750	385,860	0.45
12 Turkey	1,690	3,776	4.48
13 Switzerland	1,090	303,630	0.36
14 Mexico	1,010	61,180	1.64
15 Canada	790	137,290	0.57

Perhaps the largest caveats with regard to the EDL approach are, however, behavioural. In particular, the method is constrained in its ability to say very much about the resilience of the system to international shocks. This is partly because it ignores buffers in the system. For example, it takes no account of provisioning against losses by banks, actual and expected, nor of capital ratios. In principle, we would want a banking system to make forward-looking provisions against *expected* loss on their portfolio. This would then leave minimum capital ratios as a cushion to absorb the effects of *unexpected* losses to this portfolio. If that were the case in practice, our estimates would have relatively little to say about the resilience of the banking system to international credit shocks. In practice, however, it is unclear how many banking systems operate in this way. This means our estimates do have some bearing on the question of systemic resilience.

A second behavioural problem with the technique is that it takes no account of the potential distribution of losses across the banking system. It weights high probabilities of small losses and small probabilities of large losses equally when, in practice, the latter is the greater concern from a systemic stability perspective. Notwithstanding these caveats, these international risk rankings appear to offer a useful first-pass, ordinal measure of where the largest risks to the UK and BIS banking systems may reside. This can be valuable when, for example, allocating surveillance resources.

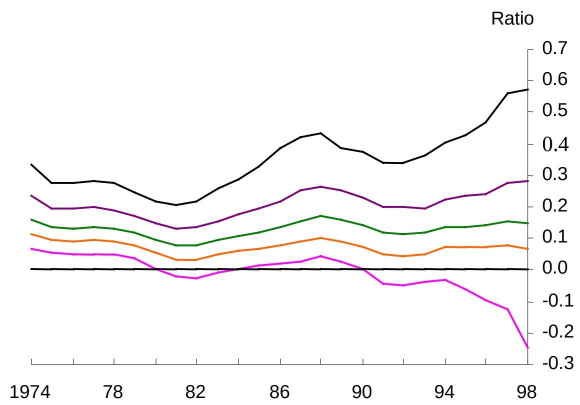
(c) Assessing the cross-section distribution of corporate sector risks

The surveillance methods described above use market-based macro time-series evidence to draw inferences on credit risks. Another approach to assessing these risks is to use firm-level micro cross-sectional data. The advantage this brings is that it provides information on the behaviour of the entire distribution of firms in the panel. Specifically, it helps identify firms in the tails of the distribution, which may be more prone to failure. Macro measures of central tendency averaged across a group of highly heterogeneous firms may fail to capture the financial stability risks posed by those firms operating in the tails.

The Bank has recently begun analysing the cross-sectional characteristics of a panel of around 1000 UK companies.[12] Data are drawn from individual company accounts dating back to 1974. Motivated by previous work on corporate sector failure (Scott (1981) and Altman (1983)), three firm-level characteristics have been focused on: profitability, gearing and liquidity. Figures 1, 2 and 3 show measures of return on capital, capital gearing and liquidity (the cash ratio) across the panel of firms over time, broken down on a percentile basis. The percentiles shown are, from top to bottom, the 90th, 75th, 50th (median), 25th, and 10th. A striking feature in Figures 1 and 2 is the widening in the dispersion of profitability and gearing across UK firms since the middle of the 1990s. For example, profits of companies in the lowest tail of the distribution are lower than at any point in the last 25 years and are much lower than at corresponding stages in previous cycles. Potentially offsetting these trends, measures of the liquid assets held by firms have on the whole been rising over time - though, less encouragingly, the cash ratio of the lower tail of firms has remained close to zero throughout the period.

Figure 1

Percentiles of distribution of return on capital

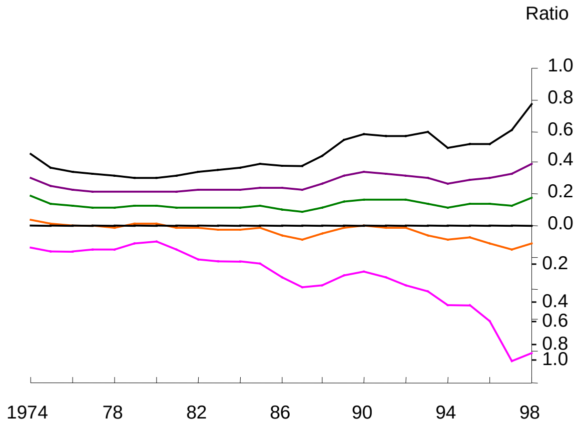


Note: As defined by profit before interest and tax divided by replacement cost of capital. Percentiles are, from top to bottom, 90th, 75th, 50th (median), 25th, 10th.
Sources: Bank of England; Primark Datastream.

[12] See Benito and Vlieghe (2000) for more details.

Figure 2

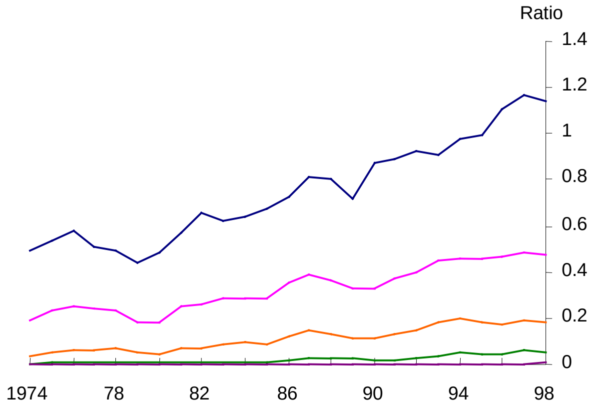
Percentiles of distribution of capital gearing



Note: As defined by net debt divided by the replacement cost of capital.
Sources: Bank of England; Primark Datastream.

Figure 3

Percentiles of distribution of liquidity (cash ratio)



Note: Percentiles are, from top to bottom, 90th, 75th, 50th (median), 25th, 10th.

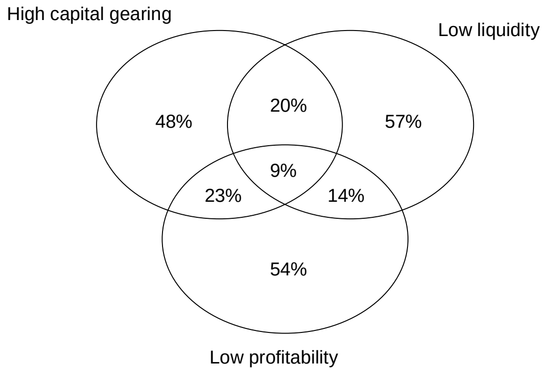
Sources: Bank of England; Primark Datastream.

To get a better idea of potential vulnerabilities, it is informative to also look at the interaction among these indicators of financial health. For example, we might reach a more sanguine view if companies with low profits also had low gearing and high liquidity. Figure 4 suggests that, on the whole, this is not the case. One third of companies with the highest gearing also had the lowest profitability. And almost a third of companies with high gearing also had low liquidity. This suggests a rump of companies that may be susceptible to adverse shocks to sales or interest rates.

What accounts for these patterns and what are their implications for financial stability and welfare? These questions are difficult ones. It does not appear that the patterns derive from firm size (different patterns between small and large firms) or from sectoral effects (for example, different patterns between the tradables and non-tradables sectors following a relative price shift). One alternative explanation would be "new economy" effects, with a widening profit dispersion reflecting a fall in search and transaction costs and higher gearing reflecting expectations of higher profits among successful firms. This would imply a larger tail of potentially insolvent firms, but an improvement in overall welfare.

Figure 4

Coincidence of financial health indicators in 1998



It is too early to reach any definitive conclusions. The Bank has recently updated these cross-sectional data for 1999. If anything, the profits and gearing distributions have widened further, perhaps consistent with a “new economy” interpretation. But were the evidence to suggest that new economy effects were not, after all, so pervasive, this would leave a large tail of corporates facing potential failure, with downstream implications for financial institutions’ balance sheets.

3. Bank capital and the economic cycle

The proposed revised Basel Capital Accord is intended to match more closely banks’ regulatory capital requirements with real risks. This should improve both the efficiency of the banking system *and* the safety of banks, at least as seen from the perspective of individual banks. However, the impact of the Accord on the stability of the financial system as a whole is less clear. As with the current Accord, the proposed revised Accord will not take account of the “externality” effects on the rest of the financial system of risks faced by individual banks. Moreover, there is a concern that the introduction of time-varying regulatory risk-weighted assets may increase the procyclicality of capital ratios and thus increase the likelihood of a credit crunch during recessions.

In principle, even in the absence of regulatory capital requirements, the ratio of capital to assets may be procyclical. In recessions, banks are likely to make more write-offs and specific provisions, which reduce capital, than when the economy is strong. It is also possible that the level of capital will be boosted in booms and reduced in recessions because of the likely procyclical nature of retained profits, which add to tier one capital. On the other hand, for both demand and supply reasons (unrelated to capital constraints), outstanding loans - an important component in the denominator - are also likely to rise in an economic upswing and fall, or at least rise less rapidly, in a recession. A priori, therefore, although the level of both capital and assets are likely to be procyclical, the impact of the economic cycle on the capital/asset ratio is ambiguous.

The current Accord

The current Capital Accord (1988) resulted in the introduction, no later than end-1992, of a minimum 8% capital/risk-weighted asset standard with assets weighted into broad classes according to their credit risk.[13] The introduction of minimum regulatory risk/asset ratios may, and indeed were intended to, affect bank behaviour. One possibility is that their introduction may have permanently raised the

[13] The standard set minimum capital ratios for internationally active banks incorporated in G10 countries. The main categories of risk weights are 0% for cash and government debt, 20% for all interbank loans to OECD banks and for loans to banks outside the OECD of residual maturity up to one year, 50% for mortgage loans secured on residential property and 100% for all other private sector loans.

level of the capital/asset ratio either through encouraging a higher level of capital or a switching into lower risk-weighted asset categories.[14] Second, to the extent that capital/risk-weighted asset ratios are procyclical, the minimum may be binding in deep recessions. If this results in banks reducing the supply of loans, which carry a high risk-asset weight, this could accentuate any economic downturn.

The impact of the Basel Accord on bank behaviour was addressed in a recent BCBS Working Paper (Jackson et al (1999)). Although there is the difficulty of not knowing the counterfactual, the report noted that since the introduction of the Accord capital ratios have increased in most Group of Ten countries. This could be partly attributable to the introduction of capital standards in inducing weakly capitalised banks to rebuild capital. For example, Shrieves and Dahl (1991) and Aggarwal and Jacques (1997) on US data, Ediz et al (1998) on UK data and Rime (1998) using Swiss data all find that banks with lower capital ratios increased their capital ratios more than those with higher ratios. Alternatively, capital may have increased because of the indirect effect of more transparent capital standards in increasing market discipline.

Cross-country differences in the growth of capital and risk-weighted assets during the 1990s may also partly reflect differences in economic performance. The countries with the highest output growth in the 1990s - the United States, Canada, the United Kingdom and the Netherlands - recorded amongst the largest increases in both capital and risk-weighted assets. In contrast, countries with sluggish growth recorded low growth in both capital and risk-weighted assets. Increases in capital ratios have more often been reflected in marked increases in capital, particularly in boom periods (more than offsetting the usual accompanying increase in risk-weighted assets). However, where banking systems have been particularly weakened, for example in the United States at the beginning of the 1990s, and Sweden throughout the first half of the 1990s, capital ratios have increased partly through a decline in risk-weighted assets. This is consistent with the view that raising new capital or boosting retained earnings may be easier in booms, whereas reducing the level and changing the composition of assets may be more cost-effective in economic troughs.

The revised Accord

The proposed capital Accord aims to better align regulatory capital with risk. However, there is a concern that a more risk-sensitive approach will also increase the sensitivity of capital ratios to the economic cycle. Thus the microeconomic benefits of the reform need to be weighed against the potential negative impact on macroeconomic stability.

Unlike currently, under the proposed Accord the weights for different assets in the capital/risk-weighted asset ratio are likely to vary over time to reflect changes in credit risk. The proposal is that the asset requirements should be based either on external credit ratings (the standardised approach) or banks' own internal ratings. If ratings are downgraded in recessions they will increase the procyclicality of regulatory capital ratios. Whether this, in turn, would cause banks to reduce assets, and thereby accentuate the economic downturn, would depend on how close they were to the regulatory minimum.[15] The effect of any reduction in lending would also depend on whether it was offset by an increase in lending by other banks or non-banks.

Whether ratings get downgraded in a recession depends in part on the scale of unforeseen events. However, it also depends on the extent to which ratings are set to take account of the economic cycle as a whole. Credit rating agencies say they attempt to do this but, perhaps not surprisingly, the evidence is that they fail to predict large economic downturns or may not always predict how well some companies will fare in deep recessions. Table 4 shows the movement of Moody's and S&P's sovereign credit ratings in 17 recent financial crises in both developed and emerging market economies. Moody's and S&P downgraded in advance in only four and one crisis respectively of the 17 crises listed in Table 4. They have tended rather to downgrade *during* crises. More generally, Nickell, Perraudin and Varotto (2000) find in a sample of 6,500 corporate and sovereign borrowers that

[14] Although there will be differences across country, a switching in assets would be likely to occur gradually because most outstanding assets are non-marketable.

[15] Given that most UK banks are currently well above their minimum (trigger) ratios, the cyclical impact, at least in the United Kingdom, would probably need to be substantial for the regulatory capital requirement to bite in an economic downturn.

bond rating downgrades tend to be concentrated in the trough of the cycle. That said, and the recent East Asian crises aside, most past crises would have resulted in only a modest, if any, switching of sovereign borrowers to higher credit risk categories had the proposed standardised credit risk-weights been in place (see column 6 of Table 4). Moreover, in a recent paper, Richardson and Stephenson (2000) calculate, again using the proposed risk-weights in the standardised approach, that the increase in capital required over the mid-1997-1999 period for BIS banks' lending to their largest emerging country borrowers would have been very small in relation to their total capital. However, this conclusion is partly attributable to the marked decline in lending to emerging countries that occurred over this period which reduced the amount of capital needed for regulatory purposes. Although this may have helped to maintain capital ratios at the large international banks, it may have been achieved at the cost of contributing to the economic recession in some emerging countries. Similarly, even if any increase in capital required by the new Accord is small in relation to BIS banks' total capital, it might have an adverse impact on some emerging countries, particularly small ones and those with limited access to other sources of funding. As regards banks' internal models, anecdotal evidence suggests that risk is only assessed over a short-term horizon, say one year ahead, rather than over the cycle as a whole.

In principle it is possible that Pillar 2 (supervisory review) and Pillar 3 (market discipline) of the proposed Accord could be used to dampen any increase in the procyclicality of regulatory capital ratio resulting from Pillar 1. However, what is less clear is how, precisely, supervisors or the financial markets will achieve this. Although supervisors could ensure that best practice is used in credit risk assessment and that stress testing is carried out, it is not clear why they should be any better at forecasting the economic cycle than credit rating agencies. In principle, if financial markets take a less optimistic assessment of the future than banks then they might discipline banks that are thought to make insufficient provisions in boom periods. However, periods of excessive bank optimism and those of excessive market optimism often coincide, resulting in both a bank credit and asset price bubble.

These problems suggest that it would be preferable if the new framework for Pillar 1 were designed to ensure that risk assessments attempt to take into account the economic cycle as a whole. In particular, under the proposed internal ratings approach, ratings should attempt to allow for borrowers' robustness to potential economic downturns rather than be measured at "a point in time". As pointed out by Crockett (2000), although risks usually *materialise* in recessions they would have actually *increased* during the previous upswings. Therefore, capital should be set aside during boom periods as a cushion against future downturns. Although the precise timing of a future downturn cannot be predicted during a boom period, there is a high probability that one will occur at some future point. Similarly, estimates of loss given default by the supervisor, or by the banks themselves, should attempt to measure recovery rates allowing for the economic cycle.

Moreover, as mentioned earlier, current accounting practices for expected loss induce cyclicality into measured capital ratios. In particular, as noted in a recent article in the Bank of England's *Financial Stability Review* (Jackson and Lodge (2000)), current provisioning policies are based largely around the recognition of *existing* impaired loans only. If banks were to attempt to make provisions against *expected* losses on a more forward-looking basis (for example, against asset impairment from an expected economic downturn), some capital would be set aside against impairment *before* arrears were apparent and before the economic downturn occurred.

Table 4

The behaviour of Moody's and S&P's long-term foreign currency ratings of countries in financial crisis[1]

Sovereign	Agency	Event signifying onset of the crisis	Number and magnitude of rating changes in the year prior to event	Number and magnitude of rating changes in the duration of the crisis	Number of risk bucket boundaries crossed in year prior to crisis	Number of risk bucket boundaries crossed during crisis
Col 1	*Col 2*	*Col 3*	*Col 4*	*Col 5*	*Col 6*	*Col 7*
		Scandinavian Banking Crisis				
Finland	Moody's	BoF took control of Skopbank - Sept 1990	0	2 changes -2 notches	0	0
	S&P's	"	0	2 changes -3 notches	0	0
Norway	Moody's	Sunnmørs-banken loses 25% of its equity capital - Sept 1988	0	0	0	0
	S&P's	"	0	0	0	0
Sweden	Moody's	Nordbanken's large loan loss provision - 1991Q3	1 change -1 notch	1 change -1 notch	0	0
	S&P's	"	0	1 change -1 notch	0	0
		ERM Crisis				
France	Moody's	Danish vote 2 June 1992	0	0	0	0
	S&P's	"	0	0	0	0
Italy	Moody's	"	1 change -1 notch	2 change -3 notch	0	-1
	S&P's	"	0	1 change -1 notch	0	0
Spain	Moody's	"	0	0	0	0
	S&P's	"	0	0	0	0
UK	Moody's	"	0	0	0	0
	S&P's	"	0	0	0	0
		Tequila Crisis				
Mexico	Moody's	Devaluation of peso 20 Dec 94	0	0 *2 watches - confirm*	0	0
	S&P's	"	0	1 change -1 notch	0	0
Argentina	Moody's	"	0	0 *1 watch - upgrade*	0	0
	S&P's	"	0	0	0	0
Brazil	Moody's	"	1 change +1 notch *1 watch – upgrade*	0	0	0
	S&P's	"	0 although not rated for entire period	1 change +1 notch	0	0
		Japanese Banking Crisis				
Japan	Moody's	Sanyo Securities filed for corporate reorganisation Nov 1997	0	1 change -1 notch *2 watches - confirm, 1 watch - downgrade*	0	0
	S&P's	"	0	0	0	0

			South East Asian Crisis			
Indonesia	Moody's S&P's	Floatation of the Thai baht 2 July 1997 "	0 0	3 changes -6 notches 6 changes -8 notches	0 0	-1 -2
Korea	Moody's S&P's	" "	0 0	3 changes -6 notches *3 watches* *- downgrade* *2 watches* *- confirm &* *1 watch* *- upgrade* 5 changes -7 notches	0 0	-2 -3
Malaysia	Moody's S&P's	" "	0 0	3 changes -5 notches *1 watch* *- downgrade and* *1 watch* *- confirm* 4 changes -5 notches	0 0	-1 -1
Philippines	Moody's S&P's	" "	1 change +1 notch *Watch – upgrade* 1 change +2 notches	0 0	0 0	0 0
Thailand	Moody's S&P's	" "	1 change -1 notch *Watch – downgrade* 0	3 changes -4 notches *5 watches* *- downgrade, 1 watch* *- no direction* 3 changes -4 notches	0 0	-2 -1
			Russian Sovereign Default			
Russia	Moody's S&P's	Devaluation of the rouble 17 July 1998 "	2 changes -2 notches 1 change -1 notch	2 changes -2 notches 4 change -8 notches	0 0	0 -1
			Summary of All Six Crises			
Average	Moody's	n/a	0.412 changes -0.176 notches	1.176 changes -1.765 notches	0	-0.412
Average	S&P's	n/a	0.118 changes -0.059 notches	1.647 changes -2.176 notches	0	-0.471

[1] Where a minus sign in columns 4 and 5 indicates a downgrade and a plus sign an upgrade. In column 7, a minus sign means a deterioration in credit quality down the risk weight scale.

4. Policy implications: liquidity management

Liquidity crises are classic examples of equilibria in which the aggregation of micro-level risks does not capture the aggregate macro risk of failure, dislocation or disturbance. That is because, in the textbook models, these crises derive from negative spillovers or externalities *among* investors. During liquidity crises, creditor behaviour is not only conditioned by fundamentals, but also importantly by the behaviour of other creditors.

What generates these spillovers? They can arise from liquidity or from informational sources - from "portfolio cascades" or from "informational cascades". A "portfolio cascade" would be a situation when the sale of an asset by one party lowers the (actual or expected) price of that asset, thereby inducing a further round of sales by other holders of the same asset, so that the downward impact on prices is compounded. This downward price dynamic will be larger, the greater the aggregation of positions in that asset, because simultaneity of (actual and expected) sales is then greater and the liquidity problem when selling thereby exaggerated. The LTCM episode falls into this category. Then, the expectation of forced sales of LTCM's positions was reinforced by the acknowledgement that the same positions were held by a number of other players, so that the resulting downward price dynamic would have been magnified (McDonough (1998)). A similar liquidity spillover, this time cross-border, was evident following the announcement of the Russian debt moratorium in August 1998. This induced asset sales in otherwise unrelated markets to unlock liquidity to meet margin calls (Kaminsky and Reinhart (1999)).

An "informational cascade" arises when creditors choose to mimic the behaviour of other creditors because they believe them to be acting on superior information. Models of "rational herding" have sometimes been used to explain such events. In Calvo (1999), for instance, uninformed investors replicate liquidity-squeezed selling from informed investors in their mistaken (but rational) belief that it is signalling weakening fundamentals. In practice, it is difficult to pinpoint precise examples of informational cascades, but many types of bank run can be interpreted in this way. So too can the response of the market across Asia following Malaysia's decision to impose capital controls in 1998.

Both types of spillover phenomenon share the feature that there is an explicit coordination problem among creditors (Morris and Shin (1999)). There are potentially multiple equilibria, each with differing levels of prices and degrees of liquidity. On occasions, a coordination failure may be so severe that it results in creditors converging on a "bad" low liquidity equilibrium. Some (albeit anecdotal) evidence of this was apparent at the time of the LTCM/Russia crisis. In many markets, there was evidence of a dislocation in prices and liquidity (BIS (1999)). There is also evidence of this low liquidity equilibrium having persisted for a number of months following the crisis.

In principle, these types of liquidity problem can arise for all types of agent - individual investors, securities houses, institutional investors etc. A necessary condition for the existence of these problems is that the agent has an asset that is non-marketable or at least illiquid. This problem will be worsened if the agent has in addition a set of liquid liabilities. This explains why liquidity crises are most often associated with banks, a large part of whose assets are usually non-marketable - for example, as set out by Diamond and Dybvig (1983) in the context of a "bank run". But liquidity problems can equally well arise for countries. For example, Chang and Velasco (1999) characterise the Asian crisis as a foreign currency liquidity "country run".

A number of authors believe that recent crises in the emerging markets were the result of a *foreign currency* liquidity problem. International bank lending figures show that a significant part of domestic credit expansion in countries affected during the Asian crisis was funded by borrowing on the international interbank market. Net interbank borrowing in the five most troubled Asian countries during 1995 and 1996 was three times the average annual rate in the early 1990s (Drage, Mann and Michael (1998)). Nearly all of this lending was denominated in foreign currency and most of it had a maturity of less than a year (Drage et al (1998)).

There have been numerous arguments put forward to explain the accumulation of these positions (eg Corsetti, Pesenti and Roubini (1998a, b)), including:

- Explicit or implicit guarantees by the government.
- Lack of attention by banks on the foreign currency mismatch due to a perception that the currency stability resulting from the pegged exchange regime would continue.
- Inadequate data on foreign exchange reserves without which creditors would be unable to assess whether the banking system *in aggregate* would be able to honour its short-term obligations.
- Poor regulation, provisioning and accounting practices.

The main policy issues as regards banking sector reform are evident from the above list of problems and include strengthening transparency and improving regulatory infrastructure. An important aspect of making supervision more effective is the introduction of robust measures to control the size of open foreign currency positions acquired by banks and the amount of maturity transformation they undertake in foreign currency at the level of the aggregate banking system. In accordance with this, the G22 report of the Working Group on Strengthening Financial Systems (October 1998) made a similar recommendation. It strongly encouraged the IMF and the Basel Committees to "consider the management of aggregate domestic and foreign currency liquidity in different sectors to complement work by the Basel Committee of Banking Supervisors on risk management of individual banks". The recent FSF working group on capital flows, chaired by Mario Draghi and which reported in April 1999, reached a similar set of conclusions.

But how should these liquidity risks be measured and managed? On the measurement issue, one well-known summary measure of the extent of a country's foreign currency liquidity risk is provided by the so-called Guidotti ratio: the ratio of a country's foreign exchange reserves to its total external short-term debt. This ratio provides a rough stress test of a country's foreign currency liquidity position. It poses the question: if capital markets were closed to a borrower for a period of time, say one year, could the country stay current on its foreign currency obligations by drawing on reserves? A Guidotti ratio below unity would suggest that the answer to that question is "no", indicating a potential vulnerability.

Table 5 provides a measure of the Guidotti ratio for a selection of recent emerging market crisis countries, in the period just prior to the crisis breaking. The measure of short-term external debt is BIS external liabilities with a residual maturity of under one year. Table 5 also shows an adjusted Guidotti ratio, which augments short-term debt with the current account deficit to give a more complete measure of the external financing requirements of the country. In each country case, the Guidotti ratio lies at or below unity ahead of crisis. If these ratios had been monitored at the time, they would have indicated an incipient vulnerability in the countries concerned. This confirms the conclusions from a number of recent econometric studies, where the Guidotti ratio has been found to be a systemic leading indicator of financial crisis (eg Busierre and Mulder (2000)). For this reason, the ratio is routinely monitored by the IMF as a "vulnerability indicator", for example in the context of its Article IV surveillance exercises. It is used in a similar way when assessing international risks at the Bank of England.

Table 5

"Guidotti Ratios" for selected emerging markets

	Reserves/Debt	Reserves/(Debt + CA)
Mexico (end-94)	0.20	0.10
Korea (end-96)	0.51	0.31
Indonesia (end-96)	0.57	0.44
Russia (end-98)	0.68	0.73
Brazil (end-98)	1.05	0.51

Table 6 updates the Guidotti ratio estimates to end-1999, and includes Argentina among the list of countries. Most of the crisis countries now look to be in a much less vulnerable position with Guidotti ratios above unity, sometimes significantly so. Many countries have accumulated a significant war chest of reserves (eg Korea) and some have reduced their short-term debt. Argentina, however, remains something of an outlier, with a Guidotti ratio below unity. On these measures, it remains vulnerable to future capital flow reversals.

Table 6

"Guidotti Ratios" for selected emerging markets

	Reserves/Debt	Reserves/(Debt + CA)
Mexico (end-99)	1.35	0.87
Korea (end-99)	4.02	14.97
Indonesia (end-99)	1.43	1.96
Russia (end-99)	1.14	-
Brazil (end-99)	1.05	-
Argentina (end-99)	0.75	0.56

The Guidotti ratio is clearly a very rough stress test of aggregate, economy-wide foreign currency liquidity risk. It is deficient in a number of respects. This is perhaps best illustrated by considering Guidotti ratios for some developed countries that have not recently faced crisis. Table 7 considers the position for the United Kingdom, Japan, France, Italy and Germany at the end of 1998. It also looks at

Luxembourg, as an offshore financial centre. For each of these countries, the Guidotti ratios are significantly below unity. For the United Kingdom and Luxembourg, they are several orders of magnitude below unity. This suggests that a simple reading of the Guidotti ratio may be misleading when applied to developed capital markets or to countries with large amounts of international banking business.

Table 7

"Guidotti Ratios" for selected developed countries (end-1998)

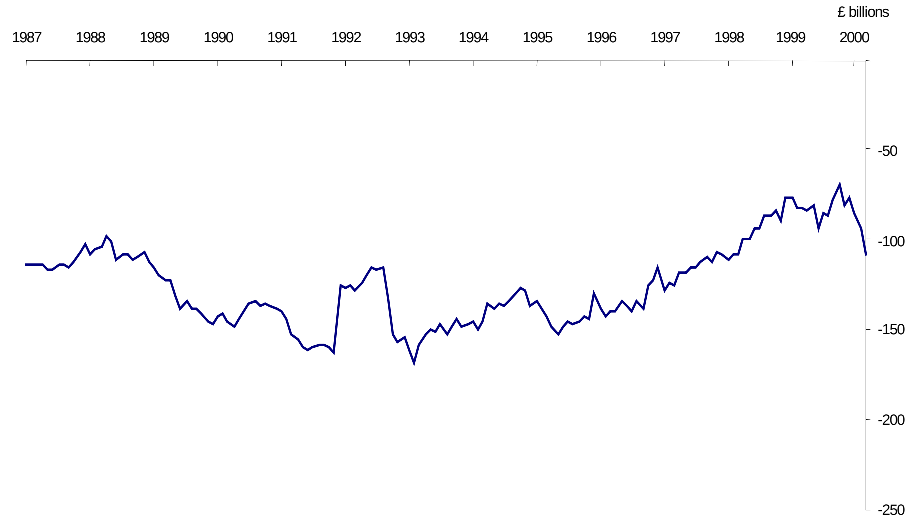
	Reserves/Debt
UK	0.02
Japan	0.21
France	0.13
Italy	0.16
Germany	0.20
Luxembourg	0.0007

First, for developed capital countries, the "stress test" implied by the Guidotti ratio - a complete loss of capital market access for a period - may simply be too strict. These countries would rarely (if ever) face an infinite shadow cost of funds. Second, the Guidotti ratio misses a potentially important source of additional foreign currency assets, namely those of the banking system. This omission is likely to be especially acute for countries with large, internationally exposed banking systems. This explains the very low Guidotti ratios for the United Kingdom and Luxembourg. More generally, it points towards the need for a more detailed sectoral assessment of the balance sheet make-up of different parts of the economy, in particular the banking sector.

Consider for example the position of the UK banking system. At the end of 1999, the net foreign currency position of UK-operating banks was roughly flat. Unlike the Asian crisis countries, their balance sheet, in aggregate, was matched in foreign currency terms. The situation is rather different, however, if we look at the net *liquid* foreign currency position of UK-operating banks. There is no generally accepted definition of "liquid". Figure 5 considers one variant based on tradability, where assets are deemed liquid if they have an established secondary market. It suggests some net liquid foreign currency mismatch between liabilities and assets on UK-operating banks' balance sheet. This mismatch amounted to around £100bn at the end of 1999, or 7% of UK banks' total foreign currency liabilities. The Bank is conducting further analysis to assess whether this foreign currency liquidity mismatch should be interpreted as a potential source of vulnerability to the UK banking system.

Figure 5

UK banking sector foreign currency liquidity mismatch ("tradability" based measure)



For other countries, foreign currency balance sheet risks may reside in other (than the banking) sectors. For example, in Indonesia the foreign currency liquidity problem built up in the corporate sector, which had borrowed unhedged from non-residents. Detecting these types of fragility calls for a more detailed decomposition of sectoral balance sheets. By way of illustration, Table 8 provides a foreign currency breakdown of the balance sheet position of the public, bank and non-bank sectors in Argentina. Argentina is interesting, in part because Guidotti ratios suggest it is a potential source of risk, and in part because, as a highly dollarised economy operating under a currency board, Argentina may be particularly prone to the build-up of foreign currency imbalances.

Table 8

Argentina's foreign currency denominated financial assets and liabilities ($ bn)

	Assets	Liabilities	Net
Public sector	27.8	113.4	-85.5
Private bank	56.0	80.1	-24.2
Private non-banks	81.1	67.1	13.9

The sectoral breakdown in Table 8 suggests that, although the Argentinian banking system is roughly matched in foreign currency terms, the public and corporate sectors have significant unmatched foreign currency exposures. These imbalances would be a concern in the extreme event of an abandonment of Argentina's currency board. In other countries, balance sheet risks may be different again - for example, reflecting exposure to interest rate rather than exchange rate or liquidity risk. In general, this calls for a thorough assessment and stress-test of balance sheet exposures, aggregate and sectoral, to capture potential sources of fragility in the face of shocks. This is the type of analysis that routinely appears in the Bank's FSR.

Measurement of these sectoral foreign currency liquidity positions is likely to be problematic for some countries, especially for the non-bank and, to a lesser extent, the banking sectors. Management of these positions is no less of a problem from a public policy perspective. Regulatory tools can perhaps be used for the banking sector - for example, guidelines or regulations on liquidity or foreign currency mismatches. But there are far fewer such levers for dealing with corporate sector liquidity mismatches. It could be argued that the public sector's balance sheet might be adjusted to offset liquidity mismatches in the economy-wide balance sheet. But such an approach risks engendering serious moral hazard problems, if it results in the private sector slackening their own efforts to manage the risks on their balance sheet. This balance sheet management issue would warrant further research. For example, what would be the optimal level of foreign currency reserves to hold to guard against economy-wide foreign currency liquidity problems?

5. Conclusions

This paper has described some of the techniques currently used by the Bank of England to monitor financial stability risks in the United Kingdom. It has also described some of the policy work underway to improve the infrastructure for managing those risks. We conclude by describing ongoing research on both fronts.

(a) Leading indicators of financial instability

There is a large and growing literature identifying and evaluating various potential leading indicators of financial instability - for example, banking crises (Demirguc-Kunt and Detragiache (1998b)), currency crises (Eichengreen, Rose and Wyplosz (1996)) and their interaction (Kaminsky and Reinhart (1999)). Also, supervisors have used early warning systems as part of their regular monitoring process of banks since the late 1970s and there is a long-established literature looking at early warning signals of (non-bank) corporate distress (Altman (1983)). One approach to using these indicators is to construct composite indices of the probability of crisis, with econometrically chosen weights and using probit-type techniques. A number of organisations are pursuing that route, including the IMF and World

Bank. This approach has also been used in Bank of England research to explain why some small banks failed in the United Kingdom during the early 1990s (Logan (2001)).

The Bank of England's more general approach to surveillance, however, has been rather different. It has drawn more on the so-called signalling approach to the use of leading indicators (Kaminsky and Reinhart (1999)). A wide range of potential early warning signals of crisis are assessed relative to some (explicit or more usually implicit) threshold values. If any of these indicators breaches a threshold, this sets an amber light flashing. This serves not as a signal of impending crisis, but instead as a prompt for a detailed assessment of that particular risk.

This eclectic approach to the use of indicators can be justified on two grounds. First, despite recent research, there is still relatively little known about the genesis of crisis. Certainly, recent crises have differed very significantly in form and severity from the balance of payments crises of the 1970s and 1980s. Indeed, a type of Lucas critique may well apply to crises, with each new bout of turbulence being sourced somewhere differently than in the past, as public policymakers learn the lessons of previous crises. For these reasons, we should probably have flat priors about the appropriate weight to place on different indicators and econometrically chosen weights may be misleading.

Second, an eclectic signalling approach would tend to miss fewer crises, at the expense of a greater number of false alarms. It implicitly gives greater weight to Type I than Type II errors. That approach is better aligned with the objective function of policymakers in practice, where the resource cost of crying wolf is small in relation to the welfare cost of failing to head off a crisis. Notwithstanding these points, there is still considerable work to be done in refining and extending the list of indicators the Bank routinely monitors, in particular micro-level indicators of bank and financial sector resilience and health, domestically and internationally.

(b) Quantifying the welfare costs of financial instability

There have been a number of recent studies evaluating the output or fiscal costs of banking and/or currency crises - the financial stability equivalent of a "sacrifice ratio". This evidence is interesting but does not map very easily into welfare. That can only be done in the context of a specific model. In the monetary stability field, there have been a number of recent studies using stochastic general equilibrium models to explicitly evaluate the welfare costs of inflation. The Bank is currently pursuing a similar approach to quantify the welfare costs of potential financial instabilities.

(c) Financial stability/efficiency trade-offs

A related and equally under-researched area is the question of trade-offs between financial stability and financial efficiency. There appears to be relatively little existing literature on this issue. It provides a framework for evaluating issues such as: what does the trade-off tell us about the optimal pace of financial and/or capital account liberalisation? What financial infrastructures improve the trade-off in a welfare sense? There is a need for further work empirically quantifying the trade-offs involved and means of improving them.

(d) Financial stability risk calibration

The Bank is investigating methods to improve its quantitative calibration of financial stability risks. For example, in a monetary policy context, inflation risks in the United Kingdom are summarised in a "fan chart" (probability density function) published by the Bank in its quarterly Inflation Report. The fan chart is a subjective probabilistic assessment of the inflation outlook. It is based on a macroeconomic model, but draws on a wide range of information, on and off-model, including market expectations, surveys and policymakers' judgement. The macro model is simply the framework ensuring this information is assembled and accounted for consistently. It may be possible to develop an equivalent framework for aggregating and assessing financial stability risks.

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Financial stability analysis using aggregated data

Benjamin Sahel and Jukka Vesala[1]

1. Introduction

It is increasingly recognised that it is necessary to look at financial stability from a "macro" as well as a purely "micro" perspective which focuses on individual institutions' risks. Financial distress can result from a *concentration of exposures* of individual institutions or exposures of individual institutions to *common factors*. There are connections between the liquidity and solvency of individual institutions when their exposures are concentrated. Financial market prices and macroeconomic conditions represent the key common factors which may affect all institutions.

Structured monitoring of the concentration of exposures amongst financial institutions and of common factors may signal the emergence of important imbalances. First, *financial market stability indicators* allow monitoring of an important set of common factors. Second, the resilience of the banking sector is monitored through *regular macroprudential analysis of EU banking system stability*, which is undertaken by the Working Group on Macro-prudential Analysis (WGMA), reporting to the Banking Supervision Committee (BSC) of the ESCB.[2]

Section 2 of this paper describes the analytical frameworks in these two fields. Examples and data are provided to give a flavour of the analysis. Section 3 addresses the most important gaps in the data currently available at the international level. Section 4 deals with the enhancement of the analytical toolkit, focusing on the issue of establishing links between macro developments and the soundness of financial institutions. An analysis of the development of asset prices and their implications for financial stability is discussed as an important example of this approach. Finally, Section 5 concludes the paper by considering the limits of the analysis using aggregated data only.

2. Activities in monitoring financial stability

The analyses considered in this section are aimed at detecting and monitoring cyclical or structural *vulnerabilities* in the financial system. When these vulnerabilities are present, certain *destabilising events* (eg a stock market crash) may (rapidly) lead to financial instability, possibly producing adverse effects on the real economy. The analyses might warn of possible threats to financial stability, but the aim is not to forecast the occurrence of destabilising events.

The framework for financial market stability indicators addresses the potential for rapid price movements or liquidity shortages in the financial markets, which may have undesirable consequences for the financial system or the economy as a whole.

The macroprudential analysis deals with the soundness of the banking system as the key systemic component of the financial intermediaries sector. Banks in Europe continue to be the key intermediaries, notwithstanding the growing importance of financial markets, on account of their activities in syndicated loans, credit lines and securities underwriting.[3] They have also acquired a

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[1] Both authors are from the ECB. Contributions from Muriel Bouchet, Peter Hördahl (Box 7.A) and Giuseppe Vulpes, also from the ECB, are gratefully acknowledged. The authors are grateful to Jesper Berg, Andrea Enria, Mauro Grande, Hans-Joachim Klöckers and Ludger Schuknecht for helpful comments. The views expressed in this paper do not necessarily reflect those of the ECB.

[2] The Banking Supervision Committee is composed of representatives of the banking supervisory authorities of the EU countries, which are either part of the respective national central banks or separate bodies, and of the European Central Bank. Its working groups have a similar membership structure.

[3] The focus on the banking sector is justified by the notion that banks continue to be crucial to financial stability, since they provide *liquidity on demand* for the other financial and non-financial sectors of the economy. To the extent that financial markets can substitute for disruptions in lending caused by bank capital shortages, the macroeconomic consequences of banking distress would be mitigated. However, there is some empirical evidence that reductions in bank lending may not be fully offset by increases in lending from other financial intermediaries or markets. See, for example, P Jackson et al (1999).

strong base in asset management because of their traditionally strong private banking activities and distribution networks. The soundness of the non-bank financial institutions is included in the framework adopted by the BSC only to the extent that non-bank financial institutions might have a destabilising impact on banks via group structures. Finally, non-financial sectors are considered so as to assess potential sources of financial market disturbances, and the debt servicing capability, leverage, and composition and development of the financial assets and liabilities of the private non-financial sectors of the economy (households and firms). The robustness of the payment and securities settlement infrastructure represents an important subject for financial stability analysis, but falls outside the scope of this paper.

2.1 Financial market stability indicators

A range of indicators based on financial market prices needs to be reviewed to assess tensions in financial markets both in the euro area and at the global level. Euro area-wide and even global views are important, since issuers, investors and intermediaries are already operating to a large extent on an international basis. The financial market tensions addressed in the analysis can be broadly defined as:

(i) departures from the usual pattern of linkages between various financial market prices;

(ii) a heightened degree of uncertainty as perceived by financial market participants;

(iii) long-lasting and sizeable divergences from the price levels which would appear to be consistent with fundamental determinants.

These tensions may reflect trends in the non-financial sector of the economy, or in foreign economies. Hence, the analysis also requires a good understanding of broader economic developments.

The monitoring exercise encompasses a wide range of indicators for *foreign exchange, interest rate, equity* (see also Section 4) and *commodity markets*. For each one of these markets, five main categories of indicators reflect, respectively:

(i) recent financial market developments;

(ii) size of price fluctuations (*measures of market volatility*);

(iii) degree of market activity (*measures of market depth and liquidity*);

(iv) credit conditions, in particular issuer or counterparty spreads (*measures of credit standing*);

(v) triggering or aggravating factors not falling into the above categories (*other measures*).

Recent financial market developments

The review of recent financial market developments forms the background for the analysis of possible tensions in financial markets. In this context, a wide array of financial market indicators need to be considered, including foreign exchange rates, interest rates and yield curves, stock price indices and commodity prices.

Measures of market volatility

These indicators focus on *historical volatility* and *implied volatility*, as well as on the *difference between them*.[4] In particular, the last type of indicator may serve as a guide to market expectations of future adjustment in financial market prices or their volatility.

Another important indicator is the *term structure of option prices*, as measured by the slope of the implied volatility curve, which may include information about how the distribution of price changes is expected to develop over time. A strongly positive slope would suggest that market participants expect increasing volatility in the future. A strongly inverted volatility curve and the forward implied volatilities

[4] Historical volatility is the square root of the variance of the past percentage changes in prices. Implied volatility is the volatility level consistent with option prices. It therefore reflects perceptions of future volatility among option traders as well as, to some extent, the simplifying assumptions in the option pricing models, which would tend to introduce a wedge between the measured implied volatility and the true expected volatility.

derived from this peculiar shape contain information about the pace at which market participants expect volatilities to return to their mean or long-term average. Because of uncertainty, term structures of volatility should be slightly positively sloped under "normal" circumstances, when there are no strong expectations of any particular change in the forward implied volatility.

In addition, a wide array of other measures of market volatility can be extracted from option prices. In particular, the prices of options on swap contracts (swaptions) or on money market futures can provide implied interest rate volatility curves.

Measures of market depth and liquidity

Although it is difficult to measure exactly the degree of market depth and liquidity, various indicators can help assess a possible build-up of imbalances in financial markets.

Bid-ask spreads provide indications of transaction costs. It is useful to complement the analysis of developments in bid-ask spreads by reviewing developments in transaction volumes, for two reasons. First, there may be cases where transaction volumes increase while transaction costs remain relatively high. Such situations could suggest a high level of uncertainty, inducing market participants to carry out a number of hedging or speculative transactions despite the transaction costs. Second, price shocks may occur in an environment of low trading activity. This could suggest that the shocks might be reversed once the more active trading conditions are restored.

Indicators of market activity also provide useful indicators of depth and liquidity; in particular the *daily traded volumes* and *aggregate end-of-day positions* ("open interest") on derivatives markets (see Box 1 for an example).

Other indicators include the *measures of the smoothness of the yield curve*. When government bond markets are very deep and liquid, arbitrageurs can take advantage of even very small pricing differences. This type of trading activity contributes to smoothing out pricing anomalies, and hence changes in the smoothness of the yield curve can provide an indication of the depth and liquidity of the government bond market. However, since this type of trading activity involves risks, the extent to which market participants engage in it will depend on their capital buffers and risk appetite.

Measures of credit standing

When financial market participants develop risk exposures which are excessive in relation to their capital buffers, it is likely that they will face tighter credit conditions if this becomes known in the marketplace. Measures of credit standing permit an assessment of such developments. The indicators monitored include various *interest rate spreads*, for example the spread between debt securities issued by banks or other firms and government debt securities.

The corporate bond market is becoming an increasingly important component of the markets for debt securities as there is a structural trend in borrowing activity away from central government to the private sector.[5] Moreover, the introduction of the euro has apparently led to a marked increase in corporate debt issuance in the euro area. As a result, a wide array of corporate bond indices has become available. Box 2 presents some newly collected data on euro area corporate bond indices and analyses the main factors which have affected developments in corporate bond yields in the euro area.

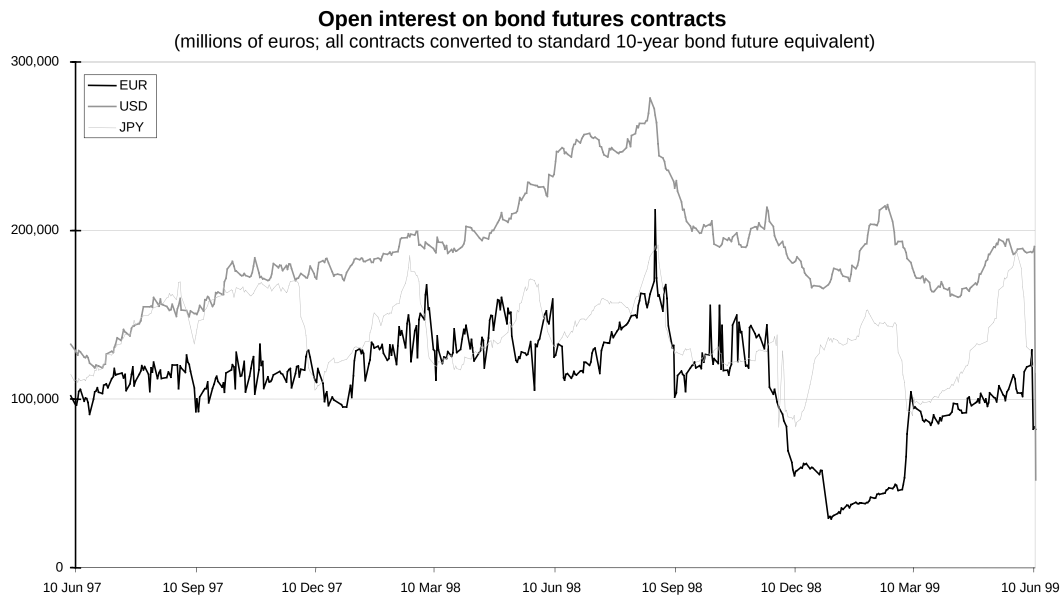
5 In the euro area, as at end-1999, the corporate bond market still constituted a relatively unimportant source of financing, accounting for only 7% of all borrowing by the private non-financial sector, compared with 29% in the United States. See Rixtel et al (2000). This reflects the more important role played by the banking sector in the euro area financial structure.

Box 1

An example of aggregated open interest in derivatives markets as a market activity indicator

Open interest on euro area government bond futures declined sharply around the end of 1998 at the time of the changeover to the euro, from around EUR 144 billion on 18 November 1998 to around EUR 29 billion on 4 January 1999. It remained subdued between EUR 30 and 50 billion in January and February 1999 and increased to over EUR 100 billion at the beginning of March 1999. Over the same period from December 1998 to March 1999, developments in open interest on Japanese government bond futures appeared to be a mirror image of those in the euro area (see chart).

Over this period, bond market interest seemed to switch from the euro area to Japan. The switch was reversed at the March 1999 rollover of positions, suggesting that it had been mainly related to a temporary attractiveness of Japanese government bond futures compared with euro area government bond futures during this period. This temporary switch of market interest may have been related to the marked increases in Japanese government bond yields towards the end of 1998, as well as to the relatively low liquidity of euro area bond markets at the end of 1998. (Japanese government bond yields increased from an average of 0.9% in November 1998 to over 2% by the end of December 1998.) Another explanation may have been that the levels reached by bond yields in the euro area at the beginning of 1999 may have been perceived by a number of market participants as being too low. Over the same period, there also seemed to be some interplay between changes in positions in bond futures and changes in positions in money market futures. In particular, open interest on yen money market futures declined sharply in December 1998. In part, this reflected the unwinding of “yen carry” positions combining short interest rate positions in Japanese yen and long interest rate positions in euros, US dollars or other currencies, which had been built up in particular by some hedge funds over preceding months.



Other measures

In addition, a number of ancillary financial market indicators can be quite useful, some of which are only relevant under certain special circumstances. One such indicator is the Japan premium, which has reflected market concerns about the soundness of certain Japanese financial institutions, particularly over recent years. Other indicators monitored include valuation indicators for stock prices (see Section 4).

Box 2

Analysis of corporate credit spreads

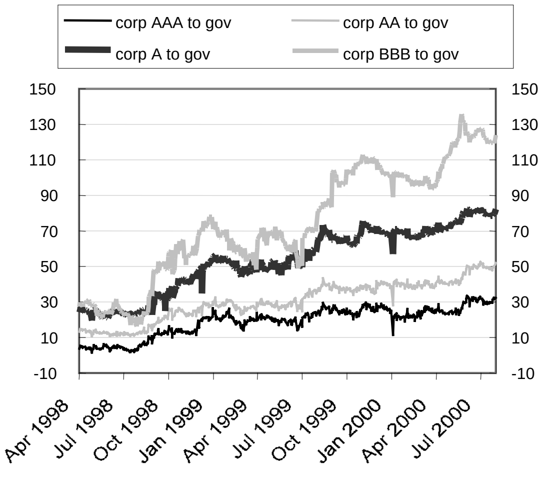
Corporate bond spreads can be broken down into three main components: (i) *market price of credit risk*; (ii) *credit risk uncertainty premium*; and (iii) *liquidity premium*. The first two components in particular depend on a number of factors. Notably, the market price of credit risk may increase when the economic outlook deteriorates but credit demand remains strong, or when firms become more highly leveraged. The credit risk uncertainty premium may increase when the volatility of earnings increases. The liquidity premium is likely to fall with the development of the corporate bond markets. However, on occasions, for example under a "flight to quality", investors may still suddenly and abruptly reorient their portfolios towards the safest and most liquid securities. This creates a temporary imbalance between the demand for and supply of both corporate and government bonds, which can lead to a temporary increase in corporate bond spreads. A spread widening can also happen for structural reasons. For example, when the government plans to reduce issuance and engage in buyback programmes (as in the United States and the United Kingdom, for example), this can push government bond prices higher and yields lower, and result in an increase in corporate bond spreads.

Merrill Lynch has recently started publishing bond indices for the euro area (available on Bloomberg), covering corporate and government bonds in euros (or legacy currencies), and in US dollars. A comprehensive range of indices exists, broken down according to sector, maturity and other characteristics of the instruments. Considering spreads based on corporate bond yields, it may be observed that spreads between corporate and government bond yields increased considerably between the second half of 1998 and end-July 2000. While there was an unclear trend in the fourth quarter of 1999 and the first quarter of 2000, there were renewed increases in the second quarter of 2000 (see charts). However, the possible existence of a "scarcity premium" complicates the interpretation of developments in spreads between corporate bond yields and government bond yields, as well as the interpretation of swap spreads. In particular, over recent months the declining supply of government bonds and government bond buybacks may have led to "scarcity premiums" tending to push government bond yields down relative to corporate bond yields or swap spreads, particularly in the United States. In the euro area, the evidence available so far suggests that this effect has remained limited in the first eight months of 2000.

In the euro area, the increases in credit spreads which occurred in the first eight months of 2000 have been relatively evenly distributed among financial and non-financial borrowers, although financial borrowers generally pay smaller spreads (see charts). All in all, the analysis suggests that credit conditions in the euro area corporate sector, in particular for debtors with lower credit ratings, have recently tightened more than the government bond yield curve would suggest.

Spreads between corporate bond yields and government bond yields in the euro area

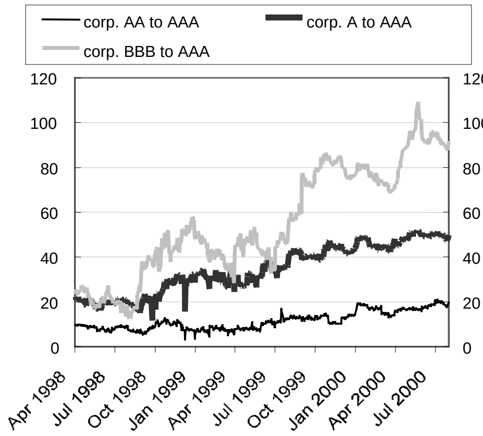
(basis points, all-maturity indices)



Sources: Bloomberg; Merrill Lynch.

Spreads between corporate bond yields in the euro area

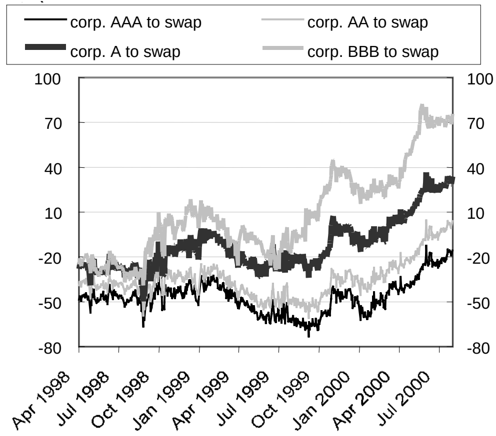
(basis points, all-maturity indices)



Source: Bloomberg and Merrill Lynch

Spreads between corporate bond yields and swap rates in the euro area

(basis points, all-maturity indices against seven-year swap



Source: Bloomberg and Merrill Lynch

2.2 Macroprudential analysis of banking system stability

The macroprudential analysis of EU banking sector stability covers both *national developments (EU 15) and those at EU/euro area level*, since both are relevant for the objective of assessing the stability of the banking system, although there is more focus on the latter. An area-wide view is necessary, since macroeconomic developments are gradually becoming more closely intertwined in the European Union and, in particular, the euro area. Major disruptions in the banking system typically stem from abrupt changes in the macroeconomic environment or in relevant sectors of the economy. Even though most retail markets are still segmented, common factors are more and more likely to affect the choices of financial institutions and their risk exposures. Moreover, elements of fragility may well arise from capital markets and especially interbank business in euros, which already have an area-wide dimension due to a significant extent to the single currency and common large-value payment system (TARGET). The area-wide perspective can also be a useful contribution for the national supervisory authorities.

However, the cyclical factors in economic growth and lending expansion, and also banks' margin and profitability developments, for example, show quite significant differences across countries. Regional imbalances, which are not detected at the area-wide level, may also arise and may generate spillover effects throughout the area. Hence, focusing only on area-wide developments would not be appropriate.

The macroprudential analysis encompasses:

(i) identification of significant exposure build-ups or fragilities *within* the banking system which could destabilise the banking system or make it vulnerable to disturbances from outside (*internal factors*);

(ii) identification of potential disturbances emerging from *outside* the banking system (*external factors)*.

The techniques which are used to conduct the analysis include:

(i) systematic and regular monitoring on the basis of the *quantitative macroprudential indicators (MPIs)* drawn from the data on the EU banking systems and macroeconomic and financial developments;

(ii) interpretation of these MPIs and the addition of relevant elements based on the *information and insight obtained through the supervisory process at the national level*.

The importance of the second aspect cannot be overstated. The feedback and additional information obtained from the EU supervisory authorities represented in the WGMA is in fact regarded as the main contribution stemming from this analysis.

Literature on MPIs

A large number of papers, especially by the IMF and World Bank suggest that severe banking distress can be associated with the following *macro-level disturbances* (some of which would most likely occur simultaneously): [6]

(i) a fall in real GDP growth;

(ii) substantial swings in inflation;

(iii) large capital inflows;

(iv) mounting foreign liabilities;

(v) rising real interest rates;

(vi) a declining capital-to-output ratio;

(vii) a fall in equity and/or real estate prices;

(viii) a substantial change in the real exchange rate;

(ix) an adverse trade shock;

(x) weak corporate (and household) balance sheets;

(xi) rapid changes in competition among banks.

A recent study also concludes that the inclusion of macroeconomic variables increases the explanatory power of those models based on micro-level information alone.[7]

There is less literature evaluating the predictive power of *aggregated supervisory information* based on profit and loss and solvency data. A recent survey suggests that these indicators have limited leading properties.[8] Nonetheless, it is clearly recognised that the degree of weakness of financial institutions with regard to withstanding shocks is a major determinant of financial crises and their timing. Studies also seem to support the idea that foreign exchange crises can provoke financial crises when the banking system is vulnerable, or when currency depreciation severely reduces the ability of banks' customers to service their debt.[9] Moreover, some other measures with more leading indicator properties, such as the deposit-to-M2 ratio, the interbank interest rate differential and bank share prices, have been found to be statistically significant.

These studies provide broad guidance for selecting MPIs for regular monitoring purposes. It is important to note, however, that the literature is not yet mature enough to make absolute choices among various indicators, and thus justifies a fairly open approach to selecting the MPIs. Some MPIs can be complementary, while also conflicting sometimes.

MPIs included in the monitoring exercise

A set of feasible MPIs has been established based on the identification of the *main risk factors* for EU banking systems stemming from internal and external elements. They are broadly (but not all explicitly) supported by the empirical literature. The main indicators are reported in Box 3, and the current data sources in Box 4. The MPIs are collected country by country and euro area/EU aggregates are provided. A major pending data issue is the lack of comparability of certain key bank profitability and balance sheet items across countries, such as provisioning and non-performing assets. A second gap is the data necessary to calculate financial fragility indicators and to evaluate financial flows (see Section 3). These data have to be considered purely on a country basis. In addition to the aggregated indicators presented, distributions of profitability, solvency and non-

[6] For a useful summary see IMF (2000).

[7] See Gonzales and Hermosillo (1999).

[8] See Demirguc-Kunt and Detragiache (1999).

[9] See Kaminsky, Lizondo and Reinhart (1998).

performing assets are monitored across the major banks (occupying more than 2% of the national market).

The following contains a brief outline of the reasons for using the selected MPIs. The indicators in Section 1 of Box 3 attempt to capture the accumulation of credit risks and other risks which could increase the vulnerability of the banking system. Both *on-balance-sheet and off-balance-sheet exposures* are included, and *sectoral credit expansion measures* are assessed. The *currency and maturity structures* are also monitored. *Global lending developments* and *exposures to emerging and developing countries* are assessed on a consolidated basis.

As for the *indicators on competitive conditions* (Section 2 of the box), shifts towards greater competition can lower profits. In response, banks may increase their risk-taking as a means of temporarily increasing profits. In particular, high lending growth together with tough competition can constitute a sign of harmful, short-sighted market share competition at the expense of long-term profitability.

Risks are one element of failure, but the degree to which banks are able to withstand pressures arising from realised risks is also important. It is important not only to measure the *capital adequacy ratio* of the banking system at any given point in time, but also to obtain an impression of the future development of capital adequacy as basically driven by *income, cost and asset quality developments* (Section 3). Information extracted from *market prices* is also used in this context. For example, the performance of financial sector shares relative to overall stock price indices can provide timely indications of earnings prospects as well as perceived soundness of financial sector firms.

The soundness of the banking system crucially depends on the sustainability of the level of corporate and personal debt as evidenced by past instances of banking problems (*financial fragility indicators*, Section 4). *Indebtedness and income-based financial fragility indicators* are recognised as key leading indicators pinpointing which financial systems could come under stress in the future. Combined with credit growth, external (non-deposit) funding of banks and asset prices, these indicators could help to detect dangerous *economy-wide leverage* in line with the debt-financial fragility theory. This area in particular entails significant pending data issues (as discussed in Section 3 of this paper).

Elevated *asset prices* (stock and commercial and residential estate prices) often lead banks to make lending decisions based on asset values which are unsustainable in the long run (Section 5 of the box), and asset price slumps following excessive asset price hikes affect banks in various ways. Hence, this area is an integral part of the macroprudential analysis.

Finally, *overall macroeconomic data* (both current figures and forecasts) on production, investment and consumption, interest rates and exchange rates provide information about the stage in the business cycle for individual countries and the European Union as a whole which is relevant to the assessment of banks' external environment (Section 6).

3. Gaps in the information base

Data on the exposures of banks are obviously very important for macroprudential analysis, and there is a need to enhance the data on *off-balance sheet credit exposures* in particular in order to provide a better overview of the direct exposures of banks.[10] Developments are taking place; for example the BIS's consolidated banking statistics are being enhanced so as to make the data reflect more closely the full magnitude of the exposures across relevant instruments and sectors of counterparties.[11] However, the supervisory and statistical authorities generally have difficulty linking the credit exposures with underlying collateral (apart from mortgages). This makes it difficult to analyse the impact of asset price declines on banks. Some efforts are also under way among EU supervisory authorities to collect more information on provisioning and on non-performing assets on a non-harmonised basis. Since the ties between banks and non-bank financial institutions are becoming stronger, patchy information on the latter can also be regarded as a major gap in the information base.

[10] See Uhl and Monet (2000).

[11] See BIS (2000); Committee on the Global Financial System (2000).

Box 3

Main macroprudential indicators

I. Internal factors	**Scope (1)**
1. Credit and liquidity risk concentrations	
Domestic credit growth and sectoral concentration (*GDP share and growth*)	
Aggregate lending	U
Aggregate new lending	U
Lending to households, concentrations	U
Lending to non-bank non-financial corporations	U
Lending to non-bank financial corporations	U
Residential mortgage lending (households)	U
Commercial mortgage lending	U
Aggregate fixed income securities holdings	U
Aggregate balance sheet total	U
Aggregate lending within the euro area	U
Currency and maturity structure of domestic lending	
Share of lending of less than one year (using the original maturities)	U
Share of lending in foreign currency (other than domestic currency)	U
Global credit exposures (*GDP share and growth*)	
Aggregate lending to the non-bank non-financial sector	C
Aggregate fixed income securities holdings	C
Aggregate balance sheet total	C
Aggregate credit equivalent of off-balance sheet items	C
Liquidity risk	
Ratio of non-bank deposits to M2	U
Ratio of total loans to non-bank deposits	U
Share of foreign short-term liabilities in total liabilities (BOP data on flows)	U
Range of interbank CD rates (highest to lowest, percentage points)	
Emerging and developing country exposures (*ratio to consolidated own funds of the exposed banks)*	
Aggregate gross credit exposure to BIS-defined emerging and developing countries	C
Aggregate gross credit exposure to Asian countries	C
Aggregate gross credit exposure to Latin American countries	C
Aggregate gross credit exposure to central and eastern European countries	C
2. Competitive conditions	
Average margin on new lending	
Average margin on new lending to households	
Average margin on new lending to non-bank corporations	
Average margin on retail deposits	
Overall margin (difference between new lending and deposit rates)	
3. Profitability and capital adequacy	
Income and cost development and profitability	
Aggregate net non-interest income per aggregate total income	C
Aggregate commissions (net) and fees per aggregate total income	C
Aggregate trading and forex results per aggregate total income	C
Aggregate operating costs (including depreciation) per total income	C
Aggregate provisioning per own funds	C
Aggregate bad debt charges per own funds	C
Aggregate profit after provisions, before tax per own funds (ROE)	C
Aggregate profit after provisions, before tax per total assets (ROA)	C

Asset quality Non-performing loans (net of provisions) per total loans Non-performing loans (net of provisions) per total own funds	 C C
Capital adequacy Aggregate risk-based capital ratio Aggregate tier one capital ratio Own funds requirement under CAD	 C C C
Market assessment All-bank share price index versus all-share index *(semiannual change)* Average yield spread between bank bonds and government bonds Average yield spread between interbank CDs and treasury bills Range or spreads between bank bonds and government bonds (highest to lowest, percentage points) Number of bank rating downgrades within the observation period	
II. External factors	
4. Financial fragility Financial debt of the non-financial corporate sector Financial debt of the household sector Interest servicing costs of the corporate sector Interest servicing costs of the household sector	
5. Asset price developments (percentage changes in the respective indices) General stock index Dow Jones Euro STOXX index US stock index Commercial real estate prices Residential real estate prices	
6. Cyclical and monetary conditions Rate of real GDP growth Rate of nominal GDP growth Rate of growth in real aggregate investment Rate of growth in real private consumption Rate of unemployment Rate of change in M2/M0 Rate of change in the three-month money market interest rate Rate of change in long-term real interest rate (10-year government bond) Rate of change in the nominal long-term interest rate (10-year government bond) Rate of change in the exchange rate of EUR, DKK, GBP, GRD and SEK versus USD Rate of change in the consumer price index (CPI)	
U = unconsolidated “host country” data, C = consolidated “home country” data.	

In addition, it is important to analyse overall *flows of financial resources* and the *development of financial fragility in other economic sectors* (households, corporations and non-bank financial institutions). This allows, for example, a better understanding of the debt servicing capability of the borrower sectors. Data are generally much less developed for these two areas than for banks. Both areas currently suffer from a lack of consistent and timely data (particularly financial accounts statistics) for EU member states (and other countries) for the purposes of euro area-wide analysis. The achievement of adequately harmonised and timely international statistics would represent a major contribution to improving financial stability analysis.

Box 4

Data sources for macroprudential indicators

A large number of MPIs have been assembled from the ECB Monetary and Banking Statistics (MBS) and other statistics. Moreover, the development of the MBS as regards non-bank financial intermediation (other than pension funds and insurance companies), MFI (retail) interest rates, and possibly also financial derivatives will provide valuable material for macroprudential analysis.

The reporting population covered by the MBS (excluding central banks), monetary financial institutions (MFIs), comprises resident credit institutions as defined in Community legislation, and all other resident financial institutions whose business is to receive deposits and/or close substitutes for deposits from entities other than MFIs and, for their account (at least in economic terms), to grant credits and/or to make investments in securities. These other resident monetary financial institutions notably include money market funds. MFIs consolidate the business of all their offices (head office, subsidiaries and/or branches) located within the same national territory. Separate information on balance sheet data on credit institutions is available. MBS data is compiled on a "host country" basis: the business of foreign branches of domestic credit institutions is reported by the country abroad, whereas the business of resident branches of foreign credit institutions is considered as domestic.

Exposures towards emerging and developing countries and other consolidated cross-border credit exposures are available from the BIS consolidated international banking statistics, which are currently being enhanced to include relevant off-balance sheet items.[12]

OECD, ECB and commercial sources (such as Datastream) are used for stock market data and macroeconomic and financial developments. Real estate prices are obtained from the BIS or European Mortgage Federation sources.

Bank profitability and solvency data are collected in cooperation with the Groupe de Contact from supervisory sources. Currently, efforts are being made to improve the database for non-performing assets and provisioning needed to assess asset quality issues. The data are collected on a consolidated "home country" basis (except for Luxembourg and Austria), that is, including the global operations of the domestically incorporated banks and covering domestically operating subsidiaries of foreign banks. The analysis of the data is subject to some complications as there are inconsistencies between balance sheet and profitability data. However, it is also useful to consider both "residency-based" and "consolidated" data. For the purposes of linking macroeconomic and financial developments in a particular market to the banking activity in this market, unconsolidated "host country" information is appropriate, while consolidated data are needed to appreciate credit exposures, profitability and solvency.

3.1 Data to capture flows of funds

Credit flows from financial institutions to households and corporations may play a fundamental role in the build-up of asset price bubbles.[13] Banks may extend more credit on the basis of the increasing value of collateral, and this trend may be exacerbated if lending policies are focused on a "point in time" evaluation of the borrower rather than on a "through the cycle" assessment of the probability of default. Furthermore, the process may be reinforced if banks engage in tough competition for market share in the credit market. Empirical findings in connection with recent Scandinavian crises are in line with this reasoning with regard to the development of an unsustainable real estate market bubble.[14] There is also evidence that bank loans to the real estate sector triggered asset price inflation in Japan, the United Kingdom and the United States in the 1980s. For example, Hargraves et al[15] take the view

12 See Committee on the Global Financial System (2000).

13 See Fisher (1993); Minsky (1977 and 1991) and Eichengreen and Portes (1987).

14 See Berg (1998) and Bäckström (1998).

15 See Hargraves et al (1993).

that asset price inflation in Japan and the United Kingdom in the 1980s was largely attributable to a mismatch between the assets and liabilities of banks. The decline in traditional lending activities, such as loans to corporations and, in the case of Japan, to the general government sector, coincided with abundant deposit funding and capital inflows. The resulting excess liquidity induced banks to expand lending in other areas, such as real estate projects which might otherwise have been rejected. Asset price inflation was less pronounced in the United States, because the changes in borrowing and saving patterns were accompanied by a decline in sources of funding for banks.

Flow-of-funds matrix

The determinants and effects of bank credit growth can be usefully studied within *a coherent framework of financial flows*, ie *a flow-of-funds matrix* (see Box 5). An ideal data set for the purposes of macroprudential analysis would comprise a rather detailed matrix which could be used, for example, to relate banking flows to other financial flows. The matrix would show the acquisition of financial assets and the composition of financial liabilities for each sector of the economy (households, non-financial corporations, banks, institutional investors, general government sector and the rest of the world). Each sector would appear both as (i) a holder of financial assets (rows) and (ii) a debtor or issuer of securities (columns). The matrix should also show the financial instruments traded in the financial markets. For the macroprudential analysis of the EU banking sector, it would ideally be constructed both at EU or euro area level and at national level, since national systems still have many peculiarities as regards financial structures and instruments and the underlying determinants of financial flows. The construction of the complete matrix at EU or euro area level would be possible only after the harmonisation of disparate national methodologies for financial account statistics.

A stock version of the matrix, constructed on the basis of the outstanding amounts, would also be highly relevant for analysing the composition of financial assets and liabilities and hence, for example, their vulnerability to a stock market decline.

Data needed to construct the flow-of-funds matrix

For the time being, it is not possible to construct a stocks or flows matrix for the euro area or the European Union as a whole. Some countries produce the data on a regular basis (eg France, Spain, Germany and Italy), but the geographical coverage and timeliness of data at international level are not adequate. However, for analytical purposes, certain data can be obtained from existing statistics on monetary financial institutions (MFIs; see Box 5) and balance of payment statistics.[16] Statistics on general government deficits and aggregated accounts of corporations represent complementary sources. Another major shortcoming is the very limited availability of data related to institutional investors and non-financial corporations. For the euro area, the ongoing work of developing financial account statistics is filling important gaps in the information base (many relevant cells in the matrix; see Box 5).

3.2 Data required to construct financial fragility indicators

Given the importance of financial fragility indicators, it is important that they are available on a timely and frequent basis (eg quarterly). Data items which are particularly relevant for calculating indicators for *household and corporate sector gross and net leverage,* and for *evaluating the composition of their financial assets and liabilities* are listed in Box 6.[17]

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16 The euro area aggregated balance of payments provides reasonably good proxies for the accumulation of financial assets and the structure of financial liabilities of the rest of the world in its transactions with the euro area. The part on portfolio investments is useful, as flows are available by instrument (debt and equity, money market instruments and others) and by sector (general government, MFIs and other sectors) for both assets and liabilities. The main shortcoming is the fact that no further sectoral breakdown is provided for the non-financial private sector.

17 In order to calculate leverage, additional data are needed. For example, in order to calculate the degree of leverage of an indebted household owning real estate, data on the value of the real estate assets would need to be combined with data on the debt liabilities.

Box 5

Flow-of-funds matrix

Composition of financial liabilities by sector	Households	Non-financial corporations	Banks	Institutional investors (non-bank financial institutions)	General government	Rest of the world	Total
1. Acquisition of financial assets			**A**		**A**	Capital outflows	**A**
Households							
Deposits (1)			**A**				
Equities							
Interest bearing securities (1)							
Non-financial corporations (NFCs)						Capital outflows by NFC	Total acquisition of assets by NFC
Deposits (1)			**A**				
Equities							
Interest bearing securities (1)							
Banks (2)	**A**	**A**	**A**	**A**	**A**	**A**	**A**
Loans (1)	**A**	**A**	**A**	**A**	**A**	**A**	**A**
Equities						**A**	**A**
Interest bearing securities (1)	**A**	**A**	**A**		**A**	**A**	**A**
Institutional investors							.
General government			**A**				
Rest of the world			**A**				
Total	**Total liabilities**	**Total liabilities**	**Total liabilities**	**Total liabilities**	**Total liabilities**	**Total liabilities**	**Sum of financial assets = sum of financial liabilities**
2. Structure of financial liabilities by instrument (3)						**Capital inflows**	**Total debt accumulation**
3. Net acquisition of financial assets (3)	**Net surplus**	**Net surplus**	**Net surplus**	**Net surplus**	**Net surplus of general government**	**Current account surplus**	**Zero**

A = available for euro area countries from the MFI and balance of payments statistics (the two sources can exhibit methodological discrepancies). The availability refers to the respective stock items. Shaded cells represent data items which are not relevant.

(1) The distinction between short-term and long-term instruments is important.

(2) Monthly stocks and flows of MFIs' holdings of loans, securities and shares are available with a basic sectoral breakdown. On a quarterly basis, data on MFI issues of such instruments are broken down by sector (households, corporations, central and other general government, other financial intermediaries, insurance companies and pension funds and non-residents Monetary Union Member States and others). The exercise is more difficult on the liabilities side, because data on securities issued by MFIs are not broken down by sector. The calculation of flows requires additional methodological steps, as stocks have to be corrected for exchange rate changes, market price variations and the effect of changes in the composition.

(3) These items have a similar structure to that for financial assets. They are therefore not reproduced in the table.

Box 6

Relevant data items from financial accounts for calculating financial fragility indicators

1. Total financial assets of non-financial enterprises
2. Total financial assets of households
3. Bonds and short-term securities held by non-financial enterprises
4. Bonds and short-term securities held by households
5. Shares and other equities issued by residents and held by non-financial enterprises
6. Shares and other equities issued by the rest of the world and held by non-financial enterprises
7. Shares and other equities issued by residents and held by households
8. Shares and other equities issued by the rest of the world and held by households
9. Shares in mutual funds held by households
10. Shares and other equities issued by non-financial enterprises
11. Short-term debts of non-financial enterprises
12. Long-term (and medium-term) debts of non-financial enterprises
13. Short-term debts of households
14. Long-term (and medium-term) debts of households
15. Gross saving of non-financial enterprises (non-financial accounts item)
16. Non-financial assets of households (non-financial accounts items)

At the moment, the main sources available for these items are the OECD Annual National Accounts and heterogeneous national sources. These sources do not, however, provide a satisfactory solution, since they are not available on a timely basis (for the OECD data, the delay is almost two years) and their frequency is generally not adequate. For macroprudential analysis, it is necessary to have access to country-level data, since the financial accounts data, for example, need to be linked to country-specific credit developments.

As noted, the situation is improving for the euro area because financial accounts statistics are being compiled (providing data for the items listed in Box 6). At present, proxies for household and corporate sector leverage and debt servicing burdens can be constructed by using money, banking, securities and interest rate statistics, but the scope of this exercise is obviously limited because credits from non-bank sources are excluded.

It would also be useful to have data for calculating measures of the debt servicing burdens of households and firms. A breakdown of debts into fixed and variable rate contracts would be valuable too.

4. Developing the analytical tools

Enhancing analytical capabilities is a never-ending task, as is the development of the information base. It is important in order to improve understanding of the links between macro developments (external factors) and the exposures and soundness of financial institutions (internal factors). The tools developed in this field could be used, for example, to evaluate asset price developments and their impact on financial stability, which is a key issue in financial stability analysis. While it is true that sharp falls in asset prices may not always trigger financial crises and that crises can occur without significant asset price cycles, a correlation between the two developments has often been found.[18]

The two aspects, (i) evaluating the current level of asset prices and correlations across markets and asset classes and (ii) analysing the potential impact of a fall in asset prices on the banking system (as part of a more general exercise to establish the links between the macro developments and banking sector soundness), are discussed in the next two subsections.

[18] A recent study found that in 16 out of 38 equity market crises from 1970 to 1999, stock market turbulence was associated with the spread of banking difficulties (Vila (2000)). The key role of the real estate market has been stressed by Herring and Wachter (1999).

4.1 Analysis of asset price levels and correlations

Analysis of stock price developments

For stock markets, the set of indicators which needs to be followed is rather large. This includes four types of indicators described in Section 2.1: measures of market volatility, market depth and liquidity, credit standing and "triggering factors", such as possible deviations of stock prices from the value suggested by fundamental determinants.

The fundamental value of stocks equals the expected value of the cash flows associated with the holding of stocks (ie dividends), discounted by an appropriate discount rate which comprises a risk free nominal interest rate and a component to compensate investors for the risk of holding equity (*equity risk premium*). As shown by Allen and Gale (1998), the inability of investors to observe how risky issuers' investments are decided upon can lead to risk-shifting behaviour and cause assets in fixed supply to be bid up further by the issuers. While an obvious example of an asset that is in fixed supply in the short term is real estate, stocks can also be considered to be in fixed supply in the short run, since it takes time to identify profitable opportunities and expand the supply of stocks. It has been claimed that, in addition to the impact of stickiness in supply, "irrational exuberance" on the part of investors can drive stock prices above the fundamental value.

Traditional measures of stock price valuation, such as the price-earnings ratio, are used to give a possible indication of overvaluation using historical pricing behaviour as the benchmark. However, this kind of assessment is subject to considerable uncertainty, since there is a large amount of uncertainty involved in identifying the factors that determine the fundamental value.

The *prices of options on stock indices* can be used to give some indications for assessing the likelihood of a sharp decline in stock prices. These prices reflect the expectations of market participants concerning possible changes in stock price levels over the lifetime of the options. A widely used indicator is the implied volatility of stock prices, which summarises the expectations of market participants about the standard deviation of stock prices from current levels. However, implied volatility cannot give any indication as to whether market participants consider stock price increases or declines to be more likely. When a wide array of option prices is available for different exercise prices, it is possible to extract information relating to the expected direction of future changes in stock prices. In particular, on the basis of assumptions regarding the shape of the probability distribution of future outcomes, it is possible to estimate risk neutral probability density functions. These functions indicate the expected probability of various magnitudes of change in stock prices assuming risk neutrality on the part of market participants (see Box 7.A).

Finally, an investigation of developments in *sector-specific stock indices* can help in the analysis of the sources of changes in overall stock prices as well as the associated risks (see Box 7.B).

Analysis of correlation

A particular source of concern is the possibility that stock price shocks could spill over across markets, or into other asset markets, such as the real estate market. Such spillover effects could reflect commercial relations between firms, sensitivity to common factors, and links between stock portfolio adjustments as a number of stock investors make portfolio allocation decisions at the global level. Box 8 shows measures of correlation across European and US stock markets, showing important links with the US market and quite significant correlations across European markets.[19] There are, nevertheless, quite significant variations across countries.

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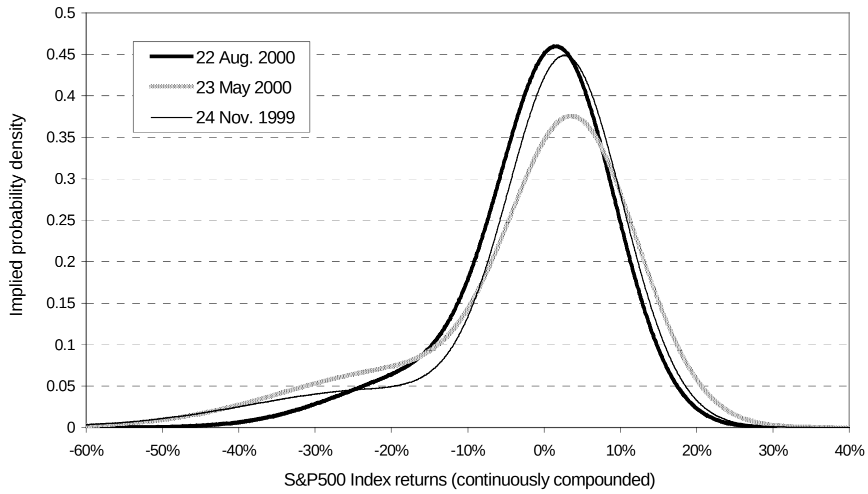
[19] Despite this high degree of interdependence between financial markets, stock prices in the euro area do not appear to respond consistently negatively, or markedly, to sharp declines in US stock prices. In the period from January 1992 to May 2000, on the 10 occasions when US stock prices declined over two consecutive months (from month-end to month-end), euro area stock prices declined over the two-month horizon on seven occasions.

Box 7.A

Extracting information on stock market developments from option prices

Looking at options on the Standard and Poor's 500 index for the United States, between May and August 2000 market participants seemed to have revised downwards the risk neutral probability of declines expected over a horizon of about four months. This is shown by the fact that, in the chart, the left-hand side of the curve shifts downwards between May and August 2000. However, the probability of sizeable declines remained larger than the probability of sizeable increases, as shown by the fact that the area under the left-hand side of the curve is generally larger than that under the right-hand side of the curve. As at 22 August, the probability of a decline of 30% or more over the next three and a half months was perceived to be just below 2%, whereas it stood at more than 6% on 23 May and at slightly less than 6% on 24 November 1999 (see table).

Implied risk-neutral probability densities for S&P500 index returns
(Based on option contracts with 114 days to expiration)



Measures of uncertainty for the S&P 500 index implied in option prices[1]

Implied probability of an **increase** of x% or more in the S&P 500 index 114 days after the respective estimation dates				Implied probability of a **decrease** of x% or more in the S&P 500 index 114 days after the respective estimation dates			
x	**24 Nov 99**	**23 May 00**	**22 Aug 00**	***x***	**24 Nov 99**	**23 May 00**	**22 Aug 00**
10%	14.1%	17.9%	11.4%	**-10%**	18.0%	22.6%	17.0%
20%	1.0%	2.1%	0.6%	**-20%**	10.4%	12.8%	6.5%
25%	0.2%	0.5%	0.1%	**-25%**	8.1%	9.4%	3.7%
30%	0.0%	0.1%	0.0%	**-30%**	5.9%	6.4%	1.9%

Descriptive statistics of implied distributions[2]	**24 Nov 99**	**23 May 00**	**22 Aug 00**
Standard deviation of implied RND	13.8%	14.8%	10.7%
Skewness of implied RND	-1.5	-1.1	-0.9
Excess kurtosis of implied RND	2.8	1.2	1.3

[1] Sources: Reuters; CME; CBOE; and ECB calculations. [2] 114-day horizon.

Box 7.B

Extracting information on stock market developments from sector indices

In April 1986, following an increase of 187% over the preceding 12 months, the price-earnings ratio in the euro area financial sector had reached a value of about 86 - well in excess of the average value of 45 observed over the period from 1973 to 1984. In the course of May 1986, stock prices in this sector declined by 12%. During that month, stock prices declined not only in the financial sector but also in most other business sectors, despite an average price-earnings ratio in the other business sectors of 16, which was well within the "standard" range of fluctuation. In the light of the above example, the prevailing high price-earnings ratios recently seen in the telecommunications, media and technology (TMT) sector may be seen as a particular source of concern both in the United States and in the euro area (see table). These high stock price valuations in the TMT sector arose principally from the sub-component constituted by firms active in information technology. High sectoral price-earnings ratios may prove to be adequate if corporate earnings increase rapidly in the sector concerned. However, until such an increase in corporate earnings starts to materialise, there is a possibility that stock prices in the sector concerned will be subject to large swings on account of changes in the perception of corporate earnings prospects.

Sectoral price-earnings ratios

(Stock index level divided by total earnings per share; figures in brackets are standard deviations)

	Euro area		**United States**	
	1973-99	August 2000	1973-99	August 2000
Resources	10.5 (6.2)	18.0	14.2 (8.1)	21.9
Basic industries	11.0 (2.8)	14.2	15.2 (6.7)	15.4
General industrials	13.1 (3.2)	20.0	14.7 (5.2)	31
Cyclical consumer goods	13.6 (13.2)	12.8	12.8 (8.6)	8.8
Non-cyclical consumer goods	13.7 (4.4)	25.1	18.3 (7.4)	31.3
Cyclical services	15.4 (4.5)	30.9	18.6 (7.3)	29.9
Non-cyclical services	14.5 (6.9)	33.1	14.7 (7.2)	24.7
Utilities	13.4 (3.8)	21.7	10.7 (3.8)	19.4
Information technology	16.5 (8.0)	58.5	20.5 (9.7)	67.8
Financials	34.0 (18.2)	18.9	11.5 (4.0)	19.7
Telecoms, media and technology (TMT)	14.0 (7.2)	43.3	17.7 (8.3)	50.8
Other than TMT	13.2 (3.5)	18.9	13.9 (5.0)	24.0
Total market	13.4 (3.8)	22.2	14.6 (5.6)	29.5

Source: Datastream.

Box 8

Correlation of stock exchange returns[1]

	BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	US
BE	1.00															
DK	0.42	1.00														
DE	0.62	0.52	1.00													
GR	0.25	0.23	0.31	1.00												
ES	0.56	0.44	0.64	0.29	1.00											
FR	0.59	0.45	0.74	0.26	0.66	1.00										
IE	0.47	0.34	0.48	0.30	0.46	0.45	1.00									
IT	0.46	0.41	0.57	0.20	0.55	0.58	0.37	1.00								
LU	na	na	na	na	na	na	na	na	1.00							
NL	0.64	0.47	0.73	0.23	0.63	0.70	0.53	0.56	na	1.00						
AT	0.58	0.31	0.56	0.27	0.44	0.45	0.36	0.36	na	0.43	1.00					
PT	na	na	na	na	na	na	na	na	na	na	na	1.00				
FI	0.33	0.34	0.48	0.17	0.43	0.46	0.36	0.40	na	0.49	0.19	na	1.00			
SE	0.48	0.36	0.60	0.25	0.57	0.59	0.46	0.44	na	0.58	0.35	na	0.58	1.00		
UK	0.54	0.44	0.59	0.18	0.57	0.63	0.57	0.48	na	0.68	0.39	na	0.43	0.52	1.00	
US	0.50	0.34	0.56	0.19	0.50	0.55	0.48	0.38	na	0.58	0.36	na	0.41	0.52	0.58	1.00

[1] Over the period May 1988 to September 2000. Correlation of weekly returns. In order to ensure the greatest possible data homogeneity across countries, all returns have been calculated on the basis of the "total market" indices computed by Datastream.

Source: Datastream.

The correlations tend to change over time. For example, from 1992 to 1998 the correlation coefficient of stock price developments between the euro area and the United States increased from around 0.2 to around 0.5, but has since declined to around 0.35. Such changes can partly be explained by changes in stock market volatility. However, the marked increase since 1992 would seem to suggest that the degree of interdependence between stock markets has increased in recent years.

Empirical studies have shown that what is especially relevant for financial stability is the fact that the correlations tend to be significantly higher during periods of financial market stress.[20] Hence, the use of correlations obtained under normal circumstances, or over a longer time span, is not appropriate when constructing crisis scenarios. Box 9.A indicates that cross-market correlations almost always increase when moving from a period of lower stock market volatility (low uncertainty) to a period of higher volatility (high uncertainty), and almost always decrease when moving from a period of higher volatility to a period of lower volatility. Box 9.B shows variations in correlations between European and US stock indices when divided into high and low volatility periods and displays the same phenomenon of higher correlations during high volatility periods.[21]

Real estate markets tend to exhibit lower cross-market correlations than the stock markets, particularly the residential market. However, data availability somewhat restricts the scope of analysis of price developments in real estate markets. Real estate prices can be correlated with stock prices, but a positive coefficient is not obtained in all cases, as shown in Box 10. Real estate prices may be stickier over the short run than stock prices. As a result, there may be positive and higher coefficients of correlation between real estate prices and *lagged* stock prices.

[20] See BIS (2000).

[21] See Forbes and Rigobon (1999).

Box 9.A

Changes in stock market correlations between high- and low-volatility periods

Changes in correlations between stock markets when moving from low- to high-volatility periods

Period	Number of increases	Number of decreases
Correlations between EU countries		
From May 1988 - July 1990 to July 1990 - Oct 1992	78	0
From Oct 1992 - Sept 1997 to Sept 1997 - Sept 2000	98	7
Correlations between EU countries and the United States		
From May 1988 - July 1990 to July 1990 - Oct 1992	11	2
From Oct 1992 - Sept 1997 to Sept 1997 - Sept 2000	15	0

Changes in correlations between stock markets when moving from high- to low-volatility periods

Period	Number of increases	Number of decreases
Correlations between EU countries		
From Sept 1987 - Dec 1987 to Jan 1988 – July 1990	0	55
From July 1990 - Oct 1992 to Oct 1992 - Sept 1997	9	82
Correlations between EU countries and the United States		
From Sept 1987 - Dec 1987 to Jan 1988 – July 1990	0	11
From July 1990 - Oct 1992 to Oct 1992 - Sept 1997	3	11

The volatility indicator used to split the 1988-2000 period is the standard deviation, which is calculated over moving and centred windows of 11 weeks.

Source: Datastream.

Box 9.B

Correlation between European and US stock exchange indices[1]

	May 1988 to September 2000 (whole period)	September 1987 to December 1987 (87 crisis)[2]	May 1988 to July 1990 (low volatility)	July 1990 to October 1992 (high volatility)	October 1992 to September 1997 (low volatility)	Sept 1997 to September 2000 (high volatility)
BE	0.50	0.62	0.39	0.49	0.46	0.57
DK	0.34	0.77	0.28	0.46	0.26	0.36
DE	0.56	0.68	0.41	0.55	0.46	0.66
GR	0.19	na	-0.01	0.25	0.04	0.35
ES	0.50	0.83	0.41	0.52	0.40	0.58
FR	0.55	0.70	0.43	0.56	0.47	0.63
IE	0.48	0.69	0.35	0.39	0.42	0.60
IT	0.38	0.54	0.21	0.36	0.24	0.57
LU	na	na	na	na	0.16	0.22
NL	0.48	0.82	0.59	0.53	0.56	0.62
AT	0.36	0.68	0.20	0.48	0.34	0.47
PT	na	na	na	0.37	0.16	0.43
FI	0.41	na	0.12	0.25	0.39	0.56
SE	0.52	0.56	0.41	0.57	0.43	0.61
UK	0.58	0.83	0.55	0.51	0.51	0.69

[1] Correlation of weekly returns. To ensure the greatest possible data homogeneity across countries, all returns have been calculated on the basis of the "total market" indices computed by Datastream. [2] This period does not form part of the "whole period" displayed in the first column.

Source: Datastream.

Box 10

Cross-correlation of asset prices

	Correlation between house prices and stock exchange prices			Correlation between commercial real estate prices and stock exchange prices	Correlation between house prices and commercial real estate prices
Frequency	**Quarterly**[1]	**Semiannual**[2]	**Yearly**[3]	**Yearly**[3]	**Yearly**[3]
BE	-0.30	-0.36	-0.22	na	na
DK	0.21	0.30	0.38	na	na
DE	na	na	0.32	0.16	0.03
ES	-0.11	-0.08	-0.17	-0.05	0.5
FR	0.45	0.54	0.05	0.05	0.71
IE	0.22	0.23	0.44	na	na
IT	na	-0.18	-0.48	-0.20	0.54
NL	na	na	0.64	na	na
AT	na	0.30	0.31	na	na
PT[4]	-0.17	-0.27	na	na	na
FI	0.25	0.39	0.53	0.20	0.67
SE	0.05	0.32	-0.13	0.03	0.29
UK	na	na	0.26	-0.11	0.58
US	na	na	0.68	0.47	0.32

[1] Quarterly coefficients are estimated on the basis of quarterly price series over the period from the fourth quarter of 1988 to the fourth quarter of 1999. [2] Semiannual coefficients are estimated on the basis of semiannual series over the period from the second half of 1988 to the second half of 1999. [3] Annual data are estimated on the basis of annual series for the years 1988 to 1998. As they rely on only 11 years of data, they should be interpreted with caution. [4] For PT, all series start in 1990.

Sources: BIS for BE, DK, ES, IE, LU, AT, PT, FI, SE, UK, JP, US; European Mortgage Federation for DE, NL; Ministère de l'Equipement for FR; Consulente Immobiliare for IT. Available data are not sufficient to carry out the correlation analysis for GR and LU.

4.2 Analysis of the impact on the banking sector

The previous sections show how the observation and interpretation of the established set of MPIs, together with the systematic monitoring of asset price developments, can provide a useful tool for identifying areas of potential vulnerability within the macroeconomic environment that could have a negative impact on the banking sector. In addition, important information can be obtained from the supervisory authorities as regards, for example, the direct credit, market and earnings risks of banks vis-à-vis asset price declines.[22]

"Stress testing" using aggregated data

By itself, the monitoring of MPIs, although inserted into a specific analytical framework, does not provide a means of estimating the impact on the banking sector of a *destabilising event*, such as a sharp decline in asset prices, since it does not explicitly consider the causal relationships between the different variables being monitored. Therefore, once the areas of vulnerability have been identified, the natural next step is to develop a set of analytical tools that permit such a result to be achieved. The outcome of the analysis could be used to evaluate the impact of a given macroeconomic scenario on the banking system (a kind of *stress testing*). In general, these stress tests would be aimed at analysing the impact of changes in key macro variables on the balance sheets of financial institutions. A stress test may follow a well defined and consistent historical or hypothetical scenario or involve simulations obtained from macroeconomic forecasting models. The IMF and the World Bank have adopted these kinds of stress testing techniques within the Financial Stability Assessment Program.[23] Such analyses can be useful, but they would have to rely on quantitative empirical results to analyse

[22] According to a recent report from the Banking Supervision Committee, *Asset prices and banking stability* (April 2000), the perception of the supervisory authorities has been that the direct credit and other commercial risks of EU banks vis-à-vis a stock market decline are quite manageable, while a real estate market slump would represent a more significant concern.

[23] See the description of the stress tests carried out in the context of the FSAPs by the IMF in Ingves et al (2000).

the impact on the banking sector. Such analyses should be distinguished from those which make use of bank-level information (as discussed at the end of this subsection).

One example is the evaluation of the effects of an asset price decline through its impact on macroeconomic performance, as simulated by a macroeconomic model. An analysis of the impact on the banking sector of a change in macroeconomic conditions triggered by an asset price decline can be divided into two parts:

(i) the effect on macroeconomic conditions of a negative shock on asset prices;

(ii) the impact on the banking sector of a change in macroeconomic conditions, for example GDP.

Box 11 contains a flow chart showing the causal links between the variables. The first part looks at the effect that a large decline in asset values may have on aggregate demand through "wealth effects" (a slowdown in consumption and business investment and a reduction in GDP). In this case, a macroeconomic model simulation would have to be used to obtain the values of the macroeconomic variables (GDP and other relevant variables). The second part of the analysis looks at the impact on the banking sector of the changes simulated in the first part of the exercise. The purpose of this is to focus on variables that can give an indication of increased vulnerabilities within the banking sector. The analysis could concentrate on assessing the impact on the level of non-performing loans as well as on other indicators of bank soundness. Box 11 illustrates the complexity of the exercise, which produces many uncertainties and makes it difficult to assess the risks involved.

Developing a model to assess the links between macro developments and bank soundness

Broadly speaking, a set of tools which would allow the kinds of "stress tests" mentioned above would comprise several instruments, the common feature of which would be that they provide a causal link between a collection of variables of particular interest for the purposes of the analysis. In other words, a distinctive feature of such a set of analytical tools would be the fact that they rely explicitly on a model.[24]

The value of models as a means of better understanding the impact of a shock on the banking sector is quite clear, but their limits should also be recognised. A model is no more than a simplified representation and for this reason its results should always be interpreted with caution. In this respect, a model can be more or less refined depending on the goals of the analysis and the kinds of constraints faced. Ideally, a full model should be capable of estimating the determinants of the main elements of the balance sheets and profit and loss accounts of banks. One particularly important set of constraints is the availability (or lack of availability) of the long back series of reliable data necessary to evaluate the relationships between the variables.

In any case, given the acknowledged need for and usefulness of a set of analytical tools, there have been several attempts to develop models aimed at analysing the condition of the banking sector. These models can be classified according to different factors, including:

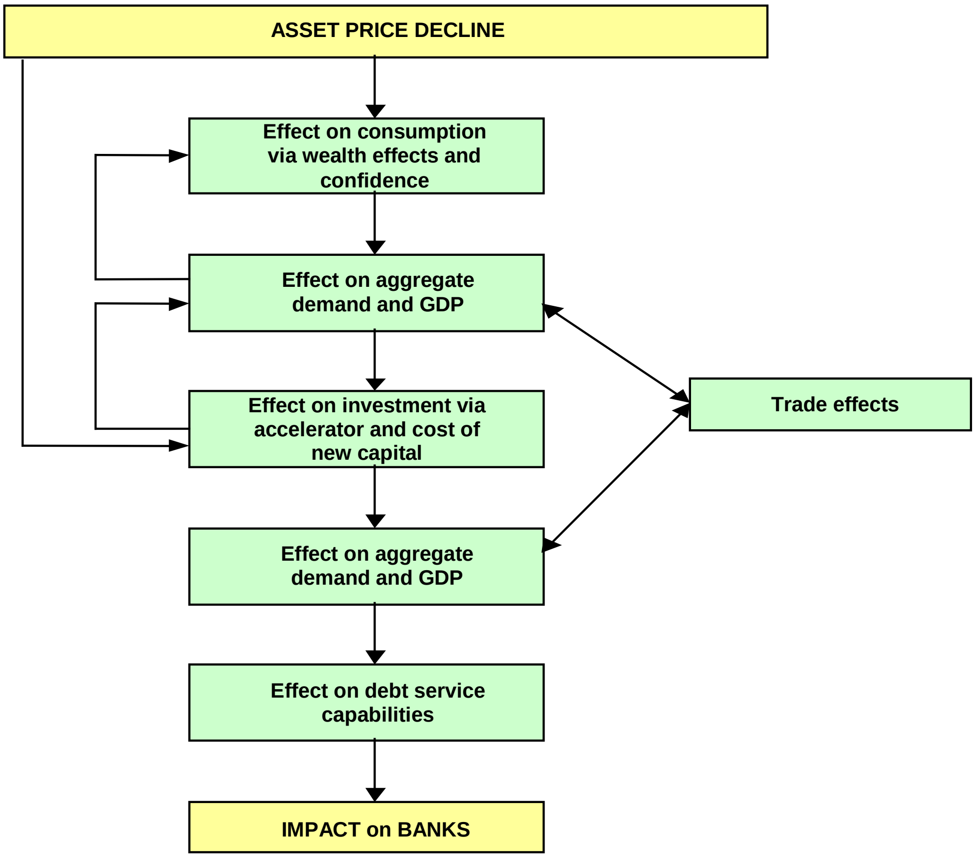
(i) the scope of the model, namely whether it is at aggregated (macro) or disaggregated (micro) level;

(ii) the type of data employed in the model (supervisory information, public information);

(iii) the variables to be explained or predicted (probability of failure, levels of bank risk, loan losses, profitability and solvency).

[24] A model is in fact usually defined as a set of causal relationships (qualitative or quantitative) between a collection of variables employed for the (simplified) description of a certain group of phenomena.

Box 11: **Impact on the banking sector of a change in macroeconomic conditions triggered by an asset price decline**



As noted in Section 2.2, there are several papers which attempt to estimate the impact of macroeconomic variables on the condition of banks. The IMF and the World Bank in particular have produced a large number of research papers on this topic. By looking at past episodes of banking crises, Demirguc-Kunt and Detragiache (1999) and Hardy and Pazarbasioglu (1998) attempt to identify macroeconomic variables able to predict the probability of a systemic crisis. Gonzales and Hermosillo (1999) make use of a combination of micro and macro variables in an attempt to predict the probability of banking crises.

At the European level, the WGMA is exploring the issue and some central banks are engaged in projects aimed at estimating the effect of changes in macroeconomic variables on their respective banking sectors. Sveriges Riksbank has developed an econometric model which reveals relationships between business failures (as an indicator of the degree of credit risk in a bank portfolio) and a number of macroeconomic variables.[25] The Bank of Finland has also developed a model relating the level of loan losses of banks as a dependent variable to a set of macroeconomic variables (rate of change in GDP, real interest rate, level of indebtedness of the banks' borrowers).[26]

25 See Lindhe (2000).

26 See Pesola (2000).

"Stress testing" using bank-level information

These kinds of stress tests need to be distinguished from the macro-level analyses described above.

First, macro variables can sometimes be entered into the *early warning systems* used by the supervisory authorities to assess the risk of failure of a single institution. There is quite extensive literature on models aimed at estimating the likelihood of individual bank failures.[27] More recently, increasing use has been made of publicly available market information (stock prices and spreads on banks' bonds) to gauge the probability of default at individual bank level.[28]

Second, stress testing is an increasingly widely used and sophisticated *tool for internal risk management in banks.* An analysis of stress tests conducted by major financial institutions may help in understanding the sensitivity of the financial system as a whole to various shocks, as well as in understanding the risks for individual institutions.[29] Some EU supervisory authorities have already required banks to conduct sensitivity analyses for certain adverse events, such as a fall in real estate prices or a substantial increase in interest rates.[30]

5. Conclusion

This paper demonstrates that there is a specific role for macroprudential analysis using aggregated data. Aggregated figures for the banking sector can yield important signals of system problems which cannot be extracted from individual data alone (accumulation of exposures at the system level and exposure to common factors). They also provide a benchmark against which individual institutions can be compared. It is important to monitor relevant developments in the non-financial parts of the economy because the health of financial institutions reflects the health of their counterparties. The monitoring of financial market stress signals is becoming an increasingly important component of financial stability analysis as markets gain in importance for financial intermediaries and for the economy as a whole. However, there is a limit beyond which one cannot go without having information on individual institutions. Most importantly, aggregate figures can mask substantial idiosyncratic exposures or problems at some systemically relevant institutions. These kinds of risks cannot be addressed by aggregated analysis, so it is necessary to have stress tests at the individual institution level, for example, in order to be able to spot idiosyncratic vulnerabilities. Aggregated data could also be misleading when addressing some specific issues, such as the extent of cross-border interbank market links and cross-border business in general, since it tends to be concentrated among large institutions rather than evenly distributed. Hence, the view of international contagion risks derived from aggregated data may be distorted. Supervisory insight is the main tool for alleviating this problem in macroprudential analysis.

Given the problems associated with the use of aggregated information alone, most financial stability reports published by central banks (eg the Bank of England and Sveriges Riksbank) include statistics referring to major domestic banking institutions. Large banks have a more diversified portfolio of activities, especially when the whole banking group is taken into consideration. But although the likelihood that large banks will incur major problems might be lower, the impact of such problems occurring at a large bank would be more widespread. Absolute size is not the only relevant factor, however. The interbank market is a major channel for contagion. Contagion may also spread through capital market activities or through difficulties experienced at non-bank subsidiaries. This being the case, structural features - such as the ownership structure or composition of the group or conglomerate to which the bank belongs - might also provide an indication of the systemic importance

27 For example, see Vulpes (1999).

28 Nickell and Perraudin (1999) provide an example of such models. They use a model based on equity prices to derive the implied probability of default and the capital requirement for a set of UK banks.

29 See Committee on the Global Financial System (March 2000).

30 See publication of the Banking Supervision Committee of the European System of Central Banks, ECB (2000).

of the bank. A particular bank might be a core intermediary in a particular market, even if it does not rank among the largest institutions.

Regular contacts with major, market-leading intermediaries are useful for producing timely and meaningful information on major trends in the financial system, such as developments in market liquidity. Monitoring only quantitative indicators could lead to a delayed and incomplete view of developments of importance for financial stability. An adequate exchange of information among responsible supervisory authorities, and where necessary with central banks, is a crucial factor in the process of safeguarding financial stability.

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Financial stability analysis at the Bank of Finland

Kimmo Virolainen[1]

1. Introduction

Central banks are generally considered to have two main tasks: maintaining price stability and promoting the stability and functioning of the financial system. The stability of the financial system, in particular the banking system, is critical for the successful conduct of monetary policy. More generally, a stable and reliable financial system is necessary for the stable and favourable performance of the economic system.

The Finnish banking system experienced a severe crisis in the early 1990s.[2] Resolution of the crisis involved public support for all the major banking groups in Finland. Although the bank support has been recovered to some extent due to favourable macroeconomic developments in the latter part of the 1990s, the current estimated net cost of the crisis to taxpayers amounts to approximately 7% of 1997 nominal GDP. As a result of the crisis, the attention of public authorities was drawn to various preventative measures for avoiding future crises of such magnitude. In practice, this is reflected in the reorganisation of prudential supervision of financial institutions so as to involve greater resources and a closer relationship with the central bank.

At the Bank of Finland, the banking crisis crystallised the need for careful monitoring and frequent projections of future developments in the profitability and solvency of the Finnish banking sector. This work laid the foundation for the systematic framework for macroprudential analysis that is currently carried out at the Bank.

This paper describes the Bank's financial stability framework. In particular, it discusses the experience gained in carrying out semiannual forecasts of the aggregate banking sector and the close links between the banking sector forecast and the Bank's macroeconomic forecast for the whole economy. The paper also attempts to identify ways to develop the banking sector forecast framework in order to enhance its applicability in the future. Finally, the paper discusses the interaction between the macroprudential analysis carried out at the central bank and the prudential supervision carried out by a separate but closely related body - the Financial Supervision Authority.

2. Components of macroprudential analysis at the Bank of Finland

At the Bank of Finland, the Financial Markets Department is responsible for financial stability analysis. In recent central bank parlance, the term "macroprudential analysis" has mainly been used to describe tasks aimed at promoting the stability of the banking sector, whereas the term "oversight" is usually understood to encompass tasks relating to financial market infrastructure, that is, payment and settlement systems. Moreover, the term "market surveillance" is sometimes used to describe the regular surveillance and analysis of securities markets by the central bank. Nevertheless, all of these tasks are important elements of the financial stability analysis carried out by a central bank and, at the Bank of Finland, the tasks of the Financial Markets Department encompass all of them. In what follows the terms "financial stability analysis" and "macroprudential analysis" are used interchangeably and should be understood to cover the financial stability tasks of a central bank in a wide sense.[3]

Analysis of the stability of the financial system is based to a large extent on combining quantitative and qualitative information and it makes use of data on overall economic developments and individual

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1 The views expressed in this paper are those of the author and do not necessarily reflect the opinion of the Bank of Finland.

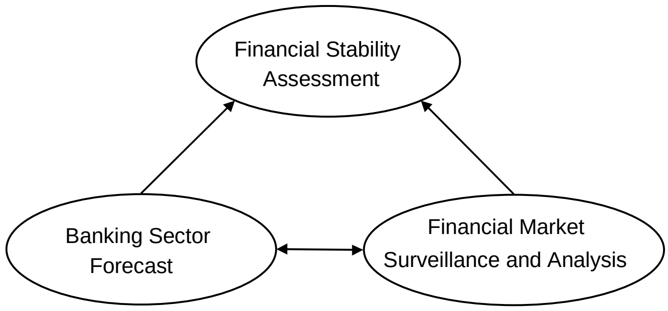
2 For a detailed description of the Finnish banking crisis, see eg Nyberg and Vihriälä (1994) or Koskenkylä (2000).

3 See Koskenkylä and Virolainen (1999) and Leinonen and Pauli (1999) for comprehensive descriptions of the Bank of Finland's activities in macroprudential analysis and oversight.

financial institutions. Macroprudential analysis at the Bank of Finland consists of three main components: (1) regular surveillance and analysis of financial market developments; (2) forecasts of aggregate banking sector profitability and solvency; and (3) summary assessment of the stability of the Finnish financial system (Figure 1).

Figure 1

Framework for financial stability analysis at the Bank of Finland



2.1 Regular surveillance and analysis

Ongoing surveillance and analysis of financial markets, which is a key element of a central bank's macroprudential tasks, provides a basis for the other tasks in the field. This analysis focuses on monitoring financial behaviour, institutions and market developments from the viewpoint of stability and efficiency. Due to the abundance of available information and the complexity involved in financial stability analysis, it is essential to identify key stability indicators, that is, macroprudential indicators (MPIs), that can be used to monitor the extent of systemic risks in the financial system and the likelihood of their realisation. It is especially important for the prevention of systemic crises to be able to identify and monitor factors that increase the vulnerability of the financial system to instability, as well as the mechanisms through which problems in one institution or market sector spread to other parts of the financial system. Past crises offer some clues for selecting these indicators, but the constant evolution of markets and institutions makes it unlikely that the next crises will be identical to those already experienced.

Under normal circumstances, regular surveillance and analysis takes up a significant amount of time and resources. For efficiency reasons, it is important to design a framework for surveillance that is robust, provides timely data and does not require a great deal of manual input.

At the Bank of Finland, regular macroprudential surveillance is broken down into the following four areas: (1) financing behaviour; (2) financial intermediation; (3) securities markets and exchanges; and (4) financial market infrastructure (payment systems and securities settlement systems). In addition to a detailed surveillance of domestic developments, regular surveillance also covers the EU/EEA and global (US and Japan) developments.

As part of the regular surveillance, the Bank prepares semiannual (spring and autumn) Financial Markets Reports. These are intended mainly for internal purposes, but the contents are such as to enable publication of the reports on the Bank's internet website.[4] As well as containing a few short articles on topical issues, each report contains a comprehensive statistical annex (see appendix for a list of figures and tables included). This statistical annex includes information on a number of macroprudential indicators for which public data are available.[5]

With regard to ***financing behaviour***, the emphasis is on identifying trends and changes in the lending and borrowing behaviour of the different sectors of the economy. This area also covers various

[4] At the moment the reports are available in Finnish only, but it is intended to start producing English versions in the near future.

[5] The contents of the report and the list of MPIs employed are constantly being developed. Confidential data, which have been obtained within the Bank or from the Financial Supervision Authority, are reported separately in internal reports.

financial fragility indicators for the economy, such as level of indebtedness, debt servicing costs of firms and households and the number of bankruptcies.

In the case of ***financial intermediation***, recent developments in profitability and solvency as well as in competitive conditions in the domestic and international banking sectors are analysed. In each report the most recent financial statement figures for all the major banking groups in Finland are summarised (year-end figures in the spring report and six-month figures in the autumn report). The autumn report also contains an overview of developments in the major foreign banking sectors, based on the annual results (for this purpose the Bank has subscribed to FitchIBCA's BankScope and augments this with its own surveillance regarding interim results for the largest banks). It also contains analyses of developments in the insurance sector and mutual fund business.

As regards ***securities markets and exchanges***, recent price developments in the stock and bond markets as well as the structural developments are reviewed. The phenomenal increase in market capitalisation and turnover of shares quoted on the Helsinki stock exchange has made it necessary to follow more closely the developments in the equity markets. Furthermore, due to the increasing pace of consolidation in both share trading (exchanges) and securities settlement, we also monitor international developments.

Financial market infrastructure covers both payment systems and securities settlement systems. From a systemic risk viewpoint, the smooth functioning of these systems has become increasingly important. With regard to the Bank's own RTGS system (BoF-RTGS), which today is a part of the EU area-wide TARGET system, a detailed and comprehensive surveillance system has been set up. A monthly internal report is produced covering a large number of transaction volume statistics (by sending/receiving institution, type of transaction etc) as well as information on banks' use of intraday credit. The overall TARGET volumes between countries in the EU area are also followed in the report and these are compared with the volumes in alternative cross-border payment systems. As regards securities settlement systems, regular surveillance covers developments in settlement volumes as well as the percentage of trades settled as scheduled.

In addition to monitoring and surveillance, more analytical work is clearly needed. Structural analyses, which help in forecasting the likely future developments in the financial sector, are an important part of macroprudential analysis. These analyses are carried out mainly by the economists in the Bank's Financial Markets Department. More time-consuming and ambitious research in this area is normally undertaken in the Bank's Research Department through a system of six-month secondment periods. From the financial stability viewpoint, the importance of structural analysis has increased significantly in recent years.

These analyses are published both in the Bank's Discussion Paper series and Working Paper series and occasionally through articles in the Bank's quarterly Bulletin. In particular, it is intended to publish separate annual reports on structural developments in the following three areas: the banking sector, securities markets and payment and settlement systems.

2.2 Banking sector forecast

An important tool used by the Bank of Finland in its macroprudential analysis is the regular forecast of the aggregate profitability and solvency of the Finnish banking sector. The origins of the banking sector forecast framework date back to the severe Finnish banking crisis in the early 1990s. In 1993, at the time when the Financial Supervision Authority (FSA) was transferred out of the Ministry of Finance and began to function as an independent authority, with an administrative link to the Bank, the FSA first adopted the so-called "Nordic Management Model" for bank-level forecasting. The model provided a quantitative framework for forecasting bank-level profitability and solvency. Soon, however, the forecast process was further elaborated by the Bank staff to focus more on the macroprudential aspects, that is, on aggregate banking sector developments.

Today, the banking sector forecast is produced semiannually, in close cooperation with the Bank's Economics Department and the Financial Supervision Authority. The forecast horizon is two years (the current year and the two following years). The banking sector forecast framework can be characterised as a "satellite model" of the Bank's macroeconomic model for the Finnish economy. There are two-way information flows between the banking sector forecast and the macro forecast. During the process, detailed discussions are held also with experts from the FSA, who provide the microprudential dimension to the analysis.

Additional information sources are banks' own budgets (analysed and summarised by the FSA), interviews and discussions with bank managers and the financial press. As the number of banking groups in the Finnish banking sector is relatively small, bankers regularly visit the Bank of Finland (typically four times a year) in order to present their interim results and discuss future developments. The information provided by the Finnish Bankers' Association is also taken into account. In particular, a quarterly survey conducted by the Association on the views of bank senior management, credit officers and bank branch managers about future loan and deposit demand and other matters is an additional information source that is used in the banking sector forecast. A regular survey, jointly undertaken by the Bank, the Ministry for Trade and Industry and the Confederation of Finnish Industries and covering the financing of small and medium-sized Finnish firms, is also taken into account in the process.

The forecast procedure is based on a simple spreadsheet system for the aggregate balance sheet of the banking sector.[6] The procedure starts with the collection of aggregate-realised balance sheet data from the previous year. Data on loan and deposit stocks and related interest rates are obtained from the Money and Banking statistics collected by the Bank as part of the statistics for the Eurosystem's monetary policy decision-making. The previous banking sector forecast is then compared with realised developments and forecast errors are carefully analysed. This is done in conjunction with the forecast error analysis of the macro model and constitutes the starting point for forecasts for the current and following two years.

Forecasts for loan developments are based on the exchange of information with the macro forecast, discussions with bank managers and the FSA staff. The forecasts for deposits are based on expected developments in monetary aggregates, which are obtained from the macro forecast. Forecasts for other balance sheet items are based on judgment and projections on possible institutional and structural changes. Certain residual items are finally determined by the balance sheet identity.

Once the balance sheet analysis is completed, the aggregate banking sector profit and loss account is analysed. An estimate for net interest income is determined on the basis of the balance sheet analysis and estimates of deposit and loan rates and market interest rates. Market interest rates are determined by the macro forecast. Estimates of banks' deposit and loan rates are made on the basis of structural developments, loan and deposit supply, demand shocks caused by institutional changes and general economic developments.

On the other hand, banks' non-interest income - which includes capital gains from securities and currency transactions, fees and commissions receivable, dividends and other income - is not as directly related to macroeconomic developments as is net interest income. Therefore, the forecast for non-interest income is more judgment-based and, in this analysis, discussions with FSA representatives play an important part. Background information is also collected from various other sources and the components of banks' non-interest income are discussed thoroughly during the forecasting process.

As regards expenses and depreciation, forecasts are partly based on banks' own estimates in their budget plans. The forecast for personnel expenses is based on estimates of the number of employees, structural changes in the sector and general wage developments. Other expenses are forecasted on the basis of the estimated number of branches, estimated depreciation and estimated investment needs of the whole sector. The forecasts for loan losses and non-performing loans are based on the FSA's supervisory information as well as analysis of other data, including data on corporate bankruptcies.

Figure 2 contains a diagram describing the banking sector forecast process. This illustrates the two-way information flows between the macro model and the banking sector forecast process, as well as the role of the FSA. As a result of the process, estimates for the aggregate profitability and solvency of the banking sector in Finland are obtained. In addition to profitability and solvency estimates, key forecast variables include estimates for asset quality, liquidity and efficiency.

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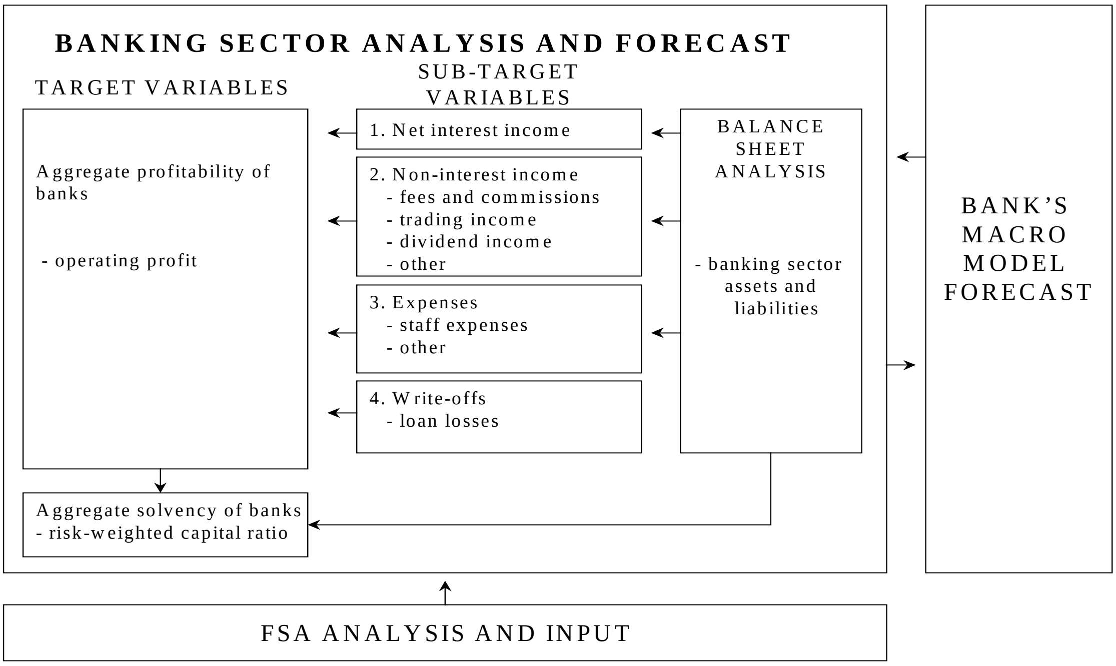
[6] For a more detailed description of the Bank of Finland's banking sector forecast process, see Andersen, Hyytinen and Mörttinen (1999).

Figure 2

Bank of Finland's banking sector forecast process



Although the point estimates are of interest, more important are the ***sensitivity analyses*** made possible by the forecast framework.[7] The aim of these is to evaluate the stress level of the banking sector and to identify potential sources of wide deviations from the baseline forecast. Sensitivity analysis is partly scenario analysis and partly robustness testing.

Examples of sensitivity analyses are those involving variations in deposit or lending rates due to possible changes in factors such as competitive conditions, industry structure, or the yield curve. A single sensitivity analysis typically includes several scenarios aimed at evaluating the stress level of the banking sector.

Finally, an important aspect of the banking sector forecast framework is that it serves as a useful educational tool. By participating in the forecast process, it is relatively easy for junior staff to become acquainted with the working of the banking sector and its relationship with macroeconomic developments.

2.3 Financial stability assessment

Regular surveillance based on an extensive set of statistical data and the banking sector forecast form the basis of the ultimate goal of the Bank's macroprudential analysis - an assessment of the stability of the Finnish financial system. This assessment is prepared semiannually in connection with the other regular reports. The whole package - Financial Stability Assessment, Banking Sector Forecast and Financial Markets Report - is twice-yearly submitted for discussion to the Board of the Bank of Finland.

The financial stability assessment is qualitative and takes into account all of the quantitative information gathered through the surveillance and the banking sector forecast process, and the supervisory information obtained from the FSA. It covers all the main areas of the financial system, but the chief emphasis is on developments and potential threats in the banking sector. The main conclusions of the assessment are presented in an executive summary and the report also includes suggestions for policy measures to improve the stability and efficiency of the financial system. Any

[7] As regards past forecast performance, it seems that the forecasts for profitability have been conservative, whereas forecasts for solvency (the risk-weighted capital ratio) have generally been overestimated.

potential threats that are deemed to require action by the authorities are discussed with the management of the FSA and, if necessary, with officials in the Ministry of Finance (mainly matters requiring legislative changes).

The stability assessment report for internal purposes is strictly confidential and it is distributed only to the Bank's Board and senior management and to FSA senior management. A non-confidential version of the assessment is published semiannually (in June and December) in the Bank of Finland quarterly Bulletin, in the form of an article titled "Financial Stability in Finland".[8] The first such article was published in the autumn of 1998. The published assessment is more limited in coverage than the internal version because of the confidentiality of some of the issues. The main aim of the published report is to raise the awareness of financial market participants and the public at large about potential threats to the stability of the financial system.

3. Future challenges for the banking sector forecast

A major challenge for the current banking sector forecast procedure employed at the Bank of Finland is the pronounced restructuring that is reshaping banking sectors throughout Europe and around the world. During the last 10 years the Finnish banking sector has undergone significant changes. As a result of the restructuring process initiated by the banking crisis, the Finnish banking sector currently consists of three major banking groups and a handful of smaller banks. More importantly, cross-sector and cross-border consolidation in the financial sector has gained momentum in recent years in Finland. At the beginning of 2001, the first financial conglomerate will commence operations through the merger of the third largest Finnish bank (Leonia) and the largest Finnish insurance company (Sampo). The largest Finnish bank (Merita) has joined forces with major partners in Sweden (Nordbanken), Denmark (Unidanmark) and Norway (Christiania Bank og Kreditkasse) to create a major regional financial services group - Nordea - which comprises both banking and insurance activities in the Nordic countries. Methods have to be designed to capture the effects of non-bank activities and foreign activities on the domestic banking sector. More generally, the consolidation process poses formidable challenges for the analysis of systemic risk in the financial markets. Due to the consolidation process - both cross-sector and cross-border - it is becoming increasingly difficult to define "the Finnish banking sector". The present procedure should also be developed to take into account more systematically competitive changes in the sector.

The current forecast procedure is a mixture of quantitative and qualitative analysis (as opposed to a rigorous econometric model). Apart from the forecasts for key macroeconomic variables, which are obtained from the Bank's macro model, the forecasts for most banking sector-specific variables are based on judgment by the Bank's forecast team. It is currently envisaged that the banking sector forecast procedure will gradually become more closely connected with the Bank's macro model and that the quantitative aspects of the procedure will be systematically upgraded.

On a more limited scale, a few prominent candidates for more careful quantitative modelling within the current framework can be identified. First, the interest rate margin, that is, the difference between the average interest rate received on loans and the average interest rate paid on deposits, is a key item in bank profitability. Hence, it would be useful to quantitatively assess its responsiveness to changes in factors such as in market rates, competition and macroeconomic conditions. Alternatively, one could evaluate how sector-level interest rates (or spreads) on household and corporate loans respond to changes in overall market conditions.

Second, a more quantitative approach to estimating the amount of banks' loan losses would be desirable. In particular, it would be useful to be able to recognise whether a regime shift in bank lending has occurred, or is about to occur, toward excessively lax credit standards and deteriorating asset quality. Substantial loan losses, such as those realised at the start of the 1990s in Finland, are of paramount interest from the macroprudential viewpoint. One could, for example, employ models that have been used to forecast bankruptcies from macroeconomic data.[9] The estimated models could

[8] See the Bank of Finland website http://www.bof.fi/ for the most recent article.

[9] See Pesola (2000) for ongoing work in this area at the Bank of Finland.

then provide a basis for scenario analyses. Methods that are capable of detecting regime shifts and/or asymmetries in the data generating processes could also provide invaluable insights in this context.

However, it is well known that structural changes and breaks that alter market participants' behaviour represent a major challenge for the successful implementation of quantitative forecasting methods. On the basis of developments over the past two decades, such breaks seem to be an inherent feature of the banking sector.

Finally, it is important to increase the utilisation of the banking sector forecast framework in various sensitivity and scenario analyses. The current favourable macroeconomic development will unavoidably come to an end at some point in the future, and in estimating the ability of the banking system to withstand the adverse developments it is necessary to carry out stress tests. In particular, it would be very useful to incorporate more systematically developments in banks' non-interest income into the sensitivity analyses.

4. Cooperation between the Bank and the Financial Supervision Authority

In an attempt to strengthen the effectiveness of banking supervision in the midst of a severe banking crisis, the former Banking Supervision Office in 1993 was transferred out of the Ministry of Finance into a closer relationship with the Bank of Finland and was renamed the Financial Supervision Authority. In connection with this operation, some Bank staff members were transferred to the FSA. Some time after that, in 1995, the FSA was further strengthened by another transfer of Bank staff members. Moreover, there have been rather frequent shorter-term exchanges of staff between the Bank and the FSA.

There are several formal and informal channels for cooperation between the Bank and the FSA. The management groups of the Bank's Financial Markets Department and the FSA meet at least twice a year. The banking sector forecast process also pulls the staff from both institutions together twice a year in a systematic manner. In addition, there is active cooperation in the form of numerous informal meetings at the staff level. In the area of oversight of payment and settlement systems, cooperation between the Bank and the FSA is based on a mutually agreed Memorandum of Understanding.

For fruitful cooperation, smooth and timely exchange of all relevant information between the two bodies is essential. Other secrecy provisions notwithstanding, there are no legal constraints on the flow of information from the FSA to the Bank, provided that the information is necessary for carrying out the Bank's statutory tasks. Similarly, the Bank is obliged - secrecy provisions notwithstanding - to provide information to the FSA for supervisory purposes.

In addition to the department- and staff-level cooperation, a representative of the Bank of Finland acts as the FSA's chairman of the Board. Normally, this is the Bank Board member who is responsible for financial stability issues at the Bank. This arrangement further enhances the smooth flow of information between the FSA and the Bank of Finland.

Finally, a number of areas of analysis and research have been identified that would benefit from close cooperation between the staff of the Bank and of the FSA. The lists of issues for analysis and research by both institutions are regularly reviewed throughout the year to identify issues of common interest. The aim is to combine the practical supervisory experience of the FSA staff with the analytical skills of the Bank staff. Recent topics for cooperation include the risks in the interbank markets and channels for contagion, and an evaluation of banks' forex risk exposures.

In summary, the current arrangement via which the FSA is closely connected to the Bank has proved very fruitful for the macroprudential analysis carried out at the Bank of Finland. The cooperation is also welcomed by the FSA in that it provides the supervisory functions with background information about the economic and financial environment in which the supervised entities operate.

5. Concluding remarks

The severe banking crisis of the early 1990s is reflected in the framework for macroprudential analysis currently employed at the Bank of Finland. A specific tool that was developed for the needs of crisis management at that time - the banking sector forecast framework - has turned out to be useful in the regular financial stability analysis of the Bank. Recent developments in the financial sector pose challenges to the forecast process, but the same is true for the macroprudential analysis of central banks in general. Some avenues for enhancing the applicability of the banking sector forecast framework were identified in this paper.

The transfer of the Financial Supervision Authority to a closer relationship with the Bank of Finland in the midst of the banking crisis has proved to be fruitful for the conduct of macroprudential analysis at the Bank. As the very idea of macroprudential analysis is to combine both macro- and micro-level information to yield new insights into the extent of system-wide risks in the financial markets and their likelihood of realisation, the smooth flow of information between the prudential supervisory and the macroprudential functions is essential. It may be noted that the work which is currently being undertaken within the ESCB's Banking Supervision Committee (BSC) aims at exactly the same objective, that is, combining both the supervisory insight of national supervisory authorities and the macroeconomic insight of national central banks and the ECB to obtain a macroprudential view of the state of EU and euro area banking systems.

The importance of macroprudential analysis is growing because of accelerating evolution of structures in the European and international financial markets. The consolidation process profoundly affects financial fragility in the economy and systemic risks in the financial markets. These trends constitute both challenges and motivation for further development of the Bank of Finland's present macroprudential framework.

Appendix: List of figures and tables included in the Financial Markets Report of the Bank of Finland

Area	Figures/tables
Financing behaviour	• Financial assets in Finland, percentage breakdown • Household debt and debt servicing costs • Financial assets of households • Household debt stock by creditor and by use • Corporate debt stock by creditor • External finance for corporations, flow-of-funds • Corporate debt, stock and per cent of value added • Number of bankruptcies by industry • Number of bankruptcies and payments in arrears • Central government debt stock by instrument
Financial intermediation	• Exposures of industrialised countries' banks to emerging countries • Exposures of EMU area banks to emerging countries • Cost/income ratios of banks in selected countries in Europe and the United States • ROE of banks in selected countries in Europe and the United States • Breakdown of income of Finnish deposit banks • Profitability of Finnish deposit banks • Solvency of Finnish deposit banks • ROE of Finnish deposit banks • Cost/income ratio of Finnish deposit banks • Credit stock to domestic public by creditor • New loans to corporations by industry • New loans to households by use • Average interest rate on new loans by domestic banks • Interest rate margin of domestic banks • Breakdown of assets of deposit banks • Deposit stock by interest rate linkage • Loan stock by interest rate linkage • Non-performing loans and credit losses of deposit banks • Market shares in deposits • Market shares in loans • Assets of mutual funds registered in Finland by type of fund • Assets of Finnish insurance companies • Investments by Finnish pension funds in central government debt
Securities markets and exchanges	• Stock market capitalisation as percentage of GDP in selected countries • Market capitalisation of shares quoted on HEX • Market capitalisation of quoted shares: euro area vs the United States vs Japan • Turnover of quoted shares: euro area vs the United States vs Japan • New issues of quoted shares: euro area vs the United States vs Japan • Stock indices: world, global industrial indices • Stock indices: euro area, United States, Japan • 10-year government bond yields: Finland, Germany, United States, Japan • International bond stock by issuer • International bond issuance by issuer, net • Financing from international markets, by instrument • Market capitalisation, HEX • Market capitalisation and foreign ownership, HEX

	• New equity issuance in HEX • Turnover of equity trades, HEX • HEX indices, general and by industry • Money market instruments, stock • Bonds issued in Finland, stock • New bond issues in Finland • Finnish government benchmark bonds, stock and trading volume • Trades settled in APK (Finnish Central Securities Depository), value and number • Percentage of trades settled on time
Payment and settlement systems	• Average size of payments processed in the EU payment systems • TARGET payment volumes within the European Union • TARGET payment volumes between Finland and other EU countries • Relative use of payment media in selected countries • Average size of BoF-RTGS payments by type • Average number of transactions in BoF-RTGS system • Average value of transactions in BoF-RTGS system

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To what extent are prudential and accounting arrangements pro- or countercyclical with respect to overall financial conditions?

Laurent Clerc*, Françoise Drumetz* and Olivier Jaudoin**[1]

1. Introduction

The 1998 financial turmoil on international capital markets has suggested some weaknesses in the Basel Committee's 1988 Capital Accord. Criticism has focused not only on the measures of risk used in this framework, but also on its ability to incorporate key insights from the theory of finance, such as the fact that it does not generate any capital advantage for banks that have well diversified portfolios. Moreover, it has also been recognised that bank capital pressures may have led to cyclical movements in banks' lending, increasing macroeconomic instability.

The paper focuses on the latter issue. It assesses to what extent the new proposals by the Basel Committee - the New Capital Adequacy Framework - address the issue, taking account of the fact that, as underlined by Furfine (2000), banks tend to optimally respond to the economic incentives they find in the regulations.

The paper argues that although the envisaged reform improves on the previous Accord, it does not reduce the procyclical character of bank lending. An illustration is provided by an assessment of one of the "pillars" of the reform that involves a greater reliance on agency and internal ratings. While such a proposal is well reasoned, it also appears not to be immune to this criticism.

Refinements, such as the extension of fair value accounting, that are also liable to put in place a new set of incentives do not seem to provide better results on these grounds, may also raise other serious concerns for the conduct of monetary policy. For example, fair value accounting may result in a situation where the countercyclical role of monetary policy could conflict with financial stability considerations. The paper then explores other alternatives proposed in the literature and elaborates on dynamic provisioning to cover expected losses.

In the context of the New Capital Adequacy Framework, the paper stresses the conceptual gap between the growing sophistication in the forward-looking measurement of risks when supervisors are dealing with capital requirements and the crude and static provisioning methods governing accounting rules. Pending a change of these accounting rules, supervisors may design capital requirements so that expected losses would be adequately covered. Some countries like Spain have already implemented such new provisioning rules.

Dynamic provisioning may serve financial stability in a number of ways including encouraging risk-adjusted pricing by banks, reducing the procyclicality of bank lending, and strengthening banking systems ahead of an economic downturn. Its implementation, however, has to overcome traditional accounting and taxation principles.

2. The envisaged reform of bank capital requirements could enhance the procyclical character of bank lending

Since the implementation of the 1988 Basel Accord in the early 1990s, several studies have discussed the effect of capital standards on banking behaviour. Evidence has been provided for the United States by Haubrich and Watchel (1993), Hall (1993), Berger and Udell (1994) or Thakor (1996), for Japan by Ito and Sasaki (1998) and for the United Kingdom by Ediz et al (1998), to name a few. The papers generally conclude that banks substituted away from high risk-weighted assets, shifting from corporate lending to increase their holding of government securities. According to these papers, banks

[1] The views expressed in this paper are those of the authors and do not necessarily reflect the opinion of the Bank of France and/or of the French Banking Commission. *Bank of France, Directorate General Research and International Relations, **French Banking Commission.

also reduced lending as a result of the implementation of the Basel Accord, though this conclusion is controversial for the UK experience. More recently, the focus has moved towards the issue of whether the current system of prudential regulation amplifies the financial and economical cycles. In this section, we analyse the extent to which the envisaged reforms of bank capital requirements may or may not reduce the procyclical character of bank lending.

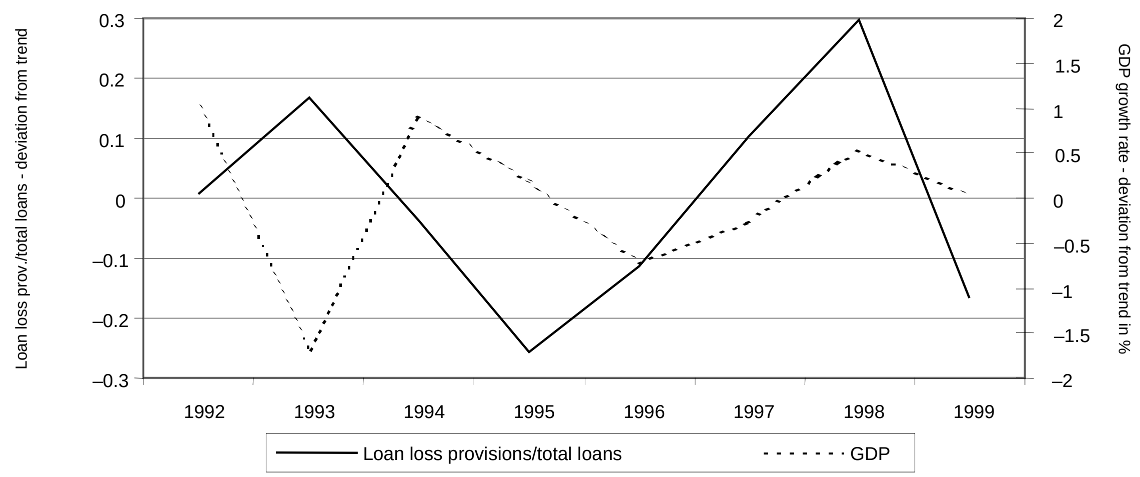
2.1 Bank lending aggregates can be expected to be cyclical

The empirical characterisation of the possible procyclicality of bank lending is made difficult since it is sometimes hard to distinguish what results from supply or demand behaviour. Credit aggregates generally summarise both these effects. In the French case, the link between credit aggregates and the business cycle is not straightforward. As shown by Grunspan et al (1997), who focused more specifically on the demand side, the dismantling of the direct control of the volume of bank lending - a period known as *the désencadrement du crédit* - accompanied by deep changes in French financial markets hase led, since the mid-1980s, to a weakening of the link observed between credit aggregates and GDP growth in comparison with the previous decade.

However, more specific indicators tend to show that banks' behaviour has remained procyclical in recent years. An illustration is provided by the ratio "*loan loss provisions/total loans*".

Figure 1

Loan loss provisions / total loans and GDP growth in France



Sources: Fitch-IBCA; Primark-Datastream; BdF calculations.

From 1992 to 1999, a period which roughly corresponds to the last French business cycle, the ratio of "*loan loss provisions/total loans*", expressed as a deviation from its trend measured over the 1990s, moved in the opposite direction to the GDP growth rate. During the 1993 recession, loan loss provisions increased quite significantly before being scaled back during the recovery period that started in 1994-95. The end of the 1990s showed a similar pattern, as loan loss provisions rose whilst the GDP growth rate moved below its trend. At the same time, total loans tended to move in line with the GDP growth rate, though it is difficult to break down this movement into demand and supply side effects. Evidence suggests that banks use loan loss provisions (LLP) to cover losses due to the default of their borrowers or their failure to repay principal and/or interest.

From a supervisory point of view, the accounting treatment of credit risk could be improved. At present, this risk is generally accounted for item by item when it occurs or is likely to occur, as a result of impairment, asset depreciation or liabilities appreciation or strong presumptions of commitment value degradation. So the accounting effects of risks are often perceptible too late, a short time before charging off. In this sense, provisions do not reflect the true inherent credit risk of the loan portfolio.

For these reasons, it can be argued that the current accounting treatment embedded in the regulation triggers the procyclicality of banks' lending behaviour.

2.2 Moreover, there is a well documented "credit cycle" in most countries, with banks moving down the credit curve as the cycle expands

2.2.1 Although the theory is not clear-cut on bank lending …

On the theoretical side, there is no clear consensus about banks' lending behaviour over the business cycle. On the one hand, it can be argued that banks behave procyclically, that is, banks reduce their provisions and expand their lending in the boom phase of the business cycle, and sharply reduce lending while increasing provisions in the recession. Such a point of view generally stresses the role of uncertainty and imperfections on the credit market. It could be mitigated, however, by the introduction of risk considerations, according to the distinction between risk and uncertainty introduced by Knight in 1921. For example, high market risk would occur if a bank's loan portfolio were concentrated on booming sectors that may be subject to boom-bust dynamics, in areas that are highly dependent on cyclical economic conditions (eg real estate) or in sectors with returns significantly higher than the market rate of return. (Gonzalez-Hermosillo (1999)). Risk considerations would, under such circumstances, imply countercyclical provisioning behaviour.

On the other hand, assuming efficient credit markets, banks should be able to accurately assess and foresee risks over the business cycle. As a result, as the demand for loans expands during the upturn, banks could increase their margins, augment their capital and constitute loan loss provisions in order to cover both future unexpected and expected losses. Conversely, the provisions accumulated in the boom phase would act as a buffer during the downturn, smoothing both the bank results and the economic cycle. Capital accumulation would provide the banks with a supplementary cushion, allowing them to cover unexpected losses. Here again, the argument has to be qualified since evidence suggests that credit markets are not perfect and are likely to be subject to information asymmetries. Moreover, competition might also increase in the boom phase. As a result, margins could be reduced by competitive pressures, contributing to the procyclical behaviour of the banking sector.

2.2.2 Credit markets are likely to be imperfect …

As mentioned above, a strand of the literature has focused on credit market imperfections. According to this view, banks are likely to overestimate the creditworthiness of borrowers in the boom phase of the business cycle, expanding loans and contributing to amplifying the cycle. Such behaviour might be exacerbated by competitive pressures. Banks may assess risks accurately and as a consequence ask for a higher premium on external finance. However, due to competitive pressures, they could also compensate for a higher premium by increasing the volume of loans.

One rationale behind this kind of behaviour is the concept of "*disaster myopia*" developed by Guttentag and Herring (1986). In this approach, the bank manager knows only that there is a small but finite probability of disaster occurring. He has neither a priori knowledge of this probability nor sufficient information to estimate it from historical record. During the boom phase of the cycle, this subjective probability of disaster may decline, leading the bank to lend to a broader range of borrowers. Put another way, some borrowers who were considered as too risky in the earlier phase of the cycle could obtain loans more easily as the cycle expands. As a consequence, the quality of banks' portfolios may deteriorate and become riskier in the mature phase of the cycle. As emphasised by Herring (1999), the financial system may become increasingly vulnerable to a crisis in periods of benign financial conditions, as the probability of disaster is considered to be nil. In the "*disaster myopia*" context, bank asset quality deteriorates without the bank having consciously taken the decision to accept greater risk.

Asymmetries and credit market imperfections also play a key role in the broad credit channel literature. Adverse selection effects, as highlighted by the seminal paper by Stiglitz-Weiss (1981), may create situations where the tendency for riskiness of default worsens as the cycle expands, because of interest rate increases due to a higher demand for loans or as a result of a monetary policy tightening. High interest rates may potentially attract bad quality or very risky borrowers, who try hard to get loans to pursue their project and who do not really bear the risk. These kinds of moral hazard considerations introduce further complications. Gertler (1988), Bernanke (1993), Bernanke and Gertler (1989), Bernanke et al (1999) and Kiotaky and Moore (1997) stressed the role of collateral in such a context:

in order to prevent moral hazard, the bank may ask the entrepreneur either to engage his own funds, or a part of his net worth, in the project or require collateral for a loan, thus introducing wealth effects in both the credit and the economic cycle. For example, in the buoyant phase of the business cycle, as net worth increases, the cost of external finance decreases, favouring investment, which reinforces both the firm's net worth and the business cycle. But these authors also point out the key role played by agency costs: a monetary tightening that raises interest rates and generates a real economic slowdown will cause a firm's balance sheet to deteriorate, raising agency costs and lowering the efficiency of credit allocation.

More generally, evidence suggests, to the extent that the credit cycle tends to coincide with the business cycle, that the risk of a sharp downturn in asset quality during the mature phase of the business cycle could rise dramatically (IMF (1998)). However, banks do not seem to increase their provisions accordingly.

2.2.3 Consequently, bank profits tend to move in line with the economic cycle

To recap, credit losses are cyclical. The pattern of bank results is then mainly driven by changes in the charge on bad and doubtful debts. The current accounting practice is to make provisions for credit risk only when the recovery of a loan is considered as dubious, because of a deterioration in the creditworthiness of the borrower. This implies that provisions or bad debt charges are related to already observed information and consequently do not reflect the real amount of credit risk the bank carries. Thus, the current method of loan loss provisioning accentuates the impact of business cycles on banking profits, which tend to be overestimated during an upswing and underestimated during a downswing.

2.3 Capital requirements are likely to affect banks' behaviour

2.3.1 The effects of capital requirements are likely to be asymmetric over the business cycle …

Asymmetries in banks' behaviour over the business cycle may also result from capital requirements. As banks' balance sheets deteriorate during downturns, in conjunction with declines in loan demand and increased default risks, banks may face a substantial capital contraction. To deal with this situation and comply with the capital adequacy regulations, banks may either try to raise new capital or cut back on lending. However, capital issuance may be difficult or very costly in situations where the economy is decelerating and banks' balance sheets are deteriorating. For such reasons, it can be argued that, during downturns, banks may prefer to cut back on their loan base (Mishkin (1999)). As mentioned in the financial accelerator literature, such a contraction in bank lending will reduce even more the firms' ability to invest and will trigger a deeper recession. Conversely, during booms, banks may find it easy to raise equity capital.

2.3.2 ... and may well have macroeconomic consequences in some periods

The Basel Committee on Banking Supervision (1999) surveys a wide range of empirical studies dealing with this issue. However, the discussion is usually plagued by the fact that it is generally difficult to isolate loan supply shocks from loan demand shocks. By contrast, focusing on the commercial real estate market, rather than on commercial and industrial lending, which is more tied to national business conditions, Peek and Rosengren (2000a) identify a true exogenous loan supply shock, which occurred through Japanese banks in the United States. One of the main findings of the paper is that "*binding risk-based capital requirements associated with the Japanese stock market decline resulted in a decrease in lending by Japanese banks in the United States*". They show that the Japanese banks' pullback significantly reduced construction activity in those US markets with a large Japanese bank penetration, leading to a significant economic shock. More important is the fact that binding capital requirements in one country may result in "*collateral damage*" (Peek and Rosengren (2000a)) in another country, pointing out that capital requirements may eventually affect the international business cycle. Though this latter development is probably extreme, it illustrates the fact that more interdependent economies are also probably more exposed to exogenous shocks.

2.4 The reform of the capital adequacy system could enhance these procyclical effects

To what extent do the proposals to reform the international capital adequacy system interfere with these procyclical effects?

2.4.1 Internal ratings

In the proposals included in the Basel Committee's New Capital Adequacy Framework, greater reliance is placed on internal processes to set banks' capital. However, this generally well perceived approach raises several problems, as pointed out by Karacadag and Taylor (2000): it probably underestimates the degree of inconsistency or inaccuracy in internal ratings, which may widely differ within and across countries. On the other hand, such a choice is nothing but the recognition that standardisation is inappropriate and that capital adequacy must vary according to banks' characteristics (quality and types of assets, management, etc). As a consequence, the use of "*mechanical formulas*" should play a rather limited role (Estrella (1998)) in the design of the New Capital Adequacy Framework.

In principle, internal ratings may have important advantages compared to external ratings: they potentially incorporate proprietary information on bank clients that is unavailable to the public and to rating agencies. They should generate more accurate credit risk assessments of the borrower. However, a problem arises since banks appear to have generally limited data and techniques available to estimate loss characteristics. Furthermore, internal ratings are generally criticised because they are "point in time" assessments of borrower creditworthiness: a survey carried out by the BIS (2000) on internal rating systems provides some evidence that banks usually base their internal rating on a borrower's current condition with a time horizon of one year. The implication of such a practice is that internal ratings are likely to be more procyclical because of this short time horizon, since it is shorter than the usual duration of a business cycle. Such an issue could be related to the concept of "*disaster myopia*" mentioned previously. Because risk assessment is based on a short horizon, and may vary quite a lot across banks, which may use a wide range of practices, most likely depending on their size, internal ratings may not really constitute an improvement regards dealing with this procyclicality issue.

2.4.2 Another proposal builds upon external ratings

Karacadag and Taylor (2000) highlight some advantages of external ratings, which will be used in the standardised approach of the new Accord: they are more likely to be stable than market prices and probably less procyclical than internal ratings. Such an approach is also probably easier to implement than the latter. The main argument is that external ratings should ensure greater accuracy and consistency of methodologies than internal ratings, which imply having to compare a wider range of practice.

However, external ratings have been criticised recently (IMF (1999)) because of the failure of agencies to give advance warning of the Asian crisis. On these grounds, rating agencies' practice also had a macroeconomic destabilising impact. As a consequence of sharp bank balance sheet deterioration, rating agencies heavily downgraded some of these banks. This decision had a procyclical effect on capital flows, as illustrated by Caballero and Krishnamurthy (1998). Furthermore, downgrades led banks to increase provisions on loans in order to satisfy capital requirements, raising the cost of external finance for firms or reducing lending. Developing an open-economy version of the model of Diamond and Dibvig (1983) on bank runs, the Chang and Velasco (1998) framework can be used to show that such a reduction in bank lending may have resulted in a deepening of the crisis. Such a process relies upon the usual credit channel or financial accelerator effects. This statement can, however, be balanced by the 1998 IMF report on international capital markets, which acknowledges the agencies' proven track record in the US market. The report also insists on the fact that ratings may have been stabilising rather than destabilising during the Asian crisis, to the extent that downgrades were much less severe than the surge in loss probabilities implied in the risk premia demanded by the market.

Nevertheless, rating agencies are private companies, in fierce competition with one another and accountable to shareholders who are motivated to earn dividends as the cycle expands. This does not prevent these external rating agencies from being procyclical as well. Furthermore, Altman and Saunders (2000) suggest that a capital adequacy system built around traditional agency ratings may follow rather than lead the business cycle, resulting in an enhanced rather than a reduced degree of instability in the banking system.

Although banks may remain the principal providers of loans, increased competition between banks and credit markets has also led to a situation where the most creditworthy bank customers can obtain credit on better terms from credit markets than from their banks. As a consequence, the average credit quality of the remaining bank loan has probably declined. According to this statement, managing credit risk is generally perceived as a very challenging issue which the development of credit risk models tries to address (cf Carey (2000) or Herring (1999) for recent references). However, credit risk models also face the problem of assessing credit risk accurately. Although some of these models rely on sophisticated approaches, the assessment of risk is generally based on recent bank experience since, here again, risk assessment is based on a horizon which is shorter than a complete business cycle. Therefore, credit risk approaches are not immune to the procyclicality criticism.

The envisaged reform improves the previous accord by focusing on risk assessment and trying to take into account bank asset quality. However, it does not seem to reduce the procyclicality of banks' behaviour. Alternatives, such as fair value accounting, are also envisaged. One is thus led to ask to what extent such an alternative deals with the procyclicality issue.

3. Fair value accounting

Under historical cost accounting, changes in value are not recognised until realised. Under full fair value accounting, unrealised holding gains and losses are recognised in current earnings. In view of the steady development of supposedly efficient financial markets, it is assumed that a "*fair value*" can be calculated for any asset or liability, even a non-traded one, by comparison with market valuations of instruments or types of risks with similar characteristics. Proponents of full fair value accounting believe that full fair values might better reflect underlying economic values and might improve the quality of information available to investors and regulators because this method of measurement captures changes in risks occurring during the holding period. It would also allow enterprises less latitude to "*manage*" earnings, thereby enhancing the comparability of financial statements.

Under the current system of partial fair value accounting, in most countries financial instruments held for trading ("*trading book*") are measured at fair value and instruments held longer term ("*banking book*") are usually recognised at amortised cost. Derivatives are accounted for in the same manner as the item hedged.

For accounting purposes, the IASC[2] favours fair value over historical cost plus accrued earnings. According to the provisions of IAS 39, all derivatives and financial instruments held for trading or available for sale will be shown at fair value.[3] Assets held to maturity, loans and most financial liabilities will be accounted for at amortised cost.

This extension of the use of fair values in accounting for financial instruments is part of a longer-term project assigned by the IASC to the Joint Working Group of Standard Setters (JWG) to develop proposals for the use of full fair value accounting for all financial assets and liabilities in the primary financial statements (Basel Committee on Banking Supervision (2000)).

3.1 According to its proponents, full fair value accounting might improve market and regulatory discipline

Berger et al (1995) argue that the book value measure of regulatory capital does not reflect a bank's ability to withstand a loss without imposing a cost on creditors or the constraint on moral hazard. Using capital ratios and net worth requirements based on full fair value accounting, regulators, by measuring true net worth, could close a bank before capital is fully dissipated. For example, using fair value

2 International Accounting Standards Committee.

3 IAS (International Accounting Standard) 39, "*Financial Instruments: Recognition and Measurement*", implementation date: January 2001. Financial instruments include shares, bonds, loans and derivatives.

accounting, regulators would have addressed the savings and loan crisis in the United States earlier (Barth et al (1995)).

Full fair value accounting would also create a framework that compels bank managers themselves to confront portfolio problems as they develop (Berlin et al (1991)).

Furthermore, full fair value accounting would be superior to the current "*mixed*" historical cost/market value model. According to Jackson et al (2000), the "*mixed*" model is not sustainable because banks tend increasingly to view their exposures on a "*whole bank*" basis. Therefore, hedging strategies do not fit easily in this model.

3.2 However, reservations or concerns have been expressed regarding the extension of fair value accounting on five grounds

3.2.1 Fair value accounting and the principle of prudence

Fair value accounting considers latent profits and latent losses similarly. However, a prudential attitude does not count latent profits except on liquid instruments. Thus, the impact of this choice can be strong as regards the volatility of financial information.

3.2.2 Full fair value accounting could impair the "special" function of the banking system

Berger et al (1991) underline that full fair value accounting is not consistent with the view that bank lending is "*special*". The definition of a market value for a bank loan is more in line with a view of banks as portfolio managers of securities than as resolvers of information and monitoring problems.

Furthermore, full fair value accounting could enhance the procyclical character of bank lending. Berlin et al (1991) assert that capital requirements based upon current market values may impair the banking system's "*special*" function as a backup source of liquidity for the real sector of the economy during periods of stringency in direct credit markets. Bank credit positions could more closely mirror those of direct credit markets.

3.2.3 Practical measurement and verification issues in defining full fair values

Under full fair value accounting, the book value of unmarketed bank instruments would have to be adjusted for changes in the credit quality of the instruments' counterparties and in interest rate levels. The choice of the method to be used in the present value calculation of non-marketable assets and liabilities raises a number of difficult issues (Berger et al (1999), Jackson et al (2000)).

For example, according to Jackson et al (2000), in the case of loans, (i) contractual returns could be discounted using the current yield on corporate bonds with a similar rating; (ii) expected losses could be deducted from future cash flows before discounting using the current expected return on similar types of loans; or (iii) in an approach preferred by the authors, contracted payments on loans would be discounted using the current yield at issue on new loans of a similar type.

Therefore, there are a number of possible implicit values that could be assigned to non-marketable assets and liabilities previously held at cost. The private nature of the information used could create a verification problem for regulators and auditors. According to the Basel Committee on Banking Supervision (2000), the difficulties in calculating reliable fair values in some countries could call into question the auditability of these values.

Moreover, the use of a current rate of interest in the present value calculation raises the issue of whether it would result in heightened volatility in values and net worth and might encourage short-termist behaviour.

3.2.4 Earnings of banks could become more volatile as realised gains and losses are passed through to the income statement

Critics of extended or full fair value accounting argue that it could have adverse effects on financial stability. Earnings figures based on variations in market prices are likely to be more volatile than those based on historical cost. This increased volatility does not reflect the underlying economic volatility of banks' operations. For many banks, "*trading book*" activities are fundamentally different from *"banking* *book"* activities and risk management is not the same in both cases. Most bank assets and liabilities are still likely to be held to maturity. Variations in the market value of an instrument held to maturity do not represent a risk as long as the financing of the holding is secured. Therefore, changes in the fair value are not clearly real changes in income or capital.

Moreover, introducing more fair value accounting on the asset side of the balance sheet while reporting most liabilities at cost, such as under the provisions of IAS 39, might not reflect the reporting bank's underlying management practice, for example in the case of matched asset and liability positions, but would increase the risk of volatility in reported earnings (Basel Committee on Banking Supervision (2000)). This increased volatility could lead to inefficient capital allocation decisions by investors, thus raising banks' cost of capital.

On the other hand, Berlin et al (1991) question the social welfare benefits arising from bank "*income smoothing*": reporting accounting numbers that reflect current economic values should presumably increase the efficiency and quality of accounting information.

According to Jackson et al (2000), whether full fair value would lead to more volatile net worth would depend on the extent to which a bank hedges its interest rate risk and on the impact of the treatment of loans. Since the value of loans is more directly dependent on the evolution of the economic cycle than on interest rate changes, it does not generally exhibit sharp fluctuations. If this characteristic were taken into account in the determination of the value of the loan book, volatility would be limited.

However, it could be argued that the use of a current market rate in the present value calculation would generate volatility.

The available empirical evidence on the effects of partial fair value accounting (eg Barth et al (1995), Yonetani and Katsuo (1998)) shows that earnings are significantly more volatile when using fair value accounting for investment securities than when using historical cost. But the market does not seem to perceive this additional earnings volatility as additional risk since share prices do not reflect the incremental volatility.

However, Yonetani and Katsuo (1998) suggest that the impact of the additional volatility could depend on the level of bank capital. Focusing on banks with low Basel capital adequacy ratios, they find, in the case of Japan, that fair value earnings volatility is reflected in their share price, thereby raising their cost of capital.

The results of these empirical studies should, however, be qualified since the introduction of full fair value accounting would represent a "*regime change*" liable to lead to a change in investors' and banks' behaviour.

3.2.5 Fair value accounting and monetary policy

The potential increase in volatility under extended or full fair value accounting raises the issue of the interferences between the choice of accounting principles, monetary policy and financial stability, particularly in the light of the recent crisis in Asia.

For example, in a developing country context, the central bank may hesitate to raise interest rates sufficiently if this tightening of monetary policy could lead to the collapse of a fragile banking system (Mishkin (1999)). Increases in interest rates can have a negative effect on bank balance sheets: if the assets of a bank have a longer duration than its liabilities, a rise in interest rates lowers the value of assets more than it raises the value of liabilities, thus causing a decline in net worth; moreover, the already high proportion of non-performing loans, because of excessive risk-taking before the crisis, is liable to increase. This known weakness of the central bank, which increases the vulnerability of the country to crises, could be compounded if fair value accounting is applied, creating additional volatility.

However, one of the explanations of this short-term conflict between the countercyclical role of monetary policy and financial stability considerations is the deterioration of bank balance sheets prior to the crisis. To prevent future financial instability, countries need to rebuild their regulatory and supervisory systems.

Given the range of issues involved and their complexity, Jackson et al (2000) conclude that a shift to full fair value accounting would be premature. The Basel Committee on Banking Supervision (2000), noting that there is uncertainty as to the benefits of fair value accounting and a lack of guidance in determining fair values, comes to a similar conclusion.

Alternative approaches to full fair value accounting have been suggested in the literature, for example adjusting the loan loss reserve to enable capital to reflect changes in the credit quality of the loan portfolio (see Berger et al (1991), Jones and King (1995)). Jackson et al (2000) note that much could be achieved, even without a move to full fair value accounting, to ensure that accounts more closely reflect underlying economic values and suggest an industry debate on the use of expected loss provisioning.

Several routes are available and need to be studied further with respect to achieving the objective of minimising the potential procyclical behaviour of the new Capital Accord.

4. The future Basel Accord provides some remedies against procyclicality

(a) Theoretically, pillar 2 provides supervisors with the possibility to devise specific instruments or procedures to adjust the level of capital to a bank's risk profile with respect to the capital requirements under pillar 1. To produce countercyclical effects, this case by case adjustment needs, however, the implementation of common criteria and objectives at the banking system level. Through supervisory review (pillar 2), supervisors should verify that regulatory capital is adequate with respect to economic capital. *Unexpected losses*, which are theoretically covered by economic capital, are likely to depend on the volatility of losses though, and hence on the economic cycle. A correct capital allocation will then have to be sensitive to the economic cycle. It is argued that a way to reduce this procyclicality could be to encourage banks to maintain sufficient capital cushions in order to insure against future downturns but this would remain a case by case approach from which it is difficult to expect countercyclical effects at the macroeconomic level.

(b) Alternative routes may also be studied under pillar 3 (market discipline). Increasing market transparency may theoretically lead to a more rapid and more accurate assessment of a bank's ability to manage its risks, and therefore increase pressure on bank managers to promptly address areas of weakness, leading to a timely revaluation of capital building. However, financial markets tend to reinforce the procyclicality of banks' behaviour. Indeed, shareholders tend to be rather procyclical by nature, requiring higher profits from banks in periods of upswing while driving them to be more risk adverse in periods of downswing.

5. Dynamic provisioning may have the advantage of addressing several causes of financial instability

First, the primary line of defence against financial instability is effective risk management at banks themselves, including adequate provisioning. The second line of defence is effective external control over banks, notably strong banking supervision. These two elements are mutually reinforcing.

It may, however, be argued that a way to lessen the sensitivity of banks' capital requirements to economic cycles could be to mitigate bank margin volatility to enable a continuous growth of bank capital, rather than trying to reduce bank capital fluctuations. This could be done using dynamic provisioning. *Expected losses* are in theory covered by margins. However, current accounting practice deals only with *actual losses* and *not expected losses* and risks usually arise with a lag in time which may not match anticipated cash flows. Potential cash flow and asset mismatches may then affect banks' profits and ultimately their capital. *Dynamic* or *forward-looking* provisions could be designed to supplement margins for the *timely* cover of expected losses. In addition, dynamic provisioning would be an in-built mechanism which would be more market friendly than discretionary capital requirements from supervisors.

The adoption of rules to encourage more prudent behaviour must make sense for both banks individually and the financial system as a whole. From this point of view, it may be worth exploring more dynamic or forward-looking provisioning techniques.

At an aggregate level, more dynamic provisioning might play a countercyclical role.

Current provisioning policies adopted by almost all credit institutions do not allow institutions to measure the future risk associated with their portfolios over the lifetime of their exposure at risk and for the duration of the economic cycle. As a result, asset quality generally deteriorates at the bottom of the cycle, the effects of which are accentuated by the need for provisioning.

Moreover, as mentioned previously, capital adequacy ratios tend to come under pressure in recessions as provisioning is often found to be inadequate. Banks, facing difficulties in raising new capital in such circumstances, may be then forced to curtail lending. A credit crunch in recessions will further depress output, and have additional repercussions for the quality of banks' assets.

The implementation of an insurance-based technique, such as establishing a minimum level of provisioning for new lending, would allow banks to cover their (statistically) expected losses with such ex ante provisions and, accordingly, make capital fully available to absorb unexpected losses. As a result, capital would become less prone to cyclical downturns. Banks would consolidate their creditworthiness and better protect their depositors, employees and shareholders, and hence the financial system as a whole.

At an individual level, more dynamic provisioning might help financial institutions to improve their pricing policies and induce them to develop more sophisticated approaches in credit risk management such as Raroc (Risk-Adjusted Return On Capital)™ techniques.

Intensified competition is one significant trend in financial systems. As a result, in order to preserve their positions, banks may be tempted to underprice their risks, notably by offering low rates and then squeezing their margins.

Moreover, this is an opportune moment to encourage more dynamic provisioning.

Most banks are benefiting from the current economic situation and are registering increasing net profits. By assigning part of these retained profits to the coverage of their future expected losses, they can make capital more available to cover unexpected risks.

Prompted by the recognition of the internal ratings-based approach (IRBA) in the Basel Accord review, banks are heavily involved in the development of internal mechanisms to calculate expected and unexpected losses. Given the costly changes that the IRBA will imply for banks' information systems, now is the right moment to draw all the benefits from these efforts.

6. Dynamic provisioning can already be observed in international practice

An examination of existing regulations and practice in the main OECD countries shows that dynamic provisioning is already used in Europe and in Japan, though in different ways. In some other countries (like the United States), regulators[4] use similar techniques based both on the assessment of expected and potential losses associated with banking books and the constitution of "*statistical provisions*" to cover them.

At this stage, such a system is compulsory only in Spain and Portugal. In other European countries, optional systems exist, including several incentives (tax incentives in Germany and Italy for instance). Systems differ from one country to another, in the calculation of provisions and in the extent of the scheme (prudential, accounting and/or fiscal). Nevertheless, in general they are based on the definition of a threshold of provisions as a fixed percentage of the amount of loans, supplementing allowances for bad loans.

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[4] In the United States, the agencies (Securities and Exchange Commission, Federal Deposit Insurance Corporation, Federal Reserve Board, Office of the Comptroller of the Currency and Office of Thrift Supervision) have provided guidance on the Allowance for Loan and Lease Losses (ALLL) methodologies (Interagency Policy Statement on the Allowance for Loan and Lease Losses (ALLL), 21 December 1993). This guidance has recently been supplemented by a proposed policy statement (Federal Financial Institutions Examination Council, Proposed Policy Statement on ALLL Methodologies and Documentation for Banks and Savings Institutions, September 2000). The determination of amounts of ALLL should be based on management's current judgments about the credit quality of the loan portfolio and should consider all known relevant internal and external factors that affect loan collectibility as of the reporting date. In particular, loan losses for groups of loans can be estimated through the application of loss rates to the groups' aggregate loan balances; such rates reflect historical loan loss experience for each group of loans, adjusted for relevant environmental factors (eg industry, geographical, economic and political factors) over a defined period of time.

Spain in particular has developed its regulations regarding dynamic provisioning and strengthened them with a new scheme, applying from 1 July 2000, with an explicit countercyclical aim, based either on the statistical failures experienced by each bank (internal ratings approach) or on a standard approach defined by the Bank of Spain (circular 9/1999, 17 December 1999).

Beyond actual differences in national regulations, it should be noted that several of the main European, US and Japanese credit institutions currently apply dynamic provisioning to several parts of their balance sheet.

7. A wider application of dynamic provisioning is still facing current accounting and taxation principles

To sum up, the main accounting rules in the world support provisioning based on human judgment, loan by loan or regarding homogenous group of loans. As the border between future losses, which have not to be provisioned, and latent losses, which should be provisioned, is very thin, there is already a scope to recognise dynamic provisioning. Yet the current accounting and taxation framework may constitute hurdles in many countries where risks on specific loans need to be identified prior to the allowance of a provision, responding to the concern of discouraging profit smoothing and tax management. In this sense the concept of expected loss, however it is determined, is still far from current accounting notions. The accounting task force of the Basel Committee is actively studying this issue in the framework of the reform.

Consequently it can be worth reconsidering the issue from the prudential viewpoint into which consideration these provisions should be made. Assuming expected losses could not be covered by provisions, one option is to establish additional regulatory provisions for credit institutions outside the statutory accounts. Under this approach capital would have to be restated taking into account any regulatory provisions not included in the accounts. For instance excess margins over the full cost of funding may be used as covering future losses like in the credit cards lending business. This possibility should also be discussed contemplating it in terms of disclosure under pillar 3.

8. How dynamic provisioning might work

The first step would be to determine the expected losses for each category of loan. This exercise may be best performed by banks from their own data on default rates, but in the meantime authorities may also consider a standard approach via a minimum provisioning requirement for each main type of loan.

The second step relates to accounting procedures:

- the requirements could include either the outstanding loans or new ones (as in insurance);
- the accounting and prudential status of the provisions need to be discussed: should they be considered as general allowances and can they be partly included in capital? The answer to this question is also linked with the tax legislation. Dynamic provisions are similar to general provisions in the sense that they are not related to a specific loan, but they cannot be included in capital to the extent they cover expected losses. However, dynamic provisions sometimes exceeding expected losses could be considered as elements of the general provisions admitted in tier two of the Cooke ratio, the main part being deducted from the denominator.

The last step regards the evolution of the mechanism. On the one hand, the provisioning rates must be constantly reassessed. On the other hand, the occurrence of risks must imply specific provisions that can be drawn from the amount of dynamic provisions.

9. Conclusion: dynamic provisioning may be a supplementary factor to financial stability

The current period can be considered by many as an exceptional one in terms of growth and funding.

American supervisors have declared "*banks are now at a critical phase in the credit cycle… After years of high quarterly profits, low delinquency rates and comfortable capital ratios, it is easy to forget the fundamentals of sound lending… It would be a substantial contribution to address potential credit problems pre-emptively before these problems have time to grow from minor disturbances to major disruptions*" (Mc Donough, 2000). French supervisors share this view and are considering how forward-looking provisioning may encourage banks to maintain their capacity to face an economic reverse.

Reliable information provided by banks about this could improve confidence in the stability of their incomes and their soundness. Investors and depositors may find advantages in this proposal. From a macroeconomic point of view, this mechanism may reduce "stop go" banking policies on lending and minimise effects on growth.

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Estimating bilateral exposures in the German interbank market: is there a danger of contagion?

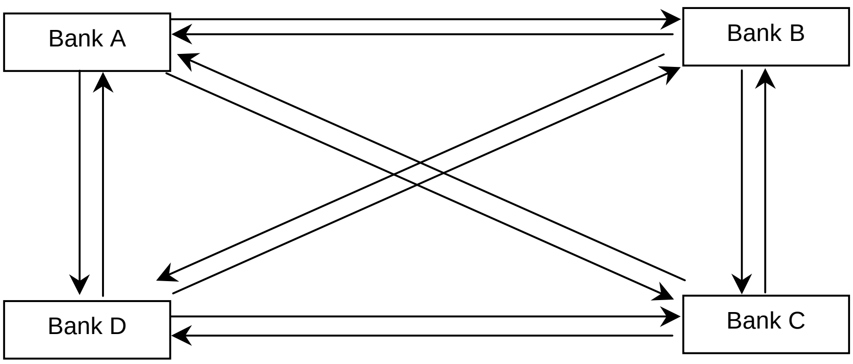
Christian Upper and Andreas Worms[1]

1. Introduction

Credit risk associated with interbank lending may lead to domino effects, where the failure of a bank results in the failure of other banks even if they are not directly affected by the initial shock. Recent work in economic theory shows that this risk of contagion depends on the precise pattern of interbank linkages. In Allen and Gale (2000), banks hold deposits with banks of other regions in order to insure against liquidity shocks in their own region. Here a "region" should not necessarily be interpreted in geographical terms but could in principle refer to any grouping of banks. If a bank is hit by a shock, it tries to meet the liquidity need by drawing on its deposits at other banks before liquidating long-term assets. This pecking order follows from the assumption that the premature liquidation of the long-dated asset is costly, for example because real investment projects have to be abandoned or because long-term lending relationships are interrupted.

Figure 1

"Complete market structure" according to Allen and Gale (2000)



In aggregate, the interbank market can only redistribute liquidity and does not create liquidity of its own. While this is not a problem if the aggregate liquidity need is lower than the aggregate holdings of liquid assets, it may give rise to contagion if the opposite is true. Instead of liquidating their long term assets, banks withdraw their deposits at other banks, thus spreading their illiquidity throughout the financial system. The possibility of contagion depends strongly on the precise structure of interbank claims. Contagion is less likely to occur in what Allen and Gale term a "complete" structure of claims, in which every bank has symmetric linkages with all other banks in the economy (see Figure 1). "Incomplete" structures, where banks have links to only some neighbouring institutions (see Figure 2 for an extreme example), are shown to be much more fragile.

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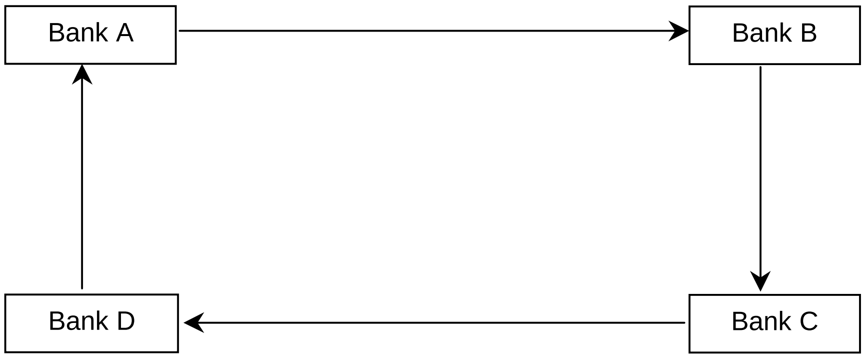
Figure 2

"Incomplete market structure" according to Allen and Gale (2000)



In a related paper by Freixas et al (2000), interbank lending arises from consumers' uncertainty not about *when* to consume (as in Allen and Gale) but about *where* to consume. Their model can be interpreted as a payment system, where interbank credit lines are used to reduce the overall amount of liquid (but costly) reserves. In their setting, contagion can occur even if all banks are solvent. If the depositors in a sufficiently large number of banks believe that they will not obtain payment, it is optimal for them to withdraw their deposits. Since this forces their banks to liquidate their investments, it triggers a run in which all other depositors withdraw their deposits and the banking system reaches gridlock.[2] Besides contagion driven by non-banks' behaviour, the authors also consider the impact that an insolvent bank has on the banking system. They find that interbank connections generally enhance the resiliency (ie the ability to withstand shocks) of the financial system. Interbank credit lines provide an implicit subsidy to the insolvent bank, which is able to spread part of its losses to other banks. Interbank lending thus contributes to loosening market discipline.[3] As in Allen and Gale, a "complete" structure of claims reduces the risk of contagion, while incomplete structures, or "credit chains" (like the one in Figure 2), increase the fragility of the system.[4]

Unfortunately, very little is known about the actual structure of *bilateral* exposures in the interbank market as banks do not report their counterparties. As a consequence, empirical studies concentrate mainly on the payment system, for which such data is available.[5] An exception is Furfine (1999), who uses settlement data to compute bilateral exposures in the interbank federal funds market. He finds that even in his worst case scenario (failure of the most significant bank and a 40% loss rate[6]) only two to six other banks fail, accounting for less than 0.8% of total bank assets. No contagion occurs at all if the loss rate is 5% - such as the one estimated by Kaufman (1994) for Continental Illinois. The results have to be interpreted with care, however, since the fed funds market accounts for only 10 to 20% of total interbank exposures in the United States, although its share is likely to be higher if only uncollateralised positions are considered.

An alternative approach followed by the present paper is to estimate the matrix of bilateral credit relationships from bank balance sheet data. In contrast to studies based on settlement data, this

[2] This can be prevented by central bank guarantees for interbank credit lines. These lines are never used in equilibrium, since by assumption all banks are solvent.

[3] This provides a second rationale for central bank involvement in financial supervision, namely to organise the orderly closure of insolvent banks.

[4] Rochet and Tirole (1996) and Aghion et al (1999) consider the incentives to bail out failing banks by providing interbank loans. The absence of a bailout could be due to a weak financial position of the banking system and thus serves as a signal triggering a bank run. They do not say much about how the precise direction of interbank linkages affects the possibility of contagion.

[5] For example, Humphrey (1986) and Angelini et al (1996).

[6] The 40% loss rate corresponds to the typical loss on assets of a failing bank estimated by James (1991).

permits us to cover interbank lending completely.[7] This comes at a cost, however. Due to the fact that we do not have complete information on the individual counterparties in the interbank business, we need to make assumptions concerning the distribution of bank *i*'s interbank loans and deposits over the other banks. In order to bias our estimates against the hypothesis of contagion, we assume that interbank lending is as dispersed as possible, given the observed distribution of loans and deposits.

Our paper is closely related to Sheldon and Maurer (1998), who estimate a matrix of interbank loans for Switzerland.[8] They come to the conclusion that the interbank loan structure that existed among Swiss banks posed little threat to the stability of the Swiss banking system in the period under consideration. Our work differs from Sheldon and Maurer's in several respects. For computational reasons, they aggregate the individual banks into 12 categories. Our approach is much more disaggregated, because we want to make use of virtually all information on the interbank market that is available to us. Firstly, we consider all German banks individually. Secondly, our data permits us to estimate separate matrices for (i) loans of savings banks to their regional giro institutions, (ii) loans of giro institutions to affiliated savings banks, (iii) loans of cooperative banks to cooperative central banks, (iv) loans of cooperative central banks to cooperative retail banks, and (v) loans and deposits of the remaining "normal" interbank loans. The interbank assets and liabilities in each of these five cases are divided into five maturity categories, giving a total of 25 separate matrices for a given month, which we add up to a system-wide matrix of interbank relationships. Since we fully use this supplementary information - consisting mainly of zero restrictions in the single maturity and loan classes - our estimate should be much more accurate than a matrix estimated with figures for total lending and deposits alone, while maintaining the assumption of a maximum amount of diversification consistent with the data.

The system-wide matrix differs considerably from a matrix estimated from aggregate exposures (across all maturities and banking groups) alone. Interbank lending is much more concentrated, thus making the banking system potentially more vulnerable to contagion according to the results of the theoretical literature. We assess the danger of contagion by letting every bank go bankrupt one at a time and compute the effect of this failure on the other banks. We find that credit exposures in the interbank market can lead to domino effects. At worst, the failure of a single bank triggers a chain that ends with the bankruptcy of almost 15% of the banking system in terms of assets. If we ignore the existing safety mechanisms such as the institutional guarantees in the savings and cooperative bank sector, the results are even more devastating. Our analysis takes the initial shocks leading to contagion as given. We are therefore not able to attach an explicit probability to our scenarios.

It is important to stress that our analysis concentrates exclusively on contagion due to credit exposures in the interbank market. We rule out other channels of contagion like bank runs, which have commanded the attention of much of the theoretical literature and have dominated the discussion on banking regulation.[9] We believe that this omission is justified not only for methodological reasons, in that it permits us to isolate one specific channel of contagion. Contagion due to bank runs by non-bank depositors in the wake of the breakdown of a single institution are highly unlikely in Germany, where virtually all deposits by non-financial institutions are insured. The type of contagion we analyse is dependent less on the *behavioural* interdependence of the respective parties and more on the interdependence due to interbank linkages. In this sense, it can be described as being "mechanical".

The paper is structured as follows. After a description of the data set, we present the estimation methodology. This is followed by a section on the structure of the German banking system in general and the interbank market in particular. In Section 5, we then estimate the danger of contagion in the German interbank market, leaving aside for a moment banking supervision and the existence of "safety nets". We find that in this case, contagion may lead to the breakdown of a large part of the German banking system. We also confirm the proposition given by the theoretical literature that symmetric (in the extreme: "complete") structures are less vulnerable to contagion than asymmetric ("incomplete") structures. Having done this, we measure the importance of the relevant "safety nets"

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7 We focus only on direct lending relationships and do not capture exposures arising in the payment or security settlement systems or exposures due to the cross-holding of securities.

8 They also estimate the probability of failure, and thus the likelihood of contagion, which we ignore.

9 The seminal theoretical paper is perhaps Diamond and Dybvig (1983).

existing in Germany in order to prevent such scenarios. Our results suggest that these institutions and regulations dramatically reduce, but not eliminate, the danger of contagion. A final section concludes.

2. Description of the data

The analysis is based on balance sheets, which all German banks have to submit to the Bundesbank every month. At this stage, we only consider the balance sheets from end-December 1998, but we plan to make use of the time series dimension of the data in future work. In their submissions, banks have to state whether their counterparty in the interbank market is a domestic or a foreign bank, a building society (*Bausparkasse*) or the Bundesbank. Savings banks and cooperative banks also have to identify lending to giro institutions (*Landesbanken*) and cooperative central banks, respectively (and vice versa). In addition, all banks have to break down their interbank business into five maturity categories (listed in Table 1)[10]. Since our data only cover domestic banks and the German branches of foreign banks, we exclude loans to and deposits from building societies, the Bundesbank and foreign banks. This leaves us with a closed system for each maturity category, where all interbank loans and deposits add up to zero in principle.

In practice, discrepancies between assets and liabilities do arise (see row “All banks” in Table 1). They are particularly acute for overnight loans and deposits, where the latter consistently exceed the former by around 10 to 15%. One possible reason could be the existence of floating transactions. Since the German payment system is mainly transfer-based, the interbank liabilities of the payer’s bank tend to increase before the corresponding asset position of the payee’s bank. For this reason, the individual asset positions were scaled such that their sum matches that of the liability positions within the same maturity category. Another possible source of the discrepancies between assets and liabilities are errors in the data. The database has been checked for consistency (eg all positions on the balance sheet have to satisfy an adding-up constraint), but entries in the wrong category remain a possibility.

Table 1 shows the maturity structure of the interbank assets and liabilities of all German banks, both vis-à-vis all other banks, including foreign banks, building societies and the Bundesbank, and vis-à-vis the banks contained in our sample only. It is apparent that over all banks, more than half of the interbank assets and liabilities have a maturity of at least four years.

However, this share varies widely across bank types: whereas long-run interbank liabilities are very important for savings banks (91.5%) and for cooperative banks (91.7%), they are less important for commercial banks (36.2%), Landesbanken (45.5%) and cooperative central banks (27.8%). The picture differs considerably when it comes to interbank assets: here, only 8.8% (savings banks) and 11.5% (cooperative banks) of interbank loans have a maturity of at least four years. For the Landesbanken and the cooperative central banks, the corresponding figures are 60.5% and 67.7%, respectively. On the whole, Table 1 shows that the interbank market consists of far more than just the exchange of liquidity on a day-to-day basis. In order to assess the danger of contagion, it is therefore necessary to consider not just these short-run relationships but also, and especially, the longer-term assets and liabilities.

10 Deposits from banks are actually broken down into six categories, which we consolidate into five in order to be able to compare them to the lending side.

Table 1

Interbank assets and liabilities by maturity and broad bank category

(end-December 1998)

	Notes	maturity				
		daily	**> 1 day & < 3 mths**	**≥ 3 mths & ≤ 1 yr**	**> 1 yr & < 4 yrs**	**≥ 4 yrs**
All banks						
Liabilities	**1**	**11.7**	**13.2**	**14.5**	**5.6**	**55.0**
	2	*12.6*	*24.3*	*17.4*	*4.5*	*41.1*
Assets	**1**	**10.6**	**14.1**	**17.2**	**5.6**	**52.5**
	2	*11.2*	*18.8*	*18.0*	*6.0*	*46.0*
Commercial banks						
Liabilities	**1**	**21.1**	**18.0**	**21.3**	**3.4**	**36.2**
	2	*18.6*	*32.6*	*23.7*	*3.2*	*21.9*
Assets	**1**	**22.3**	**30.3**	**27.1**	**5.3**	**14.9**
	2	*20.4*	*35.5*	*26.7*	*5.8*	*11.6*
Savings bank sector						
Landesbanken						
Liabilities	**1**	**9.6**	**19.0**	**17.3**	**8.6**	**45.5**
	2	*9.9*	*26.7*	*18.8*	*6.7*	*37.9*
Assets	**1**	**4.6**	**7.7**	**15.7**	**4.3**	**67.7**
	2	*4.8*	*12.2*	*18.0*	*5.2*	*59.8*
Savings banks						
Liabilities	**1**	**2.7**	**2.2**	**2.0**	**1.5**	**91.5**
	2	*2.5*	*15.3*	*2.9*	*1.4*	*77.9*
Assets	**1**	**20.7**	**38.5**	**28.7**	**3.2**	**8.8**
	2	*20.5*	*39.2*	*27.3*	*3.7*	*9.3*
Cooperative sector						
Central banks						
Liabilities	**1**	**26.5**	**20.5**	**14.3**	**10.8**	**27.8**
	2	*26.3*	*25.9*	*17.1*	*8.2*	*22.5*
Assets	**1**	**9.7**	**5.7**	**18.5**	**5.6**	**60.5**
	2	*9.8*	*10.5*	*22.7*	*5.3*	*51.7*
Cooperative banks						
Liabilities	**1**	**7.0**	**9.3**	**18.9**	**5.9**	**58.9**
	2	*6.5*	*12.8*	*18.0*	*5.2*	*57.5*
Assets	**1**	**2.9**	**4.5**	**5.1**	**7.4**	**80.0**
	2	*2.9*	*4.0*	*5.4*	*6.6*	*81.1*
Other banks						
Liabilities	**1**	**7.0**	**9.3**	**18.9**	**5.9**	**58.9**
	2	*6.5*	*12.8*	*18.0*	*5.2*	*57.5*
Assets	**1**	**2.9**	**4.5**	**5.1**	**7.4**	**80.0**
	2	2.9	4.0	5.4	6.6	81.1

1: Excluding interbank assets and liabilities vis-à-vis foreign banks, building societies and the Bundesbank.

2: All interbank assets and liabilities

3. Estimation methodology

The lending relationships in the interbank market can be represented by the following $N \times N$ matrix:

$$\boldsymbol{X} = \begin{array}{c|c} & \Sigma_j \\ \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1N} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{iN} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{N1} & \cdots & x_{Nj} & \cdots & x_{NN} \end{bmatrix} & \begin{matrix} a_1 \\ \vdots \\ a_i \\ \vdots \\ a_N \end{matrix} \\ \hline \Sigma_i \quad l_1 \;\; \cdots \;\; l_j \;\; \cdots \;\; l_N & \end{array} \qquad (1)$$

where x_{ij} is the credit exposure of bank j vis-à-vis bank i and N is the number of banks. We cannot observe the bilateral exposures x_{ij}, but we do know the sum of each bank's interbank loans and deposits,

$$a_i = \sum_j x_{ij} \quad \text{and} \quad l_j = \sum_i x_{ij}\,, \qquad (2)$$

respectively. This information does not suffice to identify the elements of X, so we are left with $N^2 - 2N$ unknowns. If we want to estimate the bilateral exposures, we have to make assumptions on how banks spread their interbank lending.

With the appropriate standardisation, we can interpret the a's and l's as realisations of the marginal distributions $f(a)$ and $f(l)$, and the x's as their joint distribution, $f(a,l)$. If $f(a)$ and $f(l)$ are independent, then $x_{ij} = a_i l_j$. The assumption of independence implies that interbank loans and deposits are as equally spread over banks as is consistent with the observed marginal distributions. It can thus be interpreted as an equivalent to Allen and Gale's (2000) "complete" structure of claims, where banks symmetrically hold claims on all other banks in the economy, conditioned on the size structure of the banks (see Figure 1).

There are many reasons to believe that independence is a rather poor description of reality, for example because assessing the creditworthiness of a borrower is costly. Nevertheless, it is a convenient way to bias our test against the hypothesis of contagion, and is therefore used whenever we do not have additional information on bilateral exposures.

The independence matrix X in (1) has the unattractive feature that the elements on the main diagonal are non-zero if a bank is both lender and borrower. In this case, using X to compute bilateral exposures would amount to assuming that banks lend to themselves. This unattractive feature does not necessarily disappear as the number of banks increases, if interbank lending or borrowing is relatively concentrated. We therefore need to modify the independence assumption by setting $x_{ij} = 0$ for $i = j$ (see (1*)).[11]

[11] Setting the elements on the diagonal equal to zero also reduces the number of coefficients to be estimated to $N^2 - 3N$ by imposing more structure on X.

$$\begin{array}{ll|l} & & \Sigma_j \\ \boldsymbol{X^*} = & \begin{bmatrix} 0 & \cdots & x^*_{1j} & \cdots & x^*_{1N} \\ \vdots & \ddots & \vdots & & \vdots \\ x^*_{i1} & \cdots & 0 & \cdots & x^*_{iN} \\ \vdots & & \vdots & \ddots & \vdots \\ x^*_{N1} & \cdots & x^*_{Nj} & \cdots & 0 \end{bmatrix} & \begin{matrix} a_1 \\ \vdots \\ a_i \\ \vdots \\ a_N \end{matrix} \\ \hline \Sigma_i & \begin{matrix} l_1 & \cdots & l_j & \cdots & l_N \end{matrix} & \end{array} \qquad (1^*)$$

Unfortunately, it is not obvious a priori how to redistribute the mass of the elements on the diagonal of X to the other elements of the matrix. In principle, we could estimate the elements of X^* by minimising the sum of the squared deviations from the independence matrix X subject to a non-negativity constraint on the elements of X^* and the adding-up constraints given in (2). In matrix notation,

$$\min_{\boldsymbol{x}} \ \boldsymbol{x}'\boldsymbol{I}\boldsymbol{x} - 2al\boldsymbol{x} \qquad (3)$$

$$\text{s.t. } \boldsymbol{x} \geq 0 \quad \text{and} \quad \boldsymbol{A}\boldsymbol{x} = [a', l]',$$

where x is a $(N^2 - N) \times 1$ vector containing the off-diagonal elements of X^*, I is the identity matrix of dimension $(N^2 - N)$, a and l are the marginals, and A is a matrix containing the adding-up restrictions (2). Since the objective function is strictly concave, programme (3) yields a unique solution for the structure of interbank lending X^* that is as close to the independence matrix X as possible.

The cost of solving (3) for a banking system of more than 3,000 banks is prohibitive. One possibility would be to follow Sheldon and Maurer (1998) and aggregate the individual banks into broad categories. Since this would entail a considerable loss of information, we follow an alternative strategy which involves approximating the solution to (3) by means of an iterative algorithm with much lower computational requirements. Our aim is to obtain a matrix that is as close as possible to the independence matrix X and that satisfies the following two conditions:

(A) The elements on the diagonal are equal to zero, and

(B) (B) the elements of row i sum to a_i and the elements of column j to l_j (corresponding to the conditions in (2)).

Our algorithm works as follows:[12]

We begin by constructing two weighting matrices A and L, with elements

$$\alpha_{ij} = \begin{cases} 0 & \text{for } i = j \\ \dfrac{a_i}{\sum_{k \neq j} a_k} & \text{otherwise} \end{cases} \qquad \text{and} \qquad \lambda_{ij} = \begin{cases} 0 & \text{for } i = j \\ \dfrac{l_j}{\sum_{k \neq i} l_k} & \text{otherwise} \end{cases}$$

respectively. Each column of A contains the relative weights of the a_i's given that $a_j = 0$, while the columns of L give the relative weights of l_j's given that $l_i = 0$. These weights add up to 1, that is, $\sum_j \alpha_{ij} = 1$ and $\sum_i \lambda_{ij} = 1$.

We compute a starting matrix $X^{(0)}$ by distributing half of the interbank assets according to the relative weights of the liabilities, and half of the liabilities using the relative weights of the asset positions. Consequently, the off-diagonal elements of $X^{(0)}$ are

[12] The algorithm was developed by Karl-Heinz Tödter.

$$x_{ij}^{(0)} = \frac{1}{2}\left(a_i\lambda_{ij} + l_j\alpha_{ij}\right) \tag{4}$$

and the elements on the diagonal are zero by construction. $X^{(0)}$ has a unit mass, but its rows and columns will not generally add up to a_i and l_j, respectively.[13]

For each row, we calculate the adding-up "error"

$$d_i^a = \sum_j x_{ij}^{(0)} - a_i \tag{5}$$

and redistribute it using L. We obtain $x_{ij}^{(1)} = x_{ij}^{(0)} - d_i^a\lambda_{ij}$.

Likewise, we redistribute the adding-up error for each column, yielding $x_{ij}^{(2)} = x_{ij}^{(1)} - d_j^l\alpha_{ij}$. We repeat this procedure until the adding-up errors fall below a specified convergence criterium.[14]

4. The structure of the German interbank market

As mentioned above, our data contain information on interbank lending and borrowing in each of five maturity categories for:

(1) deposits and loans from savings banks to regional giro institutions (Landesbanken);

(2) deposits and loans from regional giro institutions (Landesbanken) to savings banks;

(3) deposits and loans from cooperative banks to cooperative central banks;

(4) deposits and loans from cooperative central banks to cooperative banks;

(5) all interbank loans and deposits that do not belong to (1) to (4).

This permits us to compute a total of 25 matrices of bilateral exposures, which add up to give the total amount of interbank exposures. We use this added-up, "full information", matrix to test for the possibility of contagion. For (1) to (4), we can compute interbank exposures using the independence matrix X (equation (1)) because no bank appears both as lender and depositor. Where banks do appear on both sides, in (5), we use the algorithm presented in the previous section. In addition, we also compute a matrix of bilateral exposures using interbank borrowing and lending aggregated over cases (1) to (5) and over all maturities. This latter matrix ("baseline matrix") serves as a benchmark, against which we measure deviations from the "complete" claims structure.

Since most banks borrow and lend only at specific maturities (which are usually different from each other), most of the elements of a and l for the different maturity categories are zero. These zero restrictions considerably reduce the number of possible counterparts for each bank, and consequently yield much more precise estimates of the 'true' structure of interbank lending than could be obtained from using aggregate exposures alone. In addition, the full information matrix differs from the baseline matrix in that it uses the available information on the intra-lending patterns of the two giro systems. Tables 2a and 2b show that the structure of interbank borrowing and lending in Germany differs considerably from the benchmark of a "complete" structure of claims (the numbers in each row sum up to 100). The figures refer to the exposures of the average bank within a given category (they are therefore not comparable to the figures from the consolidated balance sheet of each group presented in Deutsche Bundesbank (2000a)).

[13] The choice of the starting values does not matter provided requirement 1 is met and the elements of $\boldsymbol{X}^{(0)}$ add up to one.

[14] We do not show analytically that the algorithm always converges, but we have not encountered any convergence problems in the course of our computations.

Table 2a

Exposures in the German interbank market: deposits

(average % share of banks by category, end-December 1998)

	Inter-bank matrix	Commercial banks	Savings bank sector		Cooperative sector		Other banks
			Landes-banken	Savings banks	Central banks	Coopera-tives	
All banks	full info	5.1	20.3	0.9	58.2	0.5	15.0
	baseline	*15.9*	*30.3*	*7.5*	*8.0*	*6.9*	*31.4*
Commercial banks	full info	31.7	24.6	5.3	6.2	2.2	30.0
	baseline	*15.9*	*30.3*	*7.5*	*8.0*	*6.9*	*31.4*
Savings bank sector							
Landesbanken	full info	18.6	21.5	**19.2**	4.1	1.6	35.0
	baseline	*16.3*	*28.6*	*7.7*	*8.1*	*7.1*	*32.1*
Savings banks	full info	2.8	**75.2**	**0.5**	0.5	**0.3**	20.7
	baseline	*15.9*	*30.3*	*7.5*	*8.0*	*6.9*	*31.4*
Cooperative sector							
Central banks	full info	10.0	10.7	1.8	1.4	**59.0**	17.0
	baseline	*16.2*	*30.8*	*7.7*	*6.5*	*7.0*	*31.9*
Cooperative banks	full info	1.9	5.1	**0.3**	**81.7**	**0.2**	10.8
	baseline	*15.9*	*30.3*	*7.5*	*8.0*	*6.9*	*31.4*
Other banks	full info	18.6	27.6	4.0	4.1	1.6	44.2
	baseline	*16.0*	*30.5*	*7.6*	*8.0*	*6.9*	*30.9*

Note: Linkages *within* a giro system are shaded in grey.

In the baseline, all banks hold virtually the same portfolio of interbank loans and deposits. The only difference comes from the restriction that banks do not lend to themselves. As a consequence, the share of banks within the same category is somewhat lower than average.

By contrast, the full information matrix implies that interbank exposures vary considerably between banks and bank categories. We find that both commercial banks and other banks transact much more with institutions of the same category than would be predicted by the baseline matrix. What is particularly striking, however, is the large share of the head institutions of the two giro systems in the interbank loans and deposits of the institutions at the base level. Seventy-five per cent of the interbank deposits at savings banks are held by Landesbanken, who also receive 81% of their loans. Cooperative central banks account for 82% of the deposits at and 94% of the loans of cooperative banks.

It is also striking to see that there are almost no deposits held between banks on the base level of the same giro system (savings banks, 0.5%; cooperative banks, 0.2%) and across the two giro systems (savings banks at cooperatives, 0.3%; cooperatives at savings banks, 0.3%). The full information estimate therefore shows that the interbank deposit market is organised in two tiers: The first tier consists of most savings banks and virtually all cooperative banks, who transact mainly with the Landesbanken and cooperative central banks. The second tier consists of the head institutions of the two giro systems, the commercial banks and the "other banks".

Tables 2a and 2b point to the existence of two relatively closed systems, with very few direct linkages to banks of other categories except those with the respective head institutions and deposits from "other" banks, which comprise mainly mortgage and development banks. We estimate that about half of these deposits represent credit lines that serve to refinance development loans. The upper tier consists of the commercial banks, a small number of savings banks (around 10), the Landesbanken and cooperative central banks plus a variety of other banks. Instead of focused relationships with a small number of head institutions, banks belonging to the upper tier entertain lending relationships with a variety of other banks belonging to the same tier, including those of other categories. As a consequence, in the upper tier the pattern of interbank exposures is much closer to a "complete" structure of claims than that in the lower tier.

Table 2b

Exposures in the German interbank market: loans

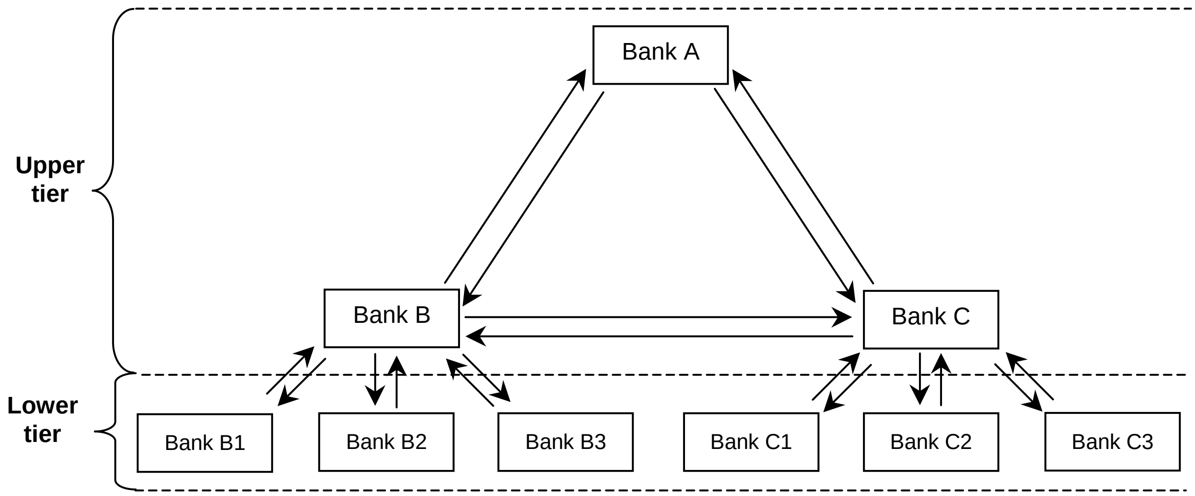
(average % share of banks by category, end-December 1998)

	Inter-bank matrix	Commercial banks	Savings bank sector: Landes-banken	Savings bank sector: Savings banks	Cooperative sector: Central banks	Cooperative sector: Coopera-tives	Other banks
All banks	full info	7.6	19.0	1.3	67.1	0.4	4.7
	baseline	*19.5*	*26.8*	*16.6*	*11.4*	*6.2*	*19.5*
Commercial banks	full info	43.1	23.0	2.9	10.3	1.3	19.5
	baseline	*19.4*	*26.8*	*16.6*	*11.4*	*6.2*	*19.5*
Savings bank sector							
Landesbanken	full info	18.4	19.7	**35.6**	5.0	1.7	19.7
	baseline	*19.9*	*25.3*	*16.9*	*11.6*	*6.4*	*19.9*
Savings banks	full info	8.3	**81.0**	**1.8**	1.9	**0.4**	6.5
	baseline	*19.5*	*26.8*	*16.5*	*11.4*	*6.2*	*19.5*
Cooperative sector							
Central banks	full info	17.5	15.6	1.8	3.2	**49.8**	12.0
	baseline	*19.9*	*27.5*	*17.0*	*9.3*	*6.4*	*20.0*
Cooperative banks	full info	1.8	1.8	**0.5**	**94.2**	**0.1**	1.5
	baseline	*19.5*	*26.8*	*16.6*	*11.4*	*6.2*	*19.5*
Other banks	full info	25.9	27.6	10.4	8.5	2.7	24.9
	baseline	*19.6*	*26.9*	*16.6*	*11.4*	*6.3*	*19.2*

Note: Linkages *within* a giro system are shaded in grey.

Figure 3

"Two-tier" structure of the German interbank market



The link between the two tiers is provided by the Landesbanken (for the savings banks) and the cooperative central banks (for the cooperative sector). On the one hand, they provide long-term loans to and take short-term deposits from their affiliated institutions. This part accounts for 36% (Landesbanken) and 50% (cooperative central banks) of their interbank loans, and 19% and 59% of their interbank deposits, respectively. On the other hand, they operate in the upper-tier interbank market as any commercial bank does. We can interpret the giro systems as some sort of "internal interbank market" whereas the "outside interbank market" consists only of the commercial banks, the head institutions of the giro systems and the "other banks".

The “two-tier” structure of the interbank market in Germany depicted in Figure 3 differs considerably from the “complete” (see Figure 1) and “incomplete” structures considered in the theoretical literature. It is not clear a priori whether such a structure leads to a significantly higher danger of contagion compared to the “complete” structure as indicated by the baseline matrix. The subsequent estimations will deal with this question.

5. Estimating the danger of contagion in the absence of any “safety net”

We estimate the possibility of contagion by letting banks go bankrupt one at a time and measuring the number of banks that fail due to their exposure to the failing bank. More precisely, the failure of bank *j* triggers the failure of bank *i* if $\theta x_{ij} > c_i$, where θ is the loss rate and c_i is bank *i*’s book capital. Contagion is not confined to such first-round effects, however. Instead, the failure of a single bank can potentially trigger a whole chain of subsequent failures (the domino effect) even if the initial impact is relatively weak. For example, suppose that bank *i* fails due to its exposure to bank *j*. This will cause the breakdown of bank *k* if its exposure to banks *i* and *j* multiplied by the loss rate exceeds its capital, that is, if $\theta\left(x_{ki} + x_{kj}\right) > c_k$. This line of argument can also be applied to higher orders. Clearly, the danger of such a chain depends crucially on the structure of the existing interbank relationships, as well as on the loss rate θ.

A necessary condition for contagion to occur is that the volume of a bank’s interbank loans exceeds its capital. As can be seen from Table 3, this is generally the case. Of the 3,246 banks that existed in Germany at the end of 1998, 2,758 (85%) had interbank loans in excess of their capital. The average ratio of interbank loans to capital was just below 3, although this is driven by the large number of small cooperative banks in our sample, which tend to hold relatively few interbank assets. The corresponding figures for the Landesbanken, cooperative central banks and other banks are well above 10. This suggests that there may be scope for domino effects.

Table 3

Interbank lending and capital, by broad banking category

(end-December 1998)

	All banks	Commercial banks	Savings bank sector		Cooperative sector		Other banks
			Landes-banken	Savings banks	Central banks	Coop. banks	
No of banks	3,246	331	13	594	4	2,256	48
Of which with loans > cap	2,758	228	13	432	4	2,043	38
Interbank loans/capital	2.96	4.64	13.73	1.95	14.39	2.69	12.94

The choice of the loss rate θ is crucial to the danger of domino effects. Ultimately, the losses incurred in bank failures vary, so the correct choice of θ is by no means obvious. The average loss realised in bank failures in the United States in the mid-1980s was 30% of the book value of the bank’s assets. In addition, creditors had to bear administrative and legal costs amounting to a further 10% (James (1991)).[15] Other estimates are much lower. For example, Kaufman (1994) estimates that the creditor banks of Continental Illinois - a bank with large interbank operations that failed due to its exposure to Latin America - would have suffered a loss of only 5% had it not been bailed out by the Fed. When BCCI failed in the early 1990s, creditors at first expected losses of up to 90%, but ended up recovering

15 This cost represents the discount of the market value of the failed bank’s assets relative to their book value.

more than half of their deposits - albeit many years after the failure.[16] Creditor banks of Herstatt have so far received 72% on their assets, with the liquidation of the bank continuing to drag on even a quarter of a century after the closure in 1974.[17] These examples show that it may not be the actual losses borne by the creditor banks that matter, but the expected losses at the moment of failure which determine to which extent the exposure to the failing bank has to be written down, and hence whether the creditor bank becomes technically insolvent or not.[18]

The loss rate also depends on the availability of collateral, for example in repos. Unfortunately, our data do not provide information on the share of collateralised positions. Only in 1999, that is, after the end of our sample period and after the major structural change of EMU, was the monthly balance sheet amended to include interbank repos. In summer 2000, such collateralised positions accounted for 6.2% of all interbank lending, although anecdotal evidence suggests that these are mostly with foreign banks.

Table 4

Incidence of contagion

(based on end-December 1998 matrix)

		loss ratio θ =					
		0.75	0.50	0.40	0.25	0.10	0.05
Contagion occurs in .... of 3,245 cases	full info	3,245	3,245	3,245	3,245	3,245	3,245
	baseline	*3,245*	*3,245*	*3,245*	*3,245*	*3,245*	*3,245*
Average number of banks affected	full info	30.3	22.2	20.0	18.0	17.0	17.0
	baseline	*22.8*	*17.3*	*17.2*	*17.0*	*17.0*	*17.0*
% of total assets of banking system affected on average	full info	0.85	0.66	0.58	0.30	0.26	0.25
	baseline	*0.45*	*0.27*	*0.27*	*0.26*	*0.25*	*0.25*
Maximum number of banks affected	full info	2,444	1,740	115	31	19	18
	baseline	*2,159*	*1,047*	*520*	*19*	*17*	*17*
Maximum share of total assets affected	full info	76.3	61.6	5.0	0.75	0.57	0.30
	baseline	*70.9*	*55.8*	*48.9*	*0.57*	*0.25*	*0.25*

Given the difficulties in determining the appropriate loss rate, we follow Furfine (1999) and test for the possibility of contagion using a variety of values for θ, which we assume to be constant across banks. We perform this exercise both for the baseline matrix that uses only aggregate information and for the full information matrix. The difference in the results is due to the additional information that is included in the full information matrix compared to the baseline matrix. This additional information refers to the relationships within the two giro systems and the breakdown into maturity categories. At this stage, we do not explicitly take into account any institutional safeguards present in the German system, which may affect the possibility of contagion, although they may in part be reflected in the bilateral lending matrix X. The results are reproduced in Table 4.

The results of this exercise are rather surprising at first sight. Contagion always occurs *no matter which loss rate we choose*, although the choice of θ determines how many banks are affected on average. There are 17 commercial banks which fail, irrespective of which bank is the first to break down. However, we should not overvalue this result. Firstly, the banks in question are relatively small,

16 Financial Times, 8 July 1998.

17 Frankfurter Allgemeine Zeitung, 26 June 1999.

18 There are several cases where regulators have been lenient in forcing banks to write down assets even though hardly anybody seriously expected their value to recover. Examples are US banks in the wake of the Mexican debt moratorium in 1992 and Japanese banks in the 1990s.

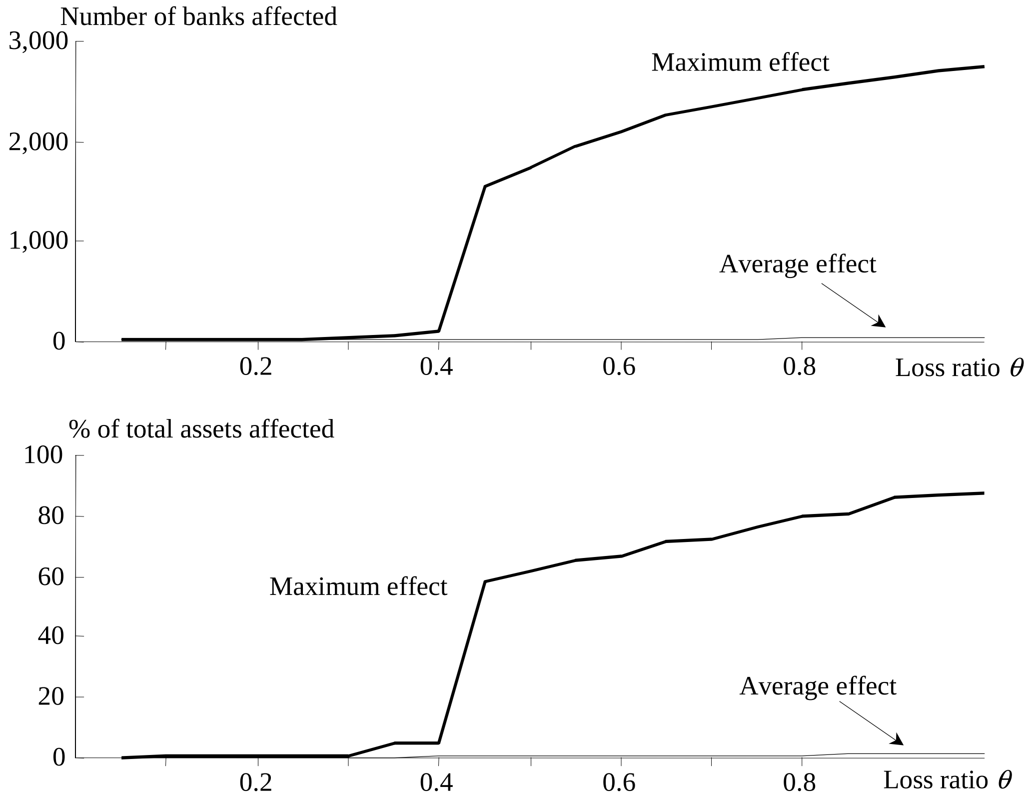
accounting for only a quarter of a percentage point of the total assets of the banking system. Secondly, the fact that 10 of them always break down in the first round, that is, due to the immediate impact, suggests that this is a reflection of our assumption that interbank exposures are as equally spread as is consistent with the data, rather than a description of reality. We would expect that small banks are much more likely to concentrate their lending on a small number of counterparties, which would preclude that the same bank always breaks down in the first round.

While the finding that contagion always occurs may be an artifact of our methodology and should not be taken too seriously, the other results are more interesting. Assuming an (admittedly high) loss ratio of 75%, the maximum number of bank failures caused by domino effects is 2,444. This means that 88% of the institutions where contagion is a possibility because interbank loans exceed capital are affected. As is to be expected, the number of breakdowns decreases with the loss rate. This decline is not linear, however. Figure 4 shows that there is a jump in the severity of contagion if the loss ratio exceeds 40%. This points to the existence of some "critical" θ: if θ is smaller than 0.40, even in the worst case the effects on contagion are rather small. With a loss ratio larger than 0.45, the increase in the damage caused by contagion again seems to be rather moderate. But, if θ lies between 0.40 and 0.45, the loss of assets due to contagion is very sensitive to changes in θ.

Figure 4

Loss ratio and the severity of contagion

(full information matrix)



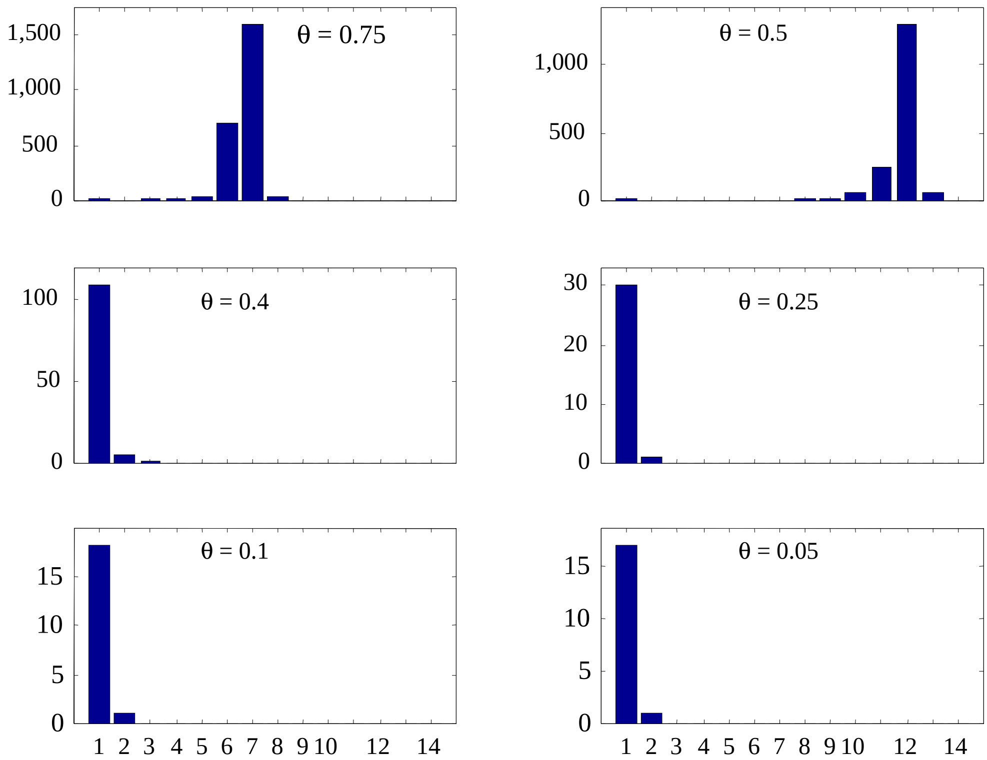
The kink in the relationship between θ and the maximum number of failures is more to the right if one considers the baseline compared to the outcome with the full information matrix. Otherwise, our findings largely confirm the theoretical results of Allen and Gale (2000) that contagion is less likely in a banking system characterised by a "complete" structure of claims relative to a more concentrated system.

Figure 5 plots the spreading of contagion over time.[19] The number of banks that fail in the worst case are plotted on the vertical axis (note the different scales), and the round of failure on the horizontal axis. For small θs, that is, when the severity of contagion is limited even in the worst possible case, the bulk of banks fail in the first round, with some minor second- and, possibly, third-round effects. For $\theta > 40\%$, the path of contagion is very different. While the first-round effects are only slightly larger than before, they do not peter out but at some point reach a critical mass that leads to the collapse of much of the banking system. However, such widespread contagion is rare even for high θs. In most cases, the initial shock leads to the breakdown of a number of banks, which in turn causes a smaller number of further failures. Then the process stops. This, together with the high values of θ necessary to cause prolonged chains of failure may explain why Furfine (1999) does not obtain higher than second-round effects. The reason why we find such a striking difference between the contagion patterns of "low" and "high" loss ratios - with the critical value of θ somewhere around 0.40 - can intuitively be explained by looking at what the failure of a single bank means for the continuation of the contagion process. Such an event generally has two implications: on the one handside, it reduces the pressure that drives the contagion process; on the other, the failure of the bank at hand also contributes to the continuation of this process, because it can affect other banks as well. These two opposing effects jointly determine the probability with which the failure of a single bank adds to the dynamics of the contagion process or dampens them. Their relative importance is determined mainly (1) by the interbank asset structure of the bank (which indicates how much the bank is affected by the preceding failures of other banks), (2) by the interbank liability structure of the bank (which is central to how the shock is transferred to other banks) and (3) by the loss ratio θ (which determines the strength of the transmission of the shock).

Figure 5

Number of banks affected in round r = ...

(Worst case, full information matrix)



19 Here we equate "time" and "rounds".

This “switching” in the time pattern of contagion has important implications for the regulation of banks and the design of institutional safeguards. It shows that it may be possible to stop the most severe scenarios with relatively low costs at an early stage, that is, before the dramatic wave of bank failures sets in. It must nevertheless be borne in mind that the “rounds” on the horizontal axis of Figure 5 are not necessarily comparable to discrete “time periods” in the usual sense. Even very “late” rounds can actually already occur a very short (calendar) time period after the initial shock, so that there may be virtually no possibility for a regulator to react to a process once it has started.

Table 5 shows the contagion effects by bank category of the initial shock for the loss rates of 0.50 and 0.10, respectively. As one would expect, the failure of savings banks or cooperative banks has very little impact on other banks. Even in the case of a loss rate of 0.50, the damage would remain below 1% of total assets. The largest contagion effects occur if a head institution of one of the giro systems fails. With θ = 50%, the failure of a Landesbank could trigger the failure of up to 1,740 banks and more than 60% of total assets. On average, 286 banks are affected, corresponding to 10% of total assets. The effects of the failure of a cooperative central bank are similar. Again, 1,740 banks - or more than 60% of the banking system in terms of assets - would fail in the worst case, and 370 banks (13% of total assets) on average. The severity of contagion is much smaller if a loss rate of only 0.10 is assumed: in neither case would the damage be more than 0.6% of total assets. What is striking is the limited effect of the failure of a commercial bank (the category that includes the large banks). Even in the worst case, it would only cause a loss of 40 banks or 1.2% of total assets. This may in part be due to the fact that a large proportion of the interbank claims of large commercial banks are on foreign banks which are not included in our data set.

Table 5

Incidence of contagion, by bank category

(based on end-December 1998 full information matrix)

	Loss rate θ =	**Max no of failures (“worst” case) in brackets: % of total assets**		**Mean no of failures (“normal” case) in brackets: % of total assets**		**Average% share in total interbank loans**
		in r = 1	**sum r > 1**	**in r = 1**	**sum r > 1**	
Commercial banks	0.50	**22** (0.61)	**18** (0.58)	**13.9** (0.22)	**6.2** (0.36)	**16.0**
	0.10	**17** (0.25)	**15** (0.25)	**13.9** (0.22)	**3.1** (0.04)	
Savings bank sector						
Landesbanken	0.50	**20** (0.75)	**1,720** (60.17)	**17.9** (0.37)	**268.4** (9.51)	**30.0**
	0.10	**17** (0.25)	**0** (0.00)	**17.0** (0.25)	**0.0** (0.00)	
Savings banks	0.50	**17** (0.25)	**18** (0.58)	**11.8** (0.21)	**8.2** (0.37)	**7.7**
	0.10	**17** (0.25)	**15** (0.25)	**11.8** (0.21)	**5.2** (0.05)	
Cooperative sector						
Central banks	0.50	**195** (1.56)	**1,545** (60.06)	**57.6** (0.54)	**312.2** (12.28)	**7.8**
	0.10	**18** (0.30)	**1** (0.27)	**17.2** (0.26)	**0.2** (0.05)	
Cooperative banks	0.50	17 (0.25)	18 (0.58)	9.3 (0.17)	10.7 (0.41)	**7.0**
	0.10	**17** (0.25)	**15** (0.25)	**9.3** (0.17)	**7.7** (0.08)	
Other banks	0.50	**25** (3.6)	**1,715** (56.95)	**15.8** (0.32)	**40.6** (1.52)	**31.5**
	0.10	**17** (0.25)	**15** (0.25)	**15.5** (0.24)	**1.5** (0.02)	

6. Banking supervision, regulation and "safety nets"

The preceding analysis ignored the prudential regulation of banks and the existence of "safety nets", both of which may limit the probability of our scenarios. In particular, as will become clear below, the relevant safety mechanisms that are in place in Germany are designed to prevent the failure of Landesbanken and cooperative central banks. The worst case scenarios identified in the previous section are therefore virtually impossible. In this section, we address this omission and extend our analysis to incorporate the safeguards present in the German system.

Prudential supervision limits the danger of contagion in a number of ways.[20] Firstly, banking supervision aims to reduce the incidence of failures by forcing (or encouraging) banks to behave more prudently. In our model, this corresponds to minimising the probability that a "shock" (ie the initial failure of a bank) will occur in the first place. Secondly, if banks do fail, swift action by the regulator could ensure that banks are liquidated before the losses become too large. This would be reflected by a low loss ratio θ. Finally, banking regulation may limit the exposure of banks to any single debtor or group of debtors, which in turn reduces the scope for contagion. For example, in Germany bank loans to a single debtor should in principle not exceed 25% of the capital of the creditor, although interbank loans are partly exempted. For the purpose of our paper, such regulations are reflected in the pattern of interbank exposures.

While prudential supervision does play an important role in reducing the risk of contagion ex ante, it cannot stop this process once it is under way. In this case, two additional mechanisms could step in. The first is the Liko-Bank, a bank owned by the banking system with participation by the Bundesbank, which exists solely to provide liquidity to illiquid but solvent banks. The second mechanism is the insurance of interbank deposits.

Deposit insurance can halt contagion through credit exposures in the interbank market - as opposed to contagion through bank runs - only if it covers deposits by banks as well as deposits by non-banks. While the statutory deposit insurance applies to non-bank deposits only (Deutsche Bundesbank [2000b]), for savings and cooperative banks, including their respective head institutions, this is supplemented by so-called "institutional guarantees". Both the savings banks' and cooperative banks' associations operate funds backed by mutual guarantees which serve to recapitalise member institutions in the event that they become insolvent.[21] In addition to the guarantee fund, savings banks are also explicitly guaranteed by the corresponding local or regional government. There are also a (small) number of public banks guaranteed by the federal government.[22]

We incorporate these safeguards into our analysis by assuming that:

- savings banks never fail;
- public banks guaranteed by the federal government never fail; and
- cooperative banks never fail in the first round and hence never trigger contagion. In further rounds, they fail only if the exposure of the aggregate cooperative sector to the banks which failed in previous rounds exceeds aggregate capital. This is equivalent to assuming unlimited cross-guarantees and may thus overstate the effectiveness of the "safety net". As a consequence, either no cooperative bank fails or the complete cooperative sector, including the cooperative central banks, breaks down.[23]

Since in the previous section we found that the largest effects were caused by the breakdown of a head institution of the savings or the cooperative sector, we should expect much lower contagion once

[20] We use the terms "supervision" and "regulation" interchangeably.

[21] In order to alleviate moral hazard problems, failed cooperative banks usually lose their independence and are merged with stronger banks, which obtain support from the guarantee fund. A detailed description of the guarantee schemes is contained in Deutsche Bundesbank (1992) and (2000b).

[22] For example, the Kreditanstalt für Wiederaufbau (KfW).

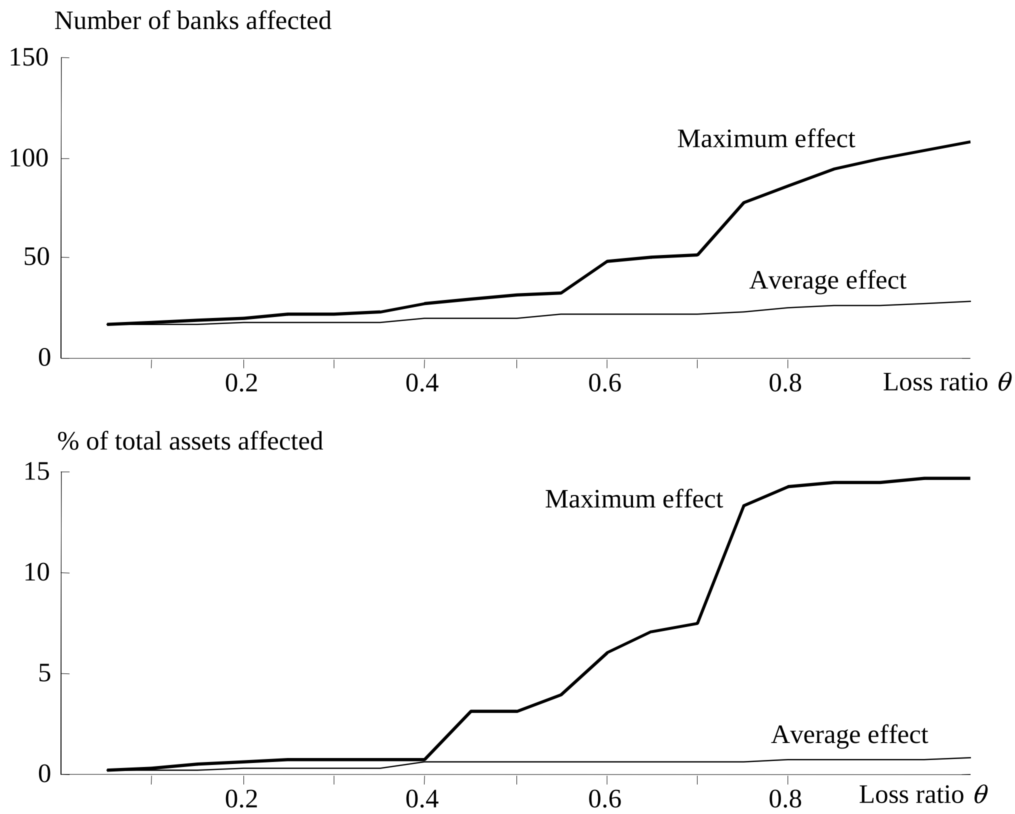
[23] The charter of the safety fund for cooperative banks stipulates that each bank has to provide guarantees amounting to 60% of its statutory credit provisions. This is in addition to the contributions to the deposit guarantee fund, which covers non-bank deposits.

we incorporate the existing safeguards. The fact that during the past half-century the stability of the German banking *system* has never been called into question despite a number of bank failures can be seen as an indication that the existing banking supervision and safety mechanisms have worked well in the past. This effectiveness is clearly confirmed by our results, presented in Figure 6.

Figure 6

Loss ratio and the severity of contagion in the case of "perfect safety nets"

(full information matrix)



We find that contagion is much more limited in scope but remains a possibility even if we incorporate safety mechanisms into our analysis. As before, we find that the maximum percentage of assets affected remains relatively flat for loss ratios below 40% but increases for higher values. For θs in excess of 75%, about 100 banks may be affected in the worst case of contagion. This corresponds to 15% of the banking system in terms of assets, which is considerably below the corresponding values of up to 80% if one ignores the safety mechanisms. In particular, we find that the cooperative system never fails, even for the highest θs.

When interpreting our results, it has to be borne in mind that we do not say anything about the *efficiency* of "safety nets", since we do not incorporate their direct and indirect costs.

7. Conclusions

Credit risk associated with interbank lending may lead to domino effects, where the failure of one bank results in the failure of other banks not directly affected by the initial shock. Recent work in economic theory shows that this risk of contagion depends on the precise pattern of interbank linkages. We use balance sheet information to estimate matrices of bilateral credit relationships for the German banking system. In contrast to commercial data sets, our data covers the entire banking system, so all domestic interbank loans and deposits add up to zero in principle. In their submissions to the Bundesbank, which provide the basis of our analysis, banks have to give a detailed breakdown of their interbank assets and liabilities, showing maturity categories and whether or not the counterparty is a head institution of the giro system the respective bank belongs to. This permits us to estimate a matrix of bilateral credit exposures for each maturity and banking group, thus imposing much more structure on the problem than would be possible with aggregate interbank loans and deposits alone. The estimated system-wide matrix differs considerably from a matrix estimated from aggregate exposures (across all maturities and banking groups) alone.

We find that interbank lending in Germany is characterised by a two-tier structure. The first tier consists of most savings banks and virtually all cooperative banks, which transact mainly with the Landesbanken and cooperative central banks. The second tier consists of the head institutions of the two giro systems, the commercial banks and the "other banks".

Our results suggest that domino effects through interbank credit exposures are possible.[24] While the danger of contagion is normally confined to a limited number of relatively small banks, bank failures that affect a sizeable part of the banking system remain a possibility even if we explicitly take into account safety mechanisms like the institutional guarantees for savings banks and cooperative banks. In the absence of such mechanisms, the effects of the breakdown of a single bank could potentially be very strong indeed. This cannot be taken as a statement on the desirability of these mechanisms or a system with publicly owned banks, though, as we do not consider the incentive effects they are associated with.

Not surprisingly, the danger of contagion crucially depends on the losses experienced by the creditor bank in the case of insolvency of the debtor bank. We find that large-scale contagion can in any case only occur if the loss rate on interbank loans exceeds a value of approximately 40%.

Our findings have important implications for banking regulation. The regulator can minimise the danger of contagion in a number of ways. Firstly, it can reduce the probability of the initial shock that could trigger contagion by encouraging banks to behave more prudently. Secondly, if a bank does fail, the regulator should ensure a quick and orderly liquidation before the ratio of losses to assets becomes too large. And finally, banking regulation can limit the exposure of banks to individual debtors.

24 We do not consider other channels for contagion, like runs by non-banks.

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Marrying the micro- and macro-prudential dimensions of financial stability - the Hong Kong experience

Eddie Yue[1]

1. Introduction

Asia's ability to manage crises was critically tested in 1997. Subsequently, the region went through a testing phase of post-crisis reflection and structural reform. There is, however, another equally, if not more, important aspect that should be carefully examined: how to prevent similar crises from developing in the future. There is a need for crisis prevention mechanisms that enable the authorities to detect vulnerabilities and distress in the financial system and take remedial action early in the day. Such vulnerabilities could arise from the "micro dimension" - at the level of individual institutions - or from the "macro dimension" - imbalances in the economy or speculative excesses of the market.

Hong Kong was also subjected to rather severe pressure during the crisis. But it weathered the storm reasonably well - the banking sector remained largely healthy, and speculative attacks were successfully fended off. Moreover, the supervisory regime proved to be very robust and resilient during the economic downturn.

This paper sets out in detail the mechanisms that Hong Kong has put in place in order to keep its finger on the pulse of both individual institutions and the market so as to detect any stress points. It discusses how cross-sector surveillance is conducted in Hong Kong, given the current institutional structure of the regulatory agencies. It also discusses how official mechanisms and market behaviour may amplify or dampen financial cycles. Finally, it analyses various policy issues, including the monetary policy response under the constraints imposed by the linked exchange rate system.

2. Monitoring financial distress

2.1 The micro dimension

Current mechanism

The micro dimension refers to the microprudential regulation of individual institutions and the possible distress that they might experience, which might spread across the sector through contagion. The Hong Kong Monetary Authority (HKMA) is responsible for the regulation of "authorised institutions", which include banks, restricted licence banks and deposit-taking companies, whereas the Securities and Futures Commission (SFC) is the authority for regulating intermediaries in the securities market. This paper will focus mainly on the former.

For the banking sector, the HKMA has in the past put in place a number of prudential measures which help ensure that banks are not overexposed to undue risks in certain sectors and have sufficient capital to withstand any shock. These measures include:

70% loan-to-value ratio - the property sector has traditionally been a very important element of the Hong Kong economy, and property lending has long been the lifeblood of many retail banks in Hong Kong. But property prices, as with other asset prices, are susceptible to boom and bust cycles. Throughout the various cycles that we have experienced, the mortgage delinquency ratio has, however, remained at a relatively low level. Nevertheless, it would be prudent for banks to build in a cushion to protect themselves from a sudden downturn in the property market.

[1] The views expressed in this paper are those of the author and do not necessarily reflect the opinion of the Hong Kong Monetary Authority.

One of the most useful cushions is provided by the rule limiting the maximum loan-to-value ratio to 70% of the assessed property value for residential mortgages. This requirement was initiated by the banking industry itself back in 1991 when the property market was surging. The industry agreed that the then market practice of lending up to 90% of the assessed value should be adjusted to just 70%, providing a cushion for banks should the market come back down. It was then adopted by the HKMA as a prudential measure for all banks.

Throughout the peaks and troughs of the property market in the 1990s, the 70% rule has never been changed. It has never been used as a policy instrument to achieve housing objectives, nor has it ever been used as a countercyclical instrument to smooth economic cycles. It is simply a prudential requirement which provides a comfortable cushion for banks in mortgage lending, whether the market is experiencing an upswing or a downturn.

But homebuyers still have the choice to borrow more than 70% of the value of the property. Since 1999, the Hong Kong Mortgage Corporation (HKMC) has been offering mortgage insurance to property buyers for the portion of the loan above the 70% requirement, up to 85% of the assessed value. In August 2000, the scheme was extended to cover up to 90% of the assessed value of the property. Since the “above 70%” portion is insured, the risks that the banks are exposed to are still capped at 70% of the property value, and the prudential 70% rule is still in force.

Overall property exposure of banks - apart from residential mortgages, banks also lend to property developers and make other property-related loans. The overall property exposure of individual banks in Hong Kong can be as high as 70% of their whole loan book. The industry average is about 50%. In 1994, when property lending was rising quickly, the HKMA introduced a guideline requiring banks whose property exposure as a percentage of loans for use in Hong Kong was above the average of the industry as a whole (about 40%) to seek to stabilise or reduce that percentage. The guideline was, however, withdrawn in July 1998 during the market downturn as it was considered less relevant to the market conditions at the time. With or without the guideline, the HKMA has always kept a close and watchful eye on the property exposure of banks and maintained the practice of discussing with banks at the start of each year the increase in property lending which they are planning to make in the year ahead.

General prudential requirements - the HKMA has in place a regulatory system which is fully in line with international standards, especially those formulated by the Basel Committee on Banking Supervision. Banks are required, among other things, to maintain adequate liquidity and capital adequacy ratios. For the former, banks are required to maintain the ratio of liquefiable assets to qualifying liabilities above 25%. For the latter, all authorised institutions are required to maintain a minimum of 8%, which can be raised to 12% for licensed banks and 16% for deposit-taking companies. All institutions are required to submit periodic returns to the HKMA on the required financial information, to adhere to limitations on loans to any one customer or to directors and employees, and to seek approval for the appointment of directors and chief executives, and for controllers. Vigilant monitoring of these prudential requirements ensures that the HKMA is able to spot potential problems at individual institutions before they escalate.

Public disclosure - monitoring of individual institutions is performed not only by regulators, but also by investors, shareholders and depositors. We are gearing our regime towards more transparency so that market discipline can also play an important role to complement prudential supervision. The HKMA issued its first Best Practice Guide on Financial Disclosure in 1994, and has been enhancing the disclosure standards with an annual package requiring more information to be published. Local banks are now required to disclose in their interim and final results a full range of financial information, including cash flow statements, asset quality, off-balance sheet exposures, maturity profiles, segmental information, and capital adequacy and liquidity information. Foreign banks meeting certain size criteria are also required to disclose major financial details such as asset quality, loan concentration, off-balance sheet exposures and liquidity information. We have already initiated a legislative procedure to provide legal backing for these disclosure requirements.

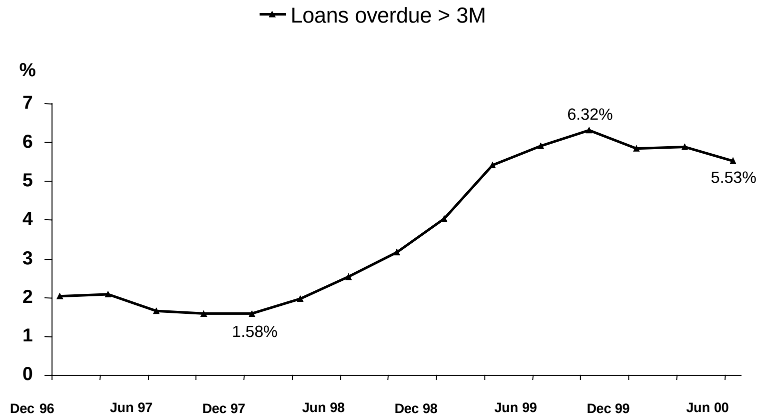
Performance during the crisis

The robustness of our supervisory regime underwent a severe test during the Asian crisis, when banks across the region were badly hit. The asset quality of banks in Hong Kong did deteriorate, especially with the default of a number of high-profile Chinese enterprises. Profits did dive, and one or two banks recorded losses for 1998 and 1999. But by and large, the banking sector remained very healthy, with no bank running into trouble.

In terms of asset quality, Figure 1 below shows that the ratio of non-performing loans of locally incorporated banks (defined as overdue for three months or more) to total loans peaked at 6.32% in the September quarter of 1999, and has subsequently come down gradually. It currently stands at 5.53% and is expected to come down further with improvement in the economy.

Figure 1

Local banks - overdue loans



With respect to the property sector, which is the largest single sector in the banks' loan book, the ratio of overdue loans for residential mortgages (defined as overdue for three months or more) to total loans rose from 0.29% in June 1998 to 1.16% in April 1999. With the property market remaining rather quiet during the first half of the year, and in the light of the possible lagged effect of the economic downturn on mortgage default, the ratio has indeed slightly increased since the beginning of this year to the current 1.26%. But with a healthier outlook for both the property market and the economy, we expect that the rate will come down gradually. In any case, a delinquency ratio of just 1.2-1.3% should be regarded as extremely low by any standard.

Throughout the Asian crisis, banks in Hong Kong remained very well capitalised and highly liquid. Figure 3 shows that, even at the height of the crisis, the average capital adequacy ratio still stood at around 18%, a whole 10% above the Basel standard. It has risen further to 18.7%. As shown in Figure 4, the average liquidity ratio of all locally incorporated banks, which was well above 40% even during the crisis, also far exceeds the 25% requirement laid down by law.

Figure 2

Mortgage delinquency ratio

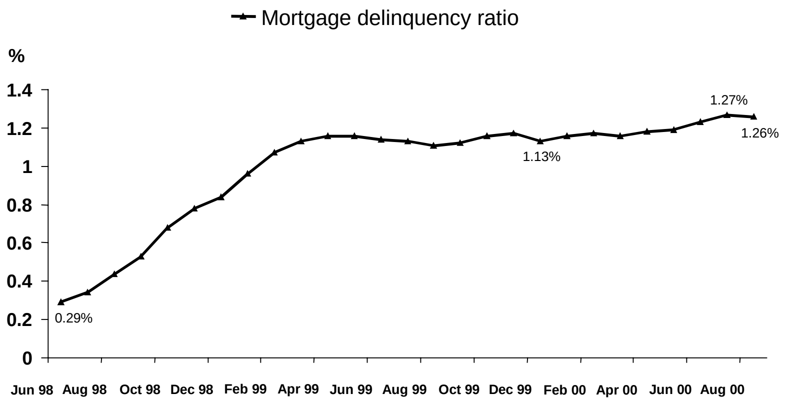


Figure 3

Capital adequacy ratio for locally incorporated institutions

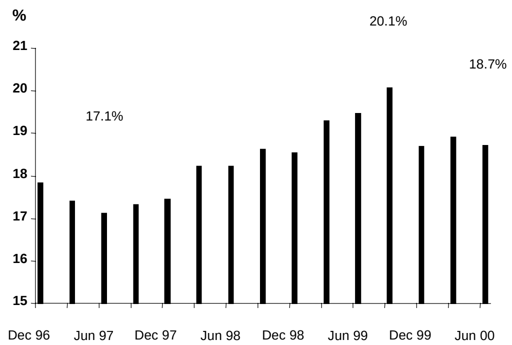
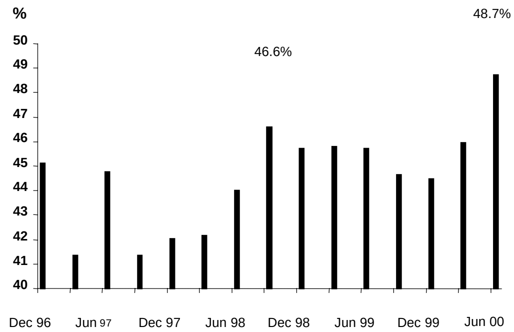


Figure 4

Liquidity ratio for locally incorporated banks



Further measures

We are seeking changes to our supervisory approach to make it more forward-looking and to improve its ability to spot the stress points at an early stage. Our current method of supervision evaluates the financial condition of an institution at a particular point in time. The final product, the CAMEL rating (Capital, Assets, Management, Earnings and Liquidity), is based for the most part on quantitative analysis of the various components of the rating system up to that point.

The main problem with the current approach is that it is based on historical data and thus fails to detect risks embedded in the business plans of banks. To tackle this problem, we are now introducing a risk-based element into our supervisory approach. Compared with the existing approach, risk-based supervision is a dynamic, fluid, forward-looking approach. It incorporates the risk profile, which encompasses the inherent risk and the quality of the risk management processes at the institution, into the CAMEL rating system. Each of the CAMEL components will be assessed taking into account one or more of the eight inherent risks (credit, interest rate, market, liquidity, operational, legal, reputational and strategic) which the HKMA has identified as risks to be assessed during the supervisory process. Unlike the current approach, which uses only historical data as the basis of assessment, the risk-based approach enables the supervisory process to inject more forward-looking judgment into the decision-making matrix in order to arrive at a final rating.

To assist in developing this new approach, the Fed has seconded one of its staff members to the HKMA since April 1999. It is expected that the HKMA will complete the implementation of the risk-based supervisory approach for all local banks within the year. The next step is to roll out the approach to all foreign banks.

With the implementation of the new supervisory approach, the preventive element of the regulatory regime will be greatly strengthened. Instead of examining banks' books when they are in trouble, we should now be in a much better position to foresee potential problems via regular discussion with banks on their business projections and via continuous assessment of the risks borne by the institutions through regular on-site examinations and off-site surveillance.

2.2 The macro dimension

Current mechanism

The macro dimension refers to the monitoring of aggregate economic and financial information economy, such as external indebtedness, the domestic credit level, and the aggregate positions of the market, such as the forex and equity positions taken by the major players.

Regarding the aggregate information on the economy, Hong Kong traditionally does not collect a wide range of macro data: we have no data on flow of funds as the government did not collect BoP statistics until recently (partly because there have been no exchange controls which would require such a reporting system); nor does Hong Kong have external indebtedness figures as the Hong Kong government essentially has no external debt.

In 1996, the government decided to start collecting BoP statistics to better understand Hong Kong's external transactions with the rest of the world, and the first set of statistics was released in April 1999, reflecting the position in 1997. At present, quarterly and annual BoP accounts are compiled in accordance with IMF standards. The government is looking into the feasibility of compiling higher-frequency BoP statistics. Should this be done, we will be able to analyse the fund flows in a much more useful and timely fashion.

As to surveillance of the financial markets, the Asian crisis has indeed sounded a warning bell on the need for such monitoring in Hong Kong. Prior to the crisis, we relied principally on price data, such as swap points, regular informal dialogues with market participants to monitor day-to-day activities in the local foreign exchange market, and regular returns submitted by banks on their foreign exchange exposures. Information on transaction volume and positions is scattered and infrequent, and there is no formalised cross-market surveillance.

After the crisis, a consensus has emerged in international forums that individual economies should strengthen financial market surveillance. The HKMA has since added a few surveys/returns to the ones it already has, all of which are listed below:

Monthly position reporting by banks - this is the usual prudential return for banks to report their foreign currency positions, including the HKD positions, on a monthly basis. The return form previously covered only net positions. In order to have a better understanding of the positions of the banking sector, gross positions will shortly be added to the return.

Weekly position reporting by 13 banks - since early 1998, the HKMA has requested 13 banks that are active in the foreign exchange business to file a weekly return specifying their net USD/HKD spot and forward positions as of Wednesday close. The data provide useful information on the changes in the banks' positions, and the aggregate open positions can be used as an indicator of market trend.

Monthly reporting of counterparty positions from three HKD liquidity providers - since July 1999, the HKMA has requested three major HKD liquidity providers to file monthly returns on net open positions with the 10 largest banks and non-bank counterparties. There is also an instrument breakdown into foreign exchange swap, spot, foreign exchange forward and money market instruments. Since large short positions must eventually be squared with the major HKD supplier banks, the reports from the banks provide useful information on the changes in the HKD positions in the market. Since September 2000, the frequency of reporting has been increased to weekly and the top 20 counterparties are now captured.

It might still be early days to assess how effective these mechanisms are in spotting early warning signals and in crisis prevention, as they have only recently been introduced. There is indeed a delicate balance between the need to improve our understanding of market dynamics and the risk of overburdening banks with reporting requirements. There is also the question of whether there is anything meaningful that we can do, under the constraints of the currency board system, even if we were alerted to, for example, a build-up of short HKD positions by one of the counterparties of the three major liquidity providers. To know is surely better than not to know, but it is important to weigh this against the reporting burden on the banks.

In discussing this, it is interesting to note that the Bank of Japan had in the past required institutions to report positions five times a day. But in response to this, institutions started shifting funds offshore to circumvent the requirements. So it turned out that while the Bank had asked for more frequent reporting, it ended up obtaining the same, or even less, information from the market. This experience is an interesting example of how over-reporting can be counterproductive at times.

Modelling/synthetic indices

The HKMA has not adopted any quantitative models for the monitoring of financial distress, nor has it compiled any synthetic index on a regular basis to serve as an indicator of the monetary conditions of the economy.

For research purposes, we earlier conducted a study on the construction of a monetary conditions index (using the real interest rate and real effective exchange rate) and financial conditions index (plus the change in equity prices) for Hong Kong. The study yielded very interesting results in explaining the underlying trend of the economy. There are, however, a couple of potential problems in using either of these indices as a policy instrument for monitoring financial conditions.

First, while the indices include important determinants of economic activity, they are not exhaustive and there could well be other elements that have been left out. For example, in Hong Kong, due to the limited scope for independent monetary policy, fiscal measures have particular significance in macroeconomic management. Expanding the indicators to include an estimate of fiscal stance should give a fuller picture. But trying to bring such an estimate in would be difficult as the data are mostly only available on a quarterly or even an annual basis, and computing an index on an annual basis would reduce its usefulness for timely analysis.

Second, the indices are built on models, which invariably contain errors and uncertainties in measuring the various determinants.[2] As discussed above, they also might not have contained all the relevant determinants. Therefore, using the indices in a habitual way to measure financial conditions might risk over-reliance on an incomplete set of data. If not used carefully, they might even provide a false sense of security. It is therefore important for those using similar indices to understand the limits of such indices and complement them with other monitoring mechanisms.

On the equities side, there have been attempts to devise early warning signals to help predict sharp corrections in the stock market, which might be driven by speculative excesses. High-frequency indicators such as interest rates, forward exchange rates and daily turnover in the cash and futures markets have been used to explain the movement of the stock index. Although some indicators appeared to be statistically significant, no model so far has provided satisfactory results in predicting abnormal volatility or sharp plunges in the local stock market. Findings generally supported the view that models can scarcely generalise market behaviour and provide a hard and fast rule for market surveillance.

2.3 Marrying the micro and macro dimensions

Microprudential regulation and macroprudential stability feed through each other in various ways. It is therefore important to ensure that efforts on the two fronts are well coordinated. This partly relates to the institutional structure for the functions of monetary operations and prudential supervision. If those functions are carried out by different agencies, there is a strong need for established mechanisms for information-sharing and policy coordination. In the case of Hong Kong, the functions of both banking supervision and monetary management come under the HKMA, and there are very well established internal coordination mechanisms for the two functions.

To illustrate how macro policies might affect the regulation of institutions, one might look at the impact of exchange rate policy on the risks borne by banks. Under the linked exchange rate system in Hong Kong, since the exchange rate cannot be adjusted to reflect fund flows, interest rates may become more volatile than in other exchange rate regimes. The interest rate risks borne by banks might therefore be higher. The implication for the supervisors is that they will need to look closer at the interest rate risks borne by banks, and how they manage such risks. Also, the supervisors will need to watch more closely the exposure of banks to the asset markets which are vulnerable to interest rate changes. This is why the HKMA has come up with the various guidelines to ensure that banks' exposure to the property market is well managed and that there is a sufficient cushion (under the 70% loan-to-value ratio) to protect banks against sudden falls in prices.

The impact can also work the other way, from the micro to the macro dimension. For example, if, while examining banks, it is found that the exposure of the banking industry to a certain sector, for example the property sector, has ballooned, this might be an indicator of the build-up of a bubble in the property

[2] A relevant concept for the interest rate in developing a monetary conditions index is longer-term real interest rates based on inflation expectations rather than past inflation. However, in the absence of indexed instruments to ascertain inflation expectations, we have used statistical approaches to estimate the long-term inflation rate. Likewise, we have to rely on the model to derive the relative weights on different components - the real interest rate, the real exchange rate and the stock index - in the indices.

market. In such a case, the HKMA or the government will have to consider appropriate macro policies to deal with the problem, for example by expanding land supply.

It is not easy to find a systematic way of building macro considerations into micro regulatory decisions, or the other way round. Falling short of an explicit mechanism, the "cross-consideration" will naturally come up when both functions are housed under one roof. They will be discussed at management meetings, and staff having cross-department training will have a wider perspective in making decisions. Where the two functions are divorced from each other, there will be a need for enhanced coordination through regular liaison meetings or cross-representation on the boards concerned.

2.4 Cross-sector monitoring

One important lesson that Hong Kong learnt during the Asian crisis is that financial market surveillance has to be conducted across markets in a coordinated manner. During the speculative attack in August 1998, Hong Kong saw "double plays" scooping profits across markets, by selling HKD to jack up interest rates, thereby reaping profits from the futures that were taken out at the same time. It is clear from that episode that to spot and fend off speculative forces, it is important that market surveillance be carried out across financial markets and that the information from such surveillance should be shared among different regulators.

Before the crisis, the HKMA had already entered into a Memorandum of Understanding with the SFC which provides a mechanism for sharing information. There were also regular liaison meetings to discuss issues of mutual concern. But these mechanisms were mostly institution-based, or micro-oriented, and did not involve elements of macro market surveillance.

After the dust settled, the government in late 1998 set up a Cross-Market Surveillance Committee, whose members were drawn from the government's Financial Services Bureau as well as the HKMA and the SFC. The Committee met every month to exchange views on market trends and developments, and to discuss surveillance reports on different fronts. Regular reports were produced, covering a series of parameters such as the forward exchange rate, the transaction summary in both cash and futures markets, and stock borrowing costs.

In mid-2000, following a review of the arrangements for regulatory coordination in Hong Kong, the structure for cross-regulator discussions on both the micro and the macro fronts was made a lot clearer. Regulators will cooperate on two clear and distinct levels:

Financial Stability Committee - this has evolved from the Cross-Market Surveillance Committee. Its tasks are to monitor on a regular basis the functioning of the financial markets in Hong Kong and to deal with cross-market issues. Macro monitoring of the markets and exchange of market intelligence are performed in this forum.

Council of Regulators - this is a new committee which is expected to be formally established in late October. The Council will comprise all regulators, including the HKMA, the SFC, the Insurance Commission and the Mandatory Provident Fund Authority. It will be chaired by the Financial Secretary of Hong Kong. Its functions will be to share information on regulatory and supervisory issues and to minimise the overlaps/gaps in the regulation of financial institutions. Its focus is more institution-based and related to microprudential regulation.

In addition, there is a Risk Management Committee of the Hong Kong Exchange Limited which deals with all the risk management issues relating to the equity and futures markets. The regulators, ie the HKMA and the SFC, are both members of the Committee, so that their regulatory concerns could be channelled to the Exchange.

3. Mechanisms amplifying or dampening financial cycles

3.1 Official mechanisms

Within the regulatory framework for financial institutions, there are usually some built-in mechanisms that will dampen the financial cycle. While the regulations are mostly imposed for prudential reasons, there is often the supplementary benefit of slowing a market upswing or downturn. In the context of

Hong Kong, the new risk-based supervisory approach as described above is a good example. By adopting a forward-looking stance in supervision, risks inherent in the business activities of banks can be identified early and mechanisms to manage such risks will be set up to deal with them effectively as they arise. This helps to nip any problem in the bud.

The property market is the largest single sector of exposure for financial institutions in Hong Kong. Movements in property prices will seriously affect the asset quality of banks. As explained above, there is currently a rule restricting banks' lending to a maximum of 70% of the assessed value of the property. Theoretically, this rule can be varied at different points of the property cycle to serve a countercyclical purpose: the ratio can be lowered as property prices surge, or raised as property prices sink. Lowering the ratio will dampen the ability of purchasers to buy, as they will need to come up with a larger downpayment. This will therefore serve to cool down the market when prices are going through the roof.

Another instrument that could serve the same purpose is the premium charged by the HKMC for providing mortgage insurance for the portion of the loan which is above 70% of the property value. If the HKMC raises the premium as the property market is heating up, homebuyers will find it less economical to take out the insurance, which will dampen their desire to buy and thus cool the market down. There is, however, the additional question of whether it is appropriate to use the HKMC insurance premium as a policy tool, since the HKMC is supposed to run on commercial principles and decide its premium on the basis of an assessment of the risks of the property market.

The HKMA so far has not sought to vary prudential rules like the ones set out above for the purpose of dampening financial conditions, as there may be a few drawbacks in doing so:

- **Policy consistency** - the consistent application of a policy like the 70% loan-to-value ratio rule will give it credibility over time. Since its introduction in 1991, the rule has undergone both the peaks and troughs of the property cycle and has remained unchanged, on the grounds that it is a prudential measure having little to do with economic or asset cycles. If it were to be varied to achieve other purposes, it might create market uncertainties with people second-guessing when the policy is going to be changed again.
- **Moral hazard** - it may not be right for market participants to rely on official assessments of risks. There is the signalling problem in that if the official sector does not impose any countercyclical measure such as varying the capital ratio or the mortgage loan-to-value ratio during a slowdown of the economy, the market might take it as a signal that the government considers the system-wide risk to be low. This will encourage further risk-taking by banks or investors at a time when they should be more cautious.

While some regulatory requirements have built-in countercyclical elements, many others are procyclical in nature. This has in fact been a subject of intense discussion in various recent international forums. Typically, during a recession, supervisory standards will tend to tighten, and higher provisions and capital ratios might be required. This will lead banks to restrict credit, thus causing difficulties for borrowers, and triggering even more problems for corporates, which will feed back to the banks. There seem to be several options in dealing with this. The first is to vary the regulatory standards through time to mitigate the amplifying impact of supervisory rules on financial cycles. The pros and cons of this approach have been discussed in the paragraph above. The second is to improve the understanding of financial system risks through the supervisory review process. Supervisors and banks should take a forward-looking approach in assessing provisioning and capital requirements. In Hong Kong, this has been incorporated in the new risk-based supervisory approach.

Market mechanisms

Some market behaviour can be very procyclical. Momentum asset management tends to exaggerate market fluctuations as investors or traders enter into momentum trading, largely disregarding the fundamental analysis of markets or individual stocks. Portfolio hedging may also tend to amplify market reactions. During a severe market downturn, fund managers might rush to hedge their portfolio at about the same time, thus driving the market further down and necessitating more hedging, which might eventually culminate in a vicious cycle. The stock market crash in 1987 was partly due to portfolio insurance, which worked in a similar way. Another example is the dynamic hedging behaviour of currency option writers. Their strategy of "buy high, sell low" unambiguously reinforces market swings and exacerbates market volatility.

However, with the advance of financial technology and more experience in dealing with market downturns, many institutions are now applying position limits for trading based on value-at-risk models. This should help institutions to limit their exposure at a relatively early stage, avoiding a mass exit as the market comes down. In all likelihood this should be a helpful countercyclical development which will prevent institutions from engaging in excessive risks. There is, however, still the problem that institutions may sharply adjust their limits when market volatility increases, which may force fund managers to unwind certain positions quickly.

The implications of the emergence of e-trading for such market feedback mechanisms are interesting. The e-trading platform helps to increase market liquidity, reduce trading costs, increase leverage and enable trading to be done round the clock. This unfortunately will probably exacerbate the procyclical nature of market behaviour because portfolios can move around a lot faster. E-trading helps broaden the investor base, increasing two-way trades. However, as evidenced by occasional asset bubbles, financial markets are, from time to time, afflicted by herd instincts and speculative excesses. E-trading is, however, a trend that is growing ever stronger, and what policymakers will need to do is to consider how best to manage the risks arising from these developments. International cooperation is particularly required, given the difficulty of imposing and enforcing regulations on e-trading that transcend national boundaries.

4. Policy issues

4.1 Monetary policy response

Under the linked exchange rate system, the HKMA has no room to vary interest rates to relieve financial stress. Indeed, the autopilot response under the currency board system is in a way quite procyclical. When there is an outflow of funds, interest rates will increase, thereby stifling growth and pulling asset markets down, in turn causing more outflows and so on.

To mitigate the impact of interest rate volatility on the economy, the HKMA built in a cushion through the technical measures introduced in September 1998, under which Exchange Fund Bills and Notes (totalling about USD 15bn) can be discounted through the discount window operated by the HKMA. Effectively, this means that the impact of any outflows on interest rates will only fully kick in when the outflow is larger than the size of the cushion. Since the introduction of the measure, interest rate volatility has come down considerably even with occasional outflows from Hong Kong.

In the light of the constraints placed by the currency board system on our ability to use monetary policy to relieve distress, the Currency Board Committee of Hong Kong (responsible for ensuring compliance with currency board principles and for seeking refinements to the monetary system) will start to monitor regularly the risks and vulnerabilities, both domestic and external, that might affect Hong Kong. This macro surveillance mechanism will enable evaluation of market conditions and to prepare policymakers, within the discipline of the currency board system, for dealing with any shock to the system.

4.2 Fiscal policy response

Falling short of the use of monetary policy to deal with financial distress, fiscal policies play a relatively more important role in dampening financial distress. As the property market overheated in the mid-1990s, partly due to easy monetary conditions imported from the United States, the government implemented a package of measures to dampen the housing market. The package included an increase in land supply, an increase in stamp duty for land transactions and an increase in public housing supply. All these measures were aimed at cooling the property market. The timing of the package was somewhat unfortunate, though, in that the property bubble was already about to burst due to the onset of the Asian crisis when the package was introduced in 1997. As the bubble burst, the package was widely seen as procyclical as it exacerbated the rapid fall in prices after end-1997.

Tax measures can also be an effective means to counter financial cycles. But there is a limit on how far they can go in Hong Kong, when the Basic Law, Hong Kong’s mini-constitution, specifies that public finance has to be managed prudently and deficit spending should be avoided. Notwithstanding this, some useful tax measures were implemented in the aftermath of the Asian crisis, including a partial cash rebate of tax paid for the year 1997/98. More tax relief was also granted. As for government fees and charges, they have been frozen since the onset of the crisis to avoid causing further stress to the system.

4.3 Regulatory response

As discussed in the above section, one contentious option for dealing with financial distress is to vary regulatory requirements through time to reduce their amplification of financial cycles, or even to make them countercyclical.

The regulatory approach adopted by the HKMA has been applied very consistently through boom and bust. There was pressure for us to relax the 70% loan-to-value ratio during the market downturn, on the grounds that the market risks have substantially come down with the drop in prices and that the relaxation can help the revival of the property market. The HKMA has strongly resisted such calls. We consider that our role is to set prudential standards to ensure that banks are not exposed to excessive risks, and not to take a view of where the market should stand. We believe that a consistent policy, free of any adjustment to suit market conditions, will be much better understood by the market and will be able to command more credibility.

The same goes for capital adequacy rules. The HKMA has all along required a comfortable margin over and above the minimum requirement stipulated in the Basel Accord. Indeed, the average CAR of local banks during the crisis remained at a high level of 18%. This has reduced the pressure on the banks to cut back on lending due to capital concerns during the recession, though they did cut back for other reasons such as credit concerns.

Rather than varying prudential requirements during boom or bust, there are measures that, if implemented, we believe will help dampen financial cycles. One example is an ongoing request from the banking industry in Hong Kong for more favourable tax treatment for general provisions. The banks are seeking to have the provisions made tax-deductible. This will provide incentives for them to make appropriate provisions at an early stage, rather than only recognising losses en masse at the height of a crisis. However, this has been rejected by the tax authorities several times for fear that the tax base will be eroded.

4.4 Other policy responses

Since there is a constraint on the use of monetary policy in dealing with excesses in the financial markets, the government had to resort to an unorthodox response in dealing with the strong speculative attacks in 1998. It went into the market to buy shares, thus frustrating the attempt of the “double plays” to profit from their speculative positions. The Hong Kong equities purchased during the operation are now being disposed of gradually through the Exchange Fund Investment Limited, in a way that will cause the least disruption to the market.

The unorthodox market operation was not an easy decision as Hong Kong is a keen supporter of free markets. But when free markets fail to work properly, and when the market is failing in its function to discover prices, there is a need for the government to step in and return the market to its normal functions. However, with the technical measures implemented in September 1998 to improve the workings of the currency system, the necessity of such an extreme response will be considerably lessened.

4.5 Transparency

An important lesson learnt during the Asian crisis and the LTCM debacle is that enhanced transparency, in both the macro and the micro sense, is a very effective means to reduce the systemic risks of a financial system and to contain the risks borne by individual institutions. If investors had had a better grasp of the economic balances of some Asian countries through up-to-date data, the crisis might not have hit so hard and quickly. If LTCM’s creditors had had a better understanding of its leverage, the impact of its downfall on the financial markets might have been a lot smaller.

At the macro level, the IMF has been improving the SDDS standards and stepping up the surveillance of compliance by emerging economies. In the context of Hong Kong, we have further enhanced our already quite transparent system:

- monetary data such as changes in the monetary base, including the aggregate balance of the banking system, are available in real time;
- records of the meetings of the Currency Board Committee are published with a short time lag;
- full subscription to the SDDS standards, including monthly disclosure of international reserves, the Exchange Fund balance sheet data, and the SDDS template on international reserves and foreign currency liquidity.

At the micro level, the HKMA issued a Guide on Financial Disclosures back in 1994, and has been introducing annual packages to improve the disclosure standards. Investors, shareholders and depositors can now review a full range of financial data from the banks' announcements of their interim and final results.

Another aspect of transparency involves the credit information made available to banks. Following the crisis, lending to small and medium-sized enterprises in Hong Kong has dwindled considerably, partly due to the collapse in the prices of their collateral (mostly properties) and partly due to the inability of banks to assess their creditworthiness without adequate financial information. The channel of banking intermediation to these small enterprises is effectively blocked by the lack of information. To enhance data transparency in this sector, thus encouraging more lending to the creditworthy enterprises, the HKMA has proposed the establishment of a commercial credit reference agency, which will aggregate and disseminate credit information on these small borrowers. This will provide banks with more information to assess the creditworthiness of these borrowers, thus allowing the resumption of lending to them. This is another useful tool to reduce the procyclicality of banks' behaviour, which sees them restricting credit to borrowers during a recession, thus causing liquidity problems for these borrowers, forcing them to default, and further increasing the stress on the system. The proposal is now under public consultation, and we hope that a decision will be made before the end of the year.

5. Concluding remarks

This paper has reviewed how micro and macro monitoring of financial distress are conducted in Hong Kong. While we have a very well developed prudential regulatory system, macro monitoring has only recently been strengthened following the experience of the Asian crisis. In particular, cross-sector coordination, in both financial market monitoring and policy formulation, has been enhanced with the setting-up of various regulatory liaison forums. We find such coordination very useful in establishing an overall picture of the market and in understanding the underlying dynamics.

While some of our regulatory tools are countercyclical in nature, the HKMA has so far not sought to introduce regulatory measures solely for the purpose of dampening financial cycles. Nor has it tried to vary regulatory requirements in different cycles of the economy. We believe that consistent application of policies should remove uncertainties and enhance the credibility of those policies. But if within the supervisory framework there are elements which are procyclical and which can be amended without affecting the prudential aspect, then such an amendment might be worth considering. But it has to be explained clearly and applied consistently thereafter.

Having established the various monitoring systems, it is necessary to consider the policy response if distress is spotted. Under the currency board system in place in Hong Kong, there is a limit on how far the monetary policy instrument can be used to relieve financial distress. Fiscal measures will therefore play a bigger role. Unorthodox measures like the market operations in 1998 might have to be conducted when there is a market failure. But with the implementation of the various technical measures to strengthen our monetary system, the need for this should be much reduced.

There is no easy way to find an airtight system for financial monitoring. Even establishing reliable early warning signals will be extremely difficult. There is also no set formula as to what policy response is appropriate when certain stress points are spotted. The important thing is probably to remain highly alert and be prepared to deal with different stress scenarios at all times. This is especially true for small and open economies, which might be most vulnerable to volatile international capital flows.

Crises and contagion: the role of the banking system

Massimo Sbracia and Andrea Zaghini[1]

1. Introduction

It is only very recently that banking and currency crises have started to be analysed from a unified perspective. The literature on "twin crises" has unveiled the important complementarities between bank insolvency and currency instability, stressing that causation may run in either direction. In the last few years, empirical studies have focused on the relevance of imbalances in the banking sector to currency devaluations. At the same time, the literature on currency crises has turned attention to the tendency of financial crises originating in one country to spread internationally. This line of research into what is usually referred to as "contagion" has just started to disentangle the specific role of banks in the international transmission of shocks. A seminal contribution by Miller (1998) has provided examples of domestic banking crises causing financial distress in foreign countries and of currency crises abroad inducing domestic bank runs.

The relevance of domestic and foreign banks in transmitting shocks across countries emerged clearly during the Asian crisis. One can define a transmission channel as a mechanism through which a financial crisis in country A brings about a financial crisis in country B. For example, a currency crisis in A might cause a sharp decline in its imports; the consequent reduction of exports in B may induce pressures on its exchange rate such that, eventually, B also faces a currency crisis (the so-called trade channel). In this paper we are concerned with channels operating through the banking system, which may be in A, in B or in a third country C. We focus on channels in which banks are involved because we believe that the banking system has specific characteristics which have to be taken into account when designing policies aimed at containing systemic risks. Unlike other papers, we do not distinguish between crises due to the *normal interdependence* between countries A and B and crises occurring because of some *discontinuity in the transmission mechanism*, since we are interested in the role of banks tout court.[2] Moreover, we ignore the transmission channels based on optimal portfolio rules even if the banking sector is directly involved. In fact, in the current globally integrated world, banks invest in international financial markets and, like other institutional investors, they can transmit shocks through portfolio rebalancing decisions. However, this channel is not bank-specific. Here, we analyse transmission mechanisms originating from changes in the value of collateral and in capital ratios, from bank runs and bank panics and from moral hazard (see Figure 1).

The first channel hinges on the specific lending function of banks. Loan contracts typically require the borrower to provide *collateral*. If the occurrence of a currency crisis reduces the market value of stocks in a country, each economy that has been backing its liabilities with those stocks as collateral has to "mark to market"; otherwise, it can face a reduction in its credit lines from the banking system. Moreover, if the bank itself has been lending to firms in the crisis country, the resulting rise of non-performing loans worsens its "value-at-risk". It follows that the bank - in order to comply with binding *capital adequacy constraints* - will have to withdraw capital from other countries, leading to a credit crunch.

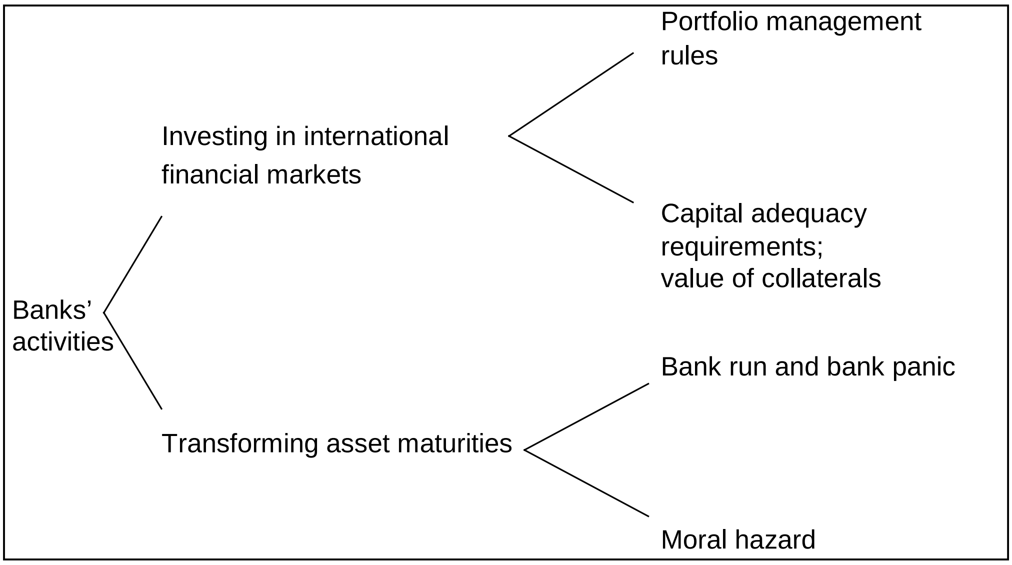
The second transmission channel is connected to the function of transforming asset maturities. Banks provide a transformation of securities with short maturities, offered to depositors, into securities with long maturities that other agents desire. This "transformation" service leaves banks vulnerable to *runs* that can potentially be transmitted to the whole domestic banking system (*bank panics*). Bank run models, as in the seminal paper by Diamond and Dybvig (1983), allow for two different equilibria: a "good" equilibrium, where only "few" investors withdraw in the short term, leaving the bank with enough liquidity to repay all its creditors, and a "bad" equilibrium, where all depositors withdraw in the

1 We are very grateful to Chiara Bentivogli, Paola Caselli, Giancarlo Corsetti, Giorgio Gobbi, Aviram Levy and Roberto Rinaldi for useful comments and helpful discussions. We also thank Antonio Covelli and Giovanna Poggi for valuable research assistance. This paper does not necessarily reflect the views of the Bank of Italy.

2 In two related papers, Corsetti et al (2000a and 2000b) provide a theoretical appraisal of studies on contagion and interdependence and an empirical analysis of the occurrence of contagion during the Asian crisis.

short term, bringing about bankruptcy. This feature of the banking system gives rise to two different classes of bank runs. First, a crisis in a country modifies the *information set* available to all agents. As a consequence, depositors in other countries may simply switch from a good to a bad equilibrium (sunspot), or they may revise their views on the quality of other banks' assets. In the latter case, herd behaviour induced by asymmetric information can make the occurrence of a bank panic more likely. Second, in models where the multiplicity of equilibria disappears, the probability of a bank run can be related to the *structure of the economy*. Hence, one can find that a shorter maturity of capital inflows, a larger share of foreign currency denominated debt and higher domestic and international interest rates increase the probability of a banking crisis. Moreover, in globally integrated financial markets, banks from different economies may form a network of firms (credit chain) that can internationally spread problems affecting a specific bank in a single country.

Figure 1
Banks' activities



In order to reduce the risk of runs, public authorities may offer guarantees on deposits. *Moral hazard* resulting from implicit or explicit government guarantees, from confidence in international rescue packages or, similarly, from the belief that some borrowers are "too big to fail" may provoke excessive capital inflows that banks eventually channel towards risky or unprofitable plans. Such overborrowing, in turn, can translate into unsustainable imbalances that make the economy vulnerable to international shocks and sudden reversals of capital flows.

In the next section, we present some stylised facts related to the channels discussed above, assessing inter alia the vulnerability to contagion stemming from the concentration of loans from the same lender. In Section 3, we examine at a theoretical level the channels that favour the transmission of financial shocks through the banking system. Finally, we discuss some empirical evidence, reviewing the variables (both bank-specific factors and macroeconomic indicators) that the literature has found to be significant in determining the probability of banking and currency crises. In particular, among the channels discussed in the paper, the presence of a common lender and of an explicit deposit insurance scheme have recently been identified as significant sources of instability. Section 5 concludes.

2. Stylised facts

Before carrying out a theoretical examination of the international transmission channels for shocks that involve the banking sector, we provide some stylised facts describing the recent evolution of borrowing/lending flows, the occurrence of bank runs and bank panics and the diffusion of deposit insurance schemes.

(1) The United States, Japan and Germany - which are the main international creditors - tend to concentrate their loans in specific regions of the world. Moreover, countries belonging to the same region tend to borrow from the same lender.

Developing countries ("DCs" in this section) rely heavily on foreign funds to finance their economic activity.[3] The United States, Japan and Germany provide most of the foreign loans these countries require. Data from the Bank for International Settlements (BIS) show that at the beginning of the 1990s loans from the three lenders amounted to over half (53%) of the total liabilities of DCs vis-à-vis BIS reporting countries. At the end of the decade, this share was still close to 45%, despite the very sharp reduction in Japanese lending.

After the two major crises that hit DCs in the 1990s (the Mexican crisis and, later, the Asian-Russian crisis), the flows of loans from advanced economies to the DCs have decreased drastically. In 1990, the *United States* was strongly exposed to DCs, which were receiving almost 70% of total US bank loans to non-residents. Most of these credits, about 60%, were directed towards Latin America; 23% were directed towards Asia-Pacific countries. At the beginning of 2000, the shares of lending to Latin America and to Asia (out of total lending to DCs) were approximately the same - 57% and 24%, respectively - but the share of US exposure to DCs collapsed to less than 20%.

A similar pattern of events characterises the *Japanese banking sector*. The weight of DCs in the balance sheet of Japanese banks increased in the mid-1990s, but, at the end of the decade, it shrank quickly. Loans by Japanese banks to DCs have always been concentrated towards the Asia-Pacific region. In 1990, 54% of Japanese loans to DCs were directed to Asia-Pacific countries; this share increased to over 80% in 1996 and dropped to 76% in 1999.

Also, the relative exposure of the *German banking sector* to DCs witnessed a sharp reduction after the crises. Nonetheless, the relative weight of international credits to Asia-Pacific countries almost doubled, from less than 12% of total loans to DCs in 1990 to over 22% at the end of the decade.[4]

A second feature of bank loans to DCs is that countries in the same area tend to share the same borrower. Consider *Latin American countries* at the end of 1994 a few days after the outbreak of the *tequila crisis*.[5] As the first column of Table 1 shows, in 1994 there were eight countries for which liabilities vis-à-vis the United States represented more than 30% of their total external indebtedness; the area as a whole was indebted to the US banking system by more than 32% of its total external liabilities.[6]

In the years following the *tequila crisis*, the relative weight of loans from US banks declined. However, at the end of the decade, the countries of the region were still highly indebted to the United States (see the second column of Table 1). Their share of liabilities vis-à-vis the common lender is still well above 20%, and in Mexico the share is higher than 30%. Also, the aggregate value shows that, in Latin America, bank loans from the United States have a smaller but still very important weight today (the share is about 24%).

A similar pattern emerges for the *Asia-Pacific region* in the late 1990s. The data show that, at the end of the second quarter of 1997, more than 35% of the region's total external liabilities were due to Japanese banks. In Table 2, among the most indebted countries, we find all the major economies that were involved in the Asian crisis (Indonesia, South Korea, Malaysia and Thailand). After the crisis, the weight of external liabilities to Japan declined quickly in the region, reaching 24% at the end of the decade (it had been 36% in 1997). Though the share of external liabilities to Japan decreased in all countries, for some countries the share of indebtedness to Japan is still higher than 30%.

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3 We use the Bank for International Settlements' definition of developing countries.

4 German banks have considerable exposure to eastern European countries. However, due to the subject of the paper, we focus on Asia-Pacific and Latin American countries.

5 Data for the second quarter of 1994, before the beginning of the Mexican crisis, do not differ significantly.

6 Each entry is the amount owed by that country to the lender, divided by that country's total debt to BIS reporting countries (grand total).

Table 1
Shares of indebtedness to the United States

Country/region	1994	2000
Argentina	30.7	19.2
Bolivia	35.4	23.0
Brazil	30.0	25.8
Chile	31.6	21.2
Colombia	30.1	24.0
Mexico	38.6	30.2
Uruguay	36.5	21.6
Venezuela	33.9	26.4
Latin America	32.2	24.4

Table 2
Shares of indebtedness to Japan

Country/region	1997	2000
China	35.9	21.2
Indonesia	41.7	29.3
South Korea	33.4	24.6
Malaysia	37.5	32.5
Thailand	55.8	39.3
Asia-Pacific	35.8	23.8

(2) The degree of vulnerability to contagion in Asia-Pacific and Latin America has sharply decreased since the period of crisis.

A situation in which many countries borrow from the same lender is not necessarily risky, provided that the lender's exposure vis-à-vis each country is not large. For instance, if the share of US external loans vis-à-vis Latin American countries had been negligible in 1994, the risk of a sudden reversal of funds due to the attempt to restore capital ratios by US banks following a default in the region would have been small. US banks were, instead, highly exposed to these countries: almost 60% of their loans to DCs were to Latin America, with Mexico receiving 17% of total external loans.

The following index provides an evaluation of the risk of "importing" a financial crisis due to the presence of a common lender. First, choose an arbitrary threshold of indebtedness to a single lender (say, 30% of total liabilities, as in Tables 1 and 2) and select the group of countries which are above this limit. Then, consider the country in the group for which the exposure of the lender is maximum. Finally, multiply the share of indebtedness of each economy towards the common lender with the value of the maximum exposure identified in the second step.[7] For Latin American countries in 1994, this procedure implies the shares in Table 1 are multiplied by 17% (ie the weight of Mexico, the

[7] The index does not take into account the possibility that a country will have large relative indebtedness but a small absolute exposure vis-à-vis the common lender. It also ignores the impact that different degrees of liquidity have on the behaviour of creditor banks. However, previous work (eg Van Rijckeghem and Weder (1999), Caramazza et al (2000)) has shown that it provides a good approximation of the vulnerability stemming from the common lender channel.

Table 3
Index of vulnerability

Country	Crisis year	2000
Argentina	521.9	57.6
Bolivia	601.8	69.0
Brazil	510.0	77.4
Chile	532.1	63.6
Colombia	511.7	72.0
Mexico	656.2	90.6
Uruguay	620.5	64.8
Venezuela	576.3	79.2
China	324.2	2.4
Indonesia	376.6	58.6
South Korea	301.6	49.2
Malaysia	338.6	65.0
Thailand	503.9	78.6

maximum in the portfolio of US banks). Table 3 reports the values of this index (multiplied by 10,000) for both Latin American and Asia-Pacific countries in the crisis year and in the first quarter of 2000.[8]

It is easy to see that the two periods differ sharply. In 1994 the value of the index in the eight Latin American countries was always above 500, signalling a very high concentration on the same source of funding and, at the same time, a large exposure of the lender vis-à-vis the region. At the beginning of 2000 the index was always below 100, indicating both the lower indebtedness of Latin American countries to the United States (the average for the zone as a whole dropped from over 32% in the crisis year to less than 25%) and the relative reduction in the exposure of the US banking system (the maximum value in the first quarter of 2000 was 3% vis-à-vis Mexico). For Asian emerging economies the index again shows a sharp decrease after the crisis: both the concentration on Japan as source of financing and the exposure of the Japanese banking system vis-à-vis Asia-Pacific countries were considerably lower at the beginning of 2000.

(3) In the last 20 years, the number of banking crises has escalated. However, episodes of bank runs and bank panics have not been frequent.

While there seems to be a broad consensus on the theoretical definitions of sound and unsound banking systems see, for example, Lindgren et al 1996, the empirical identification of a banking crisis is not a simple task. Studies are strongly conditioned by the availability and the quality of data, especially for developing countries, by the difficulties of finding homogenous sources of data at the firm level and by the lack of high-frequency data, which complicates the task of detecting crises on a timely basis. Most empirical works have defined a banking crisis by considering one or more of the following factors: the ratio of non-performing assets to total assets in the banking system; the closure or failure of important banking institutions; the occurrence of large-scale bailouts, conducted either by the government or by the private sector (eg through mergers or takeovers); the occurrence of large scale nationalisations of banks; the cost of rescue operations; the occurrence of extensive bank runs; and a fall in the stock prices of banking institutions.[9]

8 For the Asia-Pacific region, the largest exposure of Japanese banks was vis-à-vis Thailand in 1997 Q2 (9%) and vis-à-vis South Korea in 2000 Q1 (2%).

9 See Section 4 for detailed examples of definitions of banking crises.

Also reflecting such data-related problems, few studies have compared the frequency of banking crises over long horizons. Recently, Kaminsky and Reinhart (1999) have considered a sample of 20 industrial and developing countries, over the period 1970-95. In their sample, banking crises are rare during the 1970s, with only three episodes taking place. The number of banking crises per year more than quadruples after 1980, when 23 banking crises are recorded. The relevance of the phenomenon in the last 20 years is acknowledged in Lindgren et al (1996), which provides one of the most extensive studies on banking crises. These authors examined all IMF member countries, from 1980 to 1995. Since the beginning of the sample period, 133 countries, among the over 180 member countries of the IMF, have experienced *crises* or *significant problems* in the banking sector.[10] Developing and industrial countries alike have been affected, as well as all economies in transition.

Despite the large number of crises, episodes of bank runs and bank panics have not been very frequent. Lindgren et al (1996) analyse a sample of 34 countries which have experienced crises or significant problems in the banking sector, providing a large set of information on both the causes and consequences of the crises. The sample comprises 19 developing economies, eight transition economies and seven industrial countries: 36 cases of banking sector problems are singled out (for one country, Argentina, three different episodes have been considered). In this sample, bank panics have been recorded in seven cases and "sporadic" runs on individual banking institutions in just a few other episodes. Moreover, in only two cases (Argentina in 1995 and Philippines in the first half of the 1980s) can the bank panic be considered as the main cause of the failure or closure of the institution involved. In particular, in the Philippines, rural and thrift banks failed in 1981 partly because of a confidence crisis sparked by fraud in the commercial paper market. The fraud that triggered the run - known as the Dewey Dee Affair - is described in Nascimento (1991):

> "In January 1981, Dewey Dee, an industrial magnate who had borrowed heavily in the commercial paper market, fled the country, leaving behind an estimated 500-800 millions of pesos of debt. The news sent a wave of panic through money market investors and small depositors."

This episode had a very strong impact on confidence: the commercial paper market collapsed, many non-bank money market institutions went out of business and, finally, the panic propagated to rural and thrift banks. Bank panics again took place in the Philippines shortly thereafter. Following the announcement by the government of a moratorium on external debt payments in October 1983, a series of runs on the banks ensued and, unlike what had happened in 1981, important commercial banks were also hit.

The present situation, characterised by relatively infrequent episodes of bank runs, contrasts with the picture prevailing before deposit insurance schemes were heavily resorted to. For instance in the United States, the so-called Free Banking Era (1837-63) and the National Banking Era (1863-1914) were both affected by recurrent nationwide bank panics. Since the introduction of federal deposit insurance, in 1934, widespread episodes of bank runs have not taken place. The empirical relevance of bank runs as a cause of banking crises is, however, still a debated question. According to some authors, both in recent and in past periods, runs have been only a symptom of the banks' weaknesses, rather than the cause. Most banking problems have been due to a deterioration in the asset quality, rather than to bank runs. Some empirical evidence on this issue is discussed in Section 4.

(4) The number of countries with explicit deposit insurance schemes has increased sharply since 1980. The characteristics of these schemes have been adjusted in recent years, in order to reduce the risks arising from moral hazard and other agency problems.

The IMF has recently conducted an extensive survey on 72 countries with different deposit protection systems, analysing their characteristics (see Garcia (1999)). While the first explicit deposit insurance scheme for national banks was established in the United States as late as 1934,[11] other countries did not follow this lead until the 1960s. In April 1999, of the 72 systems reviewed by the IMF, 68 were explicitly defined by law or regulation. Interestingly, only 18 schemes were adopted before 1980. As

[10] A *crisis* is defined as a situation in which a sizeable group of financial institutions have liabilities exceeding the market value of their assets, and the economy experiences bank runs or other portfolio shifts, the collapse of some financial firms and government intervention. Extensive unsoundness of the banking sector, short of a crisis, is termed a *significant problem*.

[11] Some states within the United States began a deposit insurance scheme earlier, as did Czechoslovakia.

the incidence of banking crises escalated, 50 new formal schemes were implemented: 19 during the 1980s and 31 during the 1990s.

The acceleration in the implementation of formal deposit insurance schemes was particularly strong in Europe and in Africa. The 1994 European Union Directive on Deposit Guarantees - which requires countries to set up a deposit insurance scheme to which banks are forced to adhere - has led many countries to revise or to establish deposit protection systems. In countries that are, or aspire to be, members of the European Union, a standardisation of practices concerning some characteristics of the schemes (like the compulsory or voluntary nature of bank membership and the coverage limits) has been enhanced. In Africa, the implementation of formal schemes did not accelerate until 1999, when six countries (Cameroon, the Central African Republic, Chad, the Republic of Congo, Equatorial Guinea and Gabon) ratified a treaty that established a common central bank and set the rules of an explicit deposit insurance scheme.

The most important trend concerning deposit insurance seems to be the shift from an implicit scheme to an explicit formal scheme. Many countries currently maintaining explicit guarantees have, in fact, reformed their pre-existing implicit insurance. Of the four countries surveyed by the IMF and reported in Garcia (1999) that do not maintain formal guarantees on deposits, only Kuwait has never considered the implementation of explicit schemes. In Bolivia and Costa Rica, explicit schemes are under discussion or under preparation; in Honduras, the current banking law mentions that a deposit insurance law would be passed, but, in April 1999, the draft had still to be presented to parliament.[12]

Revisions of explicit guarantees have tended towards imposing compulsory adherence to the deposit insurance scheme on banking institutions. These reforms - aimed at reducing adverse selection problems - have occurred not only in Europe as a result of the 1994 Directive on Deposit Guarantees, but also in the Middle East and in the Americas.[13]

Generally, deposit insurance covers only retail deposits and only up to a certain amount. In order to reduce the room for moral hazard, the coverage limit should be low enough to encourage large depositors and sophisticated creditors (like foreign creditors and other banks) to closely monitor the investment activity of banks; on the other hand, the limit should also be sufficiently high to fully insure small depositors, typically unable to engage in an effective monitoring of banking institutions. As a rule of thumb, the IMF suggests that deposits should be guaranteed up to a limit not exceeding two times the per capita GDP. In the IMF sample, the average coverage limit is three times the per capita GDP, with the highest average in Africa and the lowest in Europe. Some countries, however, offer full coverage for all deposits and also for other liabilities.[14] Most of these countries began to offer full coverage when they declared a financial emergency, with the intention to shift to limited coverage when the conditions in the banking system became sounder. For instance, the current insurance scheme in Japan - which covers all depositors and creditors - is planned to end in March 2002 (see Freixas et al (1999a)). Sweden and Finland have already retracted the full coverage offered during their banking crises and have replaced it with limited coverage.

Finally, almost all countries with explicit deposit insurance have shifted to a system of coverage per depositor, rather than per deposit, in order to lower the effective coverage ratio and to discourage behaviours aimed at circumventing the limits.

3. Transmission channels

The role of the banking system in the transmission of financial shocks is closely related to the level of development of the credit market. In particular, Aghion et al (1999) show through a theoretical dynamic

[12] Dermirgüç-Kunt and Detragiache (2000) consider a different sample, where 23 other economies - mainly Asian and African countries - still maintain an implicit scheme.

[13] Note that if the adherence of banking institutions to a deposit insurance scheme is voluntary and charges a fixed premium, the scheme is likely to attract weaker institutions while repelling stronger banks.

[14] These countries are Colombia, Ecuador, Indonesia, Japan, South Korea, Malaysia, Mexico, Thailand and Turkey. Kuwait - which has an implicit scheme - is also supposed to cover all deposits.

open economy model that countries with an intermediate degree of development of the banking system (such as emerging markets) can be much more vulnerable to external shocks than not only countries with a highly efficient financial sector, but also countries with an underdeveloped banking system. Hence, the impact of financial shocks transmitted through the mechanisms analysed in the following sections is likely to be much stronger in emerging economies.

3.1 Common lenders and the value of collateral

In the current scenario of growing integration among banks from different countries, a common lender may be the main source of funds for several countries.[15] A problem that may arise in this context concerns the competition for funds from the same bank. When a common lender is highly exposed to a crisis country, adjustments to restore capital ratios or to reduce risk exposure may lead to a sudden cutting of credit lines to other economies. In fact, if a bank faces an increase in non-performing loans in one country, it is likely to reduce - by choice or because of regulation - its overall value-at-risk. In practice, it may shift away from lending and increase its holding of government bonds. It follows that other countries borrowing from the affected bank will become vulnerable to a retrenchment of their credit lines. Moreover, if these countries' liabilities have a short maturity and the bank's rebalancing needs are large, the crisis can trigger large capital outflows from other countries. For instance, consider the case in which the firms from two countries, A and B, borrow from the same banking system (say, country C). When a crisis hits A, banks from C may be unable to have the credit issued to country A repaid. This, in turn, implies that, in order to restore capital ratios, country C causes a credit crunch in country B by calling back the loans issued to B. In this way the productive sector of country B comes under pressure and eventually the whole country may face a crisis. Even if the economy of B is not linked to that of country A, the presence of a third party, C, causes the crisis to spread from one country to the other.

The problem arising from the existence of a common lender is twofold. On the one hand, the bank may be unwilling to extend new credits to other borrowers; on the other hand, it may refuse to roll over the existing loans. When borrowers are heavily dependent on the bank and do not have easy access to alternative sources of financing, the credit crunch may trigger a crisis in other economies too, independently of the state of fundamentals. However, three conditions must be met in order to have this transmission channel operating:

(i) the bank's exposure in the country initially affected by a financial crisis is large, implying potential substantial losses and, in turn, the need to restore capital asset ratios or to readjust risk exposure;

(ii) the same bank is an important source of credit for other countries;

(iii) the potentially affected countries cannot easily find other sources of funding.

In particular, note that the third condition relies on some form of market imperfection. If the common lender does not roll over its loans in countries with sound fundamentals, other lenders could intervene in its place. However, the common lender might have a deeper knowledge of the borrowers' economies, given their past relationship or because of geographical proximity. By contrast, if potential lenders are unable to efficiently monitor borrowers, due, for instance, to larger initial costs, they might refrain from replacing the common lender.

A similar pattern of contagion is also at work when considering changes in the value of collateral. In fact, given that banks usually require some form of asset to back the granting of credit lines, debtors provide collateral, such as government bonds or stocks, to meet this requirement. When the value of these assets changes after a financial crisis, banks demand that the value of collateral be restored. As before, when country B provides collateral from country A and a crisis hits the latter economy, the banking system (now in country B) requires the firms to update the value of collateral, otherwise it has to reduce the amount of the outstanding loans. As before, a credit crunch in country B and the transmission of the crisis (from A to B) are the likely outcome in this framework.

[15] Countries borrowing from a common lender are typically in the same region (see Section 2). However, this is not always the case. For instance, in 1997, unlike other Southeast Asian economies that borrowed mainly from Japanese banks, the Philippines was mostly indebted to the United States.

Emerging economies, which require substantial foreign resources to finance productive activities, are particularly vulnerable to changes in the value of collateral. In fact, weak international financial links, reflected in the inadequate provision of international collateral, place limits on the country's ability to acquire external financing (Caballero and Krishnamuthy (1999)). For instance, consider a region that is economically open but has an underdeveloped bank-based financial market and suppose that an economy in this region is backing its funding with asset holdings in a neighbouring country. When a crisis hits the "collateral" economy, the lender will require sounder backing for its claims. If this is impossible, the lender will downgrade the creditworthiness of the debtor and reduce the amount of credit issued, by ceasing to roll over the existing loans or by requiring a repayment of its credits. This in turn implies that, during financial crises, the country's international collateral may turn out to be insufficient to finance its productive activity. Domestic firms needing foreign funds might trade domestic assets for international collateral at prices not in line with the country's fundamentals, exacerbating the initial shock.

3.2 Bank runs and bank panics

3.2.1 Informational bank runs

The traditional explanation of a *bank run* is that when depositors observe large withdrawals from their bank, they might fear that a bankruptcy is soon to occur. Since bank assets are allocated on a *first come, first served* basis, when depositors expect a run they respond by rushing to withdraw their own deposit in an attempt to anticipate others. Withdrawals in excess of a bank's current expected demand for liquidity can cause bankruptcy. Banks, in fact, typically *transform* liquid liabilities into illiquid assets. This kind of service - which allows better risk-sharing among people with different consumption horizons (and provides the rationale for the existence of banks) - makes banks vulnerable to runs. Bank run models, as in Diamond and Dybvig (1983), exhibit multiple equilibria: a "good" equilibrium, which entails optimal risk-sharing, and a "bank run" equilibrium, which makes all agents worse off with respect to the allocation that they would have achieved without the bank intermediation (ie by trading in a competitive market).

An apparent inconsistency of the standard model is that bank runs should not be observed in equilibrium, because no one would deposit when a bank run is expected. However, the equilibrium could be selected contingently on a publicly observable random variable, provided that the probability of a run is small. As Diamond and Dybvig put it:

> "this [variable] could be a bad earnings report, a commonly observed run at some other bank, a negative government forecast, or even a sunspot. It need not be anything fundamental about the bank's condition".

Bank runs have drawn the attention of economists and regulators, because a run on an "illiquid" but solvent bank entails an *inefficient equilibrium*. Different classes of models provide different explanations of the causes of this market failure and prescribe different optimal policies aimed at preventing the problem. In the framework of Diamond and Dybvig, bank runs arise because of a *coordination problem*: depositors withdraw simply because they expect other depositors to withdraw and, by doing so, they trigger a (self-fulfilling) bankruptcy. In such a model, the optimal public policy is the implementation of a deposit insurance scheme financed with money creation. In other models (eg Chari and Jagannathan (1988)) the inefficiency is due to the presence of *informational asymmetries*: depositors are afraid that banks are insolvent, because they do not know the real state of banks' claims (and banks cannot credibly reveal it). Hence, a public policy should aim at reducing the informational asymmetries. In this perspective, Gorton (1985a) shows that a temporary "suspension of convertibility" (of the demand deposit into currency upon demand) could give banks the possibility of informing depositors that continued investment is mutually beneficial. Other authors consider as excessive "the anxiety" that bank executives and regulators have for this phenomenon and for its implications in terms of systemic risk. Hence - also in the light of past experiences in Scotland and New England (the Suffolk System) - they claim that banks should not be regulated at all (see, for instance, the discussions in Fama (1980), Gorton (1985b), Kaufman (1994) and Calomiris and Kahn (1996)).

Bank run models highlight several possible causes of the international transmission of financial shock. First, a currency or a banking crisis in one country may represent the *sunspot variable* that triggers a bank run (or an extensive bank panic) in another country. While this channel is very clear at a theoretical level, it is very hard - if not impossible - to test it empirically. The crucial issue is that multiple-equilibria models of bank runs and contagion are not reproducible and there are no econometric methodologies to test them.

Second, the *revision of beliefs* following the crisis in another country may be another cause of the transmission. If agents observe widespread episodes of bankruptcy, they may interpret them as a signal of difficulties affecting the world economy. The resulting Bayesian update of the quality of banks' assets can trigger a sequence of withdrawals and failures. Even if the transmission of shocks through this channel is more closely related to the fundamentals, it does not always lead to efficient outcomes. In particular, Chari and Jagannathan (1988) show that agents can (mis)interpret liquidity withdrawals as produced by pessimistic information about banks' assets and their reaction can cause a bank panic.

Finally, contagious bank runs can occur in the presence of *asymmetric information*. In a recent model of bank panics, Chen (1999) modifies the standard Diamond and Dybvig framework by assuming that some depositors are better informed about the value of a bank's assets. Informed depositors enjoy an advantage, since they can withdraw earlier in bad circumstances in which the bank cannot fully repay all depositors. Uninformed depositors therefore have an incentive to respond to other sources of information, before the value of the bank's assets is revealed. Failures of other banks, interpreted as a signal of worldwide (or regional) difficulties, can be one such information source. Even if the information contained in bank failures is very noisy, uninformed depositors may still respond to it and withdraw. Moreover, informed agents, knowing that uninformed depositors withdraw early, can be forced to withdraw early too, even before they receive more precise signals about the asset. In this way, a single bankruptcy can easily trigger a contagious bank panic.

3.2.2 Structural bank runs

The literature on bank runs has produced interesting developments of the original Diamond and Dybvig model where a unique equilibrium emerges. In particular, Postlewaite and Vives (1987) have presented a framework in which there is a unique equilibrium that entails a positive probability of a bank run. In their model there is no exogenous event on which agents condition their behaviour and, at the same time, there are *no* equilibria without the possibility of bank runs. An important feature of this kind of model is the possibility of making some comparative statics, relating the probability of a run to the characteristics of the economy.

Building on a variation of the Postlewaite and Vives model, Goldfajn and Valdes (1997) focus on the role of banks as intermediaries between foreign investors and domestic enterprises. The banking system typically offers foreign investors assets with a shorter maturity, which attract *large capital inflows*. This intermediation has two main consequences: it results in larger movements of capital and, at the same time, it increases the risk of sudden reversals of flows. The effects of internal or external shocks are, in fact, amplified by the action of the domestic banking system and propagated to the rest of the economy. When a shock hits the economy (eg a negative productivity shock or a rise in the international interest rates), risk-averse foreign investors - by virtue of the shorter maturity of their assets - withdraw their funds. Clearly, in this framework, the banking system increases the vulnerability of the country to contagion: shocks (like a currency crisis abroad), which without intermediation would result only in relatively small capital outflows, can give rise to a disruptive financial crisis. Moreover, assets with shorter maturities imply larger capital inflows and, in turn, a higher probability of a run.[16]

Goldfajn and Valdes extended their analysis by including in the model a central bank and the possibility of a *currency mismatch* between assets and liabilities of the domestic banking system. If domestic banks find it optimal to offer (liquid) foreign currency denominated assets, the mismatch with their (illiquid) domestic currency denominated investments translates into a higher probability of runs. When a run on domestic banks occurs, the impact of capital outflows on official reserves increases the probability of a currency devaluation. Hence, the model not only provides an explanation of the

[16] In a related paper - but in a framework with multiple equilibria - Chang and Velasco (1998) have proved that larger capital inflows increase the level of indebtedness of the banking system and, in turn, the vulnerability of the country to a bank run, triggered by a refusal on the part of the creditors to roll over their loans.

recurrent “boom-bust” cycles of capital flows observed in many emerging markets, but it also presents a consistent framework in which banking and currency crises occur together.

More recently, along the lines of Morris and Shin (2000), Goldstein and Pauzner (2000) have “solved” the coordination problem of Diamond and Dybvig by introducing some incomplete private information. In their “global game”, a unique probability of a bank run emerges, which is a function of the characteristics of the demand deposit contract. Goldstein and Pauzner find that offering a higher *short-term interest rate* (ie offering a higher return to agents demanding early withdrawal) makes the bank more vulnerable to a run. Hence, internal or external shocks that have an impact on short-term interest rates make the occurrence of a financial crisis more likely.

Finally, contagion may be due to the presence of an *international interbank market*. To the extent that interbank loans are neither collateralised nor insured against, a bank failure may generate a chain of subsequent failures. On the one hand, an international interbank market - likewise national interbank markets - promotes efficient financial management,[17] and allows single banks’ troubles to be limited. For instance, when a bank is affected by an idiosyncratic liquidity shock, the interbank market provides liquidity assistance. On the other hand, the existence of such a market increases the fragility of the banking system as a whole, since it cannot provide enough liquidity when the entire sector comes under pressure.

Freixas et al (1999b) consider banks facing uncertain liquidity needs. Long-term investment opportunities make it costly for banks to maintain liquid reserves. Thus, an interbank credit market where banks can obtain liquidity allows the reduction of the opportunity cost of maintaining liquid reserves. However, in the presence of illiquid investments, international interbank linkages expose the system to the possibility of a coordination failure, even if all banks are solvent. For instance, a liquidity shock in a foreign country may lead home depositors to believe that home banks will provide their liquidity to that country; the best response to such a belief is to withdraw home deposits, thereby generating a bank run at home. In a related paper, Allen and Gale (2000) show that contagion due to liquidity shocks depends on the degrees of completeness of the interbank linkages. When a region of the world is hit by a liquidity shock and the world demand for liquidity is larger than the world supply, international interbank linkages may propagate the shock to other regions. The consequences of such contagion turn out to be very strong if the interbank market is *incomplete* (ie each region is connected only with few other regions) and are attenuated if the market is *complete* (each region is connected with all the other regions). Finally, Kiyotaki and Moore (1997) developed a theoretical model of “credit chains” in which shocks are amplified and transmitted through a network of firms which borrow from, and lend to, each other. In such a network, temporary liquidity shocks to some firms may cause a chain reaction in which other firms get into financial difficulties.

3.3 Moral hazard

In order to reduce the risk of bank runs, many countries have implemented explicit insurance schemes for deposits. Even in the absence of explicit insurance, international investors may believe that their deposits and loans in some emerging economies are de facto publicly insured. As stressed by Diaz-Alejandro (1985), in many cases the public expects policymakers to intervene and save depositors and other creditors from losses when financial intermediaries run into trouble. Warnings that this kind of intervention will not be provided may simply appear to lack credibility, as expectations of a bailout are strengthened by past episodes of capital injections into the banking system.

Like any form of insurance, public guarantees on deposits create moral hazard. Moral hazard arises when the provision of guarantees modifies the incentive for the insured party to take preventive actions, increasing the probability of the occurrence of the event being insured against. In particular, moral hazard potentially modifies both the behaviour of international investors and the decisions of bank managers. First, the existence of explicit or implicit insurance for deposits and loans may induce a large amount of capital inflows. At the same time, it reduces the incentives of international investors to monitor the behaviour and the performance of the banks to which they are lending. Second, the possibility that the official sector will provide capital even in case of serious financial difficulties encourages bank managers and shareholders to take additional risks, so as to maximise the subsidy

[17] In particular, the decentralised operation of interbank lending facilitates *peer monitoring* (Rochet and Tirole (1996)).

implicit in such a rescue. In the case of negative shocks hitting the economy and reducing investment profitability, bank managers may not be more cautious in planning their investments. On the contrary, they may start to finance very risky projects in an attempt to recover their losses *gambling for redemption*.

Corsetti et al (1999) propose a model to explain the role of moral hazard in the unfolding of the Asian financial crisis. Their work focuses on moral hazard as the common source of overinvestment, excessive external borrowing and current account deficit.[18] Financial intermediation played a key role in channelling funds towards projects that were quite unprofitable from a social point of view. Because of moral hazard, national banks borrowed excessively from abroad and lent excessively at home. The production plans and strategies of the corporate sector largely overlooked the costs and riskiness of investment projects. Underlying this overlending syndrome may have been the presumption that short-term interbank cross-border liabilities would be effectively guaranteed either by direct government intervention in favour of international debtors, or by an indirect bailout through IMF programmes. To the extent that foreign creditors were willing to lend against future implicit bailout revenue, unprofitable projects and cash shortfalls were refinanced through external borrowing. This process, known as *evergreening*, translated into an unsustainable path of current account deficits, leading to the overall fragility of the system and to a significant vulnerability to shocks.

While Corsetti et al (1999) provide a theoretical framework consistent with the events observed in each Asian country hit by the crisis, their model does not explain why all the countries were hit at the same time. One possible explanation is that behaviours that arise because of moral hazard can be highly contagious. Moral hazard is, in fact, inherently forward-looking: a particular episode may create moral hazard only to the extent that it influences expectations of how a similar situation will be dealt with in the future. Hence, if foreign creditors make losses in a country where the public authorities were supposed to grant deposits and loans, they may also stop their investments in countries with a similar financial system. Note that the effects of moral hazard on bank managers and shareholders are likely to be negligible in countries with a well designed and effective system of prudential regulation and supervision. If a banking crisis in an emerging market economy reveals information about the weakness of banking supervision in other countries, banking and currency crises are likely to occur in the latter countries.

4. Empirical literature

Following the recent episodes of currency and banking crises, the empirical approach to the analysis of financial distress, as well as the theoretical literature, have been witnessing renewed interest. As regards the role of the banking system, the empirical literature has focused on four main issues:

(i) the relationship between banking and currency crises;

(ii) the presence of a common lender in regional financial crises;

(iii) the occurrence of bank runs and the causes of banking crises;

(iv) moral hazard arising from the implementation of explicit deposit insurance schemes.

As for the first point, several authors (Kaminsky and Reinhart (1999 and 2000); Miller (1998); Van Rijckeghem and Weder (1999)) highlighted a common pattern in the unfolding of events. After a period of financial liberalisation and growth, a country faced with a recession (caused by a worsening of the terms of trade, by an overvalued exchange rate or by an increase in the cost of credit) is likely to experience banking problems. As the banks' situation worsens, the balance of payments shows growing imbalances and the currency is attacked by speculators. Eventually, the collapse of the exchange rate deepens the banking crisis, triggering a vicious spiral.

Kaminsky and Reinhart (1999) report evidence of 26 banking crises and 76 currency crises in the last three decades. While during the 1970s there were only three banking crises, reflecting the highly regulated nature of financial markets during those years, in the 1980s and 1990s the number of

[18] For explanations of the "overborrowing syndrome", see also McKinnon and Pill (1996) and Giannetti (2000).

banking crises per year sharply increased, reaching an average of 1.44 per annum, up from 0.30 in the earlier decade. As the currency crisis episodes were almost constant over the period, it is possible to state that the twin crises phenomenon is a relatively recent one. Actually, in the 1970s only a single "twin episode" occurred (Argentina in 1977), whilst in more recent years the number of twin crises increased to 18. Moreover, in the latter period, only in five cases was a banking crisis not entwined with a currency crisis. Thus, knowing that a banking crisis is under way definitely helps to predict a future currency crisis.

In a later paper, Kaminsky and Reinhart (2000) highlight the role of indebtedness to a common source of funding as a source of vulnerability. They divide a sample of 20 countries into three different partitions and show that belonging to the same common lender cluster provides a better explanation of crisis transmission than other kinds of clustering. The first partition is dictated by *geographical closeness*, the second by *trade linkages* (bilateral and third-party) and the third by the *source of funding*. The authors report two important findings: (i) the probability of a currency crisis increases non-linearly with the number of crisis economies in the same cluster, in all three kinds of partition; (ii) knowing that there is a crisis in a country belonging to the same common lender group has a higher predictive power than knowing that the country belongs to the same trade cluster or to the same geographical cluster.

Although the "geographical" and "common lender" partitions are very similar, the authors report significant differences in the results. For instance, when 50% of the economies in a cluster are already experiencing a crisis, the probability of a crisis in an economy belonging to the same "common lender" cluster is 80% while the probability of a crisis in an economy belonging to the same "geographical" cluster is 50% (the unconditional probability of experiencing a crisis turns out to be only 30%).

Van Rijckeghem and Weder (1999) also focus on the relevance of the common source of funding. They find that there was a common lender in all recent bouts of international financial turmoil: the United States in Latin America in 1994-95, Japan in Southeast Asia in 1997 and a small group of European countries (Germany in particular) vis-à-vis transition economies during the 1998 Russian crisis. Starting from a "ground zero" country, defined as the economy where a currency crisis first occurred, they studied similarities among crisis economies with respect to international credit institutions.[19] The three "ground zero" countries are: Mexico for the *tequila crisis*, Thailand for the *Asian flu* and Russia for the *Russian virus*. Their estimates show that the structure of indebtedness is the most important factor in transmitting financial shock across countries. All the economies that experienced financial turmoil after the collapse of the ground zero economy had a liabilities structure similar to that of the starting country. Hence, the competition for funds is significantly associated with a higher probability of contagion. However, since the "infected" economies also had similar trade linkages with the ground zero economy, it is difficult to separate the two effects.

A different procedure is implemented by Caramazza et al (2000). They estimate a panel probit model in which one explanatory variable takes into account the source of financing. The common creditor in each of the major crises is identified as the country that lent the most to the first economy experiencing a speculative attack. Moreover, they consider the weight of the liabilities from the point of view of the lender. Both variables are significantly higher in the crisis economies than in the non-crisis ones. On average, the weight of crisis countries in the assets of the common lender is about 10 percentage points higher than the weight of unaffected economies, whereas the weight of the common lender in the liabilities of crisis countries is about 5 percentage points higher than its weight in the liabilities of unaffected economies.

As regards the causes of banking crises, we have already discussed in Section 2 that, in the last 30 years, besides a few anecdotal episodes, bank panics have been only a symptom of the banks' weaknesses, rather than the cause. Although there is not yet a unanimous consensus on the causes of banking crises, in most countries crises have taken place following a rise in the share of non-performing loans or other "asset-related" problems. For instance, Lindgren et al (1996) find that banking crises are mainly related to the fluctuations in the conditions of the real sector due to the business cycle. In the onset of a banking crisis, in fact, many countries have experienced a recession, large shifts in terms of trade and other economic shocks, or important non-economic events with an

[19] With respect to the index proposed in Section 2, the Van Rijckeghem-Weder indicator has a major drawback: it can be constructed only ex post, namely, when the crisis has already hit at least one economy ("ground zero" country, in their words).

adverse economic impact. Generally, these macroeconomic factors have contributed to a further deterioration of an already weak financial system, characterised by low profitability, a large debt, low levels of cash and capital relative to assets and a high responsiveness to changes in domestic or foreign interest rates.

While the apparent irrelevance of bank runs in the most recent period might be due to the worldwide diffusion of deposit insurance schemes (see stylised fact 4, in Section 2), according to many authors even at the beginning of the century most banking panics did not show the characteristics of random events, like equilibria caused by agents' self-fulfilling beliefs, possibly unrelated to the real economy. Serious problems on the liabilities side of banks (eg strong declines in total deposits) have rarely occurred in US history and have been mainly concentrated in two periods: 1893 and 1930-33. However, such problems were often accompanied by a deteriorating macroeconomic outlook, which complicates the task of assessing the direction of causality.

Even during widespread episodes of contagion among banking institutions, it is difficult to find evidence of panics propagating because of self-fulfilling beliefs. An influential study by Gorton (1988) examines the seven panics which occurred during the US National Banking Era (1863-1914), when deposit insurance had still to be adopted by the United States. The results of his analysis are consistent with the view that such panics were systematic responses by depositors to a changing perception of risk based on the arrival of new information, rather than random events. Also Kaufman (1994), in his review of the episodes of bank contagion, argues that strong shocks at one bank or group of banks did not spill over randomly to other banks. With only rare exceptions, empirical studies focusing on equity returns on banks in the United States from 1970 to 1990 report strong evidence that contagion occurred only for the banks which were financially interconnected with the initially affected bank. For instance, after the failure of the "perceived" state-insured thrift institutions in Ohio and Maryland in 1985, depositors not only were able to differentiate between federally insured and federally non-insured institutions, but also correctly differentiated between "perceived" insured and "perceived" uninsured institutions.

The relationship between bank stability and moral hazard arising from the adoption of deposit insurance schemes is analysed by Demirgüç-Kunt and Detragiache (1998 and 2000) in two recent papers. They use a multivariate logit econometric model in which the dependent variable is a banking crisis dummy and they establish that an episode, in order to be considered a fully-fledged crisis, must meet at least one of the following conditions: (i) the ratio of non-performing assets to total assets in the banking system exceeded 10%; (ii) the cost of the rescue operation was at least 2% of GDP; (iii) banking sector problems resulted in a large-scale nationalisation of banks; (iv) extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalised deposit guarantees were enacted by the government in response to the crisis.

When at least one of the above conditions holds, the problem is interpreted as systemic in nature and regarding the whole banking sector. Over the period 1980-94, 31 episodes of systemic crisis are identified by the authors: 23 took place in developing countries and eight in advanced economies. In their first work, the econometric analysis shows that banking crises tend to be more likely when the macroeconomic environment is weak (ie characterised by slow GDP growth, high interest rates and growing inflation), when an explicit deposit insurance scheme is present and when the legal system is not effective in enforcing prudential supervision of the banking system. Moreover, the authors report some evidence that banking problems are more likely when a larger share of credit goes to the private sector and when the system is vulnerable to sudden capital outflows.

In the most recent paper Demirgüç-Kunt and Detragiache investigate the characteristics of deposit insurance schemes which are relevant in generating moral hazard. Their statistical analysis shows that such explicit deposit insurance schemes are, on average, detrimental to the stability of the banking system and that their negative impact tends to be stronger when the coverage offered to depositors is large and the scheme is funded and run by the government.

Many recent papers have broadly analysed the causes of banking crises in the past decade in both developed and developing countries. There are case studies on Mexico (González-Hermosillo et al (1997)), Finland (Pazarbasioglu (1997)), Venezuela (Herrero (1999)), Asian countries (Hardy and Pazarbasioglu (1998)) and many others. Furthermore, there are papers that focus on particular aspects of the banking system like liquidity (Vlaar (1999)) or the relationship between stock price crashes and banking crises (Vila (1999)).

Table 4

Significant explanatory variables in empirical works

Paper	Type of crisis	Bank-specific variables	Macroeconomic indicators
Caramazza, Ricci and Salgado (2000)	Currency	Bank lending maturity Reserve adequacy Common lender	GDP growth Current account balance Real exchange rate M2/international reserves
Demirgüç-Kunt and Detragiache (1998 and 2000)	Banking	Credit to private sector Deposit insurance	GDP growth GDP per capita M2/reserves Real interest rate Inflation
González, Pazarbasioglu and Billings (1997)	Mexico (1994-95)	Non-performing loans/total loans Non-securitised loans/total loans Total loans/GDP Deposit fund/non-performing loans	Real interest rate Nominal exchange rate
Hardy and Pazarbasioglu (1998)	Banking	Deposit liabilities Credit to private sector Foreign gross liabilities	GDP growth Inflation Real interest rate Real exchange rate Import growth
Herrero (1999)	Venezuela (1995)	Capital adequacy ratio Return on assets/total assets Operational costs/capital	GDP growth Real interest rate
Kaminsky (1999)	Currency	Banking crisis	Exports Real exchange rate Stock prices World real interest rate
	Banking	Deposit demand	M2 Real exchange rate Stock prices Foreign debt
Kaminsky and Reinhart (1999 and 2000)	Currency	Common lender	Asset return correlation Trade linkages (bilateral and third-party) Financial liberalisation
Pazarbasioglu (1997)	Finland (1991-92)	Lending rate Deposit rate Credit to business sector	GDP growth Share price index Inflation Expected investment
Van Rijckeghem and Weder (1999)	Currency	Common lender	Trade linkages
Vlaar (1999)	Currency	Short-term debt/reserves Short-term foreign debt/total foreign debt	Inflation International reserves Nominal exchange rate Real effective exchange rate M2

A summary of the variables that have been found to be statistically significant - in a selection of 10 recent papers - in triggering a financial crisis is offered in Table 4. Despite the differences in the statistical methods used and in both the dependent and the control variables considered, the table shows that many works have found the same significant indicators.

The first column of the table describes the kind of crisis considered in the study: when the paper deals with a sample of countries, the column shows whether the episode examined is a banking crisis or a currency crisis; when it focuses on a financial crisis in a single country, the period under investigation is reported. The second and third columns list the significant explanatory variables, divided into bank-specific and macroeconomic variables. Among the bank-specific indicators, liquidity, capital adequacy ratios and a common lender dummy are the most frequent significant variables. With regard to the macroeconomic indicators, GDP growth, inflation and trade linkages appear to improve significantly the prediction of financial crises.

5. Conclusions

The paper identifies three main channels for the international transmission of financial shocks through the banking system. The first channel hinges on the specific lending activity of banks and is connected with the value of collateral and capital adequacy requirements. When the same institution is the main source of funding for several countries, the increase in non-performing loans following a financial crisis in one of the borrowing economies may induce the common lender to require an early repayment of its outstanding credits elsewhere. Similarly, the collapse of the value of debtors' collateral may worsen their creditworthiness and negatively affect the confidence of international lenders.

The second transmission channel is connected to the function of transforming asset maturities, which leaves banks vulnerable to runs. The indeterminacy of equilibria in bank run models gives rise to two different classes of runs. First, the change in the information set due to a crisis in a foreign country may lead depositors in other countries to switch from a good to a bad equilibrium (sunspot) or to revise their views about the quality of other banks' assets (wake-up call). Second, the probability of a bank run can be related to the structure of the economy. In particular, the probability of a banking crisis increases with the share of foreign currency denominated debt and the level of domestic and international interest rates and decreases with the maturity of capital inflows. Moreover, in globally integrated financial markets, banks from different economies may form a network of firms (credit chain) through which problems affecting a specific bank from a single country can be transmitted internationally.

Financial shocks can also spread because of moral hazard. The presence of implicit or explicit insurance schemes, confidence in international rescue packages or, similarly, the belief that some borrowers are "too big to fail" may provoke excessive capital inflows that banks eventually channel towards risky or unprofitable plans. A banking crisis in a country characterised by such a system of guarantees may undermine the confidence of international investors in the reliability of similar systems, leading to large capital outflows and, eventually, a financial crisis in other countries.

The stylised facts presented in the paper show that the presence of a common lender characterised most of the countries involved in the tequila crisis and in the Asian flu. Moreover, preliminary empirical studies reviewed in our work find that the probability of a currency crisis increases significantly in the presence of a unique source of funding. Thus, a set of indicators of the vulnerability of the financial system should take into account the level of indebtedness vis-à-vis the same lender. A possible indicator - proposed in the paper - suggests that vulnerability to contagion through this channel has sharply decreased after the two recent crises of the 1990s, reflecting a higher degree of diversification of the sources of funding of developing countries and a reduced level of concentration of loans from the main lenders. A statistical analysis of the predictive power of this kind of indicator and its contribution to more traditional sets of variables signalling the fragility of the financial system is beyond the scope of the present work. The empirical evidence reported so far is, however, very promising.

Finally, both stylised facts and many case studies reported above agree on the view that most banking crises - especially in recent years - have not been associated with bank runs. The clear absence of problems on the liabilities side of banks' balance sheets might be due to the widespread diffusion of explicit deposit insurance schemes. As observed, the number of explicit guarantees on deposits has escalated during the last 20 years. Whilst guarantees might have been successful in curbing the occurrence of bank runs, they might also have induced excessive risk-taking on the part of both international investors and domestic banks. In fact, empirical models have found that the very presence of public guarantees is a significant factor of risk. Hence, this evidence highlights the importance of an efficiently designed insurance scheme and of effective supervision of the banking system. Moreover, as noted in the paper, since industrial and emerging countries are differently affected by external shocks, policy instruments should be accurately tailored to the level of development of the credit market.

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Asset prices, financial stability and monetary policy: based on Japan's experience of the asset price bubble

Shigenori Shiratsuka[1]

1. Introduction

In this paper I examine the implications of asset price fluctuations for the conduct of monetary policy, based on Japan's experience of the emergence, expansion, and bursting of asset price bubbles, with special emphasis on the linkage between asset price fluctuations and financial stability.

Looking back at Japan's experience since the late 1980s, it is hard to deny that the emergence and bursting of the bubble played an important role in economic fluctuations in this period.[2] Although measured inflation remained stable in the late 1980s, the unfounded expectation that low interest rates would continue for a considerable period was entrenched both in the markets and in society in general, thereby exaggerating the asset price bubble by further intensifying the already bullish expectations existing in the market and in society (Okina et al (2001)). After the bursting of the bubble, the resultant malfunctioning of the financial system prolonged the adjustment period, thus aggravating the negative impact on real economic activities (Mori et al (2001)).

The above-mentioned experience clearly indicates that both financial and macroeconomic instability since the late 1980s have been closely related to large fluctuations in asset prices, and raises the question of what is the appropriate way to treat asset prices in conducting monetary policy. The prevailing consensus among economists and central bankers is that monetary policy should not target asset prices directly, but should respond to their effects on real economic activity and the general price level. However, asset price fluctuations affect not only the economic environment but also the stability of the financial system.

It is important for central banks to examine the implications of asset price fluctuations in connecting two objectives of central banks, ie price stability and financial stability, in a mutually complementary manner. To this end, it is necessary to identify whether asset price fluctuations properly reflect the movements in their underlying determinants, or fundamentals. This is because the misalignment of asset prices, or an asset price bubble, produces serious adverse effects on the financial system and the economy when the bubble eventually bursts. Moreover, the effect of asset price changes is asymmetric, with stronger effects in the case of an asset price decline, because the collapse in asset prices has adverse effects on the stability of the financial system.

Monetary policy influences the financial system through the behaviour of financial institutions and changes in macroeconomic conditions. To achieve financial system stability, however, it is important to maintain not only a favourable macroeconomic environment but also the soundness of individual financial institutions. In this regard, the regulatory and supervisory authorities play an important role. Thus, it should be noted that, although financial system stability is an important policy objective for the central bank, the central bank does not command the same power of influence over this objective as it does over price stability when trying to maintain a favourable environment.

The best thing monetary policy can do to foster sustainable economic growth is to deliver predictably stable prices in the long run. The relevant question in practice for the conduct of monetary policy is how to define price stability so that it supports a sound financial and economic environment as a basis for sustainable economic growth. However, a consensus has yet to emerge as to how to transform such conceptual definition into a practice of monetary policy as regards the practical interpretation of price stability.

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[1] The author would like to thank staff at the Research and Statistics Department of the Bank of Japan for providing data. The views expressed in this paper are those of the author and do not necessarily reflect the opinion of the Bank of Japan.

[2] In addition, Borio et al (1994) describe the emergence of major boom-bust cycles in asset prices in a number of industrialised countries during the 1980s.

In this regard, as Shiratsuka (2000) emphasises, a central bank should accomplish “sustainable price stability” in the first place, and, at the same time, is also required to pursue “measured price stability” as a quantitative yardstick by which to evaluate policy achievement from the viewpoint of accountability. Since observed changes in price indices are affected by various types of external shocks and measurement errors, it is indeed quite difficult to assess whether the underlying rate of inflation is stable or not. Therefore, even if “measured price stability” seems to be maintained, a central bank may need to alter interest rates promptly if it judges that the maintenance of “sustainable price stability” is at risk. Thus, in order to reconcile the two objectives, it is important for a central bank to pursue “sustainable price stability” conducive to the sound financial and economic environment that supports sustainable economic growth.

This paper is organised as follows. Section 2 reviews the implications of asset price fluctuations for macroeconomic performance, for example the relationship between asset prices and conventional price indices, and asymmetric effects that entail declines in asset prices having stronger effects on the economy than increases in asset prices. Section 3 is an examination, based on the idea of a Taylor-type policy reaction function, of the possibility of a pre-emptive response of monetary policy to prepare against the potential effects of asset price fluctuations. In this context, it is important to examine how monetary policy should respond to asset price inflation under an environment of stable prices. In Section 4, I further discuss practical issues related to the pre-emptive conduct of monetary policy. In considering the role of asset prices in monetary policy, I also suggest in this section the importance of detecting whether asset price fluctuations properly reflect movements in their underlying determinants, or fundamentals. In Section 5, I discuss several issues concerning how to ensure the compatibility of price stability and financial stability simultaneously, and emphasise the importance of pursuing “sustainable price stability”, not “measured price stability.” Section 6 concludes the paper.

2. Asset price fluctuations and macroeconomic activity

In this section, I examine the role of asset prices when they are considered as target or information variables, and summarise the relationship between asset price fluctuations and macroeconomic activity. In the following, in order to examine the properties of asset prices in relation to the current prices of goods and services, I first review the attempt to incorporate asset prices into a price index concept, rather than treating the two separately. Then, I explore the mechanism by which asset price fluctuations affect real economic activity.

2.1 The inclusion of asset prices in conventional price indices[3]

No attempt is usually made to include asset price information directly in the procedure for computing price indices. This is because price indices are thought of as tracing a consumption activity of a representative consumer at a particular point in time, and, thus, it would not be consistent to include asset prices, which are a source of the flow of goods and services. In this context, price indices include housing rental prices, rather than house prices directly. Thus, the inclusion of housing prices in current price indices raises a problem of double-counting, since current price indices generally include rental costs.

In order to include asset prices in price indices, therefore, it is necessary to change the concept of price indices so that it focuses on tracing price changes from the base period up to the current period. In this case, it would be reasonable to extend the conventional price index concept into a dynamic framework so as to trace intertemporal changes in the cost of living.

In order to provide a price index concept that takes into account asset price fluctuations, Alchian and Klein (1973) proposed the idea of the intertemporal cost of living index (ICLI). The ICLI traces the intertemporal changes in the cost of living that are required to achieve a given level of intertemporal utility. Consumer behaviour possesses a dynamic nature so that current consumption depends not only on current prices and incomes but also on the future path of prices and incomes. Considering the

[3] This subsection draws on Shiratsuka (1999b), where the points are developed more fully.

intertemporal maximisation problem for a household, its budget constraint is its lifetime income.[4] In this case, we can take asset prices as a proxy for the future prices of goods and services.

Although the ICLI has appealing features from a theoretical perspective, it is too abstract to base a practical price index on. Shibuya (1992) proposed a practical index formula based on the ICLI, and named it a dynamic equilibrium price index (DEPI), which incorporates dynamic elements into a realistic price index formula. To this end, Shibuya (1992) employs a one-good and time-separable Cobb-Douglas utility function, instead of the general form of preference assumed in Alchian and Klein (1973). Then, he derives the DEPI as a weighted geometric mean of the current price index (the GDP deflator: p_t) and asset price changes (the value of the national wealth: q_t),[5] as shown in equation (1):

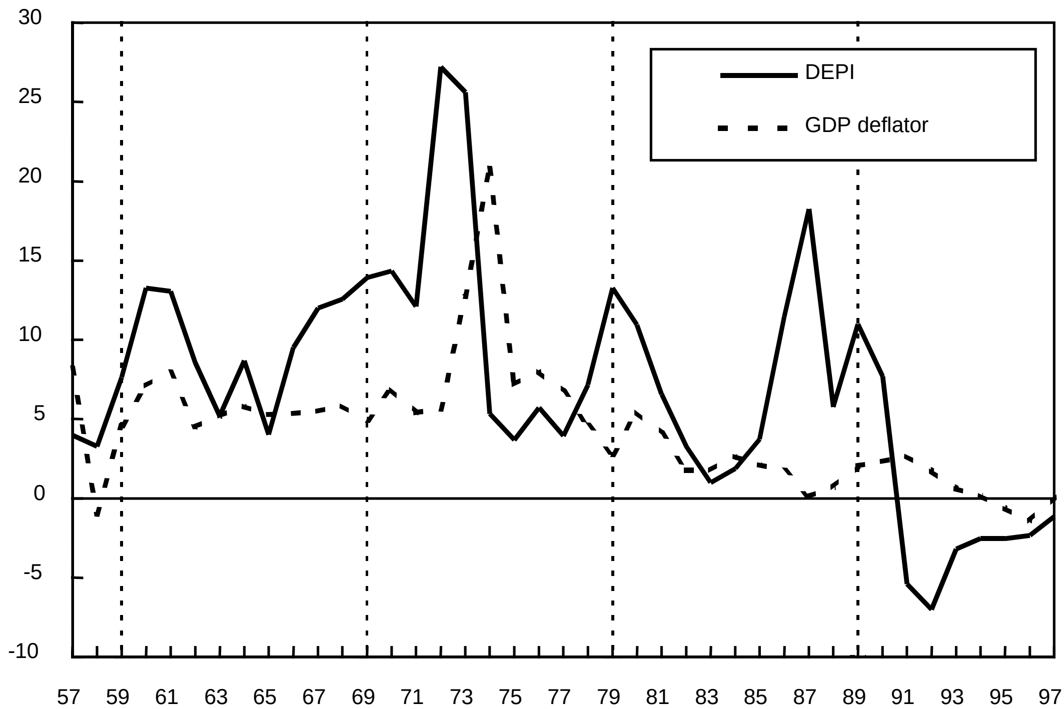
$$DEPI_{0t} = \left(\frac{p_t}{p_0}\right)^{\alpha} \cdot \left(\frac{q_t}{q_0}\right)^{1-\alpha}, \tag{1}$$

where α represents the weighting used for current goods and services $\alpha=\rho/(1+\rho)$, and ρ represents time preference.[6]

Figure 1

Movements of DEPI

(changes from the previous year, in percent)



Note: Weights for asset prices and GDP deflator are 0.97 and 0.03, respectively.

Source: Figure 1 in Shiratsuka (1999b).

4 A necessary condition for this discussion is that there exist a perfect capital market, which makes it possible to borrow money against collateral comprising all tangible and intangible assets.

5 In calculating the DEPI, we should use asset prices to represent the value of total assets, which includes all the intangible assets, such as human capital. Shibuya (1992) used the data on national wealth in the Annual Report on National Accounts (Economic Planning Agency), which has the broadest coverage among the readily available data sources. However, its coverage of intangible assets, which consist largely of households' assets, is very limited.

6 α can be written as $\alpha_t = (1+\rho)^{-t} / \sum_{s=0}^{\infty}(1+\rho)^{-s}$ in general form, and these are the normalised factors of time preference, which add up to one. Thus, when we calculate the DEPI on a monthly and quarterly basis, we have to use the rate of time preference transformed into a monthly and quarterly basis.

Figure 1, which is taken from Shiratsuka (1999b), exhibits the movements of the DEPI from 1957 to 1997. This figure shows the large divergence between the DEPI and the GDP deflator during the late 1960s, the early and late 1970s, and the early 1980s. Focusing on the development since the mid-1980s, the DEPI rose sharply from 1986 to 1990, while the GDP deflator remained relatively stable, and then the growth rate of the DEPI has turned negative since 1991. During this period, the inflation rate as measured by the GDP deflator accelerated until 1991, and the inflation rate has remained subdued since 1992. This development of the DEPI might be interpreted as an understatement of the inflationary pressure that occurred in the late 1980s and the deflationary pressure that has been present since the early 1990s.

The concept of DEPI, which extends the conventional price index into a dynamic framework and incorporates asset price information into the inflation measure, is highly regarded from the viewpoint of theoretical consistency. However, it is difficult for monetary policymakers to expect it to be more than a supplementary indicator. This is because the DEPI inherits the practical problems that make it less attractive to employ as a target indicator.[7]

The first problem inherent in the DEPI is that asset price changes do not necessarily mean future price changes because there are sources of asset price fluctuation other than private sector expectations regarding the future course of inflation.[8] Now, let me suppose that land prices increase as a consequence of technological innovations, such as advances in construction technology for the taller skyscrapers and “smart” buildings. In this case, the increase in land prices does not necessarily imply an increase in the future prices of services because a larger office area is available from the same area of land. However, the DEPI judges that the changes in relative prices between current prices and asset prices, which reflect technological progress, constitute inflation.

The deviation of asset prices from their fundamental values, ie an asset price bubble, is likely to happen when the productivity increase behind rising land prices is based on euphoria, and rising land prices are themselves driven by speculation. In addition, since asset prices depend on a risk premium, asset prices will increase if changes in the structure of market participants lower the degree of risk aversion, or market participants consider that future uncertainty is decreasing.

The second problem is the appropriateness of assigning a large weighting to asset prices in the DEPI. The DEPI is defined as the geometric weighted mean of the current price index and asset prices, and its weight for asset prices is almost equal to one, while that for the current price index is almost zero. From the theoretical viewpoint of the intertemporal optimisation behaviour of economic agents, it is reasonable to assign a small weight to the current price index, which just aggregates prices for current goods and services at a particular point in time. However, the DEPI will be a similar indicator to asset prices, if one accepts the theoretical weights for the current price index and asset prices. It might be the case that, even though current prices fluctuate markedly, the DEPI would show a negligible fluctuation, as long as asset prices remain stable.

The third problem is the accuracy of asset price statistics. While the current price indices are also affected by measurement errors, their reliability is by far higher than that of asset price statistics.[9] It is crucial to emphasise that the asset prices employed in the DEPI must cover all assets that are sources of present and future consumption, such as tangible and intangible, financial and non-financial, and human and non-human assets. This implies difficulty in constructing a reliable price index that includes asset prices.

The above analysis indicates that the DEPI is judged to be inappropriate as a policy target variable, and its use is limited to an information variable for monetary policy purposes. However, it is not necessary to construct a composite indicator, like the DEPI, if one intends to use it as just one of several information variables. Rather, it is more useful to monitor separately the current price indices and asset prices.

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7 For the details, see Shiratsuka (1999b).

8 For example, Shiratsuka (1999b) shows that Granger causality from asset prices to the GDP deflator is highly sensitive to the macroeconomic environment by conducting a rolling regression with a five-variable VAR model, which contains real GDP, the money supply and long-term nominal interest rates in addition to the GDP deflator and asset prices.

9 Regarding the issues related to the measurement errors in Japan’s price indices, see Shiratsuka (1998, 1999a), and Bank of Japan, Research and Statistics Department (2000).

2.2 The transmission of asset price fluctuations to real economic activity

As a next step, let me examine the relationship between asset price fluctuations and real economic activity. The relevant point here is to identify the determinants of asset prices.

Based on the discounted present value formula, which is the basic theoretical framework for asset pricing, the price of an asset is equal to the discounted present value of its future income flows. Profit maximisation of the firm indicates that its marginal revenue corresponds to the marginal productivity of its assets. Therefore, if we assume that the marginal productivity of capital (*MPK*), the nominal interest rate (r) and the expected rate of inflation (π) are all constant over time, the real asset price (q/p) is determined as follows:

$$q/p = MPK/(r - \pi)\,. \tag{2}$$

This equation implies that the expected return on assets and the expected nominal rate determine the fluctuation of real asset prices (fundamentals).

If asset price fluctuations properly reflect movements in their underlying determinants, economic resources are utilised in the most efficient way in line with real economic activity. Therefore, to the extent that asset price fluctuations are consistent with the fundamental values, they may be left out of consideration in the conduct of monetary policy.

Nevertheless, the prolonged deviation of asset prices from their fundamental value is often called a "bubble". In general, asset prices reflect investors' expectations about the future, and such expectations seem to have played an important role in the sustainability of bubbles.[10] A "broadly defined bubble" occurs because of excessive optimism regarding the marginal productivity of various assets. However, even if investors are perfectly rational, actual stock prices may contain a bubble element, and, therefore, there can be a divergence between asset prices and their fundamental values, or a "narrowly defined bubble". This is because asset prices could continue to increase if investors judge that they will be able to earn enough profit to ensure that they benefit from arbitrage conditions with regard to other asset prices by disposing of their assets before the collapse of asset prices. However, it is inevitable that such excessive optimism will fail to live up to expectations, and, as a result, asset prices, whose increase includes a bubble element, will unavoidably collapse.

These asset price fluctuations reflecting bubble elements affect real economic activity mainly through (1) wealth effects on expenditure activities, and (2) the effect of changes in the external finance premium on investment activities.[11] Since the rise in asset prices, even though reflecting the bubble, acts in a positive direction, the adverse effects are hardly recognised as long as the economy is expanding smoothly. By contrast, the adverse effects of the bubble are materialised as stresses expressed by the unanticipated correction of asset prices to the real side of the economy and the financial system. It should be noted, in this case, that leaving intensified bullish expectations alone might exaggerate the adverse effects by allowing expanded fluctuations in asset prices.

2.3 Asymmetric effects of asset price fluctuations

In examining the effects of asset price fluctuations on macroeconomic activity, it is important to note the following two points. First, such effects are asymmetric, so that the declines in asset prices have a stronger effect on the economy than do increases in asset prices. Second, the magnitude of effects varies in accordance with the duration of the asset price bubble and of the adjustment period after the bubble bursts.[12]

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10 In order to exclude the bubble path, it is assumed that asset prices will not diverge to infinity.

11 Bernanke and Gertler (1995) explain that frictions in financial markets, such as imperfect information and costly enforcement of contracts, generate a difference in costs between external funds such as bond financing, and internal funds such as retaining earnings. They call the above wedge the external finance premium, and emphasise that the external finance premium fluctuates coincidentally with business cycles, thereby propagating the conventional effect of interest rates on aggregate demand.

12 Kent and Lowe (1997) expressed similar views to those of the authors, emphasising that an early rise in interest rates would heighten the possibility of the bubble bursting, thereby leading to smaller fluctuations in the real economy and inflation through smaller negative effects on the financial system after the bursting of the bubble.

As Okina et al (2001) point out, with the benefit of hindsight from Japan's experience the adverse effects of the bursting of the bubble can trigger a prolonged recession through three mechanisms.[13] Of the three, while the first works symmetrically between the period of the emergence and expansion of the bubble and the period of the bursting of the bubble, the effects of the second and third mechanisms are disproportionately larger during the period of the bursting of the bubble.

The first mechanism is a decline in economic activity as a result of the correction of intensified bullish expectations. For example, we can point to the negative wealth effects on expenditure and on classical stock adjustment in the process of the bursting of the asset price bubble.

The second mechanism is a reduction in the economic value of capital equipment and reduced supply capacity. During the bubble period, capital expenditures increased dramatically on the premise of higher potential growth in the economy. The economic value of such physical assets fell sharply because they were unlikely to be utilised in the future and it would have been costly to convert them to different usage. In this context, we should recognise that the serious dynamic resource misallocation caused by misguided prices during the bubble period was a mechanism that helped to induce economic stagnation.

The third and most important mechanism is a so-called balance sheet adjustment which occurred as the fall in asset prices eroded the asset quality of both lenders and borrowers, and reduced credit availability because capital bases deteriorated, leading to a decline in economic activity.[14] The capital base functions as a buffer against future risks and losses. Such a function is not clearly recognised as long as the economy is expanding smoothly. The effects of a capital base shortage will materialise once the outlook for economic expansion changes. After the bursting of the bubble, as asset prices fell and the capital base was substantially reduced, the possibility of bankruptcy increased among financial institutions, firms and individuals. Under such circumstances, economic agents whose capital base had been eroded became cautious in taking on risks and also in doing business with counterparties whose capital base had been eroded.

Furthermore, the adverse effects of the bursting of the bubble on real economic activity are amplified through the financial system, especially when financial institutions are deeply involved in financial intermediation to purchase various physical assets. Purchases of physical assets during the bubble period were based on misguided prices. The economic value of those physical assets fell sharply when it became evident that they were unlikely to be utilised in the future and that it was costly to convert them to different uses.

The deterioration of balance sheets of firms and financial institutions and the resultant malfunctioning of financial intermediation resulted in a decline in aggregate demand in the short run, and, moreover, a reduction of aggregate supply due to lowering capital formation in the long run. It is quite important to note that the serious dynamic resource misallocation caused by misguided prices during the bubble period was a mechanism that helped to induce economic stagnation.

3. Asset price fluctuations and monetary policy

As a next step, I explore the issues concerning how monetary policymakers should consider asset prices in relation to the conduct of monetary policy, and how they should respond to the fluctuations in asset prices.

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13 Okina et al (2001) define the bubble period as the period lasting from 1987 to 1990, from the viewpoint of the coexistence of three factors, that is: a remarkable increase in asset prices, an expansion of monetary aggregates and credit, and an overheating of economic activity.

14 Bernanke et al (1996) refer to the amplification mechanism of initial shocks through changes in credit market conditions as the "financial accelerator". Changes in cash flow and asset prices arise from cyclical movements in firms' net worth, affecting agency costs and thus credit conditions, and then affect firms' investment behaviour.

3.1 Application of the Taylor rule to policy reaction to potential inflationary pressures

In order to achieve price stability in the long run, how should monetary policy respond to asset price fluctuations? The prevailing consensus among economists and central bankers is that monetary policy should not target asset prices directly, but should respond to their effects on real economic activity and on the general price level.[15] In this context, a recent study by Bernanke and Gertler (1999) has lately attracted considerable attention. They argue that central banks can treat price stability and financial stability as consistent and mutually reinforcing objectives by adopting a strategy of "flexible inflation targeting".[16]

Let me examine the above argument by Bernanke and Gertler (1999) by using a Taylor-type policy reaction function. The basic formula of the Taylor rule is that the level of the policy target rate is determined by the current level of two variables, the rate of inflation and the output gap (Taylor [1993]), or the following specification:

$$i_t = \bar{i} + \beta(\pi_t - \pi^*) + \gamma(y_t - y_t^*), \tag{3}$$

where i_t is the short-term nominal interest rate at period t (the instrument of monetary policy), $\bar{i}$ is the equilibrium short-term nominal interest rate, y_t is the output gap at period t, and y_t^* is the equilibrium level of the output gap.

The standard interpretation of the Taylor rule is that a central bank has two objectives, inflation and output, the relative importance of which is given by the coefficients in equation (3). At the same time, it can be viewed as incorporating a pre-emptive response to inflation, because current inflation and the output gap are critical variables in forecasting future inflation.[17]

In considering the monetary policy response to an asset price bubble, it is important to deal with a possible bubble in a pre-emptive manner with a view to the future risk of inflation rather than to make a belated response only after inflation or the existence of a bubble visibly materialises. In view of the Taylor-type policy reaction function, asset price fluctuations enter the monetary policy decision in two ways. First, since effects of asset price fluctuations are included in the changes in the output gap, guiding short-term nominal interest rates in line with the Taylor rule will enable a central bank to deal with the potential inflationary pressure in a pre-emptive manner. Second, a standard Taylor-type rule should be extended to incorporate asset price information directly.

3.2 A case from Japan's experience during the bubble period

Next, let me assess the attractiveness of the aforementioned framework for dealing with the potential risks stemming from asset price fluctuations in a more practical context, by focusing on Japan's experience of the emergence, expansion, and bursting of the asset price bubble.

Bernanke and Gertler (1999), as mentioned above, conduct a simulation using a structural model that incorporates the optimisation behaviour of households and firms as well as a policy reaction function with expected inflation and asset prices as explanatory variables(Figure 2). Based on their simulation results using data for Japan, they point out the following two points. First, it is inappropriate to incorporate asset prices directly into the policy reaction function, because such treatment is likely to

[15] For example, Crockett (1998) states that "the prevailing consensus is that monetary policy should not target asset prices in any direct fashion but should rather focus on achieving price stability in goods markets and creating financial systems strong enough to survive asset price instability".

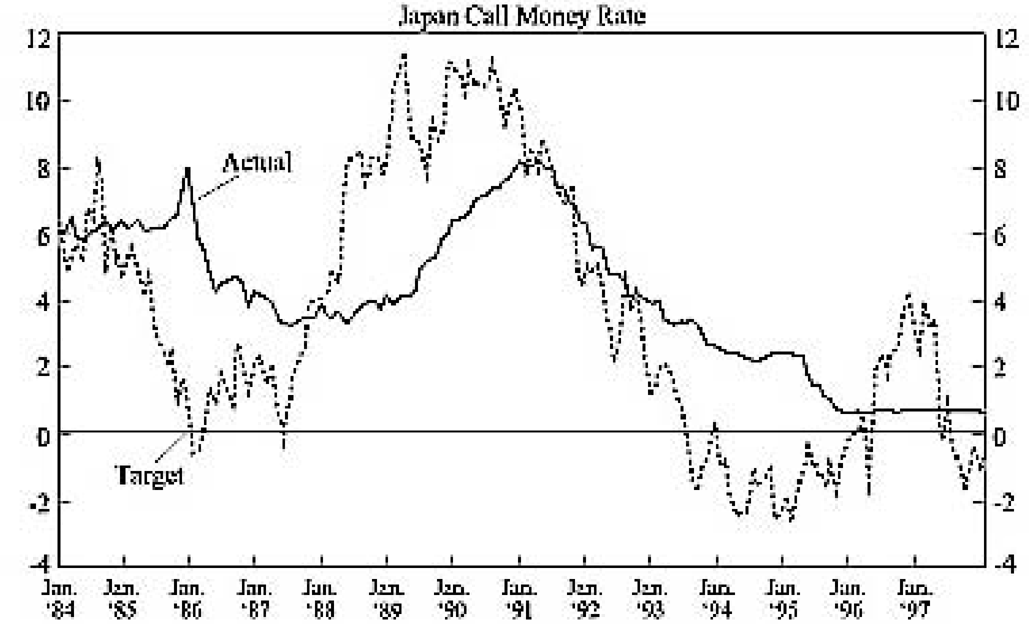
[16] Bernanke and Gertler (1999) further argue that "By focusing on the inflationary or deflationary pressures generated by asset price movements, a central bank effectively responds to toxic side effects of asset booms and busts without getting into the business of deciding what is a fundamental and what is not" (p 18). I am sceptical about this argument, and examine this point in detail in the next section.

[17] For example, Meyer (2000) emphasises that the Taylor rule is an attractive and simple guidepost for the conduct of a discretionary monetary policy because it "responds directly to deviations from the Federal Reserve's objectives - price stability and an equilibrium utilisation rate" as well as because "it incorporates a pre-emptive response to inflation" and "is closely aligned both with the objectives of monetary policy and with the model that governs inflation dynamics". In addition, Goodhart (1999) argues that the Taylor rule employs current inflation and the GDP gap as explanatory variables, because these two variables are the two most important factors for forecasting future inflation.

aggravate the economic fluctuations. Second, if the target interest rate had been raised from around 4% to 8% in 1988, the emergence of the bubble could have been prevented.[18]

Figure 2

Simulation by Bernanke and Gertler



Source: Chart 10 in Bernanke and Gertler (1999).

However, their conclusion is obtained because the Taylor rule, which they use to compute the optimal call rate, suggests a rise in the rate in response to the sharp pickup in real economic activity rather than to inflationary pressure. Raising rates just because real GDP is growing strongly but with no inflation is hard especially when favourable supply shocks are thought to be hitting the economy, leading to high potential growth. In fact, BOJ Deputy Governor Yamaguchi cast some doubt on the practical validity of simulation results in Bernanke and Gertler (1999) by commenting that “I don’t see how a central bank can increase interest to 8 or 10% when we don’t have inflation at all” (Yamaguchi [1999]).

3.3 The assignment of monetary policy with regard to asset price fluctuations under stable price developments

How, then, should monetary policy respond to asset price inflation under a stable price environment? In considering the relationship between asset price fluctuations and monetary policy, it is not so difficult for a central bank to deal with asset price inflation if price stability is undermined. Unfortunately, asset price inflation may occur under relatively low and stable price inflation, and it is quite difficult for a central bank to raise interest rates just because of potential risks inherent in asset price inflation when there is no inflation. Thus, a central bank may encounter difficulties when asset prices increase excessively, reflecting intensified bullish expectations about the future.

To deal with the above problem, in theory, it is possible to assume lexicographic ordering among monetary policy objectives, among which price stability is of primary importance, and consider other

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[18] The simulation by Bernanke and Gertler (1999) shows that the target interest rate temporarily jumped in 1987 and 1997. Such temporary fluctuations in the target interest rate might perhaps reflect the effects of the introduction of the consumption tax (3%) in April 1989 and the hike in the consumption tax (from 3% to 5%) in 1997.

objectives only when the inflation rate remains within the target range.[19] But in practice, considering Japan's financial and economic development in the late 1980s, monetary policy would have tightened just because of the possibility of asset price bubbles under stable price condition. Thus, monetary policy should be conducted to achieve the secondary objective, even though doing so is not consistent with the conduct of policy necessary to pursue the primary objective. However, the secondary objective will never surpass the primary objective in the lexicographic ordering.

Needless to say, no central bank assumes such an extreme preference among its policy objectives, but in the light of Japan's experience in the bubble period, a pre-emptive policy response was indeed needed even though prices were stable in the late 1980s. At the same time, since there was prevailing recognition that both the productivity and the growth potential of Japan's economy had increased, the necessity of such pre-emptive action was not viewed as sufficiently convincing.

The above argument indicates that the following two cases cannot be treated in the same way. One is the case that the needed policy response is in the same direction to achieve both the primary and the secondary objectives, but that additional action is required to ensure the secondary objective (for example, further monetary tightening to deal with rapid asset price inflation rather than current inflation). The other is the case that the needed policy response is in the opposite direction, and that policy reversal is necessary to pursue the secondary objective while the primary objective appears to be maintained (for example, an early policy reversal in the direction of monetary tightening to prevent the adverse effects of asset price inflation, or a possible bubble, from materialising at a time of stable price development).

The contradictory signals given by price developments and asset prices make monetary policy judgment extremely difficult, because it is indeed hard to identify ex ante whether a bubble has developed. It is fundamentally impossible to resolve this problem. The most important point for conducting monetary policy in a pre-emptive manner is, given the above problem, how to assess potential risks in such a consistent way as to ensure price stability in the long run. Such efforts will be sure to lead to more convincing arguments in favour of the pre-emptive policy response.

It should be noted that an assessment of the potential risks differs depending on how long a time horizon is assumed, because such an assessment is made when risks to the economy are nowhere to be seen. This puts a central bank in a dilemma in that pre-emptive action is not attainable if the central bank waits until most people agree upon the necessity for action to be taken. Therefore, it is important to compare the potential risks inherent in a possible scenario of the future course of financial and economic development.

4. Practical issues for the conduct of monetary policy in dealing with potential risks

In this section, I examine the practical problems involved in dealing pre-emptively with the potential risk associated with asset price fluctuations. To assess the practical validity of Bernanke and Gertler's (1999) simulation results, the following three points should be examined further: (1) measurement errors in the output gap, (2) the effects of structural changes, and (3) adverse effects on the financial system.

4.1 Measurement errors in the output gap

First, let me examine the effects of measurement errors in detecting potential inflationary pressure.

It is often pointed out that estimates of the output gap are very sensitive to ex post data revision (Orphanides [2000], Orphanides et al [1999]). Orphanides (2000) suggests that proper recognition of our limited knowledge of the current state of the economy and an accordingly lowered objective of economic stabilisation are important in averting policy mistakes in the future.

[19] Statement given by Professor Fukao at Keio University at the workshop sponsored by the Institute for Monetary and Economic Studies, Bank of Japan, on 25 January 2000 (see Bank of Japan, Institute for Monetary and Economic Studies [2000]). See also the discussion in Kosai et al (2000).

In the case of Japan, Kamada and Masuda (2000) examine the magnitude of measurement errors in the output gap in terms of estimation procedures and historical revision of data. Their main findings are twofold. First, the difference between contemporaneous estimates of the output gap and the current estimates expanded in the 1990s. Second, the ad hoc assumption that the capacity utilisation rate in the non-manufacturing sector is equivalent to 100% is the most crucial source of measurement errors in the output gap. In this context, they emphasise that new estimates of the output gap, which improve the estimation procedure by estimating the capacity utilisation rate in the non-manufacturing sector as well as dropping the assumption of a linear trend in total factor productivity, are more consistent with other indicators for demand-supply conditions.

Figure 3 plots three estimates of the output gap in the aforementioned study by Kamada and Masuda (2000). GAP1 is based on the new estimation procedure that adjusts the capacity utilisation rate in the non-manufacturing sector, and GAP2 is based on the previous estimation procedure that assumes a full capacity utilisation rate in the non-manufacturing sector. These two series are computed from the currently available data. GAP3 is computed by using the same procedure as for GAP2, but from real-time data that are contemporaneously available for each time period. Although GAP2 and GAP3 show parallel movement before 1995 while there are significant deviations thereafter, GAP3 fluctuates up and down. This implies serious effects of ex post data revision on the measurement of the output gap, thereby making it difficult to detect the underlying movements on a real-time basis. GAP1 constantly exhibits a larger magnitude of the output gap, compared with GAP2 and GAP3, due to the impact of adjustment in the capacity utilisation rate in the non-manufacturing sector. In addition, GAP1 shows a striking contrast with GAP2 and GAP3 in the late 1990s. That is, the reduction of the output gap in 1995-96 is milder, and, as a result, the expansion of the output gap in 1997-99 is relatively small, compared with GAP2 and GAP3.

Figure 3

Measurement errors in the estimates of GDP gap

Sources: Kamada and Masuda (2000).

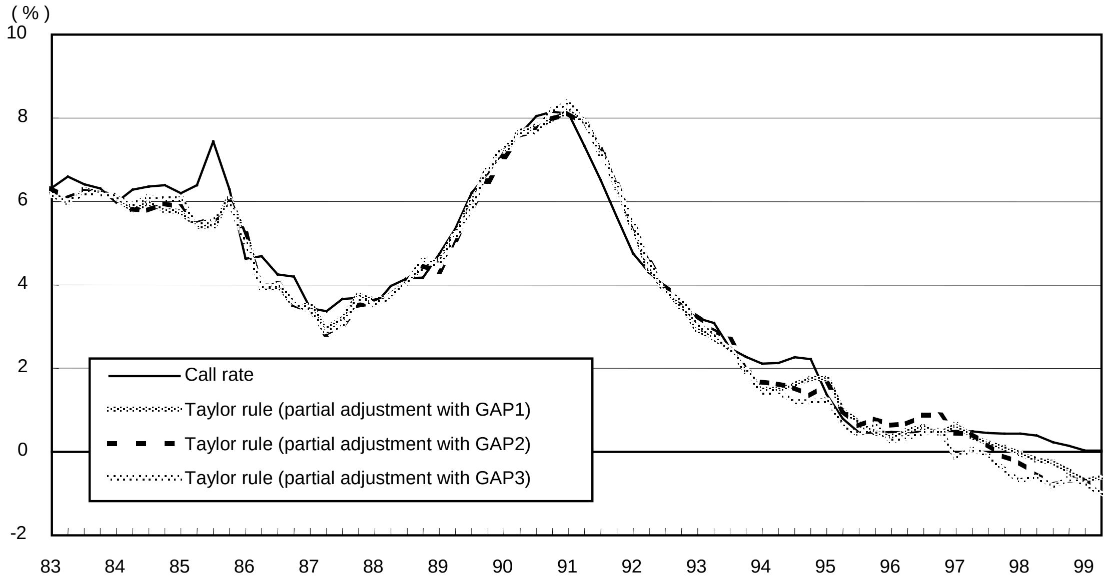
Notes: Gap 1 to 3 indicates as follows. For the details on the estimation procedure, see Kamada and Masuda (2000).

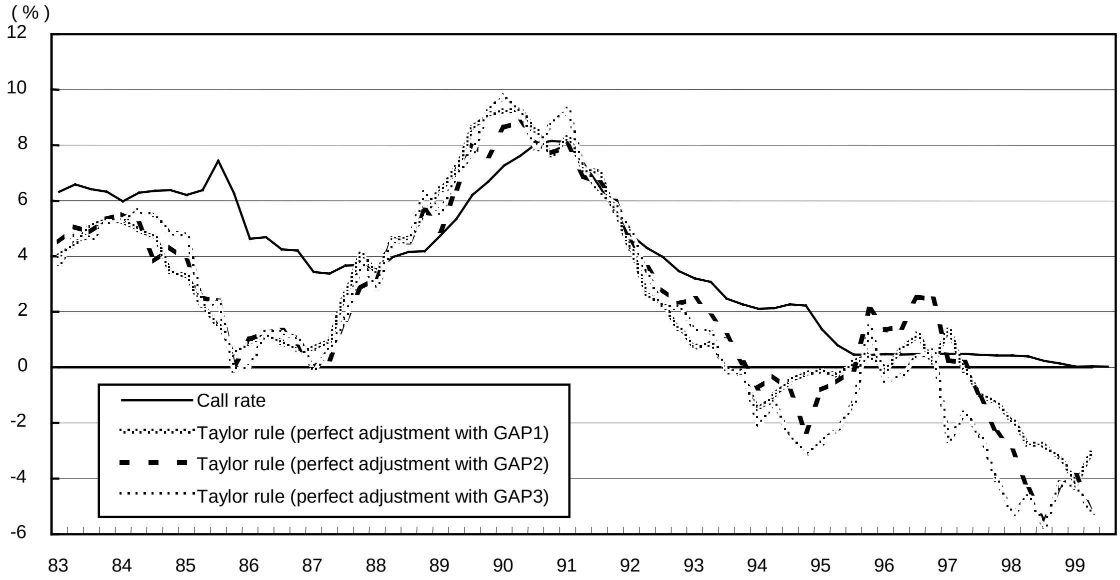
GAP1 --- Final GDP gap adjusted for the capacity utilisation in non-manufacturing sectors.

GAP2 --- Final GDP gap fixing the capacity utilisation in non-manufacturing sectors.

GAP3 --- Real time GDP gap applying the same estimation procedure employed in GAP2.

Figure 4
Estimates for Targeted Rates





Sources: Author's calculation based on the GDP gap in Figure 3.

Notes: Baseline formula of Taylor's Rule: $i_t = (1-\rho)[\bar{i} + \beta(\pi_t^e - \pi^*) + \gamma(y_t - y_t^*)] + \rho i_{t-1}$

i_t: uncollatellized overnight call rates at *t*-period

$\bar{i}$: equilibrium rate of nominal short-term rate

π_t: CPI inflation rate at *t*-period

π_t^e: target inflation rate

y_t-y_t^*: GDP gap at *t*-period

ρ: degree of interest rate smoothing (perfect adjustment ρ=0, partial adjustment ρ =0.85)

Figure 4 compares the movements of the target rate computed from a Taylor-type policy reaction function of equation (4), which takes into account the tendency of central banks to smooth changes in interest rates by gradually adjusting the target rate to optimal values computed from equation (3):[20]

$$(4) \qquad i_t = (1-\rho)[\bar{i} + \beta(\pi_t^e - \pi^*) + \gamma(y_t - y_t^*)] + \rho i_{t-1},$$

where parameter ρ captures the degree of "interest rate smoothing". I assume that the parameters for the inflation rate β and the output gap γ are 1.5 and 1.0, respectively, following the estimates in Kimura and Tanemura (2000).[21] I also assume the two formulas of the Taylor rule, ie both with and without interest rate smoothing (partial and perfect adjustment mechanisms), where the adjustment parameter of the former ρ is assumed to be 0.85.

Looking at the estimates of the partial adjustment model in the upper panel of the figure, the target rates implied by the Taylor-type reaction function generally track the movements of actual rates, regardless of the output gap employed. In contrast, estimates of the perfect adjustment model in the lower panel show a significant deviation between target and actual rates: target rates exceed actual rates in the phase of monetary contraction, and, on the contrary, target rates fall below the actual rate in the phase of monetary easing. In addition, estimates from GAP3 (real-time estimates) move up and down significantly, reflecting fluctuations in the estimate of the output gap.

The above simulation results of a Taylor-type reaction function indicate that problems of measurement errors in the output gap can be mitigated to some extent by employing a partial adjustment mechanism in the policy reaction function. In a perfect adjustment mechanism, however, the target rate responds to fluctuations in the output gap too vividly and shows volatile movement, implying that such a mechanism can hardly be employed as a yardstick for policy evaluation.

4.2 Structural changes and the assessment of potential risks

Next, let me examine the practical validity of Bernanke and Gertler's (1999) argument that potential inflationary pressure can be assessed "without getting into the business of deciding what is a fundamental and what is not".

In this context, the appropriateness of their assumption that there are no structural changes (ie that the structural model is unchanging over time) is also open to further question. This assumption implies that a "broadly defined bubble", which is caused by the excessive optimism of economic agents, is necessarily excluded from the scope of the simulation, and that the asset price bubble in their model is restricted to a "narrowly defined bubble". However, it is euphoria that triggers the bubbles that produce a serious effect on the economy. Cases in point are the historical episodes of a so-called New Economy, when a bubble is created by excessive optimism under conditions of long-run economic prosperity. In this case, it is deemed important to examine the possibility of a shift in the potential output level by taking account of structural changes with uncertain magnitude and timing.

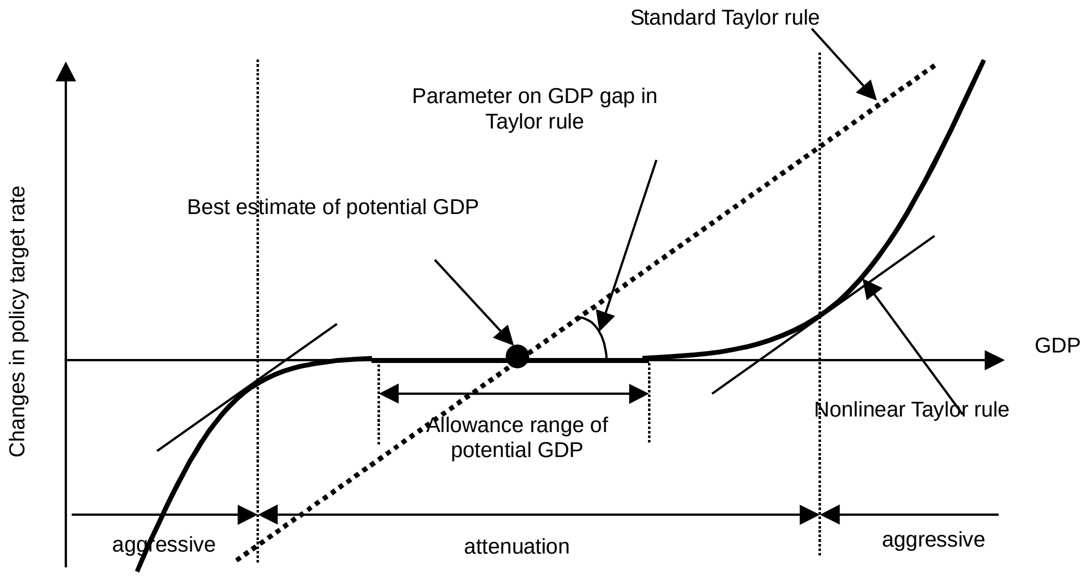
For example, Meyer (2000) states that a major challenge for US monetary policy at the moment is determining how "to allow the economy to realise the full benefits of the new possibilities while avoiding an overheated economy". He also emphasises the importance of possible changes in aggregate supply and trend growth in the evaluation of inflationary pressure. More precisely, taking account of the recent development in the monetary policy rule under uncertainty, he emphasised the following three points: (1) the estimate of the GDP gap should be updated on the basis of all available data; (2) the aggressiveness of response to the GDP gap between actual and target values should be adjusted in the light of uncertainty about their measurement; and (3) policy should become less pre-emptive and more aggressively reactive as the degree of uncertainty about the GDP gap rises.

[20] Brainard (1967) points out that, if there is uncertainty with respect to the multiplier effect of economic policy measures, then the authorities should adopt a conservative approach. See also Blinder (1998) on this point. However, Stock (1998), by using a small US model, contends that it is desirable to adopt an aggressive policy rule when the economy is undergoing structural change.

[21] In computing the target rate, I assume that the equilibrium level of the output gap corresponds to the average value from 1983/II to 1996/IV and that there is perfect foresight regarding future inflation one year ahead.

Furthermore, Meyer (2000) points out that the current strategy can be viewed as "a non-linear Taylor rule under uncertainty", which is illustrated in Figure 5. That is, although the response to the GDP gap is attenuated in a region around the best estimate of the potential GDP, the policy response should become more aggressive once the GDP gap moves sufficiently below or above the best estimate of the neutral level. The non-linear Taylor rule can be regarded as an application of the "opportunistic approach"[22] to policy evaluation of the GDP gap, which is a pre-emptive component in a Taylor-type policy reaction function.[23]

Figure 5
Non-linear Taylor rule (illustration)



The key challenges for US monetary policymakers at the moment, expressed in Meyer (2000), clearly show that the assessment of asset prices relative to their fundamental values is crucially important in evaluating potential inflationary pressure, while such an assessment becomes increasingly difficult in the face of euphoria. This implies, contrary to Bernanke and Gertler's (1999) argument, that monetary policymakers are unlikely to evaluate potential inflationary pressure stemming from asset price fluctuations "without getting into the business of deciding what is a fundamental and what is not". Instead, they are required to come up with practical ideas to deal with intensified ambiguity in our understanding of the structure of the economy, and the increased risk of measurement error with respect to key variables under structural changes of uncertain magnitude and timing.

4.3 Pre-emptive actions and stability in the financial system

Finally, let me examine how we should consider the possible adverse effects on the financial system of responding pre-emptively to potential risks in the economy.

The monetary policy of a central bank is conducted using the financial markets and financial system as its transmission channel. Therefore, monetary policy will be less effective once the financial system becomes unstable. If a financial crisis occurs and large-scale bank closures take place, it is most likely

[22] The opportunistic approach is the notion that, while maintaining price stability as the ultimate goal of monetary policy, monetary authorities should refrain from making rough-and-ready policy responses, considering the possibility of favourable external shocks on inflation if and when the inflation rate is at a level that is not so divergent from the long-term objective rate, or is not likely to diverge from the current rate. For details, see Orphanides and Wilcox (1996).

[23] It should be noted that the range of attenuation should be updated asymmetrically, reflecting subjective risk assessment on upward and downward risks in economic forecasting.

that markets will malfunction and be segmented, since liquidity constraints prevent financial institutions from arbitraging and dealing in money and currency markets.[24]

In this context, Clarida et al (1999), for example, point out that concern about stability in the financial system is one possible explanation of why central banks alter target rates gradually, a procedure which is generally referred to as "interest rate smoothing". In fact, it is hard to deny the possibility that sharp unanticipated increases in interest rates would generate huge capital losses for financial institutions, thereby possibly leading to the disruption of financial markets (see, for example, Goodfriend [1991]).

As Okina et al (2001) point out, however, bullish expectations were intensified so much during the emergence and expansion of the bubble that a small rise in interest rates would have had little impact on such expectations. In such circumstances, it is apparent that an increase in interest rates would have had to be fairly large to induce a change in market expectations.

Thus, the question we have to ask here is whether it is practically possible for a central bank to raise interest rates by sufficient increments to contain the expansion of a bubble in a pre-emptive but predictable manner.[25] In this case, a further question that needs to be considered is that of the "communication with market". A pre-emptive policy action is likely to require a central bank to effect policy actions, even if its judgment is still a minority view. Sufficient communication with market is not always the same thing as avoiding any surprise to financial markets.[26]

In fact, financial market participants often behave myopically, and "misapprehensions" of financial markets about the central banks' intentions can never be entirely eliminated. In this context, former FRB Vice-Chairman Blinder (Blinder [1998]) states that, on the one hand, "in a literal sense, independence from the financial markets is both unattainable and undesirable. Monetary Policy works *through* markets, so *perceptions* of likely market reactions must be relevant to policy formulation and *actual* market reactions must be relevant to the timing and magnitude of monetary policy effects" (p 60), but, on the other hand, "Following the markets may be a nice way to avoid unsettling financial surprises, which is a legitimate end in itself. But I fear it may produce rather poor monetary policy, for several reasons" (pp 60-1). Then he further points out the potential risks of following the markets, such as: (1) a tendency to run with the herd and to overreact; (2) a susceptibility to fads and speculative bubbles; and (3) traders behaving as if they have ludicrously short time horizons.

However, the market might have "misapprehended" not totally without reason, and it should be possible for a central bank to reduce such "misapprehensions" by offering the market clearer information on the aims and strategy of monetary policy. Such efforts will surely contribute to stabilising the formation of market expectations and will enhance the effectiveness of monetary policy.

5. Consistency of price stability and financial stability

As a next step, I examine in this section how we can ensure the consistency of price stability and the stability of the financial system. In this regard, Crockett (2000) states that "the economic history of the twentieth century can be seen as a quest to simultaneously secure the elusive twin goals of monetary

[24] In this context, the role of monetary policy under conditions of financial instability is an important issue to be considered. Saito and Shiratsuka (2001) view financial crises as the failure of arbitrage among financial markets, and take the "Japan premium" phenomenon observed in offshore money markets as an important example in favour of this view. Based on this perspective, they explore the possibility that a central bank may play an important role in recovering market liquidity by means of money market operations when financial markets are severely segmented in the absence of arbitrage during financial crises. In this sense, it should be noted that, in the midst of financial crises, the border of monetary and prudential policies is becoming unclear in situations of stress in financial markets.

[25] If a central bank raises interest rates at an early stage by a small amount, it may be possible to expect to change incorrect expectations regarding the continuation of low interest rates for an extended period of time. However, on the contrary, if such a small and early increase in interest rates succeeds in nipping inflationary pressure in the bud, it is hard to deny that it will only further strengthen already bullish expectations, thus leading to an expansion of the bubble. For further discussion on this point, see Okina et al (2001) and Goodfriend (2001).

[26] In this regard, Blinder (1998) points out that "a successful stabilisation policy based on pre-emptive strikes will appear to be misguided and may therefore leave the central bank open to severe criticism".

and financial stability". In other words, how to achieve consistency of price stability and financial stability in practice is an important unresolved issue.

5.1 A pre-emptive policy response to potential risks

As evidenced by the experience of Japan's bubble period, a bubble is not generated suddenly, but expands gradually. Therefore, it is important to deal with a possible bubble in a pre-emptive manner with a view to the future risk of inflation rather than to make a belated response only after inflation or the existence of a bubble visibly materialises.

However, as Okina et al (2001) point out, it is difficult to identify ex ante whether or not a bubble has developed. This is because, within the contemporaneously available information, the possibility cannot be denied that the economic structure might be undergoing change. In such a case, the central bank is faced with two different kinds of risk. When productivity is rising, reflecting a change in economic structure, strong monetary tightening based on the assumption that the economic structure has not changed would constrain economic growth potential. On the other hand, a continuation of monetary easing would allow asset price bubbles to expand if the perception of structural changes in the economy was mistaken.

This issue can be regarded as similar to a problem of statistical errors in the test procedure of statistical inference. Put metaphorically, a Type I error (the erroneous rejection of a hypothesis when it is true) corresponds to a case where (though a New Economy theory may be correct) rejecting the theory means the central bank erroneously tightens monetary conditions and suppresses economic growth potential. A Type II error (failure to reject a hypothesis when it is false) corresponds to a case in which a bubble is mistaken as a process of transition to a New Economy, and the central bank allows inflation to ignite. Given that one cannot accurately tell in advance which one of the two statistical errors the central bank is more likely to make, it is important in the conduct of monetary policy to consider not only the probability of making an error but also the relative cost of each error. Based on the experience of Japan's bubble period, it is important for the central bank to recognise that making a Type II error is fatal compared with a Type I error when faced with a bubble-like phenomenon.

Of course, a comparison of risks inherent in the two types of error does not necessarily imply that monetary policy should be conducted by considering which is the fatal risk. Even though the risk of a bubble is regarded as fatal, we should perhaps choose a gradual tightening rather than a rapid tightening in the conduct of monetary policy. However, even in such a case, we should take a pragmatic approach by flexibly selecting the degree of tightening while paying due attention to not only a Type II error but also a Type I error.

5.2 Price stability and sustainable economic growth

How, then, should a pre-emptive monetary policy be conducted? To this end, Okina et al (2001) stress the importance of conducting monetary policy with the emphasis on maintaining an environment conducive to the sustainable economic growth that is the ultimate goal of price stability. In this case, a favourable environment presumes both price stability and financial system stability, because the proper functioning of the financial system is also an indispensable basis for sustainable economic growth.

So long as long-run equilibrium conditions are stable, monetary policy will probably be effective enough to maintain a sound economic environment, including financial system stability, by achieving price stability as a nominal anchor for the economy. However, once the perception of changing economic structure spreads, it may become questionable whether it is sufficient to achieve low measured inflation in the short run in order to ensure sustainable stability of the economy. Of course, even though thinking this way, it is not necessarily the case that it is advisable for a central bank to aim at correcting "overvaluation" of asset prices directly, based on its assessment of fundamentals of asset prices.

In the light of the above discussion, it seems more practically feasible for a central bank to deal with asset price bubbles from the viewpoint of contributing to the sound development of the economy through the pursuit of price stability. How, then, should price stability be defined in practice? In this context, Shiratsuka (2000) classifies views regarding price stability into two: "measured price stability" and "sustainable price stability".

The first definition of "measured price stability" enables one to specify price stability numerically so as to set a tolerable target range for the inflation rate, such that price stability corresponds to a rate of inflation from zero to 2%. The second definition of "sustainable price stability" considers price stability to be an important basis for sustainable economic growth.

"Measured price stability" emphasises the importance of maintaining a specific rate of inflation measured by a specific price index at a particular point in time. However, since movements of such indicators are affected by various temporary shocks and measurement errors, price stability pursued by a central bank is not necessarily equivalent to maintaining a specific rate of inflation measured by a specific price index at a particular point in time.[27]

From this viewpoint, as Shiratsuka (2000) points out, it is deemed important that a central bank should pursue "sustainable price stability" that supports medium- to long-term sustainable growth, not "measured price stability" to maintain a specific rate of inflation measured by a specific price index at a particular point in time. More concretely, price stability is important because it is a necessary condition for maximising economic stability and efficiency. In this case, an important yardstick for price stability is whether the stabilisation of public expectations regarding inflation is attained.[28]

A central bank is required to accomplish "sustainable price stability" in the first place, and, at the same time, is also required to maintain policy accountability based on committing itself to "measured price stability" according to certain criteria. However, as Shiratsuka (2000) emphasises, the consistency of "measured price stability" with "sustainable price stability" is not always maintained so as to support sustainable economic growth in the long run. Therefore, it is important for a central bank to pursue "sustainable price stability" as the primary objective for monetary policy, while assuring accountability by showing a quantitative assessment of "measured price stability".

5.3 An assessment of the sustainability of the financial and economic environment

In order to achieve "sustainable price stability", it is deemed important to recognise the risk profile of the economy as a whole, which might adversely affect sound financial and economic conditions from the medium- to long-term viewpoint.[29]

Okina et al (2001) report that the expected growth rate of nominal GDP computed from the equity yield spread in 1990 is as high as 8 percentage points below the standard assumption based on the discount factor (Figure 6).[30] However, in view of the low inflation at the time, it is almost impossible to believe that the potential growth rate of nominal GDP was close to 8%. Hence, it would be more natural to infer that the high level of the yield spread in 1990 reflected the intensification of bullish expectations, which are unsustainable in the long run.[31]

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27 For example, it might be the case that the statistically measured inflation is highly volatile at a glance, while most of the effects are just temporary. On the contrary, it might also be the case that measured inflation remains stable, even though the changed underlying inflation trend is offset by temporary shocks. To deal with this problem, Shiratsuka (1997) and Mio and Higo (1999) empirically show that the trimmed mean estimator, which excludes the impacts of items located on both tails of the cross-sectional distribution of inflation, adequately adjusts for the impact of temporary shocks, and could well be a quite useful and powerful indicator with which to gauge the changes in underlying inflation fluctuations.

28 In this context, FRB Chairman Greenspan refers to price stability as being a state of the economy in which "economic agents no longer take account of the prospective change in the general price level in their economic decision making" (Greenspan [1996]).

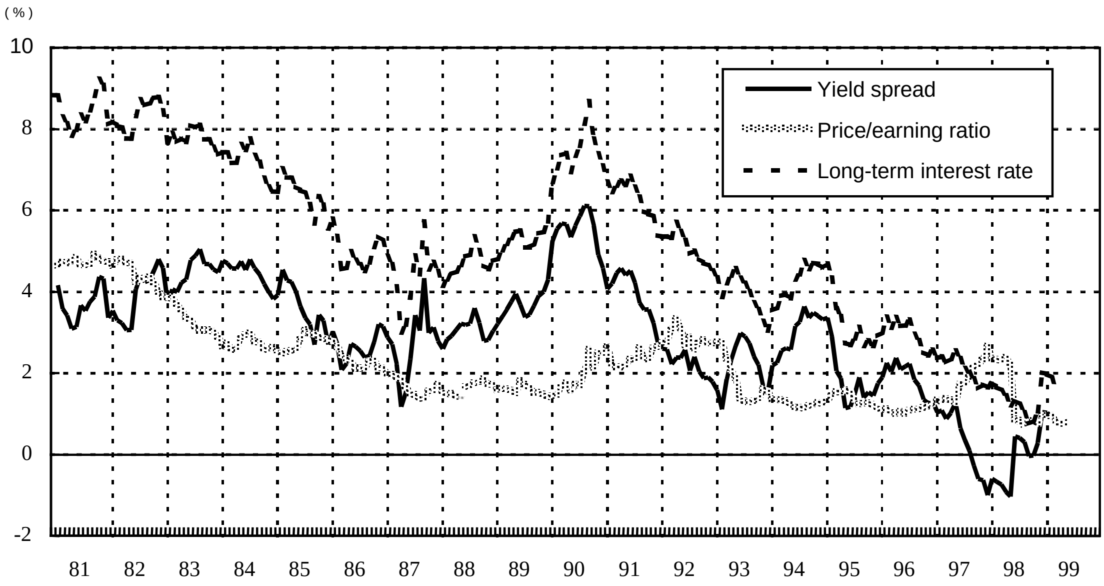
29 In this context, Okina et al (2001) point out, based on the experience of Japan's bubble period, the importance of examining potential risks from five perspectives: the output gap in the economy, the money supply and credit, asset prices, the behaviour of financial institutions, and the interaction of various risks.

30 Okina et al (2001) compute the risk premium as follows. For example, the difference between average annualised nominal GDP growth for the 10 years from 1984 to 1993 (5.3%) and the average yield spread during the same period (3.4%) is 1.9 percentage points. The difference between the nominal growth rate of 1994 (6.9%), when the declining trend of nominal GDP came to a halt, and the yield spread of the same year (4.5%) is 2.4%.

31 In this case, it is not necessarily important to distinguish between the increase in the expected growth rate and the decrease in the risk premium since both will have an impact on asset prices in the same direction. For example, if a rise in the yield spread of stocks reflects a decline in the risk premium, this suggests stronger confidence in the future, and corporate and household economic activity will become active as the expected growth rate increases. Hence, when considering the effects on asset prices, it suffices to evaluate the expected growth rate adjusted for the risk premium.

Figure 6

Equity Yield Spreads



Sources: Bank of Japan, *Financial and Economic Statistics Monthly*.

Notes: Yield spread and price/earning ratio are computed in TOPIX basis. Long-term interest rate is JGB (10-year) at the end of each month.

Against the backdrop of such unsustainable bullish expectations, financial institutions took risks that were out of proportion to expected profits. In retrospect, it is evident that there was a lack of recognition of risks related to the economy as a whole and to the financial system, and especially a lack of recognition of the concentration and interaction of risks. As supporting evidence on this point, Okina et al (2001) compare profitability, the growth rate of loans, and the ratio of real estate related lending to the total lending of seven failed and surviving relatively small regional banks, which are member banks of the Second Regional Banks Association (Figure 7). It is confirmed that these failed banks were already exhibiting poor profitability in the first half of the 1980s and aggressively expanded their loans to property-related firms from the mid-1980s onwards.

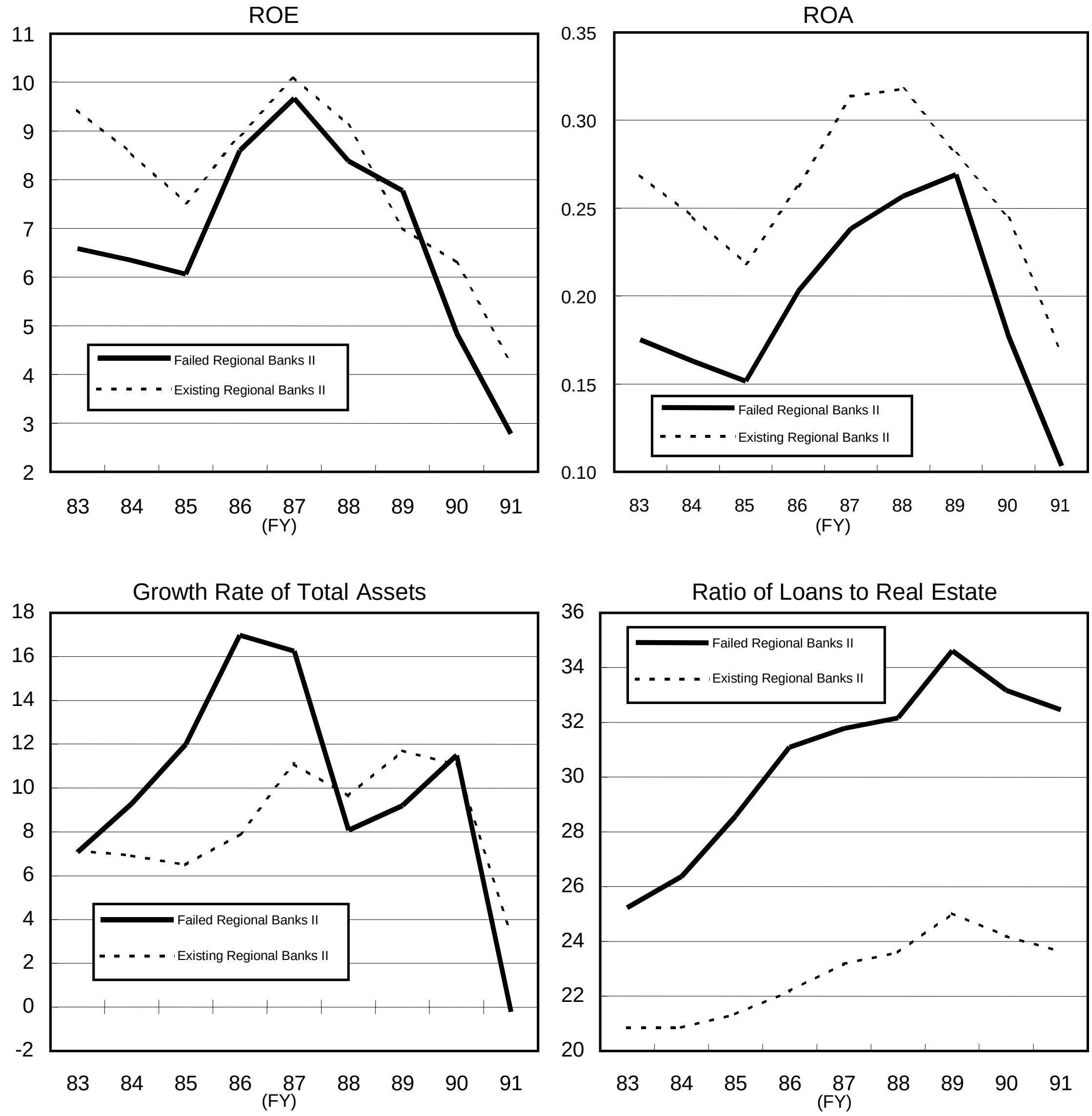
The interaction of risks takes various forms, and such aggregate risks are not merely the simple sum of risks recognised by individual economic agents. Here, the interaction and concentration of various risks play an important role. Since the interaction of risks may arise between financial and non-financial sectors, a perspective that recognises aggregate risks is quite important, and it becomes crucial to determine which risk factor should be watched in evolving economic and financial conditions. It might well be the case that an insufficient recognition of the interaction of various risks in the economy leads to an excessive concentration of risk.

In fact, looking at the land price problem from the viewpoint of the stability of the financial system, it was the potential risk brought about by the sharp rise in land prices and the concentration of credit in the real estate and related industries that were insufficiently perceived. Shimizu and Shiratsuka (2000) employ an analytical framework of value-at-risk (VaR) to estimate the aggregate credit risk inherent in the loan portfolio of Japanese banks during the bubble period ("stress testing"). This simple numerical exercise that incorporates sufficiently prudent scenarios for the probability of bankruptcy, the concentration of credit and the future fluctuation of collateral prices shows that the magnitude of non-performing loans held by Japanese banks in the 1990s could have been predicted (see Figure 8 for the scenario for land price fluctuation, and Table 1 for the estimation results).

Figure 7

Profitability and behaviour of failed Tier II regional bank

(in percent)



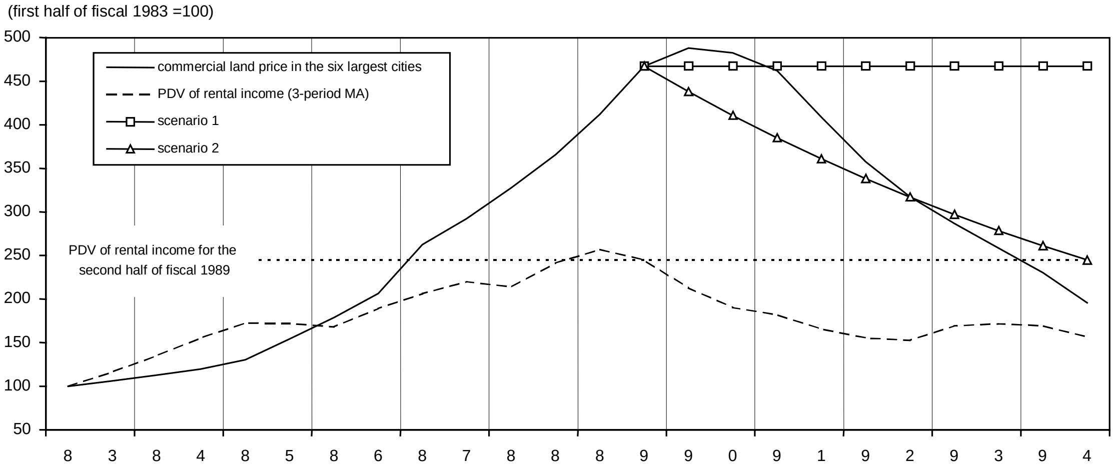
Sources: Figure 17 in Okina, Shirakawa, and Shiratsuka (2001). Originally taken from Japanese Bankers Association, *Financial Statements of All Banks*.

Notes: Tier II regional banks are member banks of Second Association of Regional Banks. Failed tier II regional banks are Taiheiyo, Tokyo Sowa, Kokumin, Niigata Chuo, Koufuku, Fukutoku, and Hyogo.

However, it should be noted that the analytical framework of Shimizu and Shiratsuka (2000) focuses on the changes in collateral values of bank loans, among various risk factors for bank loan portfolios. This approach is thus effective in the case of Japan in the late 1980s, whose financial system heavily depended on intermediated lending secured by real estate. Financial systems vary between countries in terms of the relative weights of intermediated lending and other features.

Figure 8

Scenarios for Land Price Fluctuations



Source: Figure 1 in Shimizu and Shiratsuka (2000).

Notes: It is assumed for the price fluctuation after the second half of fiscal 1989 that the price will fall at a constant rate so as to eliminate the deviation from the present discounted value in 5 years. The present discounted value land price is calculated by assuming that (i) total rental from office space remains constant as a percent of GDP, (ii) the rate of growth of rental income is equal to the rate of potential economic growth and the expected rate of inflation (with perfect foresight over a one-year horizon), and (iii) the risk premium is 2.3 percent (given by the difference between the rate of nominal GDP growth for fiscal 1981-1989 and the yield spread).

Table 1

The credit risk of the loan portfolio of City Banks (end of March 1990)

(in JPY trillions)

	Bankruptcy probability (observation period)	Assumption about portfolio diversification	Scenario for the future fluctuation of collateral prices	Amount of credit risk	
				Total	*of which, concentration risk*
1	Bankruptcy probability ('85-89)	Average diversification	Constant	2.7	1.6
2	Default probability ('85-89)	Average diversification	Constant	5.0	2.7
3	Default probability ('90-94) assuming deterioration of the credit situation of the construction, real estate and finance-related industries	Average diversification	Constant	14.9	6.0
4	The same as above	Average diversification	Deviation from the theoretical value is eliminated in 5 years	17.5	6.9
5	The same as above	Credit concentration in the real estate and finance-related industries is assumed (α: 0.1 → 0.3)	The same as above	22.8	10.5

Note: "Concentration risk" refers to the amount of risk when dynamic risk is assumed to be zero. In Case 3, the following increases for the default probability is assumed: for the construction industry, from 0.0 percent to 0.40 percent; for the real estate industry, from 0.0 percent to 0.59 percent; and for the finance-related industry, from 0.0 percent to 7.49 percent.

Source: Table 2 in Shimizu and Shiratsuka (2000).

Of course, needless to say, it is obviously important to conduct numerical exercises in line with the aforementioned stress testing. In the case of the US economy, for example, it might be more reasonable to employ a small econometric model that enables one to gauge the effects of capital gains and losses from asset price fluctuations on the economy to estimate potential risks in the economy. However, if the historical relationships among the various macroeconomic variables change, it is hard to forecast the future course of the economy accurately with conventional econometric models.

The above discussion suggests that no rules exist regarding how to recognise potential risks in the economy. In fact, Kindleberger (1995) points out that there are no cookbook rules for policy judgment, and it is inevitable that the monetary policy authority will have to make a discretional judgment.[32] It is important for a central bank to have a good track record and for it to achieve credibility regarding its pre-emptive policy actions before general agreement can be obtained. In this case, the good track record should include not only favourable financial and economic performance; such a performance must also be supported by decisive actions of the central bank with a high degree of transparency.

6. Conclusion

This paper has reviewed the implications of asset price fluctuations for the conduct of monetary policy, based on Japan's experience of the emergence, expansion, and bursting of asset price bubbles, with special emphasis on the linkage between asset price fluctuations and financial stability.

Worldwide consensus has been established regarding the importance of central banks' independence and accountability in achieving price stability. However, concerning the role of central banks in prudential policy, a global standard has yet to be formed. The monetary policy of a central bank, which aims at price stability, is conducted using the financial markets and financial system as its transmission channel. The two objectives of central banks, ie price stability and financial stability, can be considered as complementary in the sense that achieving one is a precondition for achieving the other.

In order to connect the two objectives in a mutually complementary manner, I have focused on the implications of asset price fluctuations on the soundness of the financial and economic environment in the long run. It should be stressed that it is important to identify whether asset price fluctuations properly reflect movements in their underlying determinants, or fundamentals, because a misalignment of asset prices, or asset price bubble, produces serious adverse effects on the financial system and on the economy when the bubble eventually bursts. Moreover, the effect of asset price fluctuations is asymmetric, with stronger effects in the case of an asset price decline. Monetary policy is required to respond to the potential risk of future asset price bubbles in a pre-emptive manner, based on an accurate analysis of the reasons behind the movement of asset prices.

It is important to note the following three points. First, the best thing monetary policy can do to foster sustainable economic growth is to deliver predictably stable prices. In this context, the central bank should aim at "sustainable price stability" that supports medium- to long-term sustainable growth, not "measured price stability" designed to maintain a specific rate of inflation measured by a specific price index at a particular point in time. Even if measured inflation is stable, a central bank needs to alter interest rates promptly once it judges that the risk of damaging "sustainable price stability" has increased.

Second, monetary policy also influences the financial system through the behaviour of financial institutions and macroeconomic conditions. To achieve financial system stability, it is important to maintain not only a favourable macroeconomic environment but also the soundness of individual financial institutions. In this regard, the regulatory and supervisory authorities play an important role. Thus, it should be noted that, although financial stability is an important policy objective for the central

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32 Kindleberger (1995) comments on this point as follows: "When speculation threatens substantial rises in asset prices, with a possible collapse in asset markets later, and harm to the financial system, or if domestic conditions call for one sort of policy, and international goals another, monetary authorities confront a dilemma calling for judgement, not cookbook rules of the game."

bank, the central bank does not command the same power of influence over this objective as it does over price stability when trying to maintain a favourable environment. This clearly indicates the limited role of asset prices in the formulation of monetary policy.

Third, it might be the case that a conflict exists between the two objectives of central banks, ie price stability and financial stability, in the short run. However, it is not appropriate to think that there is a fundamental trade-off between these two objectives, because the two objectives can be considered as complementary in the sense that achieving one is a precondition for achieving the other.

In this context, another important issue I have not mentioned explicitly so far is the relationship of the central bank to the financial supervisory authority. The objectives of the central bank with regard to achieving financial stability do not perfectly correspond to those of the financial supervisory authority.[33] For example, Dewatripont and Tirole (1994), one of the leading textbooks on bank regulation, states that "[bank] regulation is motivated in particular by the need to protect the small depositors" (p 31). In contrast, the main motivation for the central bank is not to protect depositors (especially small depositors) but to maintain the stability of the financial system as a whole.

It might therefore be the case that the central bank and the financial supervisory authority would have different judgments on the policy response to problems in the financial system, based on their own objectives. In this case, if the central bank were to make public its own judgment prior to that of the supervisory authority, it might cause some temporary friction in financial markets, for example by causing an intensification of concern about financial stability, thereby triggering a bank run. It is necessary for both the central bank and the financial supervisory authority to establish a complementary and cooperative relationship, based on a mutual understanding of the difference between their respective mandates. In this sense, it should be well recognised by the public that the two authorities do not always have the same views.

Of course, once a financial system falls into an unstable situation, it is also possible that this kind of central bank warning might arouse excessive fear in the financial markets. For example, BOJ Governor Hayami's warning in October 1998 that the capital ratios of 19 major Japanese banks were as low as the danger level was criticised severely as having been an "inappropriate remark".[34] In retrospect, however, it can be seen that he was quite legitimately taking a risk in order to urge an early capital injection to ensure the revitalisation of the financial intermediation system. In fact, he contributed to the decision to inject public money into the banks under the Financial Function Early Strengthening Law.

Panic in the financial system has a self-fulfilling nature. Even though warnings by the central bank are meant to accelerate the restoration of soundness in the financial system, there is always a considerable risk that such warnings may make it difficult to avoid systemic risk, once the message has been taken inappropriately. If this fear is materialised, the stakes are enormously high, especially if the safety net is not comprehensive enough to deal with imminent problems.

Central banks can contribute to sound economic development by achieving the two objectives simultaneously. To this end, the existence of a conflict between two objectives implies the necessity of coordination between the monetary and prudential policy functions in the central bank as well as

[33] Of course, as typically seen in countries in which a central bank is the only bank regulatory and supervisory authority, a central bank's commitment to designing the financial system and regulating and supervising financial institutions may vary, depending on the extent to which the central bank emphasises this aspect.

[34] The *Nikkei* (morning newspaper on 6 October 1998) article quoted an article in *The New York Times* (daily newspaper on 5 October 1998) in which it had been said that BOJ Governor Hayami participated in an unofficial meeting between Finance Minister Miyazawa and Treasury Secretary Rubin (FRB Chairman Greenspan also took part in the meeting) prior to the G7 official meeting held in Washington, DC, in early October 1998, and that Governor Hayami explained that "the capital ratios of 19 major Japanese banks were as low as the danger level". Since this article led to a widening of the Japan premium in the offshore market and temporarily made the Japanese banks' foreign currency funding difficult, Governor Hayami was criticised: for instance, the chairman of the Japanese Bankers' Association said, "The Governor made an imprudent comment, even though it is true." In response to this criticism, Governor Hayami answered in the Diet session of 7 October 1998 that it was a misleading quotation based on a misunderstanding. He also explained that his comment on the banks' capital accounts was misunderstood as a comment on their capital ratios. Later, in the Governor's regular press conference of 15 October 1998, he reflected on the bill of Financial Function Early Strengthening Law drafted by the Liberal Democratic Party, which provided for a capital injection scheme involving public funds, and said, "None of the banks is sufficiently capitalised. Hence, I wish the banks altogether would give a positive response to the scheme and apply for the scheme given by the Government that appropriates public funds for strengthening the banks' capital accounts."

between the central bank and the financial supervisory authority. It might well be that there is a case of a serious conflict between price stability and financial stability in the short run. However, it is not appropriate to think that there is a fundamental trade-off between the two objectives, because two objectives can be considered as complementary in the sense that achieving one is a precondition for achieving the other. How the central bank should go about this issue is certainly an important open question.

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Prudential regulation of foreign exchange: the Mexican experience

Pascual O'Dogherty and Moisés J Schwartz[1]

1. Introduction

The recent crises in Asia, Russia and Latin America have highlighted the challenges that the globalisation of financial markets and capital mobility pose for domestic financial systems. Countries are affected nowadays not only by their own economic mischief but also by contagion effects from events taking place in economies with which they do not have any real or financial links.

International investors in general tend to react negatively to markets that are related or share similar economic features. This type of behaviour can sometimes be explained by investors' desire to liquidate financial assets across markets. Frequently, investors attempt to offset positions in one market by taking the other side in another. Whatever the reason, the collective response of international investors makes the financial authorities' task more difficult and calls for immediate action on their part to upgrade regulatory frameworks and improve the management of foreign indebtedness and liquidity. Emerging open economies are particularly vulnerable to volatile capital flows given the size and depth of their capital markets. Consequently, their financial systems have to be better equipped to deal with highly mobile capital flows and their regulations should be aimed at preventing excessive build-ups during economic upswings.

Financial system vulnerability derives from, among other things, banks and other financial intermediaries having short-term obligations greater than the assets they can access at short notice. This balance sheet maturity mismatch is one of the main characteristics of banks. As financial intermediaries, banks engage in the business of transforming maturities.[2] However, when short-term obligations are denominated in foreign currency, financial vulnerability can easily turn into a balance of payments crisis.

Central banks throughout the world have slight differences in their mandates and objectives. However, monetary stability and sound domestic financial markets are nearly universal goals of monetary authorities. Crisis management by central banks has traditionally relied on the possibility of resorting to their role as lender of last resort for sound institutions that face transitory liquidity difficulties. Central banks represent the ultimate source of domestic liquidity, thus their role as lender of last resort has historically been one of the most important features of central banking. Nevertheless, if a central bank overuses this feature, the most likely result will be that monetary stability will be notably weakened in the short term. Hence, central banks have recognised that this facility should always be exercised with caution.

The strongest argument in favour of central banks maintaining their discretionary right to act as lender of last resort lies in their capacity to reduce the likelihood of systemic crises and to ease conditions in those crises that inevitability materialise. This is so because central banks are capable of providing the market with enough domestic liquidity to deal with crises of systemic proportions. However, a different situation occurs when central banks are required to play the role of lender of last resort in foreign currency. Unlike the unlimited liquidity that central banks can quickly mobilise during a crisis period, foreign currency resources are in limited supply. Under certain circumstances, central banks might need to utilise some of their international reserves in order to alleviate pressures on the banking sector as credit institutions are unable to refinance their debt in foreign markets.

This paper deals with the challenges that a volatile international environment poses to domestic financial systems and to the sustainability of sound macroeconomic performance. The article

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1 Pascual O'Dogherty is Director of Financial System Analysis and Moisés J Schwartz is Director of Macroeconomic Analysis at the Bank of Mexico. The views expressed in the paper are those of the authors and do not necessarily represent those of the central bank. The authors wish to thank Alejandro Díaz de León, Juan Pablo Graf, Miguel Hernández and Alberto Torres for their comments and suggestions.

2 Chang (1999).

addresses the relevance of proper foreign exchange regulations for the banking system. It is argued that appropriate regulations will result, on a microprudential level, in individual institutions with an improved ability to successfully face adverse shocks and, on a macroprudential level, in financial systems more capable of handling the volatile capital flows that characterise open and global economies. Thus, the aim of prudential regulation is to ease the adjustment costs of financial distress. The Mexican experience since the onset of the 1994-95 crisis serves as an interesting example of how a microeconomic prudential regulation that cushions banks' balance sheets from exchange rate movements reduces the likelihood that turbulence in international capital markets will cause severe macroeconomic adjustments in the domestic economy.

The paper is organised as follows: Section 2 describes the challenges that financial authorities in Mexico faced once the 1994-95 crisis erupted. Special emphasis is placed on the Bank of Mexico's involvement as a lender of last resort in foreign currency and on the loopholes that existed in the prevailing regulations. Section 3 reviews current central bank regulations on foreign exchange. Particular attention is given to the liquidity coefficient and its impact on banks' behaviour in terms of foreign exchange risk exposure. Information requirements on banks' foreign exchange exposures are also summarised. Section 4 provides evidence that supports the fact that the banking system of a small open economy, such as Mexico, that is totally integrated into global financial markets requires appropriate regulations on foreign exchange risk exposures.

There is no doubt that the speed at which investors now tend to react to changes in expectations leaves financial and monetary authorities far less room for crisis management and resolution than in the past. Even countries with solid fundamentals can now be subject to speculative attacks. In this environment, prudential regulation of foreign exchange exposures designed to prevent the build-up of imbalances takes a more prominent role. As a result of improved regulation, Mexican banks are now better equipped to deal with sudden and unanticipated capital flows.

2. The Mexican crisis of 1994-95

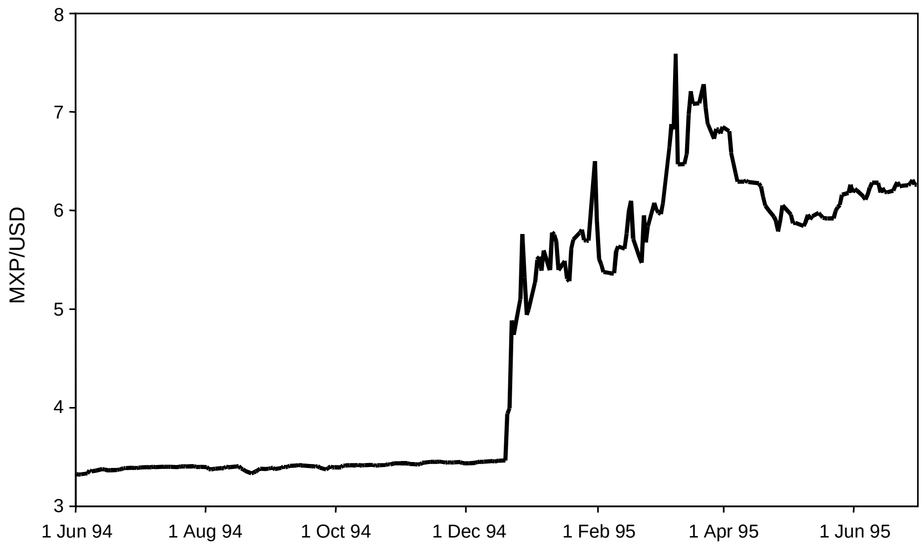
2.1 The 1994-95 crisis

The collapse of the Mexican peso in December 1994 unleashed a number of unprecedented challenges for the Mexican authorities. The exchange rate depreciated more than 100% (see Figure 1), inflation skyrocketed and the real economy plunged downwards at an alarming rate. At the same time, nominal and real interest rates increased substantially, real wages collapsed, unemployment increased, the financial system was severely strained and countless corporations and households were overwhelmed by the burden of their own debts and the concurrent decline of their real incomes. As net foreign capital inflows ceased and international reserves reached dangerously low levels, domestic investment could no longer exceed national saving, and thus the current account deficit virtually vanished.

Following the abandonment of the exchange rate peg in December 1994, the exchange rate and interest rates experienced marked volatility. Both the peso and interest rates came under heavy pressure as foreign investors liquidated their peso positions and creditors stopped rolling over their loans. The turbulence experienced by financial markets was exacerbated by the actions of speculators and several Mexican banks, who met margin calls and covered short dollar positions held through the use of exchange rate linked structured notes and off-balance sheet derivative instruments.

Before the abrupt devaluation of the peso, Mexican banks actively engaged in a variety of operations to take advantage of interest rate differentials between instruments denominated in pesos and dollars. These operations were structured in a way that enabled banks to circumvent Mexican regulations that forbid credit institutions to take long or short positions in foreign exchange in amounts exceeding 15% of their capital. Regulations also forbid banks holding securities on margin. In order to maintain short dollar positions, banks purchased notes denominated in pesos but with payoffs linked to the behaviour of the exchange rate. Many of these notes were also structured to allow banks to leverage their short dollar positions several times.[3] Some banks also took short forward dollar positions through offshore subsidiaries. Moreover, to take advantage of interest rate differentials Mexican banks borrowed foreign currency excessively in the short term in order to be able to invest in long-term higher risk securities that in turn were pledged as collateral for the loans.[4] To circumvent prohibitions on holding securities on margin, banks recorded these operations as swaps or repurchase agreements instead of loans secured by collateral.

Figure 1
Exchange rate



After the initial fall of the peso in December 1994, attempts by banks and other participants to cover short dollar positions and margin calls on swaps, repurchase agreements and structured notes exerted enormous pressure on an already battered peso, further exacerbating its volatility. Many participants not only covered short dollar positions but also took bets against the peso, adding to pressure in an already thin market.

Mexican banks, in particular, were hurt by the crisis. As foreign lenders began refusing to roll over their loans, balance sheet mismatches hampered the ability of banks to pay for their foreign liabilities. Although Mexican banks could have obtained enough funding in pesos to purchase dollars (the Bank of Mexico sterilised its interventions in foreign exchange markets), domestic interest rates increased rapidly, thus making peso funding very expensive (Figure 2). Additionally, liquidity in foreign exchange markets decreased substantially and bid/ask spreads skyrocketed (Figure 3). As a result, banks found it almost impossible to purchase dollars without substantially affecting the exchange rate.

To prevent the dangerous consequences of a systemic contagion in the event that some banks failed to honour their dollar liabilities, the central bank stepped in as lender of last resort. At that time it was considered that the failure of a single bank to meet its foreign exchange obligations could have triggered a run in the rest of the system. Between January and April 1995, financial authorities in Mexico provided liquidity support in foreign exchange to 17 Mexican banks in the amount of \$3.9 billion.[5] The support was formally provided through the Deposit Insurance Fund. Additionally, the federal government guaranteed all of the credits given by the Bank of Mexico to the Deposit Insurance

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3 These notes usually carried high coupons, but the principal repayment was linked to the behaviour of the exchange rate. A sharp depreciation of the currency could result in a negative repayment.

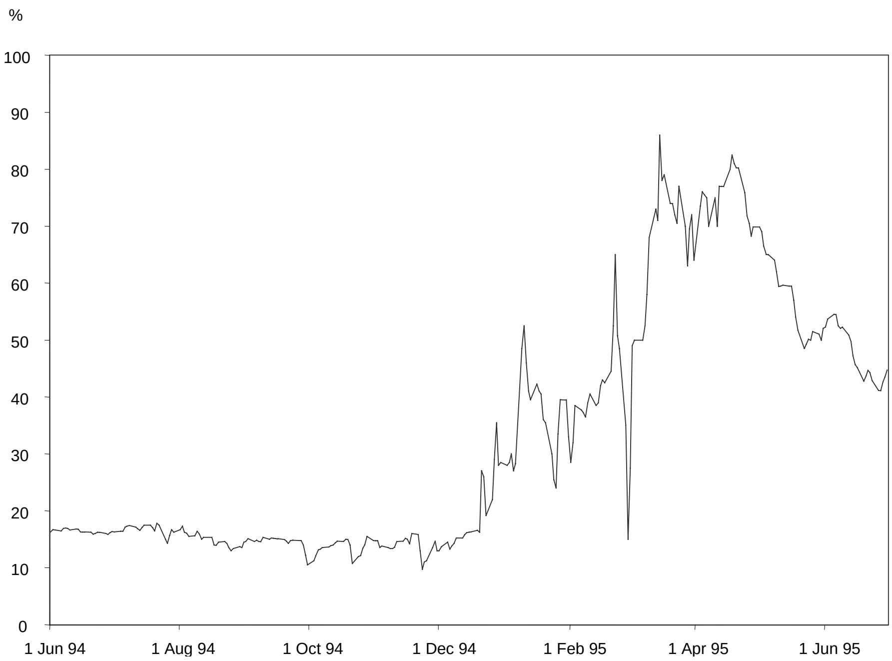
4 For more details on these operations, see Garber (1996).

5 Banco de México (1995).

Fund in order to ensure that the central bank would not assume any of the credit risk of the banks who were receiving the support.[6]

Figure 2

Interest rate
on one-day peso repurchase agreements



2.2 The aftermath *o*f the 1994-95 crisis

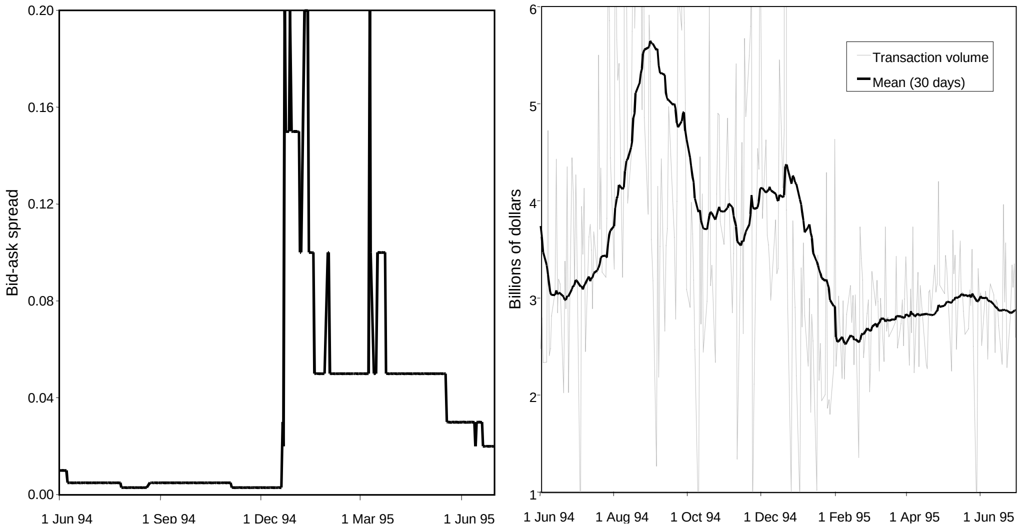
The 1994-95 crisis forced the authorities to acknowledge the importance of having timely access to information on the private sector's foreign exchange positions. This is especially true for financial intermediaries implicitly covered by the safety net. At the time, the Mexican authorities were not fully aware of the size of banks' foreign exchange imbalances, or of the amounts of their short-term liabilities.

The widespread financial distress that followed the depreciation of the peso also made evident the shortcomings and loopholes of regulations regarding foreign exchange and derivative instruments. The ample use of structured notes and other derivative products, whose value depends on the behaviour of other assets, renders regulations based on traditional accounting principles inefficient in identifying risk allocations. Therefore, the financial authorities in Mexico decided to strengthen regulations on foreign exchange by modifying the traditional definition of foreign exchange positions, establishing a liquidity coefficient in foreign currency and setting prudential limits on banks' foreign currency liabilities and on their holdings of foreign currency denominated securities. In addition, the authorities took great care in improving the process for monitoring banks' risk positions, particularly those in foreign exchange and derivatives, and established a regulatory framework for the prudent use of derivative instruments.

6 Foreign exchange assistance was granted in dollars at penalty rates that ranged from 17.5% to 25%, with the lower rate applicable to outstanding balances below a certain threshold. By September 1995, all banks had repaid their loans in full.

Figure 3

Bid-ask spread (MXP/USD) | **Dollars traded in foreign exchange market**



Another important consequence of the 1994-95 crisis was Mexico's abandonment of its pegged exchange rate regime. The Mexican experience of 1994 and the previous European episode of 1992 suggest that in today's global financial capital markets even apparently high levels of international reserves might turn out not to be enough to effectively confront a speculative attack under a fixed or pegged exchange rate regime. As an alternative, a flexible exchange rate regime can result in adequate incentives for economic agents when engaging in foreign exchange transactions. Without the implicit guarantee to currency risk-takers provided by a semi-fixed exchange rate regime, banks and other economic agents are expected to be more cautious when incurring such risks. The Mexican experience of the last five years seems to corroborate this argument.

3. The Bank of Mexico's regulations on foreign exchange

This section provides a description of the main elements of Mexico's upgraded regulations on foreign exchange. Specifically, regulation encompasses: foreign exchange positions, limits on liabilities denominated in or linked to foreign exchange, liquidity coefficients in foreign exchange, limits on holdings of sovereign debt and information requirements.

3.1 Foreign exchange positions

Banks can hold long or short positions in foreign exchange for up to 15% of their capital. The aim of these regulations is to prevent substantial losses in banks' balance sheets when the peso experiences drastic adjustments. Since credit institutions enjoy a greater capacity to leverage than other participants in foreign exchange markets, the aforementioned regulations also aim to prevent banks from engaging in significant purchases of dollars when the peso is expected to depreciate.

To leverage an attack against a weak currency, speculators have to gain access to credit either from the banking system or from the central bank. Commercial banks can always refuse to extend credit to some economic agents. However, central banks often find themselves in a difficult situation. Under a fixed or pegged exchange rate regime, central banks have to sterilise the monetary impact of their foreign exchange interventions in the domestic market. If this were not the case, the sudden shrinkage of “high-powered money”,[7] resulting from the central bank’s selling of international reserves, could impede banks from settling their customers’ accounts as well as their own transactions, thus leading to payment system failures.

When banks expect a depreciation of the domestic currency, they can either leverage themselves in that currency through the interbank market in order to acquire dollars or sell forward the domestic currency. In this situation, the central bank could easily end up doing both: buying its own weak currency (to maintain the peg) and supplying the credit needed to attack its reserves.

Central banks can always raise domestic interest rates to fend off an attack. However, these rate increases are rarely sufficient to entice speculators from not reaping the potential gains of a depreciation. Therefore, the Bank of Mexico imposed, several years ago, a limit on banks’ foreign exchange positions in order to impede banks in betting against the domestic currency or taking excessive foreign exchange rate risk to profit from interest rate differentials. Nevertheless, the 1994-95 crisis evidenced the shortcomings of the prevailing accounting practices, which focused on static valuations instead of risk exposures. As a result, some Mexican banks were able to circumvent the regulatory limits on foreign exchange positions by holding structured notes denominated in pesos but linked to the behaviour of the exchange rate.

To prevent banks from getting around the regulatory limits, the Bank of Mexico changed its definition for long and short foreign exchange positions. Thus, a *foreign exchange position should be considered to be long or short if it generates potential gains or losses from the depreciation of the exchange rate.* A “long position in foreign exchange” is defined as any position in an asset or liability (cash or derivative) that increases its value measured in domestic currency when the peso depreciates. Conversely, a “short position in foreign exchange” refers to any asset or liability that increases its value in domestic currency when the peso appreciates.

3.2 Limits on liabilities denominated in or linked to foreign exchange

The Mexican crisis of 1994-95 and the more recent events in Asia proved that banks have a tendency to overestimate the ability of their domestic borrowers to access foreign currency. Prudent behaviour by banks suggests that the currency denomination of a loan should be related to the borrower’s cash flows. However, domestic debtors frequently disregard the denomination of their flows, and attempt to take advantage of interest rate differentials by borrowing in dollars instead of domestic currency. This is especially true when domestic debtors believe that the monetary authorities are committed to maintaining an exchange rate peg. Under these circumstances, a depreciation of the exchange rate will sharply deteriorate those foreign currency loans, which is exactly what happened in both Mexico and Asia during their respective banking crises.

To prevent banks from overextending foreign currency lending in order to satisfy their customers’ demand for credit, it seems prudent to impose some limits on domestic banks’ lending in foreign currency. Since banks are subject to limits on their foreign exchange exposure, limits on lending could also be enforced through the establishment of ceilings that limit the amount of foreign currency liabilities that a bank is allowed to maintain. The ceilings also have the advantage of reducing the use of foreign borrowing by banks to finance domestic credit expansions. Finally, ceilings prevent domestic banks’ balance sheets from becoming fully *dollarised*. Thus, the Bank of Mexico has imposed limits on the amount of foreign currency liabilities (measured as a percentage of their capital) that Mexican banks are allowed to hold.

According to the Bank of Mexico’s regulations, banks are not allowed to hold liabilities denominated in or linked to foreign currency in excess of a certain amount of their capital. The limits are imposed after netting out foreign currency assets weighted according to their credit risk. Liabilities are also weighted according to their remaining maturity.

[7] “High-powered money” is composed of currency and banks’ reserves at the central bank.

3.3 Liquidity coefficients in foreign currency

3.3.1 Liquidity

Liquidity can be defined as the ability of an institution to successfully face reductions in its financial liabilities, or in its income stream. The greater the ability to roll over liabilities or obtain funds at reasonable rates and/or liquidate assets at reasonable prices, the better the liquidity position of that particular institution. When liabilities are rolled over at high rates or with great frequency, as is the case with short-term liabilities, a liquidity problem can easily become one of solvency. Hence, the concept of liquidity is closely related to that of solvency.

One can also distinguish between individual liquidity difficulties and systemic crises. The former take place when institutions face temporary difficulties in renewing their liabilities. Unless these institutions are already facing some sort of solvency problem, they can generally access the interbank market and obtain funds to cover their short-term liabilities. Nevertheless, a bank's liquidity conditions also depend on the currency denomination of its assets and liabilities, the exchange rate regime and the procedures used by the central bank to conduct its monetary policy and settle operations in the payment systems. On the other hand, systemic liquidity problems occur when a significant number of institutions are having trouble renewing their liabilities or face exorbitant increases in their funds' costs. Under these circumstances, many financial institutions tend to look to the central bank as a possible source of credit.

From the monetary authorities' perspective, banks' liquidity concerns take on a completely different dimension when a foreign currency is involved. Central banks have an unlimited capacity to provide credit in their own domestic currency. However, a central bank's capability to extend credit in foreign currency is drastically limited by the availability of foreign reserves and its ability to access other sources of funding. Compulsory bank reserve requirements in domestic currency are generally imposed for monetary policy purposes rather than to address liquidity risk considerations.[8] However, there is an increasing consensus among central bankers from emerging economies on the need to establish some type of foreign exchange liquidity cushion for domestic banks.

The next sections convey the hypothesis that compulsory domestic currency reserves are not essential to protect the banking system from liquidity crises when the central bank does not intervene in the foreign exchange market or when it sterilises the monetary impact of its interventions. Conversely, liquidity coefficients in foreign currency are an important element of an overall framework of prudent risk management for an emerging economy.

3.3.2 Liquidity in domestic currency

Under a flexible exchange rate regime, in which the central bank's intervention in the foreign exchange market is limited or virtually non-existent, banks may never face a liquidity problem in their domestic currency balance sheet, unless they face an insolvency situation. This is due to the fact that, under a free float, the central bank does not purchase nor sell foreign currency in the foreign exchange market. Thus, the monetary base remains constant. Under normal market conditions, a bank could obtain enough funds to cover its deposit losses from the very banks that gain the resources.

The situation is the same even if the loss of deposits is caused by a substitution of domestic currency for foreign-denominated assets. When the central bank does not intervene in the foreign exchange market (ie the monetary base remains unaltered), increases in the demand for foreign currency assets have to be compensated for by an equivalent increase in the quantity supplied, at a new equilibrium exchange rate. Therefore, the amount of "high-powered money" remains constant, and banks are able to balance their domestic currency denominated liabilities' gains and losses through the interbank market.

Under a fixed exchange rate regime, banks could face liquidity problems in their domestic currency balance sheets only when the central bank does not fully sterilise its interventions in the foreign exchange market, as may be the case under a currency board scheme. With a currency peg, increases in the demand for foreign assets force the central bank to sell foreign currency in exchange

[8] Currency boards may be an exception.

for its own to maintain the exchange rate peg. These interventions destroy the monetary base and decrease domestic currency denominated deposits. In order to offset the reduction in deposits, banks must use reserves held at the central bank. Under these circumstances, banks may not be able to compensate for the loss of domestic currency deposits unless they obtain funds in foreign currency to sell to the central bank or, as was previously mentioned, the central bank sterilises its interventions in the foreign exchange market through open market operations.

Therefore, it can be concluded that, ceteris paribus, there is no reason for a solvent bank to face a liquidity crisis in domestic currency if the monetary base remains unaltered. The monetary base will remain constant as long as the central bank does not intervene in the foreign exchange market or if it sterilises its interventions through open market operations.[9]

3.3.3 Liquidity in foreign currency

The above situation fails to hold when banks' liabilities are denominated in foreign currency. Liquidity problems immediately arise when a bank faces a run on its foreign currency denominated deposits or experiences difficulties in rolling over its foreign-denominated liabilities. This may be particularly the case when liability holders are foreign residents who can not assess the situation of banks. Rumours can also precipitate a run against an otherwise healthy bank, or lead to difficulties in rolling over external credit lines.

It is important to mention that runs on foreign currency denominated deposits or difficulties in rolling over foreign currency denominated liabilities do not necessarily result in liquidity crises. Banks can always resort to borrowing funds in domestic currency, which they can then use to purchase enough foreign exchange to pay for their upcoming liabilities. In this sense, banks will be substituting domestic currency liabilities for liabilities denominated in foreign currency. To compensate for the increased asset/liability mismatch in foreign currency, banks can simultaneously sell foreign currency forward.[10] However, during a severe systemic crisis, liquidity in foreign exchange markets could diminish substantially. In those circumstances, the central bank might be forced to step in as lender of last resort to prevent excessive depreciation of the exchange rate as a result of banks' purchases of foreign currency (to meet liabilities falling due). Further depreciation of the exchange rate under those extreme events will only cause non-performing foreign currency denominated assets and the liquidity situation of domestic banks to deteriorate.

3.3.4 Different approaches to the management of liquidity in foreign currency

The most common approach to dealing with banks' foreign currency liquidity in emerging markets is to establish minimum liquidity requirements related to the size and term structure of foreign liabilities. Setting minimum requirements has certain advantages for both supervisors and credit institutions. For authorities, it is relatively easy to set minimum ratios and supervise the compliance of individual institutions. For banks, with little experience in modern risk management systems, it might also be more convenient to comply with fixed parameters. However, a regulatory framework based on fixed ratios attached to balance sheet items could bear little relation to real liquidity risks.

This traditional approach does not appropriately consider the differences in behaviour of certain liabilities, as well as alternative sources of liquidity not recorded on balance sheets (ie credit lines or greater access to markets). Hence, fixed liquidity ratios could be set either at levels below the "appropriate" level, which in turn will have implications for banks' liquidity risk exposure, or above the "appropriate" level, which will then jeopardise banks' ability to compete against other financial intermediaries. Furthermore, fixed liquidity coefficients may not consider changes in underlying sources of liquidity risk, making them unnecessarily high during upswings (abundance of liquidity sources) and too low in downturns (liquidity scarcity). On the other hand, when liquidity risk

[9] The argument assumes that the treasury maintains its resources outside the central bank or that any movement in the treasury's account at the central bank is fully sterilised.

[10] During the Mexican crisis of 1994-95, prevailing regulations prevented banks from engaging in forward transactions in foreign exchange. However, following the Asian and Russian crises some Mexican banks sold dollars forward to compensate for the substitution of peso liabilities for dollar ones. Foreign banks are generally more willing to disregard country risk in forwards because their exposure is smaller when they provide credit through the use of forwards than when they resort to direct loans.

materialises, banks may find it difficult to comply with regulatory liquidity ratios. At this time, enforcement of regulations will exert excessive pressure on the whole system, and thus authorities may be inclined to ease liquidity requirements. Additionally, rapid financial innovation will make it difficult for authorities to keep track of the development of new financial instruments, and as the distinction between financial intermediaries becomes blurred, the requirements imposed on certain types of institutions may become ineffective.

A modern approach being implemented in many developed countries follows the Basel Committee on Banking Supervision's guidelines, which give banks full autonomy and responsibility to measure, monitor and control their liquidity positions in foreign currency. The role of the supervisor under this framework is to verify that banks have appropriate liquidity systems in place, and that liquidity risks bear relation to their capital. Nevertheless, the Basel Committee also considers the possibility of imposing minimum required liquidity coefficients under extreme situations.

As explained above, after the crisis of 1994-95 Mexico introduced liquidity coefficients for foreign exchange, along with other reforms to strengthen the liquidity position of banks. This regulation is explained in the next section. It is important to note, however, that regulation in Mexico is moving towards a framework in which banks will establish their own risk management systems. The final goal is to move from compliance-oriented supervision to self-regulation of institutions that meet stringent standards on risk management and capitalisation. This is a commitment to advance towards the deregulation of financial markets by letting the better equipped institutions have more room to handle their risk and to introduce innovations. The fixed coefficient approach implemented in Mexico is by no means the best way to address liquidity risk management. However, this regulation was considered as a necessary first step towards the implementation of an up-to-date regulatory framework for risk management, and the development and dissemination of modern risk practices in banks.

3.3.5 The minimum required foreign currency liquidity coefficient

The goal of this regulation is to encourage banks to show prudent behaviour in their foreign currency balance sheet, to compel them to maintain adequate liquid assets in foreign currency and to promote long-term financing in foreign currency.

According to this regulation, foreign currency liabilities with less than 60 days left to mature that have no corresponding assets of the same or shorter maturity must be matched entirely by high-quality liquid foreign currency denominated assets. Liabilities with less than 60 days left to mature that are matched by non-liquid assets of the same or shorter maturity must be offset by such high-quality liquid assets in a percentage linked to their maturity. That percentage ranges from zero for those liabilities that have a maturity of 60 days to 50 for liabilities that have one day left to mature.

3.4 Limits on banks' holdings of foreign currency denominated securities

Prior to the 1994-95 crisis, some Mexican banks took out short-term loans in order to invest in Brady and other sovereign bonds denominated in foreign currency and thus take advantage of interest rate differentials between the short and long ends of the curve. These bonds were often pledged as collateral for the loans. Each transaction was recorded as either a swap or a repurchase agreement in order to circumvent Mexican regulations that prohibited banks from holding securities on margin. The price of sovereign debt is extremely vulnerable to investors' perceptions of country risk and thus tends to fall sharply during financial crises. The decline in the value of the Brady bonds forced banks to increase their long dollar positions so that they would be able to meet their counterparties' margin calls compensating for the loss of the bonds' value pledged as collateral, and also to keep unaltered their foreign exchange position. As a result of these considerations, the Bank of Mexico decided to place a limit on Mexican banks' holdings of foreign currency denominated sovereign debt.

3.5 Information requirements

To comply with Bank of Mexico regulations on ceilings for foreign exchange liquidity coefficients and liabilities, banks had to make major efforts to improve their information technology resources in order to concentrate, process and send to the central bank information about their daily operations and positions in foreign exchange. As a result, the monetary authority has gained timely access to a wide range of data from banks, including details of high-quality liquid assets in foreign currency (overnight deposits in A-1 or P-1 banks, US Treasuries and credit lines), high-quality assets (time deposits with remaining maturity of 60 days or less and high-rated commercial paper) and the credit portfolio weighted by rating, as well as information on foreign exchange liabilities classified according to remaining maturity.

The development of a debt monitoring system for Mexican commercial interbank external credit lines represents an important element in an overall strategy to preclude resident banks from engaging in risky positions in foreign exchange. The system includes a daily early warning indicator that detects changes in the condition of banks accessing this type of credit. The Bank of Mexico has utilised this system since July 1999 to continuously monitor information from banks and their non-resident branches and agencies. The information that banks are required to provide to the Bank of Mexico is classified by creditor (NAFTA countries, European Union, other European countries, Latin America, Asia and multilateral institutions), and by the type of operation it tracks (call money, trade-related credit, officially guaranteed credits, etc). With regard to the term structure of debt, the central bank also has access to data regarding the amount due from commercial banks as of the next day, the next week and/or the next months. The interest rates at which credit is contracted are also available on a daily basis, as is the spread between the original agreed rate and US Libor.

The ongoing monitoring of this information represents an important step towards a better understanding of the risks that financial institutions face when conditions in international capital markets deteriorate. Moreover, the high-frequency monitoring of borrowing by domestic commercial banks should allow the financial authorities to rapidly identify changes in market sentiment towards Mexican banks. This, in turn, enables the authorities to be better prepared to confront periods of uncertainty. Consequently, the appropriate mix of regulation and information requirements should allow Mexican banks to successfully deal with sudden and unanticipated swings of capital flows and with the corresponding volatility in domestic markets.

4. Mexico's close linkage with external developments: an example of the importance of foreign exchange prudential regulation

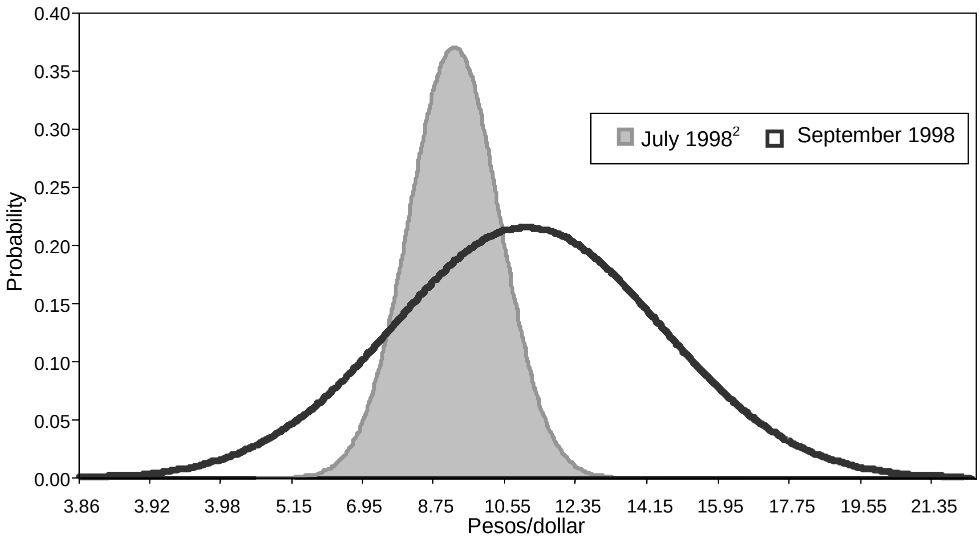
Recent crises in emerging markets have clearly shown the challenges that capital mobility poses to domestic financial markets and have thus reinforced the need to build solid systems capable of handling sudden and unanticipated swings of capital flows. This section provides evidence that supports the fact that the banking system of a small open economy, such as Mexico, which is totally integrated into global financial markets, requires appropriate regulation for overseeing foreign exchange risk exposure. To this end, it is useful to illustrate the magnitude of the shocks that Mexico's exchange rate is subject to as well as the origins of the turbulence. Once this is understood, the importance of establishing prudent foreign exchange risk exposure regulations that would enable banks to handle volatile capital flows and swings in the exchange rate is evident.

Derivatives markets allow for the construction of risk neutral probability distributions of the corresponding underlying assets. In this case, it is of particular interest to show how market expectations regarding the future course of the Mexican peso/dollar exchange rate are affected once an external shock, such as the Russian sovereign debt default, occurs. Figure 4 shows the monthly average of the three-month-ahead probability distribution for the implied peso/dollar exchange rate in derivatives markets for two different periods, July and September 1998. In other words, the figure shows different levels of uncertainty in domestic markets, both before and in the midst of the Russian crisis. This procedure assumes that the exchange rate follows a normal distribution[11] and uses the average three-month forward peso exchange rate and the average implied volatility in option prices as the mean and standard deviation of the probability distribution.

[11] Although there is evidence to suggest that exchange rates do not follow a normal distribution, the purpose of this exercise is just to highlight the difference in market expectations before and after the occurrence of an external shock.

Figure 4

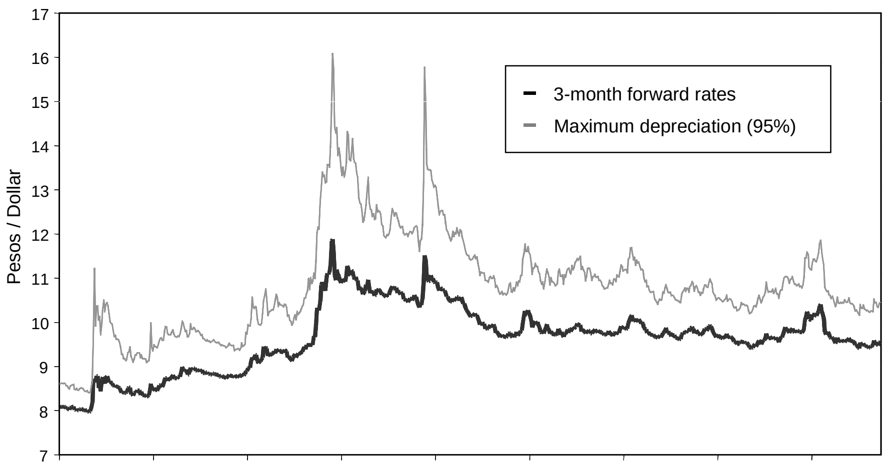
Three-month-ahead exchange rate probability distribution[1] before and after the Russian crisis



[1] Assuming the forward exchange rate follows a normal distribution. [2] Constructed using the average three-month forward price and implicit volatility for at-the-money forward options.

Figure 5

Three-month forward exchange rate and maximum depreciation implicit in forward and option markets at 95% confidence level[1]

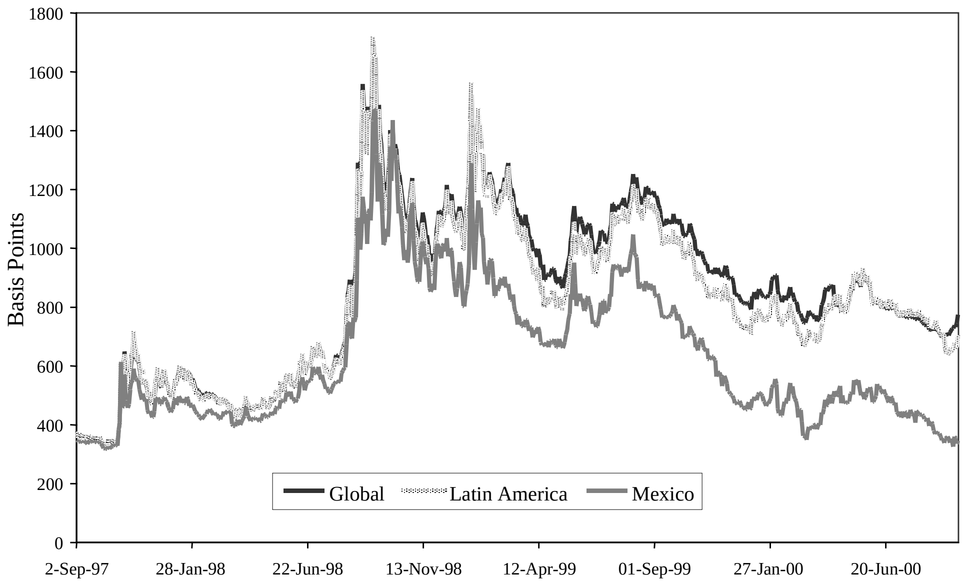


[1] Assuming the forward exchange rate follows a normal distribution.

After the Russian debt default, the level of uncertainty surrounding emerging markets and the peso/dollar exchange rate increased significantly. As the figure indicates, the mean and standard deviation of the probability distribution of the three-month-ahead peso/dollar exchange rate went from 9.3 pesos to the dollar and 12% respectively in July to 11.1 and 30% in September of the same year. To help us understand the impact of increased foreign exchange uncertainty over a longer period of time, Figure 5 shows the three-month peso/dollar forward exchange rate and the maximum exchange rate depreciation implied in derivatives markets (at a 95% confidence level and assuming a normal distribution). As is evident, both the behaviour of the expected exchange rate and the uncertainty surrounding the exchange rate[12] reacted vigorously to external developments. This was the case for the Asian crisis in late 1997, the Russian debt default in September 1998 and the Brazilian devaluation in January 1999.

Figure 6

Emerging Markets Bond Index sovereign spread (EMBI)



External developments are closely related to Mexico's country risk. Figure 6 shows the evolution of global emerging markets' country risk, as well as that of Latin America and Mexico, depicted by the Emerging Markets Bond Index spread (EMBI spread).[13] From the figure it can be inferred that, in times of international financial distress, Mexico's country risk, and that of the rest of the emerging markets, tends to increase. Events surrounding the Asian, Russian and Brazilian episodes confirm this claim. Thus, it seems that the risk perception of a particular emerging market such as Mexico is affected not only by domestic events but also by developments taking place in other emerging economies.

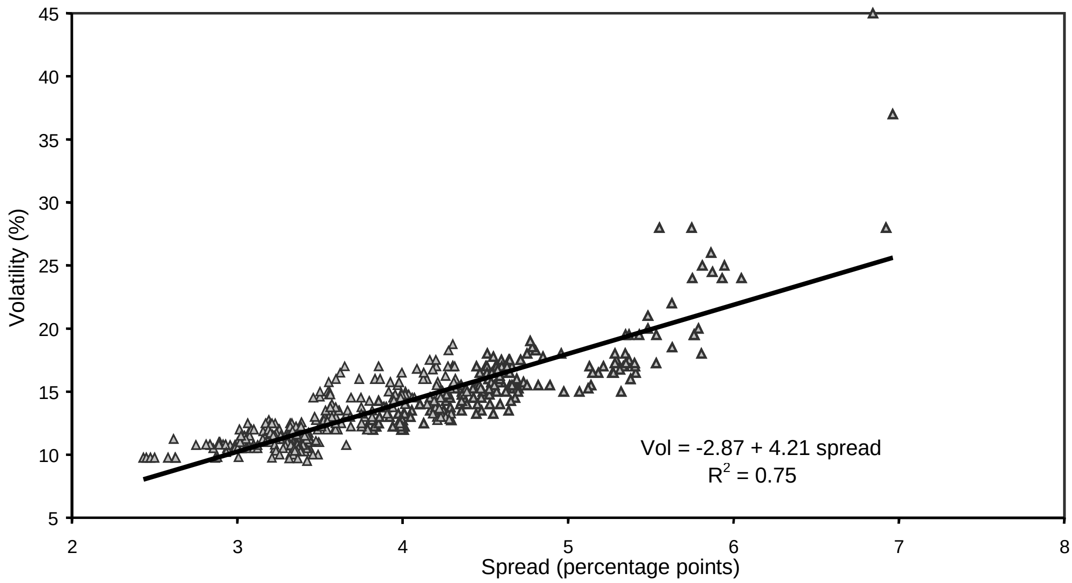
The relationship between Mexico's country risk and the implied exchange rate volatility is depicted in Figure 7. The scatter plot shows a linear relationship between these variables. Thus, it is clear that an increase in Mexico's risk perception results in higher levels of uncertainty in the peso/dollar foreign exchange market. Moreover, not only is the expected peso/dollar exchange rate affected when unfavourable external developments take place, but the prevailing exchange rate is also significantly altered. Figure 8 indicates that, in addition to the performance of oil prices, Mexico's country risk perception plays a crucial role in explaining the behaviour of the peso/dollar exchange rate.

[12] Captured by the maximum depreciation implicit in the forward and option markets for foreign exchange.

[13] Computed by JP Morgan.

Figure 7

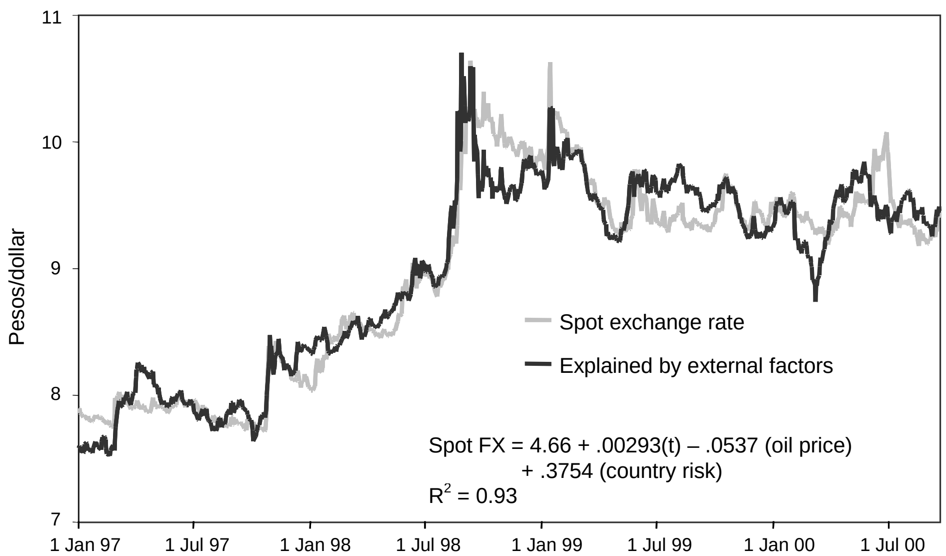
Exchange rate volatility implicit in three-month options[1] and country risk (spread between UMS 2026 and 30-year treasury bond)



[1] Implicit volatility for at-the-money three-month forward options.

Figure 8

Exchange rate behaviour explained by external factors

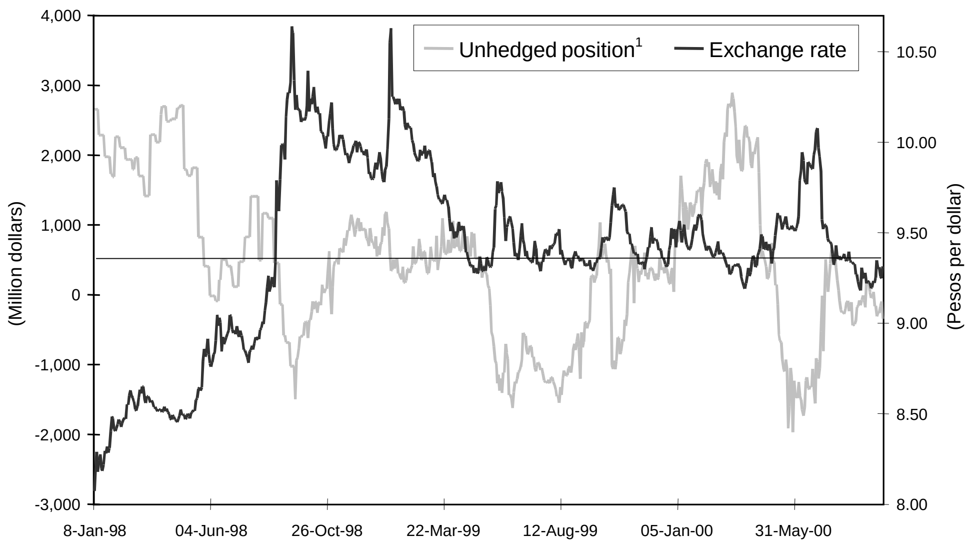


Mexico's increased country risk perception and the resulting peso depreciation suggest a diminished appetite for peso-denominated debt. Figure 9 shows the behaviour of international investors' unhedged positions in fixed income peso-denominated securities and the peso/dollar exchange rate. As expected, during turbulent episodes in emerging markets, the unhedged peso position has been reduced and, on several occasions, foreign investors have more than covered their peso holdings with foreign exchange.[14] Moreover, the unhedged position seems to be negatively correlated with the exchange rate.

Financial distress in emerging markets has not only been reflected in reduced foreign holdings of peso-denominated fixed income securities or equities, but also in a far more difficult environment for the private and public sectors to access international capital markets. Figure 10 illustrates how episodes of market turmoil, such as the Russian crisis and the Brazilian devaluation, resulted in a diminished placement of debt in global capital markets by the Mexican non-banking private sector, in terms both of amount and of the number of placements.[15] Furthermore, in some instances capital markets were completely shut off.

Figure 9

Foreign residents' unhedged positions in fixed income peso-denominated securities and exchange rate



[1] Last observation: 13 September 2000.

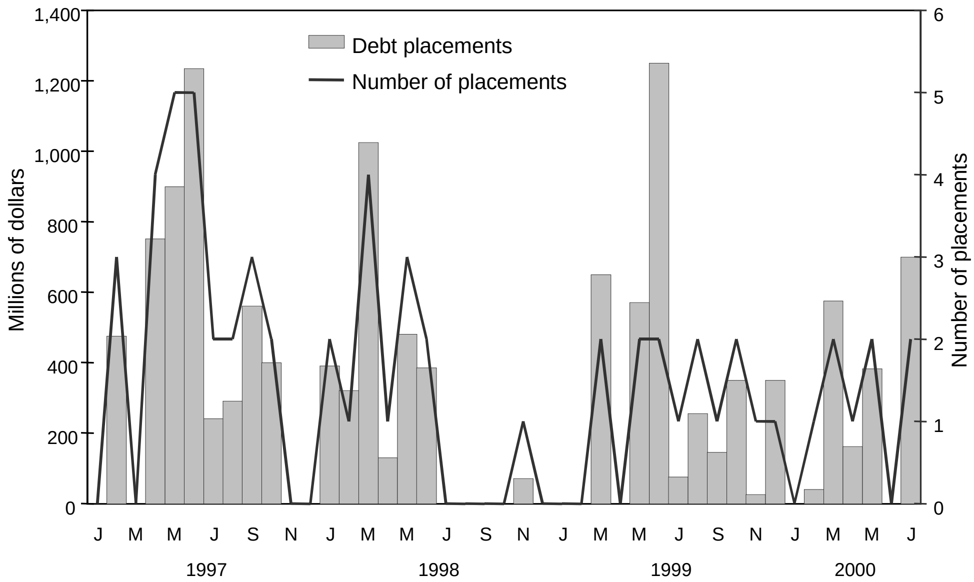
Thus, the analysis supports the claim that, during the last few years, the major shocks experienced by the peso/dollar exchange rate and peso-denominated holdings of foreign investors can be attributed in large part to the shocks experienced by other emerging markets. With this in mind, the Mexican authorities have developed proper prudential regulations on the foreign exchange exposure of banks. These regulations should allow Mexican banks to successfully confront a volatile international scenario characterised by massive portfolio shifts.

[14] The unhedged position in pesos becomes negative.

[15] Banking and public sector debt placements show similar behaviour.

Figure 10

Non-banking private sector debt placements in international capital markets



5. Final remarks

The Mexican experience in late 1994 and 1995 was one of the first economic and financial crises to occur within the new context of integrated global financial markets. Furthermore, in recent years other emerging markets and economic regions have also been subject to severe disruptions in their financial systems. Global financial markets characterised by volatile flows of capital and abrupt movements in exchange rates can be the source of unprecedented negative externalities in domestic financial systems. These externalities can easily be magnified if financial systems are feeble and macroeconomic disequilibria are present.

This article claims that the regulation of foreign exchange risk exposures serves to soften the impact of abrupt movements in the exchange rate on commercial banks' balance sheets. This hypothesis is supported by the results derived from the significant regulatory changes that have taken place in Mexico over the past few years. Moreover, the improved regulatory approach to monitoring banks' foreign exchange risk exposure abates the pressures that financial authorities might face when market conditions deteriorate. The paper presents empirical evidence that supports the fact that the banking system of a small open economy, such as Mexico, that is integrated into global financial markets would benefit from appropriate regulation of banks' foreign exchange risk exposure. This is so because most of the major shocks traditionally experienced by the peso/dollar exchange rate have been, in large part, caused by external factors. Therefore, regulations that allow commercial banks to cushion the impact of exchange rate movements on their balance sheets provide some guarantees that domestic financial systems will not be drastically affected by the turbulence taking place in international capital markets.

In today's globalised financial markets, investors tend to react swiftly to changes in expectations. As a result, financial authorities have witnessed a drastic restriction in their ability to manoeuvre in times of market distress. Even countries with solid fundamentals can now be subject to speculative attacks. In an environment such as this, prudential regulations on foreign exchange designed to prevent the build up of imbalances take on a more prominent role. Thus, this article claims that, as a result of improved regulations, Mexican banks are better equipped to deal with sudden and unanticipated capital flows.

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News filtering, financial instability and the euro

Henriëtte Prast[1] and Marc de Vor[2]

1. Introduction

Policymakers have always been concerned with financial stability issues, as financial crises are very costly events, particularly in terms of macroeconomic performance. The financial crises of 1997/98 brought about a fresh wave of attention to predicting, avoiding and managing episodes of financial distress. Following these crises, many attempts are made to detect and assess potential financial vulnerabilities in the international financial system. In this context, the present paper studies whether filtering of information in currency markets (eg ignoring some news releases or overreacting to others) may contribute to explaining the build-up of mechanisms underlying financial instability.

The first part of this paper describes several phenomena in asset markets that may be labelled, from the viewpoint of efficient markets, irregularities. These phenomena create imbalances and could be a source of instability that policymakers should be careful to detect, as conventional policy reactions may not be sufficient or adequate. Understanding the mechanism underlying irregularities is a first step towards formulating policy recipes to prevent or mitigate them. In this paper, contributions in the field of cognitive psychology are invoked to explain irregular patterns in financial markets. Special attention is paid to the theory of *cognitive dissonance*, which states that individuals filter publicly available information to make it correspond to their so-called framework of reference.

The second part of the paper is empirical, and investigates whether information filtering may have influenced the exchange rate of the euro vis-à-vis the US dollar. The empirical analysis provides some indications that, at least on days of large exchange rate movements, investors reacted differently to news about the euro area than to US news. However, based on our data set and results, it cannot be concluded that the fall in the euro can be attributed (partly) to news filtering. Further research using daily data should shed more light on this issue.

2. Several irregularities

Economic theory generally assumes that agents gather, process and interpret information in a rational way. This assumption is indeed useful for building models of market behaviour, but - as North (1990) pointed out - economists can enhance their understanding of many phenomena by allowing for other behavioural aspects in their models. In particular, it may be useful to take into account the contributions by cognitive psychologists on the processing of information by individuals. Both theoretical research and empirical evidence have shown that individuals may exhibit biases in processing information, and it is reasonable to assume that economic agents are no exception. In fact, several phenomena observed in asset markets in the Netherlands, the euro area and Asia suggest that investors show biased reactions to news as well as herd behaviour, with destabilisation as an observed or potential result.

A *first* example is the housing market in the Netherlands. House prices have doubled over the past five years. Many homeowners have used this increase in their wealth to take out additional mortgage loans to help finance consumption. Over the past years, the Netherlands Bank has repeatedly warned homeowners not to be over-optimistic. A recent poll by the Netherlands Bank shows that homeowners expect an increase in interest rates in the near future, believe that house prices are too high, and foresee that within 10 years the tax deduction of mortgage interest payments will be limited.

[1] Netherlands Bank, Directorate Supervision, Sector Strategy, Policy and General Support, Section Banking and Supervisory Strategies, and University of Amsterdam, Faculty of Economics and Econometrics, Department of Economics.

[2] Netherlands Bank, Monetary and Economic Policy Department, Section Financial Stability. The authors thank Frans Vermeer for research assistance. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Netherlands Bank.

Nonetheless, homeowners expect house prices to rise further and plan to take out additional mortgage loans in the near future (Netherlands Bank (2000)). A similar, though less pronounced pattern is observed in the New York housing market.

A *second* example is the development of prices in technology stocks. Keijer (2000) shows that the hype in technology shares on the Amsterdam Stock Exchange (AEX), which ended in March 2000 shortly after the scandalous introduction of World Online, was at least partly due to a biased reaction by investors to news about the IT sector. Keijer's empirical analysis focuses on explaining the difference between changes in IT shares and the AEX general stock market index. He concludes that the increase in IT prices following good news about this sector is significantly larger than the decrease in the case of unfavourable news.

A *third* example is, again, found in the Amsterdam stock market. Research for the period 1983-99 indicates that from the third year after their initial public offering, the performance of newcomers on the AEX, measured in terms of their share prices, trails behind that of established firms, and that in the fifth year the difference amounts to 30%. Further analysis shows that from the first year after their introduction, growth figures and profits of newcomers fall. This is not reflected in the stock prices, however, until the third year. Hence investors show a long lag in their reaction to bad news about the newcomers, something the researchers are unable to explain (Bosveld and Venneman (2000)).

A *fourth* example dates back to the Asian crisis. Kaminsky and Schmukler (1999) try to explain the 20 largest one-day swings in stock prices in nine Asian countries during 1997 and 1998. They find that some of these swings cannot be explained by economic or political news only. Kaminsky and Schmukler conclude that, in the period surrounding the Asian crisis, investors exhibited herd behaviour. Their evidence indicates that stock prices overreact with the deepening of the crisis, and investors react more strongly to bad news than to good news. They suggest that bad news in crisis episodes may increase uncertainty and accentuate herd behaviour, but do not explain what kind of mechanism would be at work here. The theory of cognitive dissonance outlined in the next section provides some insights in this respect (Prast (2001)).

3. Cognitive psychology and financial markets

Rational models of economic behaviour, including those that try to explain herding by investors, have in common that they focus on the *availability* of information, not on how individuals *gather*, *process* and *interpret* information. In fact, no attention at all is paid to the possibility that individuals may deal with information in a biased way. That makes these theories inappropriate to explain the type of behaviour by market participants described in the examples of Section 2.[3] Other disciplines - notably cognitive psychology - have intensively studied this subject, and have developed views on information seeking and processing that can be applied in economic and finance theory. Some of these have already been used to explain financial market behaviour. Daniel et al (1998) use the psychological concepts of overconfidence and biased self-attribution to explain sequential herding and under- and overreactions by securities markets.[4] The concepts of overconfidence and biased self-attribution could provide an additional explanation for biased responses to news. Barberis et al (1998) use a concept introduced by cognitive psychologists Tversky and Kahnemann, the "representativeness heuristic", to

[3] For an overview of rational herding models, see Devenow and Welch (1996). Most relevant for financial market fragility is the so-called informational cascade model of herding (Banerjee (1992)). This assumes that agents have limited private information and that publicly visible actions by others act as an additional source of information. This may lead to a situation in which the individual's private information is rationally overruled. As a result, extensive herding may occur. This type of model may explain the emergence of financial market fragility, as it shows that small changes in publicly available information can reverse the direction in which the crowd is moving (Bikchandani et al (1992)). Therefore, it can contribute to offering a rational explanation of financial fragility and sudden panics and flights to safety. A qualification is, however, that the participants act in an exogenously imposed ordering: they cannot postpone their actions. Moreover, efforts to gather information are not modelled. And, perhaps most importantly, it is assumed that prices do not move with demand.

[4] Overconfidence among investors would imply that they overestimate their ability to value securities. Biased self-attribution relates to the dynamics of self-confidence: confidence is assumed to grow when public information confirms private information, but does not decline in case of a contradiction between the two. An interesting implication is that if, as some psychological evidence indicates, experts are more overconfident than inexperienced individuals, aggressive expert trading will intimidate other traders and lead to higher returns. See Daniel et al (1998).

analyse investor behaviour. This concept implies that people have a tendency to see patterns in random events, which may lead to overreaction in the sense that people draw far-reaching conclusions on the basis of only little evidence. The implication for investor behaviour may therefore be an overreaction of stock prices to news. Barberis et al admit that, although their model results confirm some (but not all) of the empirical evidence, it is not clear why certain types of news are relevant in the eyes of the investor and others are not. They conclude therefore that "to push this research further, it is important to develop an a priori way of classifying events by their strength and weight" (Barberis et al (1998), p 333).

The theory of cognitive dissonance - developed almost half a century ago by Festinger - may prove to be useful in this context. Festinger (1957) defines cognitive dissonance as a situation where the individual is faced with two contradictory cognitive elements. Cognitive elements may include opinions, information and beliefs. According to Festinger, cognitive dissonance is unpleasant and individuals have the subconscious psychological mechanism to diminish the dissonance they perceive:

> "The presence of dissonance leads to seeking new information which will provide cognition consonant with existing cognitive elements and to avoiding those sources of new information which would be likely to increase the existing dissonance" (Festinger (1957), p 264).

In Festinger's view, individuals may diminish dissonance in a number of ways.[5] The most important is the filtering of information. Thus, when faced with dissonance, individuals engage in actively seeking out information that confirms their belief and the choices they have made. Also, they tend to avoid information that would suggest they have made the wrong choice. Finally, they may try to find support and comfort in the fact that other people have made identical decisions. When the dissonance in relation to the existing framework of reference becomes so large that it is impossible to reduce it by selective gathering and interpretation of information and by finding social support, the individual switches to the opposite method of dissonance reduction. Instead of trying to find evidence that his opinion is correct, he will now, faced with too much unfavourable information, make an effort to change his belief or opinion.[6] He does so by actively seeking out *dissonance-increasing* information. The dissonance then disappears because the large amount of dissonance between the individual's opinion and the information received enables him to change his existing belief. The reversal in the biased information-seeking behaviour occurs when the dissonance perceived by the individual equals the resistance to changing his framework of reference. Festinger pays special attention to what he calls mass phenomena. If many people, for one reason or another, suffer from the same cognitive dissonance, it is particularly easy to find support in the pursuit of dissonance reduction. In particular, he analyses the role of rumours, especially in situations in which fear is widespread, but evidence justifying fear is not available.

The theory of cognitive dissonance, when applied to financial markets, would explain so-called "sequential herding": the phenomenon that investors, analysts and fund managers "herd" on previous behaviour. Furthermore, the theory predicts that investors, when faced with dissonance, find comfort in the fact that they are part of a group. This may explain crowd behaviour and reinforces the bias in information gathering in situations where many investors have previously made similar decisions. As time goes by, unfavourable information (bad fundamentals, increased probability of default) may grow in intensity and frequency. At a certain point this cannot be disregarded anymore, not even by an individual who is part of a crowd. Investors start paying attention to it, first gradually, but when the cognitive dissonance between the new (unfavourable) information and the existing (optimistic) mood becomes too large, they start actively seeking information that increases dissonance, enabling them to change their framework of reference (optimistic mood) about the investments made. Obviously, the dissonance is reinforced when the group starts falling apart. This happens as soon as the dissonance

[5] In his own words, "by changing one or more of the (cognitive) elements involved in the dissonant relation, by adding new cognitive elements that are consonant with already existing cognition and, finally, by decreasing the importance of elements of the dissonant relation itself". From these three "strategies", the second and third are the most important for the purpose of this paper, as they both have to do with information gathering and interpretation on an individual basis and with finding social support for the decision that has been taken.

[6] Examples abound both in the realm of mass psychology and in daily life. Religious fanatics try to reduce the cognitive dissonance between their belief and real-world evidence by attracting new souls to their group. "Shooting the messenger" is a well known stereotype reaction, especially at a group level.

has become too large for one or more investors, but the mere fact of their departure from the crowd increases the dissonance of the remaining investors, who in their turn will start seeking out dissonance-increasing information. The theory, therefore, would predict a sudden reversal of the crowd, which once it has started will proceed at a high speed. The timing of the reversal is unpredictable because, although the reversal ultimately depends on the fundamentals, it depends on the (subjectively perceived) dissonance and resistance to change of some investors. Nonetheless, one may try to influence this turning point by careful timing of a policy measure or announcement. Kindleberger (1996) argues that cognitive dissonance has been a recurrent source of herding and of inertia in decision-making. Cailloux (2000), finally, develops a theoretical model of investor behaviour, taking the possibility of cognitive dissonance reduction into account by assuming that investors seek and process information to make it correspond to their strongly held internalised beliefs. All in all, it seems clear that the concept of cognitive dissonance provides a framework in which biased reactions to news can be explained.

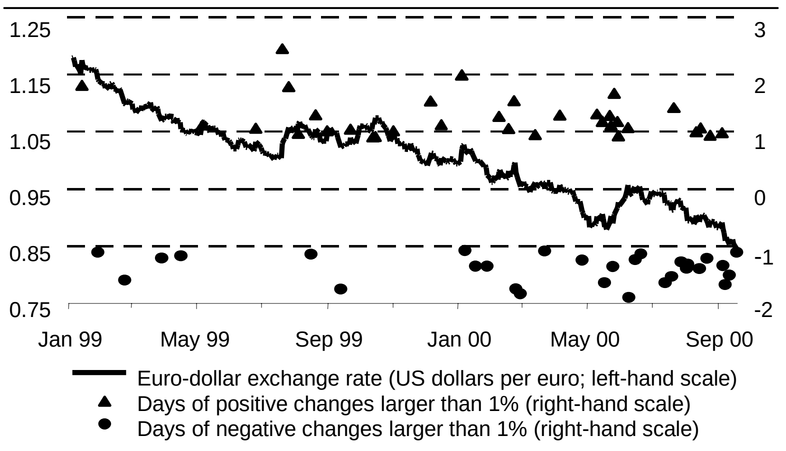
4. The impact of news on the euro-dollar exchange rate

4.1. Empirical analysis: method and data

Since its introduction on 1 January 1999, the euro has steadily declined with respect to the US dollar (see Figure 1). Both the reasons behind this development and its implications for economic stability are currently among the most frequently discussed issues among academics and policymakers. Several comments have suggested that investors in currency markets show a biased reaction to news. Wellink (2000), for example, has suggested that investors react in an asymmetric manner to news about the euro area and the United States respectively. De Grauwe (2000) has expressed similar views. Moreover, these asymmetric reaction patterns may not be harmless. This is obvious from the theory discussed in the first part of this paper, but also from comments by international institutions. The IMF (2000) has, for instance, suggested that a further weakening of the euro might have serious adverse implications for economic stability worldwide. According to the Fund, a prolonged weakness of the euro would hamper adjustment of the existing current account imbalances across the major currency blocks, which could increase the prospects of a disorderly adjustment in exchange rates and give rise to protectionist pressures. Furthermore, a sustained period of misalignment would lead to a shift towards now more profitable traded goods sectors in the euro area and away from such sectors elsewhere. If a rapid appreciation of the value of the euro were to take place, a corresponding and probably costly reallocation of resources would follow.

Figure 1

Euro-dollar exchange rate



In general, the impact of news on exchange rates has been the subject of extensive research, although much of the work has concentrated on announcements of US macroeconomic data (Edison (1996)). More recently, studies have been undertaken to analyse the effects of economic news released in other countries such as the United Kingdom, Germany and Australia (Clare and Courtenay (2000)). One of the differences between these studies and the approach used in this paper is that, in addition to economic news variables, we consider statements by central bankers and politicians (eg on the strength of the currency or the economy) to be possible determinants of exchange rate changes, and therefore take them into account. Our analysis is in this sense similar to the aforementioned analysis by Kaminsky and Schmukler (1999), although their focus is not on asymmetries in reactions to news coming from different countries, but rather on asymmetric responses to good and bad news during crisis periods.

In order to test the hypothesis of biased responses to news, we have studied the reaction of the euro-dollar exchange rate to news from 1 January 1999 until the first coordinated intervention to support the euro by the world's main central banks on 22 September 2000. The study focuses on the largest exchange rate movements, namely those exceeding ±1%. This choice is based on practical considerations, and the analysis is to be seen as a first step towards assessing the role of information filtering in influencing the exchange rate. During this period, there were 63 days on which the change in the euro-dollar exchange rate exceeded this threshold. We analyse the effects of relevant economic and non-economic news regarding the euro area and the United States on the exchange rate on these 63 days. The main focus is *not* to explain these movements per se, but rather to verify whether different reaction patterns exist related to news about the euro area and the United States. The Dutch financial newspaper *Het Financieele Dagblad* is used as the source of information. It has been verified that this journal contains information consistent with alternative news sources such as Bloomberg.

Included in the data set are economic news releases, statements by central bankers and politicians, and political events that can be thought of as relevant for investors in the foreign exchange rate market. The economic news variables are divided into three categories: real economic variables (economic growth, industrial production, (un)employment rates, confidence indicators, trade deficits, budget deficits and changes in taxation and social security); inflation (forecasts); and changes in the official interest rates. The non-economic news items include: statements of central bankers in the euro area and the United States, reflecting the importance of ECB- and Fed-watching; statements of politicians, reflecting the fact that political risk is one of the important factors for investors in currency markets; and major national and international political events (such as the Kosovo crisis). As far as news about the euro area is concerned, only the news items referring to the largest countries - Germany, France and Italy - and to the euro area as a whole have been taken into account. This choice is made because a development in the smaller countries is unlikely to have a major effect on investor behaviour. Moreover, including these items would create an asymmetry with the US news, as economic and political developments in individual US states have *not* been included in the data set. When interpreting the results, it should be kept in mind that the 63 days on which the change in the euro-dollar exchange rate exceeded ±1% do *not* reflect the steady decline of the value of the euro since its birth on 1 January 1999; 33 observations of the sample of 63 relate to a *rise* in the value of the euro.

Where possible, the announcements of news figures are compared with expectations of market participants and included only if there is a difference between the two. An unexpected increase in real economic activity is assumed to lead to an appreciation of the currency. Furthermore, if announced inflation is higher than expected, we assume that the currency will depreciate. An actual increase (decrease) of the official interest rate is expected to have an upward (downward) effect on the exchange rate. Also, it is assumed that statements by central bankers hinting at future interest rate increases (decreases) have an upward (downward) effect on the exchange rate.[7] By including changes in the official interest rate as a separate dummy variable, it is possible to assess whether or not market participants expect these changes, and thus incorporate them in the exchange rate. Statements by politicians interfering with monetary policy are categorised as unfavourable, because it is generally assumed that independent central banks have more credibility in safeguarding the internal value of their currency. This applies especially to the euro area, where the Eurosystem decides on monetary policy for an area covering 11 different countries, all with their own governments.

[7] One could argue that any statement by a central banker should be interpreted as a hint at future interest rate policy. However, this may not be the case, because central bankers also give peptalks and warnings.

Table 1

News releases on the euro area and the United States relevant for the euro-dollar exchange rate, by category[1]

Type of news	n	Favourable €	Unfavourable €
Euro area	**148**	**89**	**59**
Real economy	85	60	25
Inflation	17	6	11
Official interest changes	1	1	0
Statements and political events	45	22	23
	n	**Favourable $**	**Unfavourable $**
United States	**56**	**33**	**23**
Real economy	37	21	16
Inflation	8	5	3
Official interest changes	2	2	0
Statements and political events	9	5	4
Total	**204**	**122**	**82**

[1] News releases during the 24 hours preceding the official release of the euro-dollar exchange rate by the ECB at 2.15 pm.

In all, there were 204 relevant news items on the 63 days of large exchange rate changes. Of these, 103 were about the economy in the euro area, of which 67 were favourable and 36 unfavourable. There were 47 items about the US economy, of which 28 were favourable and 19 unfavourable. Finally, 45 news items referred to statements by central bankers or politicians, or to political events in the euro area (about half were favourable for the euro), and nine news items in this category referred to the United States (about half were favourable for the dollar). There was only one day of large exchange rate movements without any relevant news releases (see Table 1). A full list of the news items, including their classification, can be obtained from the authors upon request.

4.2 Effect of economic news and statements/political events

To examine the impact of economic news and statements/political events on the euro-dollar exchange rate, a regression is run of the changes in the euro-dollar exchange rate on the news variables mentioned above. For this purpose, the news items are transformed into dummy variables representing each of the news categories. The first regression equation is:

(1) $E_t = \alpha + \beta_i D_i + \varepsilon,$

$(i = 1,2 \dots. 8)$

where E_t is the percentage change in the euro-dollar exchange rate from t-1 (2.15 pm) to t (2.15 pm). D_i (i = 1…8) represent dummy variables reflecting news about, respectively, the euro area real economy, euro area inflation, ECB official interest rate changes, central bank or political statements and political events concerning the euro area, the US real economy, US inflation, Fed official interest rate changes, central bank or political statements, and political events concerning the United States in the same period. The dummy variables may take a value of +1 or -1 when relevant news for the euro-dollar exchange rate has been released, and 0 if on a specific day no relevant news releases took place. To be more precise, the “real economy” variable takes the value +1 (-1) when the release suggests a better (worse) outlook for the real economy, and 0 otherwise. The inflation dummy is equal to +1 (-1) when the item suggests a better (worse) inflationary outlook, and 0 otherwise. The interest rate dummy takes on a value of +1 (-1) in the case of official interest rate increases (decreases), and 0 if official rates remain unchanged. Finally, the variable “statements and political events” is equal to +1 whenever there is news in this field that can be expected to support the currency, -1 in opposite cases, and 0 otherwise. The approach implies that all news items are considered to be equally important. This method is appropriate because the focus is not so much on the elasticity of the exchange rate to, say, a change in the trade balance, but rather on the question of whether the reaction pattern of investors, as indicated by the change in the relative price of the two currencies, differs depending on whether there is news about the euro area and the US economy respectively. Table 2 gives the results.

Table 2

Regression results equation (1)

Explanatory variables	**Dependent variable** Percentage change in euro-dollar exchange rate[1]
Constant	-0.08 (-0.47)
Real economy, euro area	0.40 (1.86)
Inflation, euro area	-0.62* (-2.06)
Change in official interest rate, ECB	0.23 (0.18)
Statements/political events, euro area	0.56** (2.61)
Real economy, United States	-0.65** (-2.64)
Inflation, United States	0.10 (0.21)
Change in official interest rate, Fed	-0.81 (-0.82)
Statements/political events United States	-1.21** (-2.61)

Number of observations	63	D-W statistic	1.69
Method	OLS	F-statistic	4.2
R^2	0.38	Jarque Bera test	0.58[2]
Adjusted R^2	0.29		

Note: * indicates statistical significance at a 95% confidence level; ** indicates significance at a 99% confidence level (t-statistics in parentheses).

[1] Dollars per euro. [2] Normality of errors cannot be rejected on the basis of this test.

Keeping in mind that the results provided by this event study should be interpreted with caution, a number of interesting conclusions emerge from Table 2. *First*, all coefficients except those of the inflation dummies have signs in accordance with intuition. Thus, good news about the real economy in the euro area, ECB official interest rate increases and favourable statements/political events has a positive effect on the euro-dollar exchange rate, whereas the coefficients of US news dummies in these different categories have a minus sign. *Second*, the effect of euro area real economic news is *not* significant at the conventional minimum confidence level of 95%, whereas the dummy of real economic US news releases is significant at the 99% confidence level. This suggests that investors react more strongly to US economic news and may imply that in periods with favourable economic news in both areas, there is a tendency for the US dollar to rise. *Third*, the impact of official changes in the interest rates in both the euro area and the United States is not significant; apparently these changes have largely been priced in by the markets. *Fourth*, statements and political events have a significant effect at a 99% confidence level for both the euro area and the United States, confirming both the importance of Fed- and ECB-watching and the role played by politics in influencing the taste of investors for a currency. *Last but not least*, good news about inflation in the euro area depresses the value of the euro vis-à-vis the dollar. This effect is significant at the 95% confidence level. For the United States the data do not show a significant effect of inflation figures and forecasts. The adverse effect of price stability in the euro area on the euro suggests that investors interpret lower than expected inflation news as an indication that monetary policy will not become restrictive. In other words, it leads investors to believe that interest rate increases are not likely in the near future, and they react by turning their back on the euro. In a way, one might conclude that, at least in the short run, the ECB is judged not so much on its ability to keep prices stable, but rather on its plans for interest rate policy. Obviously, this makes life somewhat difficult for the ECB.

Table 3

Regression results equation (2)

Explanatory variables	Dependent variable: Percentage change in euro-dollar exchange rate[1]
Constant	-0.56 (-1.22)
Good economic news, euro area	0.69 (1.66)
Bad economic news, euro area	0.57 (1.20)
Good economic news, United States	-0.41 (-1.07)
Bad economic news, United States	0.58 (1.36)
Good statements/political events, euro area	0.77* (2.07)
Bad statements/political events, euro area	-0.46 (-1.04)
Good statements/political events, United States	-1.30* (-2.09)
Bad statements/political events, United States	1.46* (2.13)

Number of observations	63	D-W statistic	1.73
Method	OLS	F-statistic	3.16
R^2	0.32	Jarque Bera test	1.36[2]
Adjusted R^2	0.22		

Note: * indicates statistical significance at a 95% confidence level (t-statistics in parentheses).

[1] Dollars per euro. [2] Normality of errors cannot be rejected on the basis of this test.

4.3 Cognitive dissonance?

Our finding that the euro reacts more strongly to US real economic news than to that about the euro area does not in itself imply that investors react more strongly to "good" US news compared to "bad" US news; in fact, the results merely indicate that the response of investors to both good and bad US news is more pronounced than to euro area news. In order to see whether investors have reacted differently to good and bad news we have run a second regression splitting up the news into good and bad news categories. Thus, we have created new dummies for good (bad) news in the various categories, which take on a value of 1 if there is a good (bad) news release and a value of 0 if there is no good (bad) news in that specific category. In doing so, we follow the approach taken by Kaminsky and Schmukler (1999). The second equation is:

$$(2) \quad E_t = \alpha + \beta_1 DEG^{euro}_t + \beta_2 DEB^{euro}_t + \beta_3 DEG^{US}_t + \beta_4 DEB^{US}_t + \beta_5 DPG^{euro}_t + \beta_6 DPB^{euro}_t + \beta_7 DPG^{US}_t + \beta_8 DPB^{US}_t + \varepsilon_t,$$

where DEG (DPG) is a dummy for good economic (political, ie statements and political events) news, which has a value of 1 if there has been a good news release and a value of 0 otherwise, DEB (DPB) is a dummy for bad economic (political) news, which takes on a value of 1 if there has been a bad news release and a value of 0 otherwise. In order to limit the number of dummies, official interest rate changes are included in the economic news variables. Table 3 shows the results of this regression. Three dummies for statements and political events are significant at the 95% confidence level. Economic news, be it good or bad, for the euro area and the United States, does not have a significant effect (which can perhaps be attributed to the reaction of investors to inflation news, as illustrated in the regression results of equation 1 above). Therefore, our conclusion is that on the basis of the data used in this paper, cognitive dissonance in the sense of a systematically different reaction to good and bad news does not seem to be an important phenomenon in explaining the largest exchange rate changes in the euro-dollar exchange rate. It should be kept in mind that these large changes are an increase as often as a decrease, and thus do not reflect the steady fall of the euro since 1 January 1999.

5. Conclusion

In this paper we studied the reaction of investors in foreign exchange markets to new information about the euro area and the United States on days of large changes in the euro-dollar exchange rate. Our aim was quite modest. Rather than fully explaining the exchange rate movements - which would require the use of a complete model - the purpose was to verify whether on these days investors reacted differently to news about the euro area and the United States. Given the nature of the data set, the results should be interpreted with caution. Nonetheless, it appears that the impact of news about the US real economy on the euro is significant, whereas the impact of news about the real economy of the euro area is not. Moreover, investors seem to punish the ECB for keeping prices stable: they react to good inflation news in the euro area by turning away from the euro. A similar pattern is not found for reactions to inflation news in the United States. Importantly, no indications were found for cognitive dissonance on the part of investors.

It should also be kept in mind that the exchange rate changes analysed in this paper do not reflect the steady fall of the euro in the past two years. Further research should clarify whether the patterns found in the paper for the largest exchange rate swings are confirmed in an analysis of daily exchange rate changes, and to what extent the downward trend in the euro can be attributed to news filtering.

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A model based approach to analysing financial stability

Øyvind Eitrheim and Bjarne Gulbrandsen[1]

1. Introduction

Many countries have reported some form of banking system distress or crisis during the past 25 years or so. A recent survey by the IMF reports that banking crises typically have followed a period of financial liberalisation, and have occurred more frequently in countries with weak regulatory institutions, notably developing countries (Demirgüç-Kunt and Detragiache, 1998). Three of the Nordic countries experienced a serious banking crisis in the early 1990s (Norway, Sweden and Finland), and Englund (1999) inter alia has argued that there seem to be some common patterns in the macroeconomic developments leading up to these crises. They were initiated by the liberalisation of financial markets (deregulation), which in turn led to rapid credit expansion and booming asset prices (for example housing prices). When the asset price bubble burst and prices fell, a financial crisis developed as a result of increasing rates of non-performing loans, bankruptcies, and after a while a dramatic increase in credit losses. This pattern has also been discussed in Allen and Gale (1999), who point to two important lessons for policymakers which can be drawn from the recent experiences. The first is to prevent or at least dampen potential bubbles in asset prices, and the second to try to minimise the spillover to other parts of the economy during post-bubble banking crises. Financial crises have historically happened in a rather wide range of different circumstances. The banking crises in the Nordic countries are notably different from the recent financial crisis in Southeast Asia. According to Allen and Gale (1999), nepotism, corruption and lax banking regulations are less probable causes of the Nordic banking crises, and the authors suggest that these crises were due rather to some common market failure than to idiosyncratic causes.

This paper is organised as follows. In Section 2 we describe the macroeconomic developments in Norway over the past two decades. In Section 3 we outline the Central Bank of Norway's surveillance of financial stability, its objectives and methods, focusing on how the Central Bank of Norway's quarterly macroeconometric model RIMINI is used to help forecast trends and developments in important macroprudential indicators of financial stability.[2] Section 4 is devoted to a brief description of the model, focusing on the monetary transmission channels. In Section 5 we discuss some econometric considerations and model specification criteria, and Section 6 contains a brief presentation of some of the main submodels. In Section 7 we discuss model properties based on simulation exercises, and Section 8 focuses on the trends and developments in the macroprudential indicators. Finally, Section 9 contains a short summary.

2. Macroeconomic developments in Norway from 1980 to 2000

In the mid-1980s, the Norwegian economy experienced a very strong domestic-led expansion similar to developments in many other countries, inter alia Sweden and Finland. Monetary policy was expansionary, notably in the form of very low real after-tax interest rates, in an environment of gradual liberalisation of the credit markets and with surging asset prices in real estate markets. The bubble had to burst sooner or later, but in Norway it was punctured rather early by the fall in oil prices in 1986. Fiscal policy was tightened in order to adjust domestic absorption to the new income level, and the Norwegian krone was devalued by 9.2% in May 1986. The tightening of the structural fiscal deficit

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[1] The first author is a head of research in the Research Department, Central Bank of Norway and the second author is a head of office in the Financial Analysis and Market Structure Department, Central Bank of Norway. The views expressed are those of the authors, and do not necessarily represent those of the Central Bank of Norway. We are grateful for comments from Arild Lund. Thanks to Solveig K Erlandsen and Elin Vandevjen for help with the data on financial sector losses, and to Ida Wolden Bache and Fredrik Wulfsberg for valuable assistance and comments.

[2] Macroprudential indicators can be broadly defined as indicators of the health and stability of financial systems; for a comprehensive discussion, see Evans et al (2000).

amounted to 4.5% of GDP (accumulated over the years 1986, 1987 and 1988). The deep economic recession from 1987 to 1990 (mainland GDP was reduced by 1.5% during the period) contributed to an increasing stock of non-performing loans, and ultimately to a dramatic build-up in recorded financial sector losses. The expected upturn following this recession did not materialise, however. One reason may have been that the domestic economy was in deeper trouble than was generally realised. Another contributing factor was German unification, and the tighter monetary policy that followed because of Norway's ECU peg.

The upturn in the Norwegian economy was thus delayed for three crucial years, and did not materialise until 1993. In the meantime the banking sector experienced severe problems following the rapid credit expansion of the mid-1980s. The operating results for both commercial and savings banks were negative in these years, and the guarantee funds of the two bank groups, as well as the government, were subsequently led to organise rescue operations for several small and large banks. Three of the largest banks (all commercial banks) lost all their capital and could only continue to operate with the aid of new capital injected by the government.[3]

Since 1995 the Norwegian economy has experienced a period of strong growth in domestic demand, eventually causing the economy to grow above its long-run potential. At the same time there has been a rapid downturn in unemployment, and eventually wage growth has picked up along with stronger CPI inflation, despite falling import prices. Also during this period the housing market has experienced a boom with double digit price growth at the end of the century, and credit growth is showing a strong positive trend fuelled by strong domestic demand growth.

3. The Central Bank of Norway's surveillance of financial stability

3.1 Background and motivation

In Norway, the Ministry of Finance, the Banking, Insurance and Securities Commission and the Central Bank of Norway share a joint responsibility for endorsing and securing financial stability. The Ministry of Finance has the overall responsibility and ultimately provides the funds for resolving solvency crises, whereas the Banking, Insurance and Securities Commission is responsible for surveillance of individual market participants. The Central Bank of Norway's primary objective in this area is to promote robust and efficient payment systems and financial markets.[4] Accordingly, the central bank has an overall responsibility for financial stability along with the Ministry.

To motivate preventive work in this area, it is worth recalling the need to carefully analyse the three Cs of financial instability according to Mayer (1999). In his introduction to the recent special issue on Financial Instability of the *Oxford Review of Economic Policy,* Mayer (1999) assesses the Causes, Consequences and Cures of financial instability. Mayer states that prevention is much better than cure, and also that where financial crises threaten the stability of the financial system, governments and central banks should act decisively.

For obvious reasons, the central bank's responsibilities in "tranquil" periods are very different from those it faces during a financial crisis (Kaminsky, 1999). In the following we will outline some elements of the Central Bank of Norway's preventive work in this area, which is based on the experiences of the financial crisis in the early 1990s. The primary purpose of the Central Bank of Norway's effort is to identify developments that may threaten financial stability. In this work it is also important to identify mechanisms by which a local financial crisis may spread to other parts of the financial system. Several studies have made efforts to identify common features of developments which historically have led to the full outburst of financial crises. Wood (1999) and Mayer (1999) stress in this respect the need to distinguish between "pseudo" crises and "real" crises. More precisely, this means that it is necessary

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3 For a brief description of the Norwegian banking crisis in 1987-92, see Allen and Gale (1999); for further details, see, for example, Norwegian Official Reports No 30E (1992), Report to the Storting No 39 (1993-94) and Document No 17 (1997-98).

4 A further description of The Central Bank of Norway's responsibility is given in Lund and Solheim (1999).

to understand why some initial negative asset price or terms-of-trade shocks in some situations magnify and develop into a fully-fledged financial crisis while in other situations they do not.

A typical chain of events like the boom-to-bust development discussed by Englund (1999) and Allen and Gale (1999) has already been mentioned among potential causes behind the Scandinavian banking crises in the early 1990s. Since the authors also include financial deregulation in this chain, one might argue that this is a one-time event, which should preclude it from ever playing such a role again. Although the relatively fresh memories of the Scandinavian banking crises should reduce the likelihood of a similar chain of events, some writers stress the fact that economic agents may suffer from "disaster myopia". Hence even the "crisis awareness" arising from the quite recent financial crises could soon be so heavily played down by (new) myopic agents that the repetition of previous mistakes becomes unavoidable.

Although it seems like a daunting task to develop fully appropriate tools to systematically analyse microprudential and macroprudential indicators of financial fragility, several efforts have been made in this area in recent years. The IMF (Demirgüç-Kunt and Detragiache, 1998) has developed a model for monitoring banking sector fragility, estimating a multivariate logit model for 65 countries using variables from International Financial Statistics for the period 1980-95. Kaminsky (1999) has developed an early warning model for financial crises based on simple macroeconomic indicators. The idea is simple and intuitive. Suppose we know the distribution of an indicator of financial fragility, I, based on accurately and timely measurable information and the careful monitoring of current events. We could then extract a warning signal if $I>I_{\varepsilon}$ where $\varepsilon = Prob\ (I<I_{\varepsilon}\ |$"Crisis" state), ie ε is the probability of observing values of the indicator less than I_{ε} if a crisis occurs, hence controlling for the Type I error. If the distribution of the indicator in "tranquil" states is sufficiently shifted to the left as compared with the "crisis" state, we would expect the probability of making a Type II error to be of a negligible magnitude, ie $Prob\ (I< I_{\varepsilon}\ |$ "Tranquil" state) ≈ 1. Hence a false alarm would be very unlikely. In practice, however, it may be very difficult to extract a signal with such nice properties. The distribution of the indicator may be unknown and potentially complex, the measurement may not be sufficiently accurate or timely, and the definition of what actually distinguishes states of "crisis" or "pseudo crisis" from "tranquil" states may not be clear-cut.

3.2 Macroprudential surveillance in Norway

The preventive work undertaken by the Central Bank of Norway to maintain financial stability can be divided into three areas of activity:[5]

- Work to reduce the risk and improve the robustness of the payment and settlement system.
- Continuous monitoring of factors that affect financial stability.
- Assessment of the impact of monetary policy and other economic policy components on financial stability.

Promoting a safe and stable financial infrastructure

An important part of the Central Bank of Norway's work on macroprudential surveillance takes the form of promoting a safe and stable financial infrastructure. The payment and settlement system plays a pivotal role in this regard. Disturbances that may develop into a systemic problem can be transmitted through the payment and settlement system. Several measures have been introduced over the last few years to strengthen this system, reduce settlement risk and improve efficiency. It is, however, still a high-priority task of the Central Bank of Norway to identify risks and, together with the industry, contribute to more secure and effective systems.

[5] See Eklund and Gulbrandsen (2000) for a further description of the Central Bank of Norway's surveillance of financial stability.

Monitoring of factors that affect financial stability

The primary purpose of the Central Bank of Norway's monitoring is to identify developments that may threaten financial stability. It is also important to expose mechanisms that contribute to the spreading of problems from one part of the financial system to another. The analyses strive, therefore, to provide an overall picture of the situation and developments in the financial sector. The analyses focus on the different types of risk to which financial institutions are exposed through their operations. The primary focus is on the banks' financial situation and trends, with a view to providing a picture of the banks' financial strength in relation to their risk exposure. The analyses concentrate on banks because they are large and are key participants in the financial sector, and also because the central bank has a distinct role in relation to banks. In view of the Central Bank of Norway's role, developments at individual banks receive little attention. Analyses of stability in the financial system are based on a combination of quantitative and qualitative information. Extensive data are analysed with the purpose of identifying developments that can increase the vulnerability of the financial system. More qualitative information about the participants' behaviour and strategies also helps establish a general picture of potential developments.

The analyses include an assessment of the effects that any major disturbances may have on the financial sector. The consequences of substantial disturbances in the economy depend on several factors:

- Banks' exposure to different types of risk.
- Developments in underlying conditions which influence the different types of risk, such as the debt burden of households and enterprises.
- Banks' earnings and financial strength, ie how well equipped banks are to deal with any losses.
- The extent to which mechanisms exist which ensure that problems arising in one part of the system are not amplified and/or do not spread to other parts of the system.

To a certain extent the analyses also contain an assessment of the likelihood of major disturbances or marked changes in expectations, which depend on the financial system's overall risk exposure, macroeconomic conditions and conditions that have an impact on the structure of the financial system. Therefore, in addition to monitoring the institutions, it is important to monitor conditions that more generally affect financial institutions and financial markets. The combination of the likelihood of disturbances and possible consequences gives an indication of total risk exposure in the financial sector.

A major element of the Bank's work on macroprudential surveillance is the biannual Financial Stability report. The report is published after having been discussed with the Banking, Insurance and Securities Commission and the Ministry of Finance. The publication offers a comprehensive analysis of the overall situation within the financial sector, including an assessment of the outlook for the next couple of years. This assessment is based on the Bank's own macroeconomic forecasts, produced for the quarterly Inflation Report. The Bank's macroeconometric model, RIMINI, is then used to elaborate on developments in the stocks of assets and liabilities of households and enterprises and their ability to service their debt, for instance when major changes in the interest rate occur.

An important aspect of the analyses is to shed light on the effect of macroeconomic conditions on the debt servicing capacity of households and enterprises, and thereby on credit risk in banks. Major emphasis is put on the potential for losses on loans to households and enterprises. Lending to households account for approximately 40% and 70% respectively of commercial and savings banks' total loans. A major portion of banks' total credit risk will therefore be tied to households' capacity to service their debt. In addition, the interplay between the household and enterprise sectors has a significant impact. Developments in the housing sector constitute the key component of an assessment of the household sector's financial situation. Home ownership is very high in Norway. Housing is the major household asset, whereas the share of financial assets is relatively small. Hence, developments in the housing market and house prices in particular are important in an assessment of the household sector's robustness in case of major shocks.

Of particular concern in this regard is the enterprise sector, where about 85% of the bank losses in the banking crisis of the early 1990s occurred. To help assess the risk of the enterprise sector, the Bank uses the macroeconometric model RIMINI, which will be discussed in the rest of this paper, as well as a risk classification model based on data from the annual accounts of all Norwegian limited companies (see Eklund and Gulbrandsen (2000) for a presentation of this model). The risk classification of the individual enterprise is based on three key variables: self-financing ability as a share of long term debt; equity as a share of total assets; and a liquidity measure. In addition to the accounts, the data for this model provide detailed information about the industry and geographic location as well as some information about payment history. This allows us to follow the sector as a whole as well as to monitor developments in enterprises' credit risk, divided by industry and geographic location.

Acknowledging the interdependence of financial and monetary stability

The objective of monetary stability - which in Norway means exchange rate stability and low inflation - and the objective of financial stability are interdependent. High - and thereby in practice varying - inflation and unstable exchange rates can threaten financial stability through several channels. First, it is more difficult to assess the risk of investment projects. Second, fluctuations in the inflation rate are often accompanied by interest rate variations. A sharp rise in interest rates can result in losses. Financial stability primarily contributes to price and exchange rate stability by facilitating the use of monetary policy instruments. Unstable institutions and markets constrain the use of interest rates.

3.3 The use of the macroeconometric model RIMINI

The RIMINI model is in use at the Central Bank of Norway, and the model is continuously updated and revised. The increased attention to financial stability issues arising from the Norwegian experiences with the banking crisis in 1991-92 spurred the inclusion of a set of indicators of financial fragility (see Davis (1995) for a discussion). The baseline operative version of RIMINI has since 1995 contained indicators of the debt and interest burden in the household and enterprise sectors, for example indicators of debt service to income and capital gearing ratios. Future versions of the model will be further enhanced in this area, and we plan to extend the set of indicators of financial fragility in particular of the private non-financial enterprise sector. In addition, we have extended the model with a simple submodel for financial sector losses which further enhances the model's linkages between monetary policy and macroeconomic behaviour on the one hand, and indicators of financial fragility and loan losses on the other. The following table presents the macroprudential indicators for *households* and *enterprises,* which we will focus on in this paper, and the data are plotted in Figures 1 and 2.

Households

- Interest expenses/cash income (disposable income + interest expenses)
- Gross loan debt/disposable income
- Gross loan debt/gross financial assets excluding insurance claims
- Gross loan debt/value of housing wealth

Enterprises

- Interest expenses/cash surplus (value added - wage costs + capital income)
- Cash surplus less interest expenses/gross interest bearing debt
- Gross interest bearing debt/gross interest bearing assets
- Four quarter growth in interest bearing debt/fixed capital formation

Households

Figure 1a shows that the households' debt service to income ratio peaked around 1988, following a series of increases in the nominal interest rate and the rapid credit expansion of households after the deregulation of the Norwegian housing and credit markets in the first half of the 1980s. The ratio decreased to below 10% only after the drop in the international interest rate level in 1993. The debt service to income ratio stabilised and increased in 1998, primarily due to increasing interest rates, but also to some extent since household credit growth picked up again towards the end of the 1990s.

The rapid credit expansion of the 1980s is also reflected in the dramatic increase in the debt to income ratio, which increased from around 100% to 160% in 1988 (see Figure 1b). From then on it gradually decreased during the period of "debt consolidation" from 1990 to 1995 before levelling out around 125%.

The debt to financial asset ratio in Figure 1c shows broadly the same development until 1988 following the rapid credit expansion, and the gradual decline in the ratio thereafter reflects the fact that households' accumulation of financial assets (excluding insurance claims) has been stronger than their debt accumulation. Finally in Figure 1d we see that the debt to housing capital value initially increases because household loans grow faster than housing prices. Whereas housing prices reached their peak level around 1988, the debt to housing capital ratio continued to increase until 1993, first due to strong credit expansion and later on due to the fact that housing prices fell dramatically from 1989 to 1992 before the housing price growth started to pick up again from 1993. Thus, the debt to housing capital value reflects the strong cyclical movements in housing prices during this period, and while credit growth has also shown significant swings over this period, it is the housing price cycle which leads while the credit growth cycle follows with a lag.

Non-financial enterprises

Figures 2a-2d broadly reflect a similar boom-to-bust development as we have seen above for the household sector.

4. The macroeconometric model RIMINI

The macroeconometric model RIMINI[6] has been operative as a forecasting model for nearly 10 years. It is used by the policy departments to make short-term forecasts for the Norwegian economy four to eight quarters ahead, which are published in the quarterly inflation reports. Once a year the forecast horizon is extended to four-five years ahead, and these projections also underlie the Bank's published reports on financial stability. A key quality of the model is thus its capability to forecast variables like output growth and CPI inflation, but in practice policymakers will be interested in the developments of a large number of other variables. The model should therefore be able to adequately describe the behaviour of households and enterprises, as summarised by variables such as aggregate output, employment, private consumption, the current account, housing prices, housing investments and business sector fixed capital formation. In the context of the present application we could add to this list net wealth of households and enterprises as well as appropriate indicators of financial stability, which we will denote as RIMINI's macroprudential indicators.

Although the model is mainly used as a projection tool, it has become increasingly used by policymakers to analyse the effects of alternative scenarios for key exogenous variables, such as the growth in international markets and world market prices, in particular the price (in USD) of crude oil. It is also frequently used to assess the effects of changes in key monetary policy variables like short-term interest rates and exchange rates, which are both treated as exogenous variables in the baseline version of the model. It is, however, easy to supplement the model with an exchange rate equation and/or a reaction function for short-term interest rates in order to obtain a more realistic representation of monetary policy issues in the model.

RIMINI is by Norwegian standards a fairly aggregated macroeconometric model. The core model consists of some 30 stochastic equations, and there are about 100 non-trivial exogenous variables which must be projected by the forecaster. RIMINI is a fairly closed model in the sense that the most important macroeconomic variables describing the Norwegian economy are all determined by the model, whilst the model forecasts are made conditional upon "outside" variables like foreign prices and output as well as policy variables like interest rates, exchange rates, tax rates and other fiscal policy variables. The model is basically a two-sector model and distinguishes between the manufacturing and construction sectors (producers of traded goods) and services and retail trade (producers of non-traded goods), for which there exist complete submodels. The oil and shipping sectors are treated exogenously in the model, as are agriculture, forestry and fisheries and the public sector.

6 RIMINI is an acronym for a model for the Real economy and Income accounts - a MINI-version; see Eitrheim and Nymoen (1991) for a brief documentation of a predecessor of the model.

Figure 1 *Households:* Indicators of financial fragility. Historical data 1983 Q1 - 1998 Q4

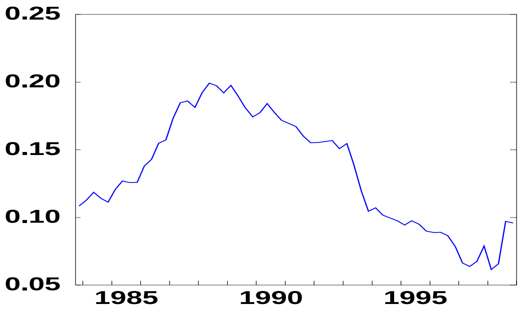


Figure 1a Interest expenses/cash income (disposable income + interest expenses)

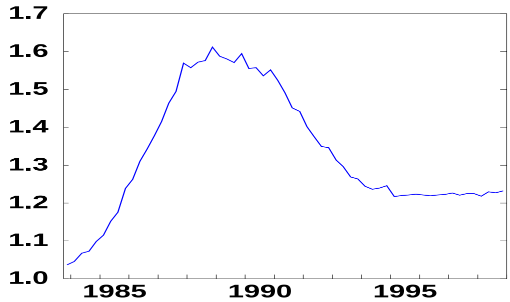


Figure 1b Gross loan debt/disposable income

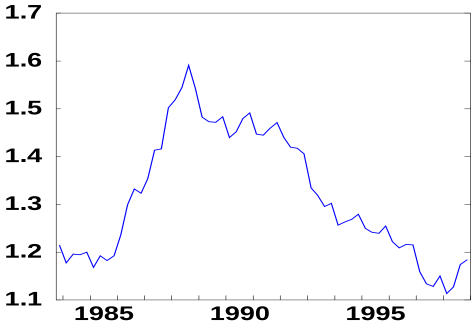


Figure 1c Gross loan debt/gross financial assets excluding insurance claims

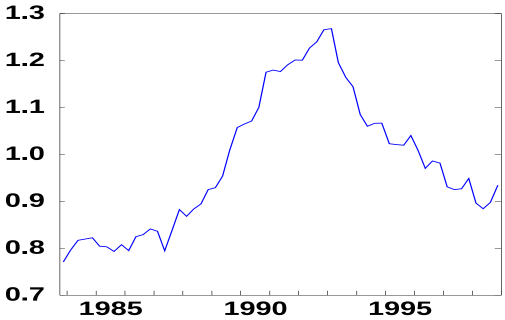


Figure 1d Gross loan debt/value of housing wealth

Figure 2 *Non-financial enterprises:* Indicators of financial fragility. Historical data 1983Q1 -1998Q4

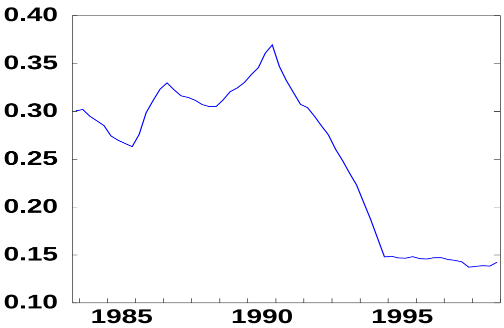


Figure 2a Interest expenses/cash surplus (value added - wage costs + capital income)

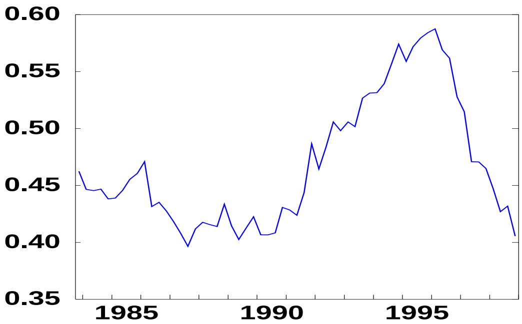


Figure 2b Cash surplus less interest expenses/gross interest bearing debt

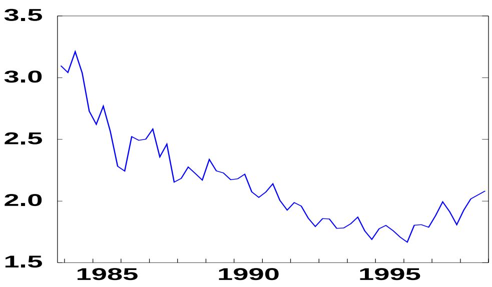


Figure 2c Gross interest bearing debt/gross interest bearing assets

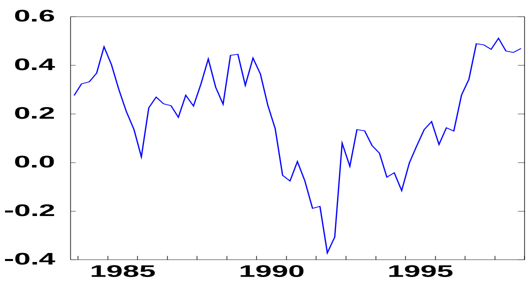
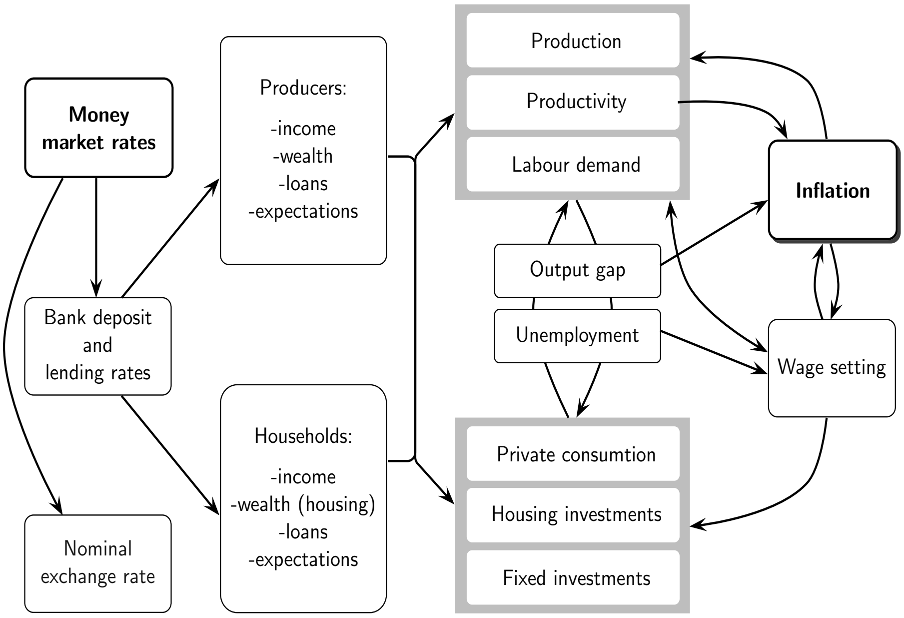


Figure 2d Four quarter growth in interest bearing debt/fixed capital formation

4.1 Monetary transmission channels in RIMINI

In RIMINI there are two main channels through which monetary policy instruments affect employment, output and prices - the interest rate channel and the exchange rate channel. Figure 3a below outlines the interest rate channel, highlighting the submodels for households and enterprises, and shows also the main interaction between the demand side (lower shaded box) and supply side (upper shaded box).

Figure 3a Interest rate channels in RIMINI. Given constant exchange rates



Assuming fixed exchange rates, a change in the central bank interest rate (the signal rate) immediately affects the money market interest rate, which in turn affects the banks' borrowing and lending rates with a lag. Aggregate demand is affected through several mechanisms, as shown in Figure 3a. There is a negative effect on housing prices which (for a given stock of housing capital) causes real household wealth to decline, thus suppressing total consumer expenditure. Also, there are negative direct and indirect effects on fixed capital formation in the traded and non-traded sectors, and on housing investments.

The main submodels for households are discussed in Eitrheim and Gulbrandsen (2001), where we focus on the interaction between asset price inflation in the housing market (see also Eitrheim, 1994) and the submodels for household loans, private consumer expenditures (see Brodin and Nymoen, 1992) and housing investments, and point to some important linkages with the indicators of financial fragility presented above. Compared with the household sector, the current version of RIMINI contains fewer submodels for non-financial enterprise behaviour. We find it reasonable, however, to assume that asset price inflation, for example, in the stock market and/or real estate markets, interacts with investment behaviour as well as the loan behaviour of the enterprise sector.

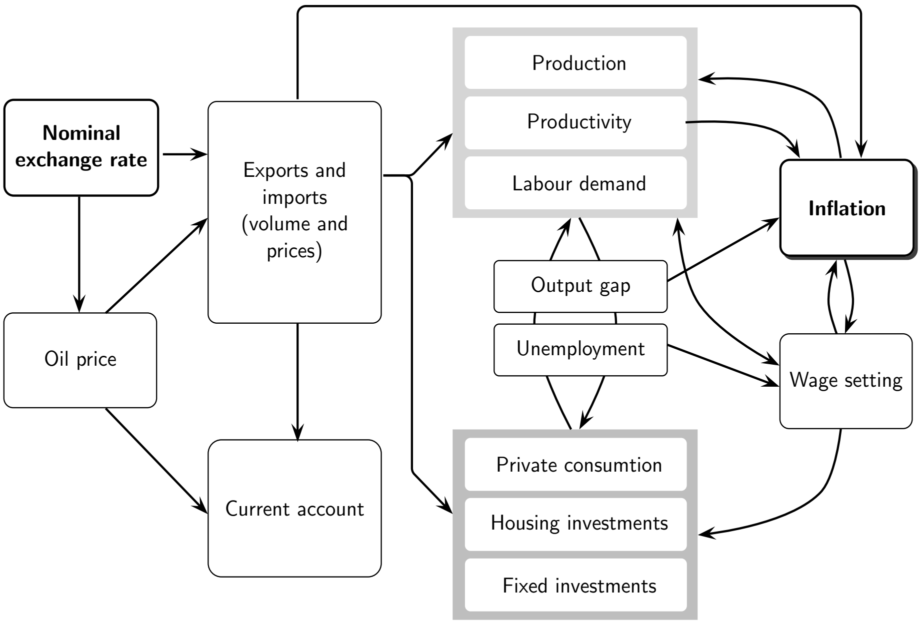
CPI inflation is reduced after a lag, mainly as a result of the effects of changes in aggregate demand on aggregate output and employment, but also as a result of changes in unit labour costs. Due to labour hoarding effects, the initial productivity response in the model is countercyclical. The core model for wages and prices is consistent with a conflict model of inflation where inflation plays the role of an arbiter between mutually inconsistent real wage claims for trade unions and firms in a small open economy; see Kolsrud and Nymoen (1998) and Baardsen et al (1998).[7] An updated version of this wage and price model has recently been documented in Baardsen, et al (1999), who find strong

7 The role of inflation as an arbiter of conflicting claims was brought out in Haavelmo's conflict model of inflation; see Qvigstad (1975).

support for the steady state properties of the wage and price relationships, and Eitrheim (1998) showed that a similar model of CPI inflation was found to be robust when exposed to a series of tests against potentially neglected monetary effects on inflation.

An appreciation of the krone has a more direct effect on CPI inflation than an interest rate change. As illustrated by the first box in Figure 3b, it works mainly through reduced import prices with a lagged response, but such that there is complete pass-through in import and export prices after about two years. The model specification allows for a non-constant mark-up factor on unit labour costs in import and export prices in the short run. Furthermore, a currency appreciation has a weak negative effect on demand for traded goods. In addition to small relative price elasticities in the export equations, export prices (in local currency) adjust with a lag and tend to restore relative prices.

Figure 3b Exchange rate channels in RIMINI. Given constant interest rates



5. Model specification criteria and econometric considerations

As is clear from the outline above, the RIMINI model is too big and complex to be modelled simultaneously. Thus, we need to deal with the submodels for the different sectors in the model in turn and finally graft them into the complete model. Jansen (2000) discusses how this approach implies that we impose simplifying restrictions on the model through sequential factorisation of the joint density function of all observable variables in the model. He also points to the risk that by putting together subsystems modelled separately, one may ignore influences across different subsystems, which could potentially lead to inefficient statistical estimation and inference.

The aim of our modelling approach is, however, straightforward and clear, ideally we would want the model to be a congruent representation of all salient features of the data generating process (Hendry, 1995). Modern econometric methods are well suited to meet this end, and we apply dynamic model specification and cointegration analysis to represent the non-stationary (trending) nature inherent in many macroeconomic time series. Cointegration and equilibrium correcting models, VEqCMs, are useful since they quite often facilitate the economic interpretation of the model's properties, and their long-run (steady state) properties can in many cases be associated with equilibria derived from economic theory.

The different issues which arise in the context of the specification of a macroeconometric model which is designed to satisfy the objectives discussed above are summarised in the following list (see Jansen (2000) for a more detailed discussion):

- **Data admissability** (adequate representation of the trending properties of data. Model residuals should ideally be innovations):

  well specified dynamic equations, assuming difference stationarity;

  cointegration/EqCMs (equilibrium correcting models);

  acceptable model design criteria;

  encompassing results from rival models.
- **Theory coherency** (sensible theoretical properties):

  identifiable structure, imposed on the long-run (steady state) relationships;

  reasonable interim multipliers.
- **Acceptable ex post and ex ante forecasting properties**
- **Invariance of model parameters:**

  to extensions of the information set;

  to shocks in exogenous variables.

6. Econometric specification of main submodels

Outline of the household sector model

This section outlines the household sector model in RIMINI. We present some of the decompositions we have made into conditional and marginal submodels, and for each submodel we indicate some of its main variables. See Jansen (2000) for a more comprehensive discussion of different econometric issues which arise in the context of modelling subsectors of the economy. Details on the econometric results can be found in Eitrheim and Gulbrandsen (2001).

Total consumer expenditure, ch_t, is modelled as a function of real disposable income, yh_t, and real total household wealth, wh_t. Small letters denote variables in logarithms. Total wealth consists of the real value of the stock of housing capital plus total net financial wealth. The stock of housing capital is denoted H_t and the real housing price is PH_t / P_t. Net real financial wealth is the difference between real gross financial assets and real loans $M_t - L_t$, hence

$$wh_t = \ln\left[(PH_t / P_t)H_{t-1} + M_{t-1} - L_{t-1}\right]$$

- Conditional submodel for total real consumer expenditures, ch_t, (Brodin and Nymoen, 1992)

$$D_{c|yw}(ch_t \mid yh_t, wh_t; \lambda_c)$$

RIMINI also contains submodels which allow the joint forecasting of all the individual components which determine real household wealth, wh_t, above, such as housing prices, ph_t, nominal household loans, $(p+l)_t$, net additions to the housing capital stock, Δh_t, and the price on new housing capital, phn_t. RL_t denotes the interest rate on bank loans. The long-run (steady state) consumption function estimated on quarterly data for the period from 1986Q1 to 1998Q4 can be written as follows (leaving out the intercept). Standard errors are reported in parentheses.

$$ch_t = \underset{(0.23)}{0.70} yh_t + \underset{(0.10)}{0.18} wh_t$$

The model for aggregate consumption satisfies the criteria listed above. The formulation is consistent with the broad implications of the life cycle and the permanent income hypotheses, but see the discussion of rival hypotheses in Eitrheim et al (2000), where the relative merits of consumption functions of the type presented above and well known Euler equation models are compared. The inclusion of wealth in the consumption function allows a similar interpretation as offered in Hendry and von Ungern-Sternberg (1981), ie that consumers seek to attain long-run proportionality between consumption and real disposable income as well as between consumption and real wealth respectively.

- Conditional submodel for housing prices, ph_t, (Eitrheim, 1994) and real household loans, l_t

$$D_{w|y}(ph_t, l_t \mid RL_t, yh_t, h_{t-1}; \lambda_w)$$

Real housing prices and household loans are jointly determined, and there may be substantial feedback effects in the dynamic models describing the housing and credit market behaviour, noting that the housing capital is used as collateral in typical household mortgage loan contracts. In the long run, real housing prices are determined as a function of real disposable income, yh_t, the level of housing capital, h_t, and the real after-tax loan interest rate, $RL_t(1-TM_t)-\Delta_4 p_t$. Household loans are negatively affected by changes in the rate of unemployment, reflecting uncertainty about the future income and debt servicing capacity of private households, and in the long run nominal loans, $(p+l)_t$, are determined by the value of the housing capital, $(ph+h)_t$, with a long-run elasticity of 0.80. The estimated joint long-run system for real housing prices, $(ph-p)_t$, and real loans, l_t, can be rewritten as:

$$\begin{aligned}(ph-p)_t &= 0.83yh_t + 0.67h_t - 0.17p_t - 3.33\left(RL_t(1-TM_t)-\Delta_4 p_t\right)\\ l_t &= 0.67yh_t + 1.33\,h_t - 0.33p_t - 2.67\left(RL_t(1-TM_t)-\Delta_4 p_t\right)\end{aligned}$$

- Conditional submodel for recorded financial sector losses

We link the financial sector losses to the developments and trends in some of the indicators of financial stability using household sector indicators as proxy variables for determinants of losses arising in the non-financial enterprise sector. Losses are assumed to depend on the debtor's ability to service the debt as well as on the value of the collateral in loan contracts and the level of unemployment. Recorded financial sector losses have been scaled by the level of private sector debt, and we have modelled this ratio, TAN_t, (as a percentage) as a function of the debt service to income ratio of households, $FFRU50_t$, (debt service ability), the real after-tax loan interest rate, $RL_t(1-TM_t)-\Delta_4 p_t$, and the unemployment rate, $UAKU_t$, (uncertainty about future income and debt servicing ability). The submodel for financial sector losses is inspired by empirical studies of UK household and enterprise sectors in Davis (1995) and earlier work on models with bankruptcy costs; see, for example Wadhwani (1986). We refer to Eitrheim and Gulbrandsen (2001) for estimation results and discussion.

$$TAN_t = \underset{(0.22)}{4.09}FFRU50_t + \underset{(0.58)}{1.08}\left(RL_t(1-TM_t)-\Delta_4 p_t\right) + \underset{(0.86)}{3.81}\left(\textstyle\sum_{i=0}^{3} UAKU_{t-i}\right)/4 + \underset{(0.02)}{0.30}CRISIS91_t$$

The dummy variable $CRISIS91_t$ captures the bulk of recorded losses which were recorded in 1991 and the first quarter of 1992, primarily in commercial banks. Eitrheim and Gulbrandsen (2001) discuss some alternative interpretations of this dummy variable in the equation for recorded financial sector losses.

7. RIMINI simulations

In this section we compare ex post forecasts over the period 1990Q1 to 1998Q4 based on stochastic simulations of the RIMINI model. In the following figures we report observed values (solid line) and the estimated mean from 1,000 replications of stochastic simulations of the model (dashed line) for a subset of the variables determined in the model. To illustrate the prediction uncertainty, we have plotted the boundaries of 50% (dotted lines) and 95% (dashed lines) prediction intervals for each of the reported variables. The RIMINI model is simulated "as is", and we have made no intercept corrections beyond those embedded in the estimated coefficients of the model in terms of impulse- and step-dummy variables.

As explained above, RIMINI can be viewed as a system of equilibrium correcting relationships, EqCMs, in which variables in differences are combined with linear combinations of variables in levels (cointegrating relationships). An alternative class of models which are widely used are formulated in terms of differences in the data only, ie without equilibrium correction terms, such as dVAR models (VAR models in differences), univariate models in differences (DV), or double differences (DDV). Clements and Hendry (1999) have provided analytical results on the relative merits of the forecasting properties of these models, Eitrheim et al (1999) compare forecast error biases across five corresponding forecasting models for the Norwegian economy over different forecasting horizons, and Eitrheim et al (2001) focus on inflation models' forecast accuracy. The latter paper also provides a comparison of forecasting uncertainty as represented by an estimated 95% prediction interval around the models' forecast over different horizons.

Ex post historical tracking

Figure 4a shows the simulated growth in mainland GDP. The model underpredicts domestic growth in 1994-95 and 1997, but the model's overall ability to track many real economic variables seems to be quite good, in particular viewed against the background of considerable cyclical variation during the 1990s. The household savings rate provides one example; we see in Figure 4b that the savings rate is somewhat overpredicted towards the end of the simulation period, but there is no indication of a forecast failure in the sense of Clements and Hendry (1999). Turning to headline CPI inflation, we see from Figure 4e that the annual rate of inflation is somewhat overpredicted in 1991-92, underpredicted in 1994-95 and, again, somewhat overpredicted towards the end of the simulation period. The trajectory for inflation can, at least to some degree, be explained by the model's tendency to underpredict unemployment in the beginning of the simulation period and overpredict unemployment towards the end; see Figure 4f. Likewise, there have been changes in indirect taxes in 1994-95, only partly reflected in the price/wage model, and, similarly, there have been shocks in energy prices (electricity, oil and gasoline), which may explain some of the deviations of simulated from actual CPI inflation towards the end of the simulation period. This lends some support to the interpretation in Eitrheim and Wulfsberg (1999) that the inflation forecasts from a model like RIMINI, which seems to be quite successful in picking up the underlying trends and developments in annual CPI inflation, can be interpreted as forecasts of underlying or "core" inflation. Again, we can find no sign of any serious forecast failure for the annual rate of inflation in Figure 4e. The simulated development in the real after-tax rate of interest mainly reflects the forecast properties of CPI inflation; see, Figure 4c. Finally, we see that housing price growth, despite considerable prediction uncertainty, is simulated quite accurately across a period with substantial variation; see Figure 4g. Likewise, the growth in household loans is fairly well on track, although we see some tendency in Figure 4h for the simulated growth path to "cut through" the actual development, such that the model does not quite capture the decline in household loans in the early 1990s, and also to underpredict the rather strong growth in household loans towards the end of the simulation period.

Figure 4 RIMINI simulations of key macroeconomic variables. Stochastic simulation over 1990 Q1 - 1998 Q4 (mean, 50% and 95% prediction intervals)

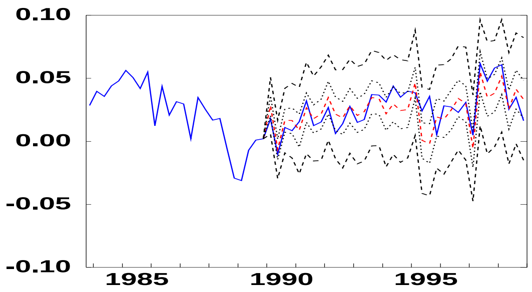


Figure 4a Annual mainland GDP growth

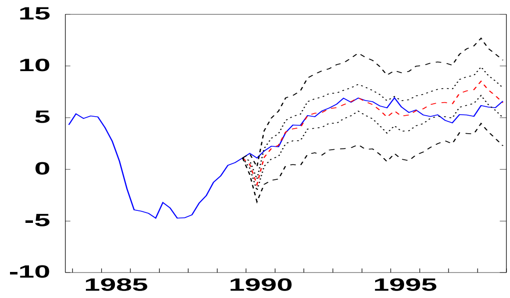


Figure 4b Household savings rate

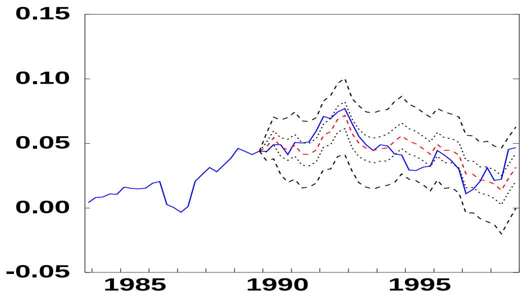


Figure 4c Real after-tax bank loan interest rate

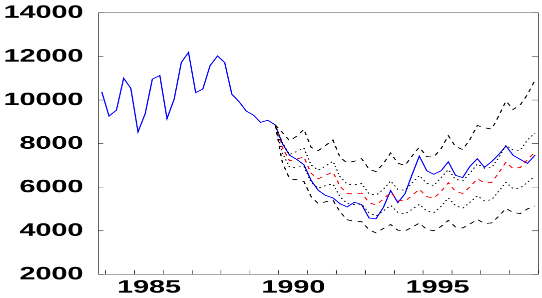


Figure 4d Housing investments

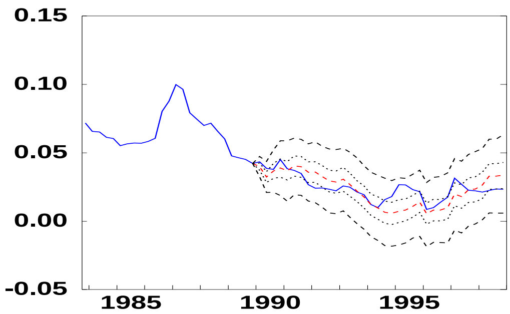


Figure 4e Annual CPI inflation

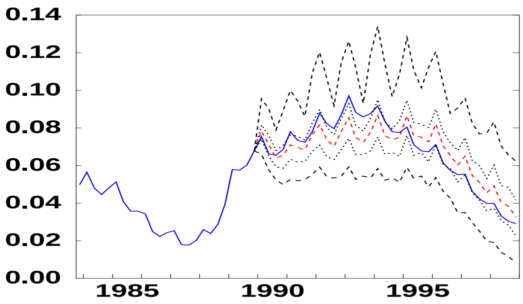


Figure 4f Total unemployment rate

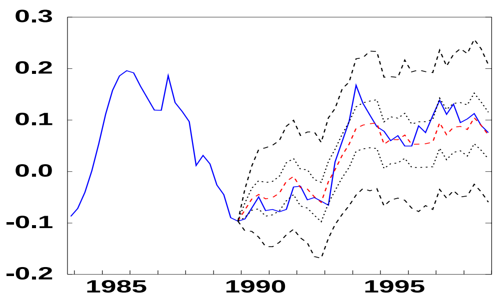


Figure 4g Annual housing price growth

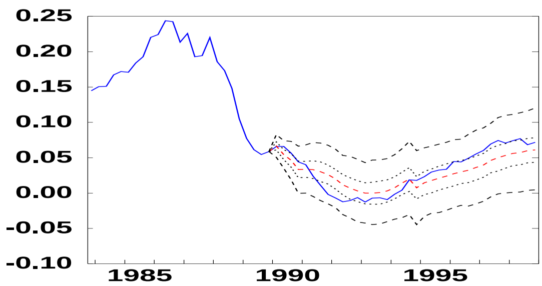


Figure 4h Annual growth in household loans

8. Simulated indicators of financial fragility

Ex post historical tracking

Figures 5 and 6 show the development in the indicators of financial fragility for households and non-financial enterprises over the period 1990Q1 to 1998Q4 as described by the Central Bank of Norway's macroeconometric model RIMINI. We see that the developments in the four selected ratios are all fairly well described by the model. Conditional on the (exogenous) development in the money market interest rate level, the debt service to income ratio falls as shown in 5a. We have seen above that the model's tracking performance for the annual growth in housing prices and household loans is quite good, and that this also seems to hold for the household savings rate. These are important determinants for all the indicators of financial fragility for the household sector, and it is therefore not unreasonable to find that the selected set of indicators of financial fragility also seems to track reasonably well; see Figures 5a-5d.

Figure 5 *Households:* Indicators of financial fragility. Stochastic stimulation over 1990 Q1 - 1998 Q4 (mean, 50% and 95% prediction intervals)

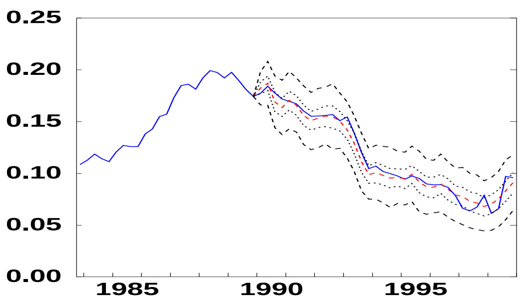


Figure 5a Interest expenses/cash income (disposable income + interest expenses)

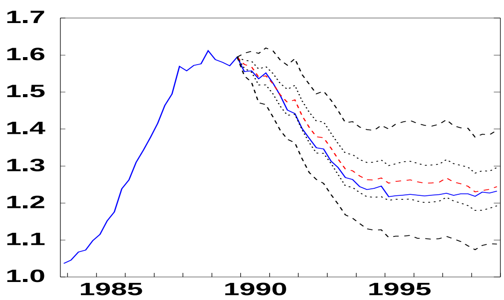


Figure 5b Gross loan debt/disposable income

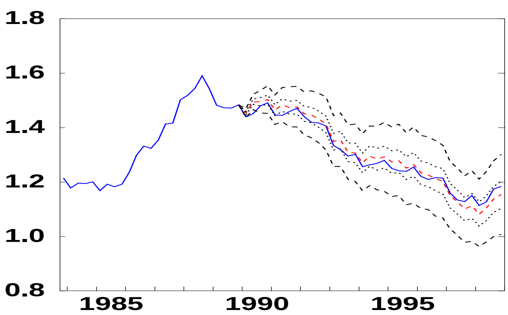


Figure 5c Gross loan debt/gross financial assets excluding insurance claims

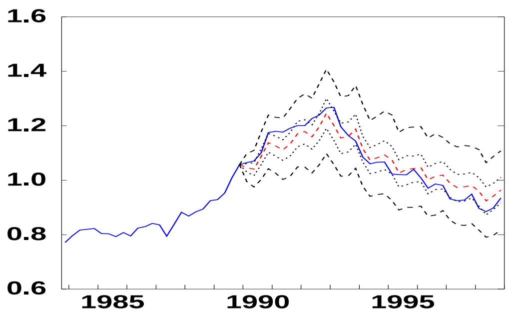


Figure 5d Gross loan debt/value of housing wealth

Figure 6 *Non-financial enterprises:* Indicators of financial fragility. Stochastic simulation over 1990 Q1 - 1998 Q4 (mean, 50% and 95% prediction intervals)

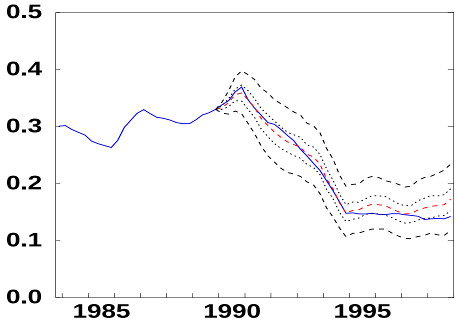


Figure 6a Interest expenses/cash surplus (value added - wage costs + capital income)

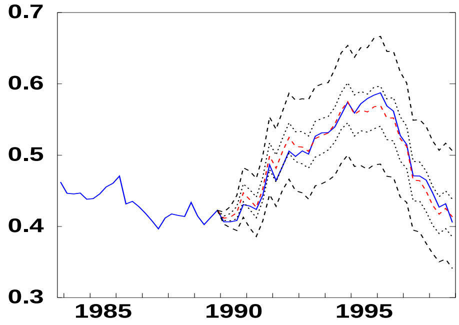


Figure 6b Cash surplus less interest expenses/gross interest bearing debt

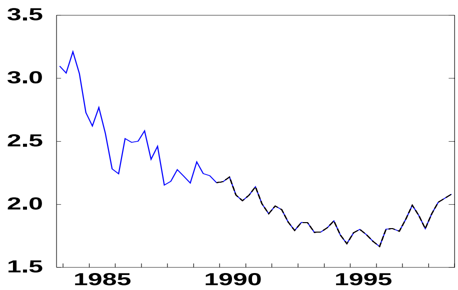


Figure 6c Gross interest bearing debt/gross interest bearing assets

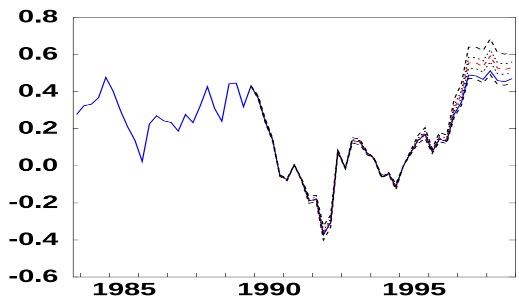


Figure 6d Four quarter growth in interest bearing debt/fixed capital formation

Simulated effects of a temporary and permanent increase in the money market interest rate

Here we investigate the effects of a temporary and permanent increase in the money market interest rate. The debt service to income ratio in Figure 7a shows that we obtain a corresponding temporary or permanent shift in the debt service to income ratio. Both debt and income are negatively affected by a negative demand shock, but due to the immediate negative shock in housing prices which spills over into a corresponding negative effect on household loans, the negative effect on the numerator of the debt to income ratio dominates that of the denominator; see Figure 7b. The ratio of debt to income drops correspondingly, but gradually at a slower rate since the effect on the activity level, employment level and wage level picks up, but also because the effects on household loans after a while start to fade out. A similar effect can be seen on the debt to asset ratio, which is negatively affected by both a permanent and a temporary increase in short-run interest rates; see Figure 7c. Finally, the ratio of debt to housing capital value shows an inital increase following the shock, since the negative housing price effect affecting the denominator dominates the negative debt effect in the numerator; hence the ratio increases until the housing price effect gradually becomes smaller and dies out as the debt effect eventually dominates before gradually fading out as well. It is, however, important to realise that the combined effects on housing prices and household loans contribute to quite substantial persistence in the shock to the debt to housing capital ratio, as a response to a permanent increase in the interest rate level; see Figure 7d.

Figure 7 *Households:* Indicators of financial fragility. Effects of a 100 bp permanent shift in short-term interest rates and a corresponding temporary shift (two years)

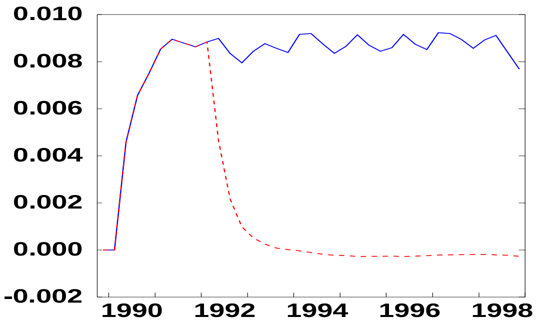


Figure 7a Interest expenses/cash income (disposable income + interest expenses)

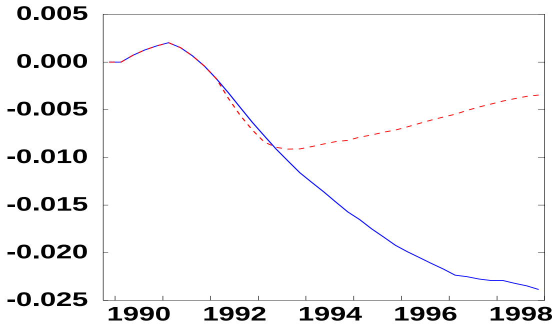


Figure 7b Gross loan debt/disposable income

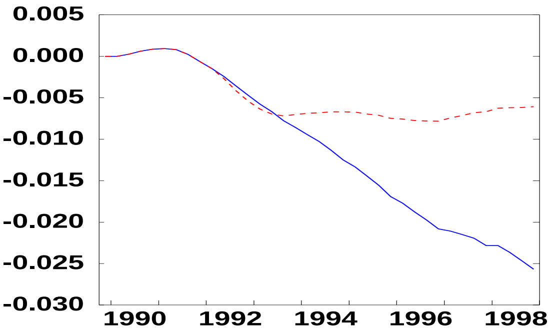


Figure 7c Gross loan debt/gross financial assets excluding insurance claims

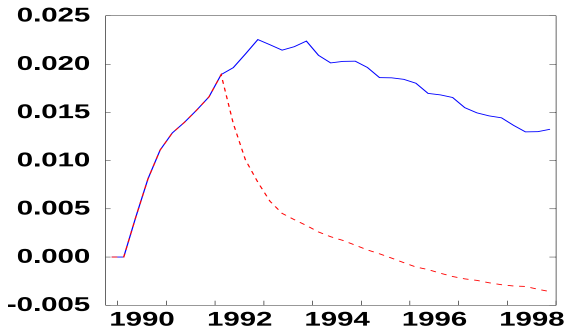


Figure 7d Gross loan debt/value of housing wealth

Figure 8 *Non-financial enterprises:* Indicators of financial fragility. Effects of a 100 bp permanent shift in short-term interest rates and a corresponding temporary shift (two years)

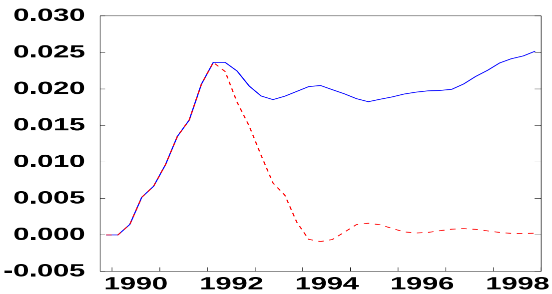


Figure 8a Interest expenses/cash surplus (value added - wage costs + capital income)

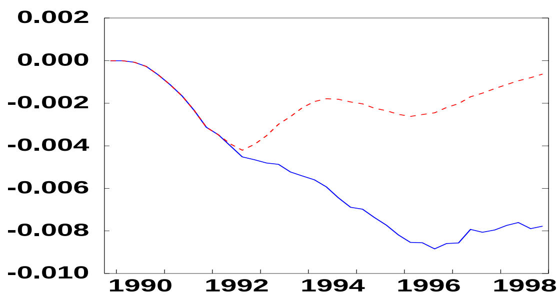


Figure 8b Cash surplus less interest expenses/gross interest bearing debt

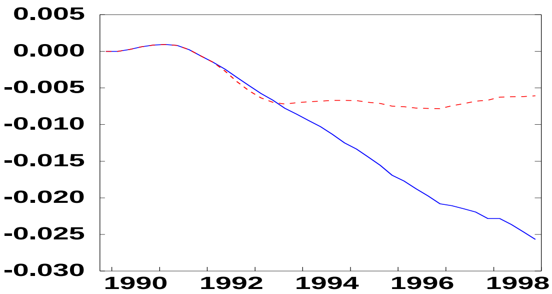


Figure 8c Gross interest bearing debt/gross interest bearing assets

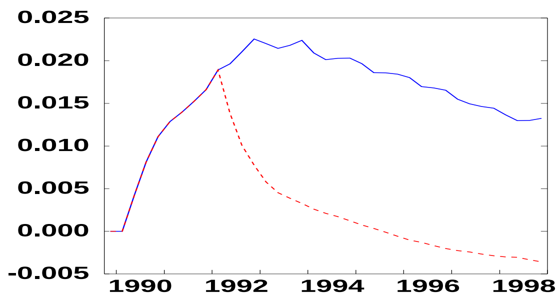


Figure 8d Four quarter growth in interest bearing debt/fixed capital formation

Figure 9 *Banks*: Indicators of financial fragility. Left column: Stochastic simulation over 1990 Q1 - 1998 Q4 (mean, 50% and 95% prediction intervals). Right column: Effects of a 100 bp permanent shift in short-term interest rates and a corresponding temporary shift (two years)

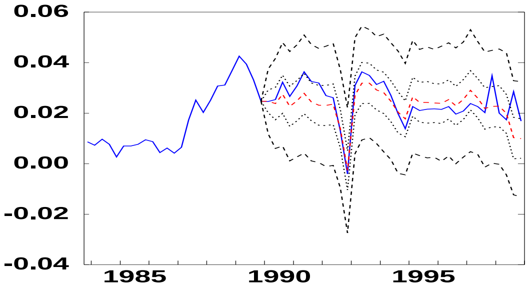


Figure 9a Bank loan interest rate margin

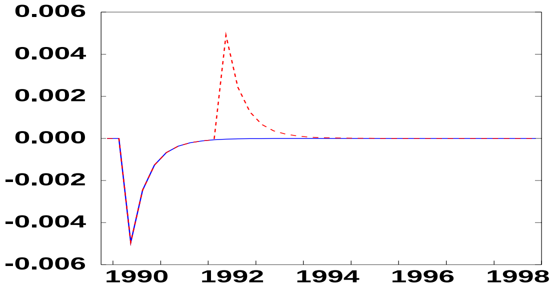


Figure 9b Bank loan interest rate margin

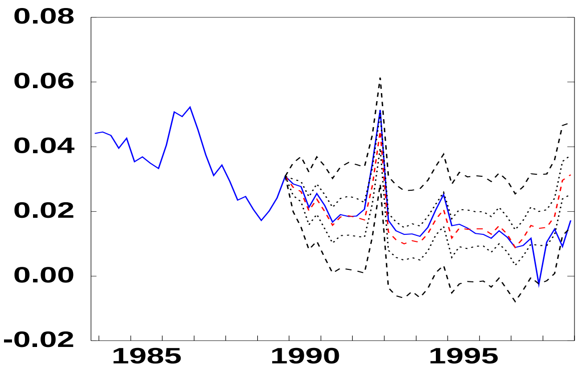


Figure 9c Bank deposit interest rate margin

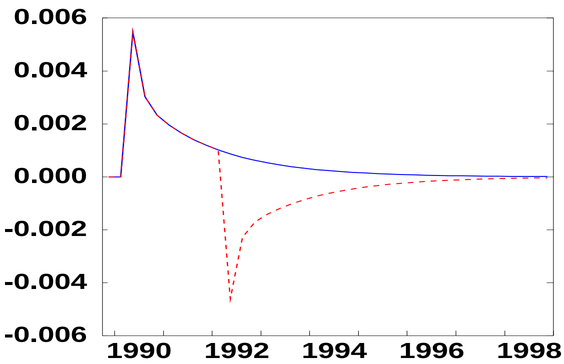


Figure 9d Bank deposit interest rate margin

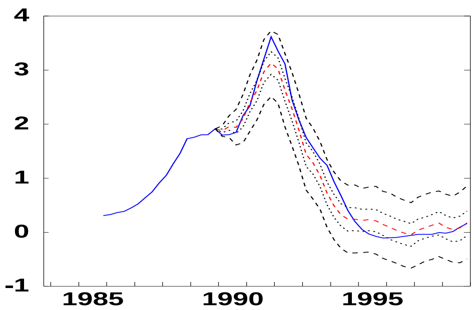


Figure 9e Ratio of financial sector losses to total bank loans

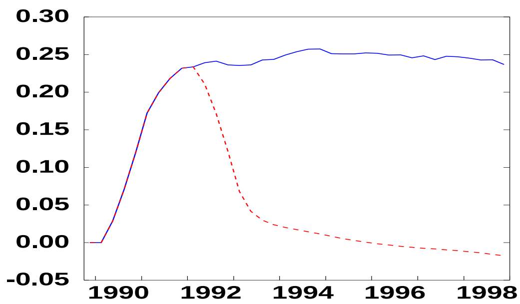


Figure 9f Ratio of financial sector losses to total bank loans

Figures 9a and 9c show the simulated interest rate margin for banks' average loan interest rate and average deposit interest rate respectively. The tracking performance of the banks' deposit rate is quite bad at the end of the simulation period, and the model misses the upswing in the deposit rate in 1998. It is, however, interesting to see that financial sector losses measured as a fraction of the banks' total volume of loans seem to track the actual development reasonably well (Figure 9e) although some intercept corrections during the banking crisis in 1991 are strongly required. Without these corrections the model would have substantially underpredicted the recorded losses during the peak year of the Norwegian banking crisis. Some corrections were also necessary towards the end of the simulation period, ie from 1997 to the end of 1998.

9. Concluding remarks

The main contribution of this paper is perhaps basically a methodological one: we have discussed the potential usefulness of macroeconometric models in the analysis of macroprudential indicators of financial stability, using as an example the recent version of the Central Bank of Norway macroeconometric model RIMINI. We have stressed the need for a *congruent* model representation, and the overall forecasting properties of the model seem to be quite satisfactory. This enables us to simulate the selected set of macroprudential indicators with reasonable accuracy. The simulated prediction intervals provide information about the level of expected forecast accuracy of the model, and are useful in detecting sources of forecast failure. It is important from a policy perspective to establish the invariance of the key submodels to different types of shocks to the system, such as policy shocks, terms-of-trade shocks and asset price shocks, which may heavily influence the macroprudential indicators.

We have shown that shocks to the system, for example in the form of permanent or temporary interest rate changes, may cause quite persistent effects on macroprudential indicators like debt service to income ratios and capital gearing ratios. It is important to identify such properties, which are useful in the process of monitoring the macroprudential dimension of financial stability. Obviously, the transmission mechanism lies at the heart of this matter, and it is vital that a model is able to adequately represent the key channels of transmission from interest rates. In particular, we have demonstrated that it is important to assess the effect shocks may have on asset prices, either affecting exchange rates or through the effects on domestic real estate and stock markets. The link through the stock market has not yet been explored empirically in the RIMINI model, and further work is required, in particular to improve the submodel for non-financial enterprises. On the other hand, the links between housing prices and household loans play an important role in the submodel for household behaviour, and provide the key links to the set of macroprudential indicators considered, and notably to the submodel for recorded financial sector losses.

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Credit growth, problem loans and credit risk provisioning in Spain

Santiago Fernández de Lis, Jorge Martínez Pagés and Jesús Saurina[1]

1. Introduction

The purpose of this paper is to analyse the growth of bank credit and its prudential implications in Spain. This is an ever present item on the agenda of banking supervisors, since most banking crises have had as a direct cause the inadequate management of credit risk by institutions.

Disaster myopia, herding behaviour, perverse incentives and principal-agent problems explain mistakes in bank credit policy in an expansionary phase. Banks could be forced into an excessive credit expansion as a result of an informational externality that makes bank credit policies interdependent. Short-term concerns, coupled with the fact that the market is more forgiving if mistakes are made by many players at the same time, force bank managers into an overly expansionary credit policy that will increase borrowers' debt levels excessively and that will result in an increase in problem loans.

Bank supervisors are well aware of this problem. However, it is very difficult to persuade bank managers to follow more prudent credit policies during an economic upturn, especially in a highly competitive environment. Even conservative managers might find market pressure for higher profits very difficult to overcome. This is compounded by the fact that for many countries loan loss provisions are cyclical, increasing during the downturn and reaching their lowest level at the peak. To a large extent, this reflects an inadequate accounting of credit risk. As a result, book profits follow the opposite pattern. Many credit risk mistakes are made during the expansionary phase of the economic cycle although they only become apparent ex post in the downturn. In this paper we present a regulatory device recently adopted in Spain that could contribute to correcting this problem.

The new loan loss provision introduced by the Bank of Spain, the so-called statistical provision, is explained in detail in this paper. The statistical provision is aimed at a proper accounting recognition of ex ante credit risk. Expected loan losses exist from the moment a loan is granted. This should be reflected in the risk premium included in the price of credit and hence in the income stream coming from the loan since its very beginning. Therefore it seems logical to build up the corresponding provision for loan losses also at that time. This change is expected to reduce the cyclical behaviour of loan loss provisions, correcting the resulting bias in the profit and loss account, decreasing bank profit volatility and improving bank managers' awareness of credit risk. The statistical provision should also be regarded as a mechanism to overcome the coordination problems of individual banks at the peak of the cycle and to reinforce medium-term bank solvency.

The paper is organised as follows. The following section analyses the patterns of bank lending in Spain, while Section 3 looks into the determinants of ex post credit risk from an individual bank level perspective. Section 4 is devoted to the analysis of past loan loss provisioning policies in Spain. Section 5 presents recent changes in provision requirements, in particular the introduction of the statistical provision. Its functioning is analysed and its expected effects explained. The final section makes some concluding remarks.

2. The cyclical pattern of bank lending in Spain

As Figure 1A clearly shows, the growth of bank lending is characterised by alternate periods of expansion and stagnation. Despite the profound structural changes undergone by the Spanish

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economy over a period as long as that considered,[2] bank lending has maintained its cyclical pattern. This growth cycle matches the business cycle very precisely.

Credit is not only procyclical, but tends to grow faster than GDP during expansions and more slowly during recessions, which is reflected in the behaviour of the ratio of bank lending to GDP (see Figure 1B). This ratio displays a tendency to grow over time, consistent with the progressive financial development of the economy, which is temporarily interrupted by periods of economic and credit stagnation.

This behaviour can be explained by demand and/or supply factors. On the demand side, the composition of expenditure is an important determinant of credit. Different types of household and firm expenditures are financed to a differing extent with bank loans. For example, business investment, residential investment and durable consumption are expenditure decisions requiring a higher resort to external finance than non-durable consumption. Moreover, debt can finance not only real expenditure but also financial acquisitions, which are not included in GDP and show a particularly intense cyclical pattern. On the other side, real interest rates are also an important determinant of credit demand. Finally, relative prices can also have an impact on credit demand. Thus, for example, demand for mortgages depends on housing prices. Since bank loans are deflated by CPI to obtain a measure of real credit, an increase in housing prices would lead to an increase in our measure of real credit.

On the supply side, there is a growing literature on credit rationing that relates its level to borrowers' net wealth. Hence, the cyclical behaviour of net wealth is an essential element for explaining the cyclical behaviour of credit.[3] The effect on the business cycle is to increase cyclical fluctuations in what has been denominated the "financial accelerator effect".[4] Apart from that, misalignments in asset prices may lead to inadequate lending and borrowing decisions and to financial fragility.

For our purposes the most important supply factor is bank lending policy. If this is relaxed during the upturn, risk accumulates and this potentially affects bank solvency in the downturn. This is compatible with the financial-instability hypothesis of Kindleberger (1978) and Minsky (1982), according to which the financial system is inherently unstable. There is a tendency towards "excessive" accumulation of debt in times of plenty, when borrowers appear able to bear higher levels of expenditure and debt. This "excess" is then corrected during recessions through deflation and economic crisis. The result is again an increase in business cycle fluctuations.[5]

Table 1 summarises the available data on the behaviour of credit and its above-mentioned determinants in the Spanish economy during the period from 1963 to 1999.[6] All explanatory factors display a procyclical behaviour, except the real interest rate on loans,[7] thus contributing to explaining the procyclical pattern of the credit-to-GDP ratio. Expenditure items more dependent on credit, such as residential and non-residential investment and durable-goods consumption, exhibit a stronger procyclical behaviour than GDP; the same is true for financial acquisitions.

[2] In particular, the Spanish financial system was characterised in the 1960s by administratively fixed bank rates, mandatory investment ratios, restrictions on the opening of branches and on the setting up of new banks, poorly developed financial markets and the practical absence of an active monetary policy. It was gradually transformed into a liberalised, internationally integrated financial system in the early 1990s. Some of the main landmarks in this process were: the implementation of an active monetary policy from 1973, the progressive liberalisation of bank interest rates throughout the period from 1974 to 1987, the elimination of mandatory ratios and restrictions on the opening of new branches or banks between 1974 and 1988, the creation of an efficient government debt secondary market in 1987 and reform of securities markets in 1988.

[3] See, for example, Kiyotaki and Moore (1997) or Suárez and Sussman (1999).

[4] See, for example, Bernanke et al (1998). However, net wealth not only affects credit supply, but also credit demand.

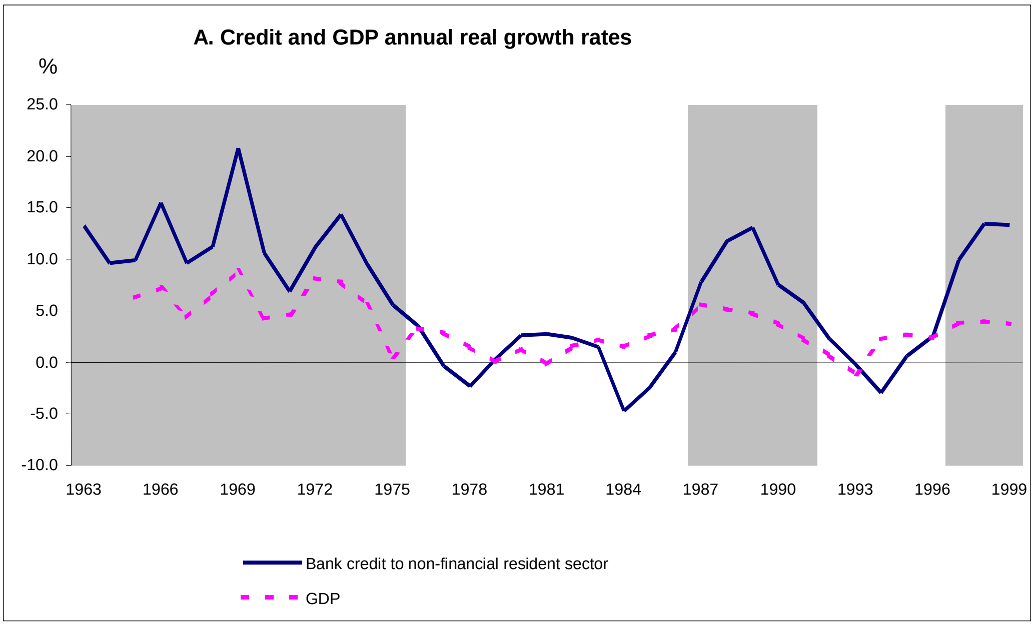
[5] This kind of behaviour has been explained by disaster myopia (Herring 1999), herd behaviour (Rajan 1994) or as a result of perverse incentives, eg the existence of a safety net.

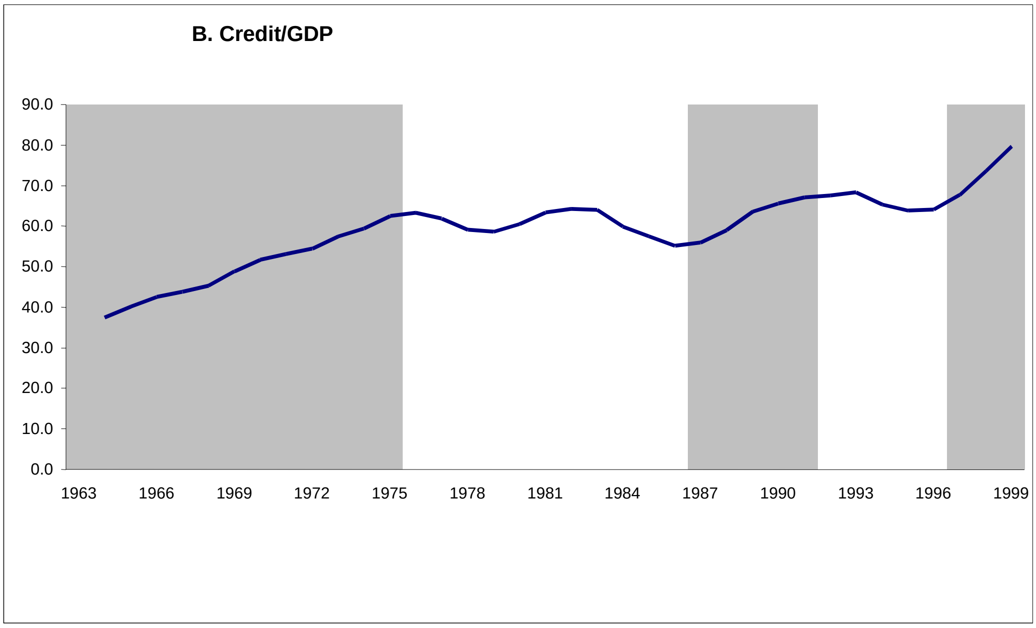
[6] Although an appropriate indicator of total (real and financial) wealth of the non-financial private sector in Spain is not available, there are some incomplete but potentially useful indicators, which are presented in Table 1.

[7] Structural changes in the Spanish economy (essentially liberalisation in the early period and EMU in the late period) mask the cyclical pattern of real interest rates.

Figure 1

Long-term behaviour of credit





The prices of real and financial assets also tend to grow faster in periods of economic expansion,[8] boosting private sector wealth. Finally, net financial assets of non-financial firms and households, although showing a long-run upward trend, are comparatively higher at the beginning of the cyclical upturn, before deteriorating progressively over the expansionary phase. The absence of adequate information on bank lending policy does not allow us to draw any conclusion with respect to this potential explanatory factor. Nevertheless, some anecdotal evidence can be drawn from the analysis of the various credit cycles in the period considered.

8 In the case of share prices, they also tend to lead changes in GDP growth.

Table 1
Summary of the behaviour of bank loans and their main determinants

Variables	Average 1963-75	Average 1976-86	Average 1987-91	Average 1992-96	Average 1997-99
Bank loans to non-financial resident sectors (annual real growth rate)	11.4	0.3	9.2	0.5	13.1
Mortgage loans[1]	13.7	1.2	15.8	8.1	16.4
Other loans	10.9	0.0	7.1	– 3.3	10.7
GDP (annual real growth rate)	5.8[2]	1.8	4.3	1.4	3.8
Residential investment	5.0[2]	– 2.2	4.6	1.6	6.0
Non-residential investment	9.2[2]	– 0.6	11.2	0.3	8.5
Durable-goods consumption	7.7[2]	0.7	6.5	0.0	11.6[3]
Net acquisition of financial assets (% GDP)		18.2[4]	19.1	13.6	20.4
Average real interest rate of loans[5]	– 2.4[6]	0.0	10.1	7.6	3.9
Wealth indicators					
Housing price index (annual real growth rate)			13.0[7]	– 4.4	4.9
Stock Exchange price index (annual real growth rate)	– 0.3	– 7.9	– 0.5	5.5	29.6
(lagged 1 year)	0.8	–14.1	11.6	1.4	29.2
Net financial assets of non-financial firms & households (% GDP)		26.4[4]	47.6	54.7	85.9
Memorandum items					
Annual inflation rate (CPI)	8.9	14.5	5.9	4.4	2.1
3-month interbank real interest rate[5]		1.1[8]	8.3	5.3	2.1
Indicators of bank health					
Non-performing ratio[9]	0.9	3.8	3.7	6.2	2.2
Indicator of banking crisis[10]		27.7	0.3	7.0	0.0
Real profitability before taxes (over own funds)	7.8[6]	– 0.5	13.2	8.2	13.3

[1] Loans secured with real assets. [2] Data from 1965. [3] Data to 1998. [4] Data from 1980. [5] Nominal interest rate less current inflation rate. [6] Data from 1971. [7] Data from 1988. [8] Data from 1977. [9] Doubtful and non-performing loans over total loans to non-financial residential sectors. This series is not homogeneous due to regulatory changes. Prior to 1982 there was no strict definition of doubtful or non-performing loans and since then, more regulatory changes have taken place, particularly in 1987. [10] Sum of the percentages over total capital and reserves of capital and reserves of banks with solvency problems during the period considered. It refers only to commercial banks since they represent the bulk of entities with solvency problems.

Sources: Bank of Spain; INE; Ministerio de Obras Públicas, Transportes y Medio Ambiente.

The first credit cycle is particularly remarkable. Before the mid-1970s oil crisis, the Spanish economy grew strongly and government-controlled interest rates were set at very low levels. The loose monetary environment, compounded by the absence of appropriate incentives and management skills among bank managers, contributed to the strong growth of bank lending and to an excessive indebtedness on the part of Spanish non-financial firms. The total debt (bank loans, fixed income securities, loans from non-residents and trade credit) of Spanish non-financial firms as a percentage of GDP reached a historical peak at the beginning of the 1980s (see Figure 2). This must have contributed to the impact of the oil price shocks of 1973 and 1979 on the Spanish economy and to the severe banking crisis that affected half of Spain's commercial banks (which accounted for around 25-30% of the total capital of the sector) between 1977 and 1985. This banking crisis is likely to have exacerbated the economic stagnation, pushing back economic recovery until the mid-1980s. Between 1976 and 1986, despite low real interest rates, average annual bank lending growth was just 0.3%.

That is, the bubble pattern of non-financial firms' debt seems to point to bank lending policies contributing to the exacerbation of the business cycle.

An important explanatory factor of the 1987-91 boom in bank lending was the increase in housing prices, which rose more than 100% during the second half of the 1980s. Owing partly to the huge increase in housing prices and partly to the shift by commercial banks towards the business of lending to households, the volume of mortgage loans granted by Spanish banks grew strongly from 1985[9] (see Figure 3). In the stagnation period between 1992 and 1996 bank lending was almost flat, but this occurred against the background of a very tight monetary policy and without a generalised banking crisis.

The current bank lending expansion is not independent of the greater macroeconomic stability (low inflation and real interest rates) stemming from EMU. Other potentially important elements are the increase in asset prices and in the acquisitions of financial assets, particularly abroad, by Spanish non-financial firms and households (see Table 1). Also, growing competition among banks may be boosting credit growth. This growing competition is reflected in declining bank margins, although not in bottom-line profits due to the very low level of loan loss provisions in recent years.

To sum up, bank lending in Spain is strongly procyclical. There are several potential explanations for high credit growth during economic expansions, not all of them having the same implications. Since we are interested in credit growth as an indicator of risk, we are particularly concerned about the possibility of an excessive accumulation of debt resulting from a systematic easing of bank credit conditions during periods of strong economic activity. Although some anecdotal evidence and some theoretical arguments point in that direction, the incomplete quantitative information available, the important structural changes the Spanish economy has undergone and the identification problems at an aggregate level render the estimation of the relative impact of each factor extremely difficult. One potential way of casting some light on this issue is to analyse the relationship between credit growth and problem loans at the level of individual institutions, which is the aim of the next section.

3. Credit policy of individual banks and problem loans

There is a very close relationship between problem loans and the economic cycle. During recessions problem loans increase as a result of firms' and households' financial distress. When the economy grows strongly, the income of non-financial firms and households expands and they can repay loans easily, contributing to the decline in banks' problem loans ratios.Figure 4 depicts the strong correlation between the problem loans ratio of Spanish deposit institutions and the GDP growth rate. Of course, this relationship has a negative sign as problem loans increase when GDP growth rates slow, and vice versa.

Different types of banks show a very similar relationship between bad loans and economic activity. Figure 5 plots the ratio of problem loans for Spanish commercial and savings banks, which represent more than 95% of the total assets of credit institutions. Although the level of the ratio differs, the cyclical pattern is very similar.

The ratio of problem loans also differs by type of loan. Households and firms have different levels of bad loans. On average, the former is lower than the latter. Among households, mortgages have very low delinquency levels compared to consumer loans, credit card loans or overdrafts. Among firms, there are substantial differences in problem loans ratios by economic sector: for instance, on average over the cycle, real estate developers show more problem loans than credit extensions to public utilities as indicated by data from the Bank of Spain Credit Register (CIR).

[9] Mortgages were traditionally the niches of savings banks. Since the late 1980s, commercial banks have competed intensively to gain a higher share of this market. While mortgages accounted for 20% of total loans in 1985, they now (first half of 2000) stand at around 45% of total loans.

Figure 2
Total debt/GDP

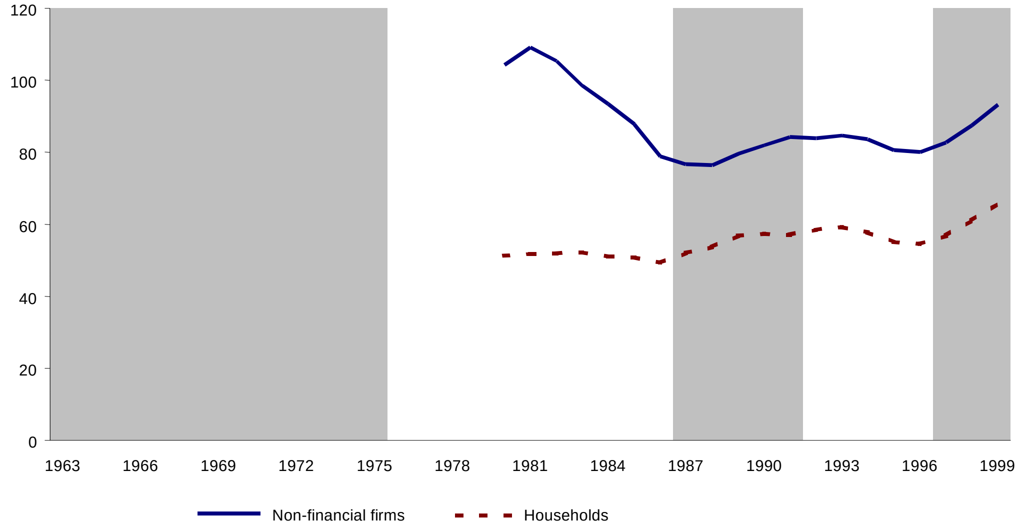
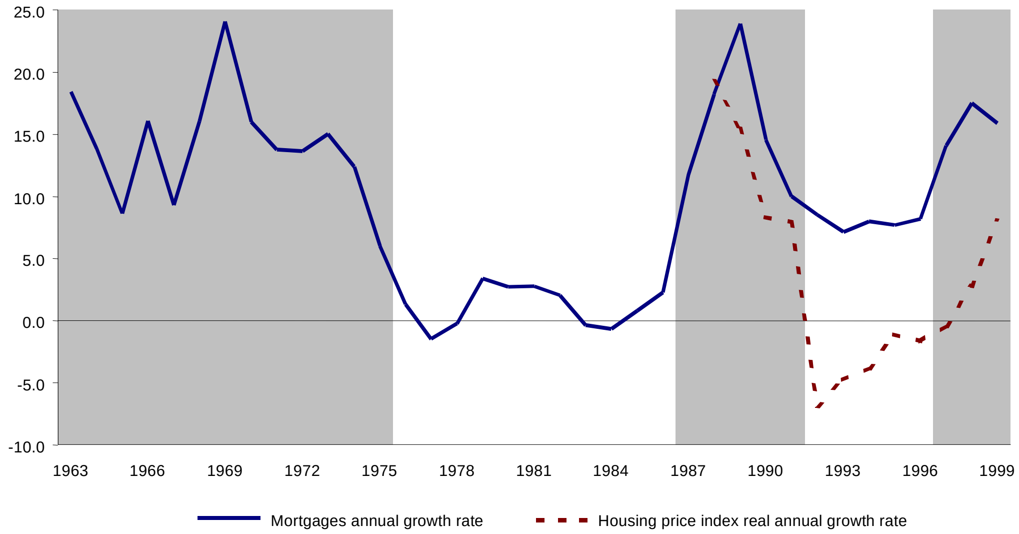


Figure 3
Mortgages and housing prices



In addition to these macroeconomic factors, the credit policy of each individual institution is crucial for understanding its level of problem loans. Figure 6 gives the number of banks (both commercial and savings banks) whose ratio of problem loans deviates from the simple annual average ratio by a certain number of percentage points. It is shown that there is considerable dispersion among problem loans ratios for the same cyclical or macroeconomic position.[10] At the same point in the cycle, some banks have significantly below average problem loans ratios while others have much more ex post credit risk.

[10] The comparison is calculated with the simple average of ***each*** year. Although certain institutions have a regional basis, Spanish regions are not different enough to have independent economic cycles, and it can be concluded therefore that most of them share the same cyclical position.

Figure 4
Problem loans ratio and GDP growth rate
depository institutions

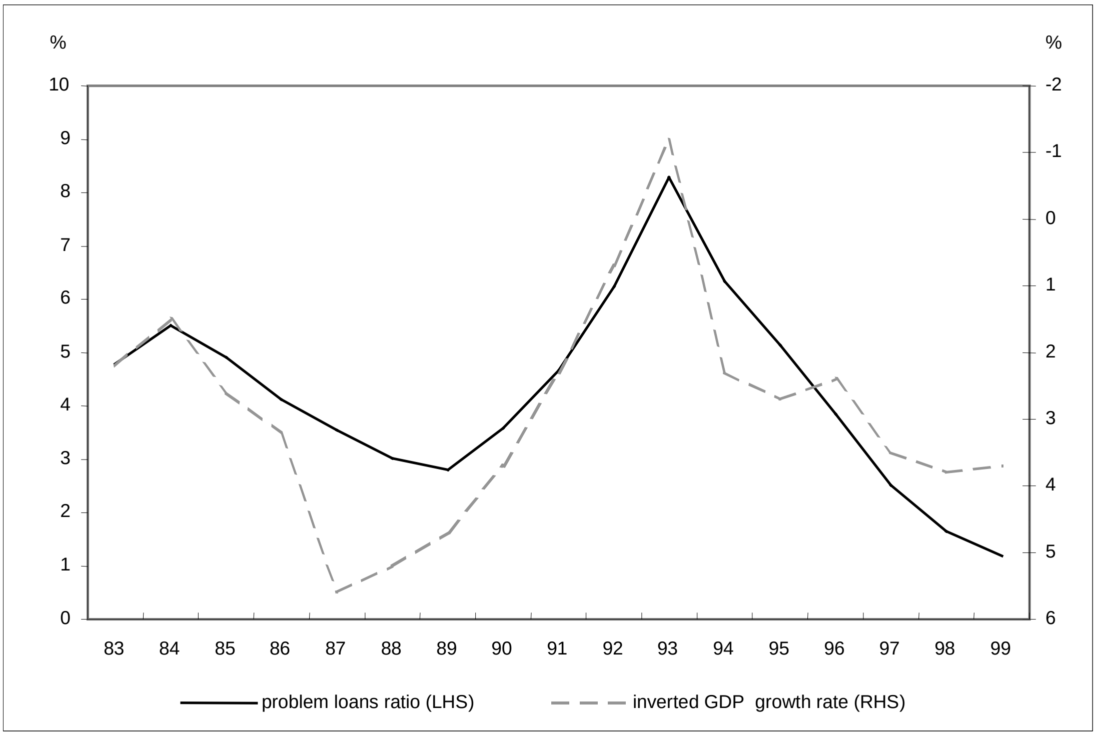


Figure 5
Problem loans ratio
commercial and savings banks

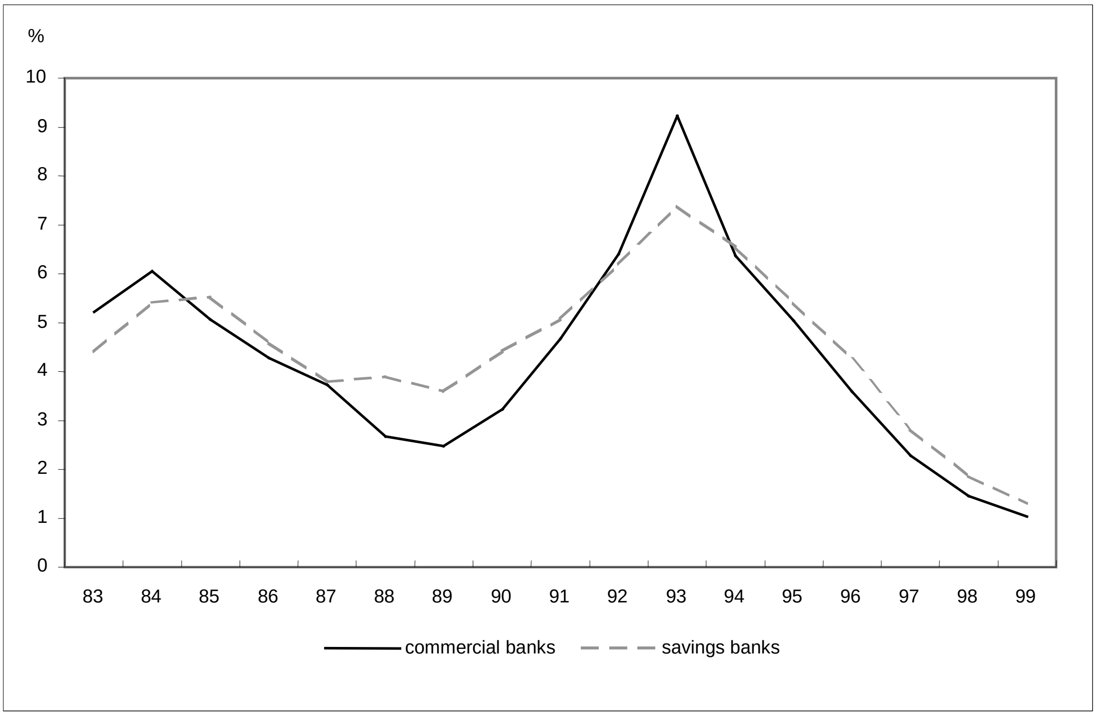


Figure 6

Dispersion of problem loans ratio around the mean
1983-99

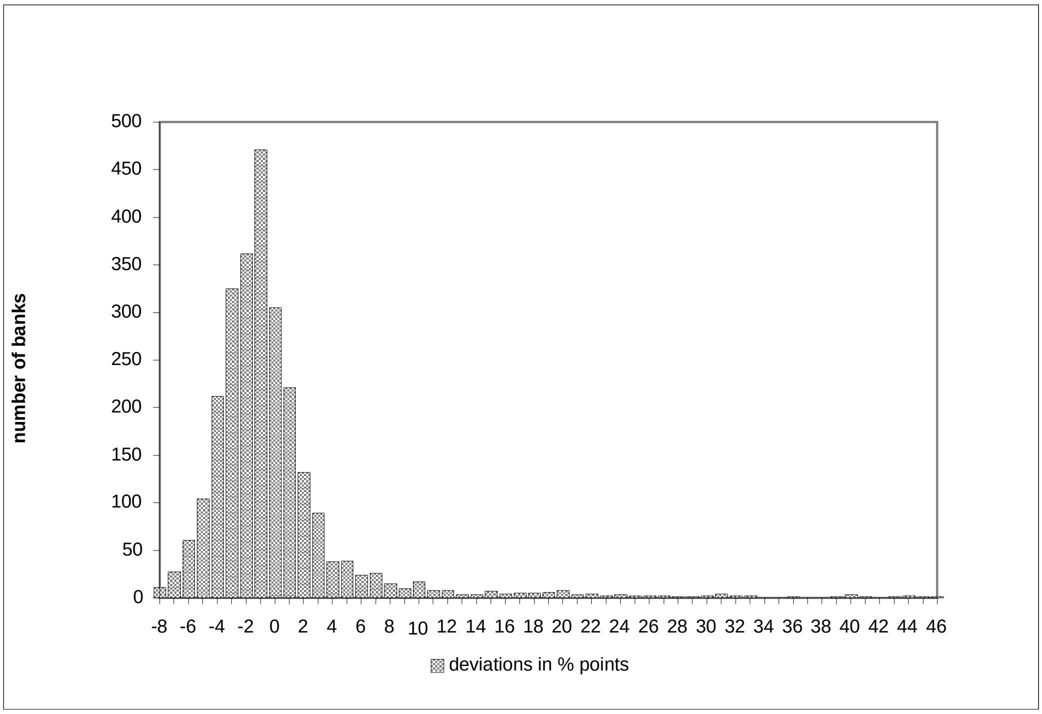


Figure 7

Dispersion of problem loans ratio
1992-94 and 1997-99

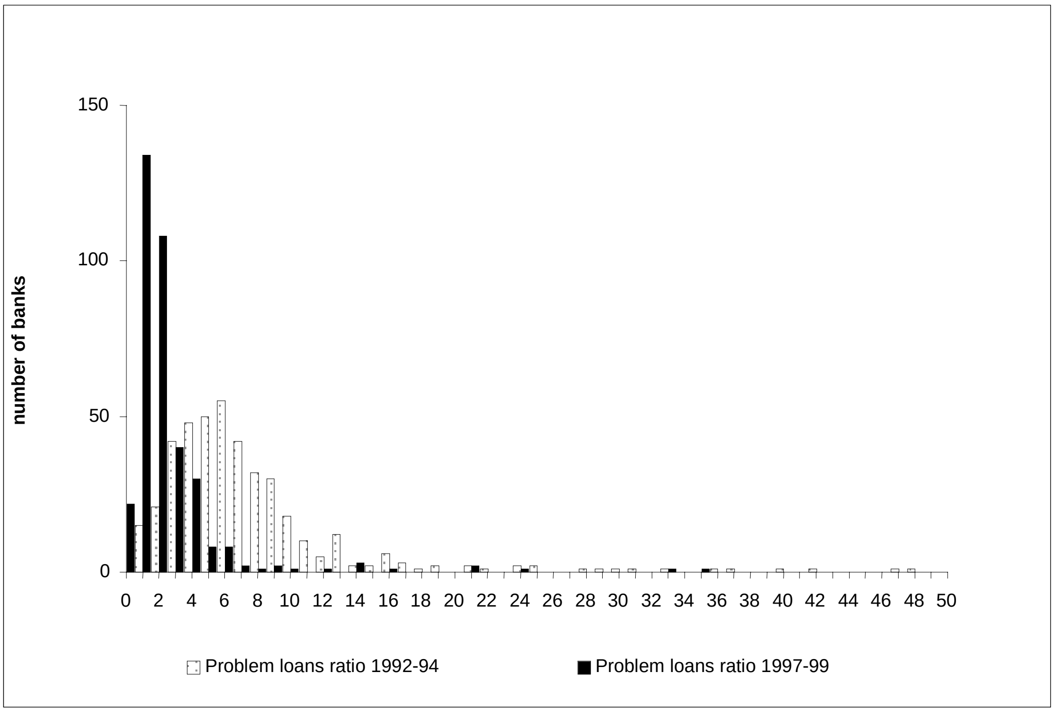


Figure 7 shows the distribution of the ratio of problem loans in two different positions of the cycle: an economic downturn (1992-94) and an economic expansion (1997-99). As expected, the mean and the dispersion of problem loan ratios are higher at the trough than at the peak of economic activity. The distribution of problem loans is asymmetric with a long tail on the right hand side, indicating that the number of banks with significantly above average problem loans is larger than those significantly below average.

The above indicators underline that microeconomic variables at the level of each bank must play a determining role in explaining bank problem loans. In addition, the cyclical position of the economy affects the level and dispersion of the problem loans ratio.

A rapid credit expansion is deemed one of the most important causes of problem loans.[11] During economic expansions many banks are engaged in fierce competition for market share in loans, resulting in strong credit growth rates. The easiest way to gain market share is to lend to borrowers of lower credit quality. This market share strategy is even more dangerous if the bank is a new entrant in a product or regional market. Initially, banks selling new products will probably have more problem loans in their new business simply because they lack the necessary expertise. Banks entering a distinct regional market will be subject to adverse selection. Incumbents will allow the riskiest customers to leave the bank but will retain the best ones. The risk profile of a client becomes known only with time. The informational disadvantage of new entrants together with their appetite for market share might be a recipe for later loan portfolio problems.[12]

Principal-agent problems could fuel credit expansion because bank managers focus more on gaining market share than on shareholder profitability. Managers that are poorly monitored by shareholders might be willing to increase risk in order to bolster short-term profitability. Therefore, managers could have incentives to overextend credit in order to maximise their utility.[13] It can take a long time to realise the danger of these risky strategies because managers may be engaged in income smoothing practices.[14]

Shareholders of banks with very low solvency levels might be tempted to increase credit risk as a bet on resurrection. A subtler case of dangerous incentives appears in banks that are experiencing slow but steady declines in their charter values.[15] Crockett (1997) points out that increasing competition may encourage disaster myopia. Similarly, herd behaviour can fuel overly liberal credit policies because the penalties for being wrong in company are much lower than for being wrong in isolation.[16] Several additional factors could affect the level of bank problem loans. First of all, loan portfolio composition plays an important role as an indicator of bank risk profile.[17] Besides, risk concentration is an additional source of concern, as many banking crises have shown. Secondly, inefficient banks performing poor screening and monitoring of borrowers will have lower portfolio quality.[18] Thirdly, the overall competitive environment in which a bank operates could also affect the level of credit risk the bank is willing to take. If the bank has some degree of monopoly power, it has the possibility of charging higher interest rates in the future. Therefore, a higher number of firms of lower quality could

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11 Clair (1992), Salas and Saurina (1999b) and Solttila and Vihriälä (1994) find evidence that past credit growth explains the current level of problem loans, after controlling for the composition of the bank loan portfolio.

12 Shaffer (1998) shows that adverse selection has a persistent effect on new entrants.

13 Gorton and Rosen (1995) show that when bank managers receive private benefits of control and are imperfectly monitored, managers will take on excessive risk if the industry is unhealthy.

14 Fudenberg and Tirole (1995) analyse the theoretical foundations for income smoothing. The empirical literature has widely confirmed the existence of such practices among banks. Saurina (1998) contains a survey of the theoretical and empirical literature on earnings management.

15 Keeley (1990) shows how the deregulation of the American banking industry brought about an increase in competition that eroded bank charter values, giving incentives to managers to shift to riskier policies (more credit risk and less capital). Salas and Saurina (1999a) find similar results for Spanish commercial banks.

16 See, for instance, Rajan (1994).

17 See Boyd and Gertler (1993), Davis (1993), Domowitz and Sartain (1999), Keeton and Morris (1987), Murto (1994), Pensala and Solttila (1993) and Randall (1993). Berger and Udell (1998) and Freixas and Rochet (1997) discuss, from a theoretical point of view, the role of collateral.

18 Berger and DeYoung (1997) and Kwan and Eisenbeis (1997) find that inefficient banks are more prone to risk taking.

obtain funds from the bank. This would not happen in a competitive market where it is not possible to recover present losses in the future because the firm, after solving its difficulties, would not pay an interest rate above the market rate.[19]

Salas and Saurina (1999b) have modelled the problem loans ratio of Spanish banks in order to gauge the impact of loan growth policy on bad loans. They were interested in capturing the lag between credit expansion and the emergence of problem loans. Macroeconomic developments, regulatory changes and portfolio composition, size and the incentives bank managers and shareholders face were controlled.[20]

Table 2 shows their empirical estimation results using a set of panel data of commercial and savings banks from 1985 to 1997. As expected, the cycle (measured through the current and lagged-one-year GDP growth rates) has a negative and significant impact on problem loans. The current impact is much more important. Additionally, increases in non-financial firms' indebtedness raise problem loans.

Regarding the bank-specific variables, there is a strongly significant and positive impact of credit growth on problem loans but with a lag of around three years. Therefore, an increase in credit today will have a negative impact on problem loans three years hence. Branch growth also has a positive impact on problem loans with a three-year lag, underlining the importance of adverse selection in bank expansion strategies.

Other results from the same paper confirm that inefficient banks hold riskier portfolios, collateralised loans are less risky and large banks have fewer problem loans, probably as a result of their better portfolio diversification opportunities. These results are quite robust to many specification changes.

The finding that credit growth affects problem loans with a relatively long lag is a matter of concern for supervisors. If bank managers are interested in short-term targets they will not take proper measures to limit medium-term exposures to credit risk. Given that credit expansion usually occurs during favourable economic periods where optimism is widespread, it is easy to understand how difficult it is for supervisors to convince bank managers of the need to be cautious. Furthermore, conservative bank managers are under strong pressure to act like their riskier colleagues in order to reach higher short-term profits (based on increased volumes and riskier borrower profiles). Things are even more worrying when the book value of the loan portfolio and profits are not properly adjusted - through the related provision - by the expected future losses. Hence the importance of provisioning rules.

4. Loan loss provisions

There is no harmonisation of asset classification rules at an international level. The definition of problem loans or asset impairment varies across countries. Some countries allow bank managers and/or external auditors to establish the amount of bad loans instead of having a definition of impaired assets. These practices differ from those of other countries where a precise definition of impaired assets is provided by regulators. However, even in this latter group of countries, asset classification criteria differ. Ninety days overdue is a quite standard period to classify a loan as non-performing but some countries use different overdue dates depending on the credit product. Some national regulations classify as doubtful those credit exposures that, although not yet overdue, are already showing signs of a very low repayment probability.

[19] Petersen and Rajan (1995) find that a higher percentage of young firms are financed in a concentrated banking market than in a competitive one.

[20] The literature on problem loan determinants is scarce. Some authors (Brookes et al (1994) or Davis (1992)) have only focused on macro variables whereas others (Keeton and Morris (1988) or Solttila and Vihriälä (1994)) use only micro data. Very few papers analyse both macro and micro determinants of problem loans. Among these are Clair (1992) and González-Hermosillo et al (1997).

Table 2

Estimation of the problem loans equation in first differences
(dependent variable $\ln(RM_{it}/(1-RM_{it}))$, with RM the ratio of problem loans to total loans)

Variables	**Parameter values**	
Dependent lagged 1 year ($\ln(RM_{it-1}/(1-RM_{it-1}))$)	6681***	(13.64)
Aggregate		
GDP growth rate (ΔGDPt)	– 0.0799***	(– 7.13)
GDP growth rate with 1 lag (ΔGDP_{t-1})	– 0.0159**	(– 2.01)
Families' indebtedness ($DFAM_t$)	– 0.0092**	(– 1.83)
Debt-equity ratio ($DEMP_t$)	0.0017***	(2.83)
1988 Regulation (REG88)	0.1482**	(2.49)
Individual		
Loan growth rate with 2 lags ($\Delta LOAN_{it-2}$)	0.0005	(0.43)
Loan growth rate with 3 lags ($\Delta LOAN_{it-3}$)	0.0020**	(2.14)
Loan growth rate with 4 lags ($\Delta LOAN_{it-4}$)	0.0002	(0.20)
Branch growth rate with 2 lags ($\Delta BRAN_{it-2}$)	– 0.0007	(– 1.17)
Branch growth rate with 3 lags ($\Delta BRAN_{it-3}$)	0.0007***	(2.60)
Branch growth rate with 4 lags ($\Delta BRAN_{it-4}$)	– 0.0001	(– 0.09)
Inefficiency ($INEF_{it}$)	0.0029*	(1.64)
% Loans without collateral (NCOLit)	0.0128**	(2.51)
% Assets over total assets ($SIZE_{it}$)	– 0.0811**	(– 2.38)
Net interest margin with 2 lags ($INTM_{it-2}$)	0.0422*	(1.69)
Net interest margin with 3 lags ($INTM_{it-3}$)	0.0120	(0.38)
Capital to total assets with 2 lags ($SOLR_{it-2}$)	– 0.0297	(– 1.43)
Capital to total assets with 3 lags ($SOLR_{it-3}$)	– 0.0012	(– 0.14)
Market share ($MPOW_{it}$)	0.0275	(1.17)
No of observations and time period	934	1988-97
Variance of residuals (σ^2)	0.0857	
Sargan's Test (S)	45.61	(38)
Second order autocorrelation (m_2)	– 1.430	

The equation is estimated using the DPD package written by Arellano and Bond (1991). RM_{it-1} and $NCOL_{it}$ are treated as endogenous, using the Generalised Method of Moments with 2 and 3 lags to instrument these two variables. t-value in brackets, *** variable significant at the 1% level, ** at the 5% and * at the 10%. In the Sargan test (which follows a χ^2), the degrees of freedom are in brackets; its theoretical value at the 95% level for 38 degrees of freedom is 53.36. m_2 follows a N(0,1).

Source: Salas and Saurina (1999b).

The differences among countries increase when examining loan loss provisioning rules and practices. There are specific and general provisions with different requirements in each country, sometimes set by the regulators, sometimes left to the choice of bank managers (although reviewed by external auditors).[21] Besides, tax treatment of loan loss provisions also differs widely.

There is a contrast between the considerable efforts made to harmonise capital requirements at an international level and the lack of such harmonisation in terms of asset classification and provisioning rules.[22] The issue is important, since some apparently safe capital ratios can suddenly disappear in a banking crisis when the loan portfolio has not been properly classified and provisioned.

21 The differences are highlighted in Beattie et al (1995).

22 The European Union is currently focusing on the convergence of regulatory practices regarding loan loss provisioning rules.

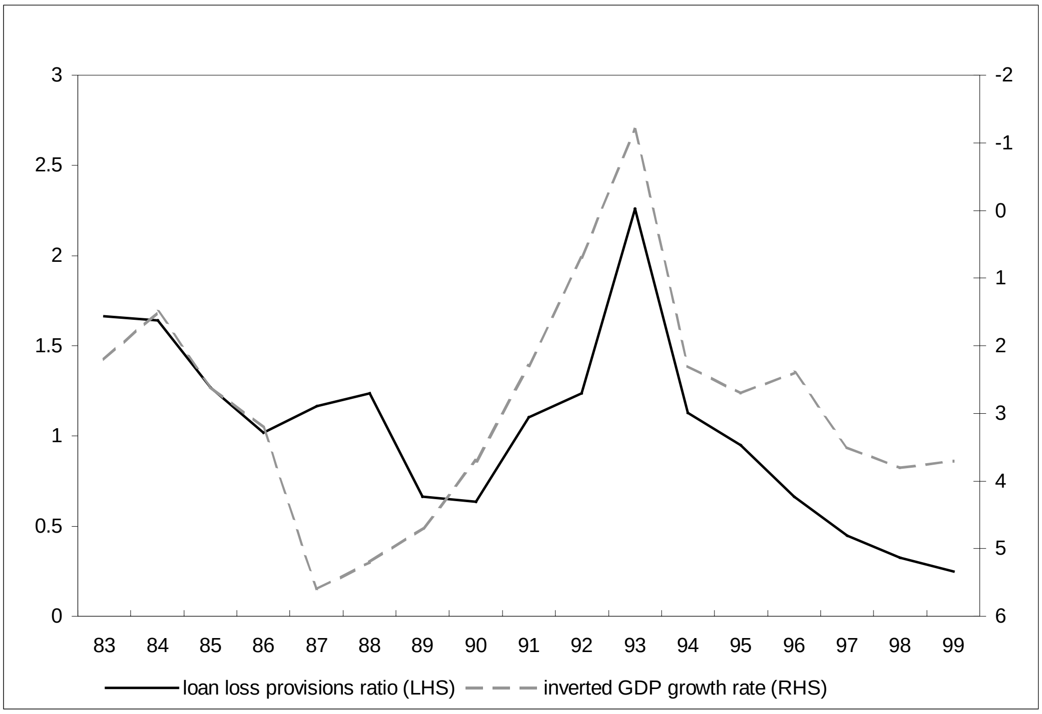
Spain has a very detailed regulatory framework for asset classification and loan loss provisions, which limits bank managers' discretion. The accuracy of both is checked thoroughly by on-site inspections carried out regularly by the Bank of Spain. The traditional Spanish regulatory system distinguishes between specific and general provisions. A third category of provisions has recently been created, the so-called statistical provision. The general provision is a fixed one, while the specific provision aims at covering impaired assets (ex post credit risk). The statistical provision is intended to acknowledge expected losses, as explained below.

Before describing the characteristics of the statistical provision and the reasons for it being set, it is worth quickly reviewing the asset classification and "old" provisioning rules. Annex 1 contains a brief summary of asset classification criteria and loan loss provision requirements. Note that provisions calculated following Annex 1 criteria are generally treated as an expense from a tax perspective.[23] Banks are obviously free to provision above the legal requirements, but an excess over the minimum does not benefit from this tax advantage.

Figure 8 plots the loan loss provision ratio (provisions of the year over total loans). It can be seen that the loan loss provision in Spain shows a strong cyclical behaviour: the ratio of provisions to total loans falls during periods of economic growth and rises considerably during recessions.

Figure 8

Loans loss provision ratio and GDP growth rate depository institutions



Since 1994 the ratio of provisions to total loans has continuously decreased, reaching an all-time low last year as a result of the economic expansion and the strong decline of problem loans. Loan portfolios have, at the same time, been showing strong rates of growth over the last two or three years. Given the positive (although considerably lagged) relationship between credit growth and problem loans, these developments are worrying. In the downturn, the increase in impaired assets and demanding procyclical loan loss provisions could threaten the profits of the riskiest institutions.

From a conceptual standpoint, it is important to keep in mind that credit risk appears at the very beginning of the loan operation when the borrower receives the money. Of course the bank cannot

[23] The only exception is the general provision for mortgages (0.5%) which is not considered as a tax-deductible expense.

know whether a particular loan will default, but it knows that a certain proportion of the loans in its portfolio will certainly default.[24] This should be reflected appropriately by the bank, by charging the borrower with a risk premium. The income stemming from the risk premia should cover the expected losses resulting from problem loans. These are an ex post realisation of credit risk and tend to concentrate in the trough of the business cycle, resulting in a different accounting recognition pattern of income and costs over time.

As a result of the provisioning accounting rules discussed in Annex 1, the latent risk of loan portfolios was not properly recognised in the profit and loss account under the old system. In periods of economic expansion the fall in doubtful loans goes hand in hand with the decrease in provisions, which in turn allows bank managers to improve bottom-line profits. However, there is something wrong in the level of profits shown if the latent credit risk in the loan portfolio is not properly taken into account. Every loan intrinsically has an expected (or potential) loss that should be recognised as a cost by means of an early provision. Otherwise, the picture of the true profitability and solvency of the bank over time could be distorted. More dangerously, the overvaluation of profits might lead to an increase in dividends that could undermine the solvency of the bank. Therefore, the acknowledgement of latent losses is a prudent valuation principle (similar to the mathematical reserves set aside by insurance companies) that contributes to correcting the cyclical bias that currently exists in the profit and loss account.

If the total cost of the loan is not properly recognised and accounted for, bank managers willing to gain market share may be tempted during economic expansions to underprice loans. More conservative managers will face strong incentives to follow this aggressive pricing behaviour in order to protect market shares. This herding behaviour is very dangerous for the stability of the whole banking system.

All these facts and potential or real problems seem to point in the same direction: there is a need for a statistical provision that covers the expected loss inherent in the loan portfolio. This statistical provision should be considered as a cost for the bank and should be taken into account in the pricing of the operation.

5. The statistical provision for insolvency

The new regulation on provisions was approved at the end of 1999 but came into effect on 1 July 2000. Poveda (2000) explains the rationale and the mechanism underlying the so-called statistical provision.

There are two different approaches to complying with this provision. First, banks can use their own internal models in order to determine the statistical provision. Internal models use the bank's own loss experience to determine the provision. However, they must be integrated into a proper system of credit risk measurement and management, use the bank's own historical database spanning at least an entire economic cycle and be verified by the supervisor. The loan portfolio should be segmented in homogeneous groups. If the bank only has internal models for one or some of these groups, the inspectors of Bank of Spain will verify that the bank is not practising a cherry-picking strategy. The internal model approach has been accepted by the regulator so as to stimulate banks to measure and manage their credit risk more in line with the new BIS proposal to reform the Capital Accord. Those banks that have started to use these models for their own internal purposes will be rewarded with its use for the statistical provision.

Alternatively, for those banks that have not yet developed their own internal models, there is a standard approach based on a set of coefficients established by the regulator. The standard approach establishes six risk categories with the corresponding coefficients. Such coefficients are multiplied by the exposure.[25]

[24] The situation is similar to that of insurance products.

[25] Loans to credit institutions are excluded.

1. Without risk (0%): those risks involving the public sector.
2. Low risk (0.1%): mortgages with outstanding risk below 80% of the property value as well as risks with firms whose long-term debts are rated at least A.
3. Medium-low risk (0.4%): financial leases and other collateralised risks (other than those included in point 2).
4. Medium risk (0.6%): risks not mentioned in other points.
5. Medium-high risk (1%): personal credits to finance purchases of durable consumer goods.
6. High risk (1.5%): credit card balances, current account overdrafts and credit account excesses.

These categories correspond roughly to the different levels of credit risk in the portfolio. Our historical experience shows that credit cards, overdrafts and consumer loans are far riskier than mortgages or public sector loans. The coefficients reflect the average net specific provision over the economic cycle. They are based on figures for the period 1986-98, but also take into account the improvements in credit risk measurement and management made by Spanish credit institutions during these years. The statistical provision is obviously intended to anticipate the next economic cycle rather than to reflect past ones.

The fund of the statistical provision for insolvency will be charged quarterly in the profit and loss account by the positive difference between one quarter of the estimate of latent global losses in the different portfolios (using the standard or internal model approach) and the net charges for specific provisions in the quarter. If the difference is negative the amount will be written as income in the profit and loss account, deducting the fund of the statistical provision for insolvency (as long as there is an available balance). The fund built in this way has an upper bound set equal to three times the result of multiplying the coefficients by the exposure.[26] It should be borne in mind that the statistical provision is not a tax-deductible expense.

Some simple algebra will help illustrate the working of the old and new system of provisioning.

Old system

General provision:

Balance: $GF = g*L$, where L stands for total loans and g for the parameter (between 0.5% and 1%).

Annual provision: $GP = g*\Delta L$

Specific provision:

Balance: $SF = e*M$, where M stands for problem loans and e for the parameter (between 10% and 100%).

Annual provision: $SP = e*\Delta M$

Annual total provision in the old system (general + specific):

$AP = GP + SP = g*\Delta L + e*\Delta M$

New system

General and specific provisions: as before.

Statistical provision:

Latent risk measure $Lr = s*L$, where s stands for the average coefficient (between 0% and 1.5% in the standard approach).

Annual provision: $StP = Lr – SP$

If $SP < Lr$ (low problem loans) => $StP > 0$ (building up of the statistical fund)

If $SP > Lr$ (high problem loans) => $StP < 0$ (depletion of the statistical fund)

[26] The limit takes into account the maximum non-specific deduction (4%) set by the European Union Directive (86/635/EEC).

Balance of the statistical fund: $StF = StP_t + StF_{t-1}$, with a limit: $0 \le StF \le 3*Lr$

Annual total provision in the new system (generic + specific + statistical), assuming that limits are not reached:

$$AP = GP + SP + StP = g*\Delta L + SP + (Lr - SP) = g*\Delta L + s*L$$

The expected effects of the new statistical provision

The statistical provision was designed not to replace but to complement the specific provision. Hence it is expected to have a counterbalancing effect on the strong cyclical behaviour of loan loss provisions in Spain. The statistical provision increases precisely during the expansionary phase. During recessions the specific provisions increase while the use of the statistical fund smoothes its impact on the profit and loss account of the bank. The combined effect of both provisions will be a better accounting recognition of both income and costs stemming from bank loan portfolios and hence an improved measurement of bank profits.

The volatility of bank book profits will decrease. The extent to which this lower volatility would have real effects is a much more complex issue that goes beyond the aims of this paper.[27] The main stabilising effect of the statistical provision will be seen in the next recession when banks will be able to use the statistical fund to cover the specific loan loss provisions requirements.[28] Managers pursuing very aggressive credit growth strategies have to set aside more provisions.

From a theoretical point of view, the establishment of the statistical provision might be viewed as a device provided by the regulator to facilitate the coordination of individual banks in order to sidestep the trap indicated by Rajan (1994). Forcing a general increase in loan loss provisions during the expansionary period contributes to reinforcing medium-term bank solvency, to better match income and expenses from an accounting point of view, to decrease earnings volatility and probably to make bank managers more aware of credit risk. Without this "external" intervention, if loan loss provisions were left to the discretion of bank managers, we could end up ex post with an overextension of credit and an excessive build-up of imbalances in the financial sector that might result in financial fragility and distress throughout the economy.

A simulation exercise

Table 3 shows a simulation of the impact of the new statistical provision and its interaction with the profit and loss account. For the sake of simplicity, the calculations have been made annually although the provision is required on a quarterly basis.

It is necessary to make hypotheses about the growth of the loan portfolio (normalised at 1000), the statistical provision parameter value (set at 0.5%)[29] and the ratio of specific loan loss provisions to total loans (for the general provision, a 0.75% parameter is set). Additionally, a hypothesis about profits before taxes is needed.

Figure 9 shows the impact of the old and new system of provisions. Under the old system the joint effect of the specific plus the general provisions was strongly cyclical. The introduction of the statistical provision has a counterbalancing effect, as it has the opposite cycle profile. The joint effect of the old system plus the statistical provision is to smooth provisions during the cycle. As shown in Figure 10, the statistical fund builds up during the expansionary period (low problem loans) and decreases in the downturn. The scenario depicted in Table 3 allows us to illustrate the impact of the statistical provision

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[27] If bank stockholders perceive the lower profit volatility as a measure of lower risk, they could fund the bank at cheaper rates.

[28] Note that when the statistical provision requirement is below the specific one, the difference is credited to the profit and loss account and therefore has the net effect of decreasing the amount necessary to comply with the specific loan loss provision.

[29] The 0.5% is a rough average of the six risk category parameters (from 0% to 1.5%), weighted according to the share of each risk category in the portfolio.

over time. Credit risk grows strongly during the first two years. From the third year a relatively abrupt economic landing starts, profits before provisions decline at the lowest point of the cycle (year 6) and resume thereafter in line with outstanding loans recovery. The statistical fund is built up during the first four years as long as the statistical provision is above the specific one. Two thirds of the statistical fund limit are reached in year 4. As soon as the specific provision requirements outpace the statistical ones (year 5), the statistical fund is depleted, reaching its lowest level in year 8 when it is almost exhausted. From year 9 onwards, the build-up resumes as the cyclical position of the economy improves.

Table 3 shows that the joint effect of the specific plus the general loan loss provisions (those existing in Spain until last year) was slightly below 15% of profits before provisions until the economy turned down. When economic conditions deteriorated, profits decreased strongly. In year 6 almost three quarters of profits before provisions were wiped out.

Under the new system, the statistical provision represents more than 15% of profits up till the recession. Later on, it becomes negative as the statistical fund is used. When all the loan loss provisions are considered together, the picture is much more reassuring: during almost all the period simulated, the joint impact of the three types of provisions on profits is around 35%, although it increases slightly over time as a result of the hypothesis made on the course of profits before provisions and total loans. Contrary to the "old system" scenario, in the recession there is no abrupt fall in profits after provisions.

Other scenarios, changing one or several of the hypotheses used in Table 3, have been tested. For instance, if instead of using a 0.5% parameter for the statistical provision we set its value at 0.4%, the statistical fund is completely exhausted in year 6 and does not start to build up again until year 10. On the other hand, if we use 0.6% as the value of the parameter, the statistical fund never approaches the lower limit and the impact on the level of profits is higher.

The real impact of the statistical provision will depend on the coefficient applied by each bank (the standard one or the result of internal models), the course of profits before provisions, credit growth, and the future specific provisions that the bank will need. Loan portfolio composition affects the value of the standard coefficients used and, therefore, changes the amount of the statistical fund.

Table 3
Simulation exercise

Items	y0	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11
Total loans												
Outstanding stock	1000.0	1160.0	1345.6	1507.1	1627.6	1725.3	1794.3	1902.0	2035.1	2197.9	2417.7	2707.8
Rate of growth (%)		16.0	16.0	12.0	8.0	6.0	4.0	6.0	7.0	8.0	10.0	12.0
Profits before provisions												
Level	21.5	23.2	25.0	26.0	26.5	26.5	26.0	26.5	27.6	29.3	31.6	34.8
Rate of growth		8.0	8.0	4.0	2.0	0.0	– 2.0	2.0	4.0	6.0	8.0	10.0
Net loan loss provision												
Specific[1]		1.7	2.0	3.0	5.7	9.5	17.9	14.3	11.2	8.8	7.3	5.4
General[2]		1.2	1.4	1.2	0.9	0.7	0.5	0.8	1.0	1.2	1.6	2.2
Total		2.9	3.4	4.2	6.6	10.2	18.5	15.1	12.2	10.0	8.9	7.6
Statistical provision												
Parameter value (%)	0.5											
Estimated expected loss[3]		5.8	6.7	7.5	8.1	8.6	9.0	9.5	10.2	11.0	12.1	13.5
Actual statistical provision[4]		4.1	4.7	4.5	2.4	– 0.9	– 9.0	– 4.8	– 1.0	2.2	4.8	8.1
Statistical fund	0.0	4.1	8.8	13.3	15.7	14.9	5.9	1.1	0.1	2.3	7.2	15.3
Upper limit	15.0	17.4	20.2	22.6	24.4	25.9	26.9	28.5	30.5	33.0	36.3	40.6
Total loan loss provisions		7.0	8.1	8.7	9.0	9.4	9.5	10.3	11.2	12.2	13.7	15.7
Profits after provisions												
Without statistical provision		20.2	21.6	21.8	19.9	16.3	7.6	11.5	15.4	19.2	22.7	27.2
With statistical provision		16.2	16.9	17.3	17.5	17.2	16.5	16.2	16.4	17.0	17.9	19.0
% over total loans												
Net loan loss provision		0.25	0.25	0.28	0.41	0.59	1.03	0.79	0.60	0.46	0.37	0.28
Specific		0.15	0.15	0.20	0.35	0.55	1.00	0.75	0.55	0.40	0.30	0.20
General		0.10	0.10	0.08	0.06	0.04	0.03	0.04	0.05	0.06	0.07	0.08
Statistical provision		0.35	0.35	0.30	0.15	–0.05	–0.50	–0.25	–0.05	0.10	0.20	0.30
Statistical fund	0.00	0.35	0.65	0.88	0.97	0.86	0.33	0.06	0.01	0.11	0.30	0.56
Upper limit	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Total loan loss provisions		0.60	0.60	0.58	0.56	0.54	0.53	0.54	0.55	0.56	0.57	0.58
Profits after provisions												
Without statistical provision		1.74	1.61	1.45	1.23	0.95	0.42	0.60	0.76	0.88	0.94	1.00
With statistical provision		1.39	1.26	1.15	1.08	1.00	0.92	0.85	0.81	0.78	0.74	0.70
Provisions over profits before provision (%)												
Specific + general provisions		12.7	13.6	16.2	24.9	38.5	71.0	56.8	44.2	34.2	28.2	21.8
Statistical provision		17.5	18.8	17.4	9.2	– 3.2	–34.5	–17.9	– 3.7	7.5	15.3	23.4
Total provisions		30.2	32.4	33.6	34.1	35.3	36.5	38.9	40.5	41.7	43.5	45.2

[1] The specific provision is linked to problem loans and hence cyclical. Here we make a hypothesis about its behaviour along a complete cycle. [2] 0.0075*Change in outstanding loans. The parameter 0.0075 is a weighted average of the coefficients applied to mortgages and other risks. [3] Parameter of the statistical provision multiplied by the outstanding stock of loans. [4] Estimated expected loss minus the specific provision, unless the statistical fund reaches its upper or lower limit.

Figure 9

**Provisions over total loans
(simulations exercise)**

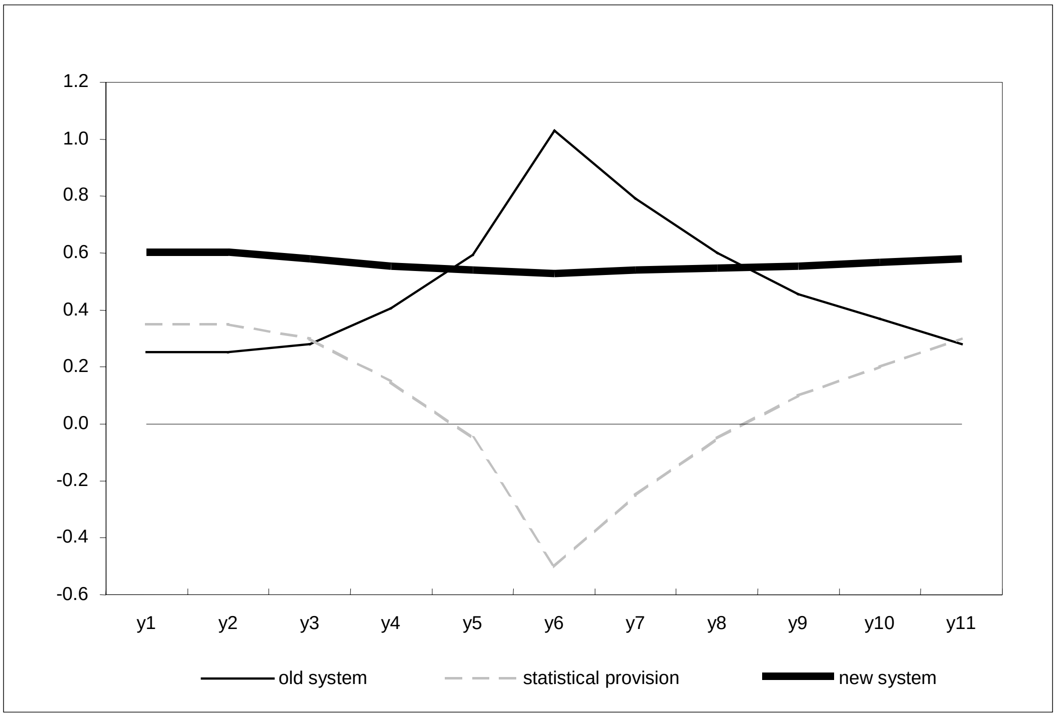
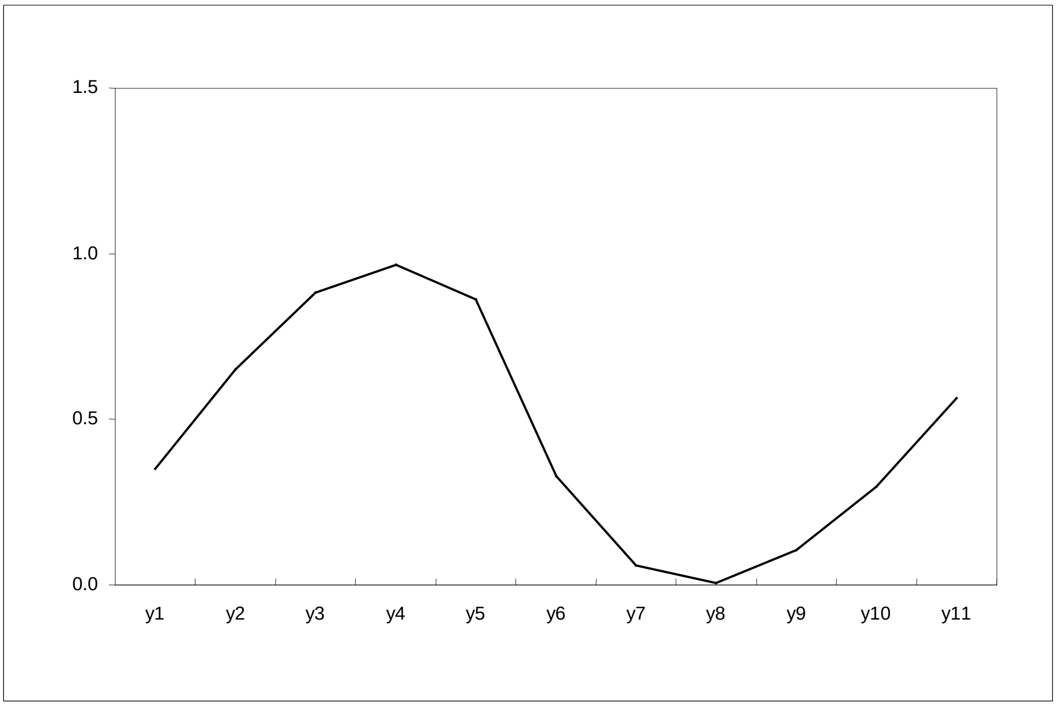


Figure 10

**Statistical fund over total loans
(simulations exercise)**



6. Concluding remarks

In this paper the rationale for a proper accounting of provisions for bad loans is discussed and analysed. Bank lending is strongly procyclical in Spain, as it is in many other countries. In a context of strong competitive pressures, there is a tendency for loose bank credit conditions in an upturn in view of the low level of contemporaneous non-performing loans. This may contribute to the build-up of financial imbalances in the non-financial sector. The low credit quality of these loans will only become apparent with the ex post emergence of default problems, which will tend to appear during downturns, with an estimated lag of approximately three years in the case of Spain.

Provisions in Spain have traditionally had a procyclical bias as they were largely linked to the volume of contemporaneous problem assets. The potential coincidence at the peak of loose credit policies and low provisions is an important concern for bank supervisors. Low provisioning reveals that latent risks are not properly acknowledged. As a result, book profits tend to overstate true profits in periods of low non-performing loans and high credit growth (upturn) and understate them in periods of high problem loans and low credit growth (downturn).

The new *statistical* provision introduced recently attempts to fill the gap, as it aims at covering expected losses. The statistical provision is an increasing function of portfolio risk. It is inversely related to the specific loan loss provision. When the latter decreases the statistical provision increases, building up a statistical fund. When specific provisions rise again in the downturn, the statistical fund is progressively depleted and the impact on profits is smoothed. As a result, there is a better matching of income and expenses stemming from loan portfolios throughout the cycle and hence, a better measurement of bank profits.

From a theoretical point of view, the new provision could also be seen as a device that corrects the effects of certain inefficiencies that arise in the banking sector as a result of disaster myopia, herd behaviour, asymmetric information and short-term concerns of bank managers.

The introduction of the statistical provision is expected to improve bank managers' awareness of credit risk, leading to a proper recording and recognition of ex ante credit risk, reducing the procyclical behaviour of loan loss provisions, and correcting cyclical biases and volatility in banking profits as a result of the improved accounting acknowledgement of expected losses in bank loan portfolios.

Annex 1

Asset classification criteria

There are two main criteria for classifying an asset as doubtful:

- Outstanding debts more than three months overdue. Additionally, in relation to a single risk: the accumulation of unrepaid matured sums for an amount of over 25% of the outstanding debt will entail the classification of the entire loan as doubtful. In relation to a customer: the accumulation of sums classified as doubtful of over 25% of the outstanding risks will classify the total risk with that customer as doubtful.
- Debts, matured or not, which do not meet the first criteria are classified as doubtful if there are reasonable doubts concerning their repayment. There are some objective circumstances: if the borrower has negative equity, continuous losses, general delays in payment, an inadequate assets-to-liabilities or equity-to-liabilities ratio, cash flow problems or the impossibility of obtaining additional financing. At the same time, debts that are in the process of legal recovery, debts of borrowers who are for the time being illiquid, etc.[30]

A debt, matured or not, will be classified as very doubtful and written off when the borrower is declared bankrupt or if it has been classified as doubtful for three years (six years for mortgages).

Provisioning criteria

Specific provisions

For assets classified as doubtful because they are in arrears, the provisions will be provided according to percentages of their value based on the time elapsed since the maturity of the first quota.

1.1 In general:

- Between 3 and 6 months: 10%
- Between 6 and 12 months: 25%
- Between 12 and 18 months: 50%
- Between 18 and 21 months: 75%
- Over 21 months: 100%

1.2 Mortgages:

- Between 3 and 4 years: 25%
- Between 4 and 5 years: 50%
- Between 5 and 6 years: 75%
- Over 6 years: 100%

[30] This is meant to further curtail managers' discretion.

- While the amount of the outstanding risk is greater than 80% of the value of the property, the general percentages (1.1) shall be applied.

Risks with the public sector do not require provision.

In the case of assets classified as doubtful for reasons other than insolvency (existence of arrears), provisions should be created up to the estimated value of the non-recoverable amounts. In general they cannot be less than 25% of the balances classified as doubtful. Credits of over €25,000 which are not classified as doubtful, and are not adequately documented, will be provisioned at 10%.

General provisions

Regardless of the funds considered for provision previously, credit exposures, contingent liabilities and doubtful assets for which there is no obligation to make specific insolvency provision (with the exception of public sector exposures) will require funds to be set aside applying the following percentages:

0.5% for mortgages (with outstanding risk below 80% of the property value)

1% for all other risks

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The cost of a guarantee for bank liabilities: revisiting Merton

Christian Braun[1]

1. Introduction

Information based on market prices can be a useful tool for assessing a bank's condition (see, eg, Flannery (1998)). Market prices contain all the information currently available to market participants and lend themselves to being combined into meaningful indicators supplying bank supervisors with additional assessment criteria. One such indicator may be the value of an explicit third-party guarantee for part or all of a bank's liabilities or the value of an implicit guarantee, eg under a de facto too-big-to-fail doctrine. A guarantee for bank liabilities transforms a formerly risky debt into a riskless obligation by shifting the risk from the creditors to the guarantor. As with every other insurance, such a transfer of risk has value for the insured party and imposes a cost on the insurer. Provided that the guarantee is politically binding, that cost is essentially the same for both explicit and implicit guarantees. The cost itself varies with the amount of risk transferred: high-risk banks impose high cost on the guarantor and vice versa. Because of the connection between the cost of the guarantee and the risk of the bank, estimates of that cost lend themselves to being used not only to fix actuarially fair insurance premia (ie compensations for third-party guarantees), but also to give bank supervisors an (additional) indication of the condition of a bank - whether that bank has a guarantee or not. The question, of course, is how to estimate that cost.

In 1977, Merton showed that a guarantee for the liabilities of a bank is equivalent to a European-style put option written on the assets of the bank. According to this, the value of the guarantee, ie the actuarial insurance premium attached to the given protection, is a decreasing function of the asset-to-liability ratio and an increasing function of the volatility of the asset returns. This insight gave rise to an extensive body of literature on the valuation of (deposit) guarantees and prepared the ground for bank-specific estimates on the basis of market data collected over quite a short time period. One of the most influential implementations of Merton's concept is the model conceived by Ronn and Verma (1986). Their relatively easy-to-use method became a kind of standard approach and was subsequently adopted by Giammarino et al (1989), Duan et al (1992), Sheldon (1996) and others.

The beauty of Merton's concept and Ronn and Verma's implementation lies in its simplicity. But as in the old saying, this beauty comes at a price. Like the Black-Scholes option pricing model on which it is based, the Merton-Ronn-Verma approach is subject to shortcomings and distortions that result in a tendency to misprice far-out-of-the-money and deep-in-the-money options (see, eg, Black (1988)). The root of the problem is that the standard Black-Scholes option pricing model assumes the price of the underlying asset to follow a geometric Brownian motion, ie it assumes normally distributed returns. Empirically, however, the returns of a bank's assets are not normally distributed. They rather show a negative skewness, ie a relatively higher density in the area of (highly) negative returns. As a result, the standard Merton-Ronn-Verma approach systematically underestimates the default probability - empirical default probabilities tend to be significantly higher than those implied by the Merton-Ronn-Verma approach - and, consequently, the cost of the guarantee.

The purpose of this paper is to present a suggestion on how to overcome that weakness while trying to retain as much of the original model's simplicity as possible. The suggestion we make is an empirical enhancement of the Ronn-Verma model that is based on a procedure employed by KMV Corporation.[2] The modification itself consists of an ad hoc adjustment of the model-implied volatility of a bank's asset returns to a level which brings the default probability consistent with the original model into line with rating agencies' empirical findings on default probabilities of corporate bonds. The adjusted volatilities are then used to generate an alternative set of estimates for the cost of the guarantee. Mainly for illustrative purposes, both the standard approach and the modified version are

1 Many thanks go to Christian Walter for his collaboration in the early stages of the project and to Christof Stahel for his much appreciated assistance.

2 KMV Corporation is a provider of credit risk measurement and management technology to financial services firms.

estimated on a monthly basis from July 1997 to June 2000 using data on selected Swiss banks with full, partial or no explicit third-party guarantee. We find large variations over time as well as across institutions and make out a substantial difference in level between the original model and the modified version.

The remainder of the paper is organised as follows: Section 2 develops the original as well as the modified model employed to estimate the cost of the guarantee for bank liabilities. Section 3 discusses the data and gives some background information on the characteristics of the banks considered; Section 4 presents the findings, and Section 5 contains a summary and conclusions.

2. Models

As shown by Merton (1977), a guarantee for a single, homogeneous term, discount debt issue can be modelled as a European put option written on the debtor's assets which in this case serves as the underlying. The exercise price of the put option is equal to the maturity value of the debt obligation, and its maturity corresponds to the maturity of the debt issue. By writing such an option, the guarantor gives the creditors the right to sell him their claims on the debtor's assets at a price equal to the outstanding liabilities. Since it is a European option, it can only be exercised on the maturity date. If at that time the value of the debtor's assets is smaller than the value of the liabilities, ie if the debtor is bankrupt, the creditors' put option will be exercised. According to the above, the value of the guarantee, *G*, at the maturity date is

$$G = Max[0, L - A], \tag{1}$$

where *L* stands for the liabilities and *A* for the assets. Applying this analogy to a real bank, however, raises practical difficulties. The boundary condition in equation (1) requires the same maturity date for all the debtor's obligations. A real bank doesn't meet that requirement, of course. Its liabilities rather mature over a broad spectrum of dates. Merton (1977) suggests overcoming that difficulty by reinterpreting the maturity of the liabilities as the length of time until the next bank audit. After examination by the auditors, the bank is either declared solvent or bankrupt. If the bank has a positive net worth, the put option, according to equation (1), has zero value and expires unused; it will then be replaced by a new one. If, on the other hand, the bank is bankrupt, the option has a positive value $(L - A)$ and will thus be exercised.

a. The standard approach

The standard approach upon which we build the proposed modifications is the Merton-Ronn-Verma approach, ie the method proposed by Merton (1977) and implemented by Ronn and Verma (1986).[3] Hence, making the standard assumptions of the Black-Scholes option pricing model, the formula for the value of the guarantee, *G*, can be derived analogously to the formula of a standard put option as derived by Black and Scholes (1973). It can be written as

$$G = -A \cdot N(-d_1) + L \cdot N(-d_2), \tag{2}$$

where

$$d_1 = \frac{ln(A / L) + (\sigma_A^2 / 2) \cdot T}{\sigma_A \cdot \sqrt{T}},$$

$$d_2 = d_1 - \sigma_A \cdot \sqrt{T},$$

[3] Ronn and Verma (1986) use a modified closure condition in their model, which sets the default point - the asset value at which a firm defaults - below the value of total liabilities. That feature is not adopted here. We set the default point at its theoretical level instead, ie where assets equal total liabilities, thereby taking account of the change in institutional conditions and the reduced (public) tolerance towards forbearance.

$N(\cdot)$ is the cumulative density function of a standard normal random variable, σ_A denotes the volatility of the (logarithmic) rate of return on the bank's assets, *A*, and *T* refers to the life of the option. *L* stands for the nominal value of the liabilities and can be taken from the bank's balance sheet.

In order to make the value of the guarantee comparable across banks, it has to be normalised, ie stated in terms of a certain amount, *k*, of insured liabilities.[4] The value of the guarantee per *k* Swiss francs of insured liabilities, *g*, can then be determined by multiplying both sides of equation (2) by (k / L). Thus, equation (2) transforms into

$$g = \frac{k}{L} \cdot G = -k \cdot \frac{A}{L} \cdot N(-d_1) + k \cdot N(-d_2), \tag{2a}$$

where d_1 and d_2 are the same as above.

The solution of the model presented in equations (2) and (2a) requires estimates of the market value of the bank's assets, *A*, and the volatility of their returns, σ_A. Both of these variables cannot be observed. However, they can be determined by means of two additional equations. The first equation goes back directly to Black and Scholes. In their seminal 1973 paper, they point out that it is possible to also view the equity of a firm as a European call option on the assets of that firm. In that framework, Black and Scholes consider the creditors as de facto owning the assets of the firm. By issuing a call option on these assets, they give the shareholders the right to buy the assets back. According to this, the shareholders' call option will be exercised if on the maturity date the value of the assets exceeds the value of the outstanding liabilities, ie if the firm is solvent. Hence, on the maturity date the value of that option representing the firm's equity, *E*, is equal to

$$E = Max[0, A - L],$$

where *A* and *L* are defined as above. Since the parameters of that call option are exactly the same as those of the put option written by the guarantor and held by the creditors, the shareholders' exercising behaviour must be the exact opposite of the exercising behaviour of the creditors: if the shareholders exercise, the creditors don't and vice versa. Given the standard assumption of the Black-Scholes pricing model, the formula for the equity viewed as a call option can then be written as

$$E = A \cdot N(d_1) - L \cdot N(d_2), \tag{3}$$

where d_1, d_2 and $N(\cdot)$ are the same as in equation (2).

The second equation required to determine the market value of the assets, *A*, and the standard deviation of the rate of return on *A*, σ_A, can be derived from Ito's lemma and postulates a functional relationship between the volatility of the equity returns, σ_E, and σ_A (see, for example Hull (1997)). From Ito's lemma, it follows that the standard deviation of the process *dE*(*A*, *t*) is

$$\sigma_E = \frac{A \cdot \frac{\partial E}{\partial A}}{E} \cdot \sigma_A, \tag{4}$$

where $\frac{\partial E}{\partial A}$ is the delta of the option and equal to $N(d_1)$.

By means of equations (3) and (4), the observable market value of equity, *E*, and the volatility of equity returns, σ_E, it is now possible to simultaneously estimate the two unknowns *A* and σ_A by a numerical routine. Together with the other known variables - *L* and *T* - these estimates can then be inserted into equations (2) and (2a) to solve for the respective values of the guarantee, *G* and *g*.

[4] For the calculations, *k* is set equal to CHF 1,000 ($k = 1{,}000$).

b. The modified approach

It is well known that the Black-Scholes option pricing model tends to misprice far-out-of-the-money and deep-in-the-money options (see, eg, Black (1988)). Unfortunately, that weakness has an effect on both options considered in the Merton-Ronn-Verma approach: for a solvent bank, the put option in equation (2) representing the guarantee is usually far out of the money, and the call option in equation (3) representing the equity is usually deep in the money. Hence, "the holes in Black-Scholes" may cause distortions in both cases. These distortions become apparent when empirical default probabilities are compared to corresponding default probabilities extracted from the Black-Scholes option pricing formula used in the Merton-Ronn-Verma approach. In this comparison, the latter tend to be significantly lower than the empirical data indicate. This underestimation of default probabilities can be attributed to the fact that the normal distribution of returns as assumed by the Black-Scholes model is only an imperfect description of reality. The deviations are especially strong in the area of highly negative returns, where the real distribution, which has negative skewness, shows a significantly higher density. We try to take account of this problem by combining the standard approach described above with empirical elements. Specifically, we use rating agencies' empirical findings on default probabilities to increase the model-derived volatility of asset returns to a level which brings the corresponding default probability into line with the empirical findings. In other words, we equate the density in the relevant part of the tail of the model-implied distribution with that of the real distribution and thereby increase the volatility of asset returns. The adjusted volatilities obtained by equalising the densities in the relevant part of the tail of the model-implied and the real distribution[5] are then reinserted into equations (2) and (2a) in order to obtain alternative estimates of the fair insurance premia.

To this end, we first create a functional link between the respective bank's estimated distance to default and the probability of default based on empirical data. The distance to default is a measure of soundness used by KMV Corporation. It expresses the size of a firm's capital buffer in terms of standard deviations of its rate of return on assets according to the formula

$$DtD = \frac{A - P}{A \cdot \sigma_A}.$$

Here *DtD* stands for the distance to default, *P* denotes the point of default, defined as the asset value at which a firm defaults, and *A* and σ_A are the same as above. The distance to default combines asset value, business risk and leverage in a single measure of default risk. The higher the distance to default, the lower the default risk of the firm and vice versa. KMV Corporation assumes the point of default of firms to lie somewhere between total liabilities and short-term liabilities. But since banks are heavily regulated and closely supervised, we assume the point of default to be equal to total liabilities and therefore set $P=L$. With estimates of *A* and σ_A available from the standard approach described above and the nominal value of the liabilities, *L*, known, results for *DtD* can be obtained easily. In order to create the functional link between the distance to default and the empirical probability of default, a two-step procedure is applied. In step one, we estimate the distance to default for a sample of 40 international banks with ratings ranging from AAA to BBB- (ie investment grade ratings). The distances to default are then regressed on the corresponding ratings for long-term debt using the equation

$$DtD = u + v \cdot \log R + \varepsilon\,, \tag{5}$$

where *DtD* is the distance to default as defined above, *R* the rating category[6] and ε the error term. In this way, a functional relationship between the distance to default and the rating is created. The resulting distances to default for each rating category are shown in column 2 of Table 1 below. In step two, we replace the ratings by their corresponding historical default probabilities and, after adjustments for small-sample noise in the higher rating categories,[7] create a function approximating the

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[5] There is no need to know the exact shape of the real distribution, since all we need is the density below the default point, ie the empirical probability of default.

[6] The ordinal ratings are replaced by cardinal numbers ranging from 1 for AAA to 10 for BBB-. The parameters *u* and *v* are: $u = 6.263118$ and $v = 0.816924$.

[7] The empirical default frequencies listed in column 3 of Table 1 are the one-year cumulative default rates from Standard & Poor's. They show that defaults of highly rated firms within one year are very rare. As a result, the data in the higher rating categories tend to be noisy. To obtain monotonically rising default rates and to take into consideration that insolvencies of

relationship between the distance to default and the adjusted empirical default probability. This function can then be used to translate a bank's distance to default into a default probability that is consistent with the empirical tendency of corporate bonds to default. The translation function itself is a composite function created by linking up a hyperbola and a parabola at $DtD = DtD_{BBB-}$; the hyperbola translates the *DtD* values above $DtD = DtD_{BBB-}$, the parabola those below. The fit was achieved by minimising (i) the squared differences between the hyperbola's and the parabola's respective slopes at $DtD = DtD_{BBB-}$, (ii) the divergence of the parabola's intercept with the vertical axis from the 100% mark, and (iii) the squared differences between the empirical and the approximated values.[8] The approximated default probabilities corresponding to the respective rating categories are shown in column 5 of Table 1.

Table 1

Relationship between rating, distance to default and default frequencies

Col 1		**Col 2**	**Col 3**	**Col 4**	**Col 5**
Rating		**Estimated distance to default**	**Empirical default frequency (1 year; in %)**	**Adjusted default frequency (1 year; in %)**	**Approximated default frequency (1 year; in %)**
ordinal	**cardinal**				
AAA	1	6.263	0.000	0.010	0.007
AA+	2	5.697	0.000	0.015	0.013
AA	3	5.365	0.000	0.020	0.020
AA-	4	5.130	0.000	0.025	0.030
A+	5	4.948	0.030	0.030	0.042
A	6	4.799	0.040	0.040	0.060
A-	7	4.673	0.070	0.070	0.084
BBB+	8	4.564	0.130	0.130	0.118
BBB	9	4.468	0.200	0.200	0.167
BBB-	10	4.382	0.220	0.220	0.242

From the above, it is obvious that only the upper part of the translation function - the one described by the hyperbola - is well supported by empirical data. The parabola, on the other hand, has only two anchor points: one at $DtD = DtD_{BBB-}$, the other at DtD=0, where the empirical probability of default, PD_e , is 100%. This restriction is mostly due to the fact that sub-investment grade banks are not the norm and satisfactory data are correspondingly scarce. Estimates falling into the lower part of the spectrum (where $DtD < DtD_{BBB-}$) therefore have to be treated with due care.

By means of the functional link between the estimated distance to default and the empirical default probability, we can now estimate the alternative values of the guarantee, *G* and *g*. This too is done in two stages. In the first step, we adjust the model-implied volatility of asset returns to a level which brings the default probability generated by the standard model into line with our estimate from the translation function. The probability of default generated by the standard model described above corresponds to $N(-d_2)$ in equation (2). According to the Black-Scholes option pricing formula,

highly rated firms do indeed happen, we replaced the original default frequencies for the four highest rating categories by the (italic) figures shown in column 4 of Table 1.

8 The resulting translation function has the form

$$PD_e = \begin{cases} \dfrac{a}{(DtD - b)^c}, \text{ if } DtD \geq DtD_{BBB-} \\[2ex] d + e \cdot DtD + f \cdot DtD^2, \text{ if } DtD < DtD_{BBB-} \end{cases} .$$

The upper part represents a hyperbola with *a*=0.04594783, *b*=3.90965221, *c*=2.21549399, the lower part a parabola with *d*=100.00091548 (intercept where PD_e =100%), *e*=-44.39572746, *f*=4.9361389. PD_e denotes the empirical probability of default, and *DtD* the distance to default.

$N(-d_2)$ is the probability that a put option will be exercised. In our application of that formula, the put option represents the guarantee; it will be exercised if at the maturity date the bank is bankrupt. Hence, $N(-d_2)$ is equivalent to the bank's current probability of default (the probability that in its current condition the bank becomes insolvent within the life of the option) and we can set

$$PD_e = N(-d_2) = N\left(-\frac{ln(A/L) + \left(\sigma_A^2/2\right) \cdot T}{\sigma_A \cdot \sqrt{T}} + \sigma_A \cdot \sqrt{T} \right). \tag{5}$$

Here, PD_e is the empirical probability of default as calculated by the translation function described above and $N(-d_2)$ is defined as in equation (2). With PD_e determined, equation (5) can implicitly be solved for the corresponding volatility of asset returns, σ_A. In step two, these modified volatilities are inserted into equations (2) and (2a) in order to generate the modified values of the guarantee and the guarantee per CHF 1,000 of insured liabilities, respectively.

From a theoretical point of view, this "rough-and-ready" approach may be disputable. It is inconsistent insofar as one part of the analysis builds on the assumption that the underlying stochastic process for the evolution of the banks' asset values follows a Brownian motion, whereas the other part explicitly attempts to correct for some of the inadequacies of that very assumption. But we see this empirically enhanced version of the standard Merton-Ronn-Verma approach primarily as a practitioner's method that tries to remedy the well known empirical shortcomings of the standard model. In the absence of a coherent and consistent alternative that would both overcome the empirical shortcomings of the standard approach and be implementable at a similar cost in terms of data requirement and computational burden, we see the modified version as a viable alternative.

3. Data

The two approaches described in the preceding section - the standard Merton-Ronn-Verma approach and the modified version - require as input the equity value, E, the volatility of past equity returns, σ_E, the nominal value of total liabilities, L, and the life of the option, T, ie market prices as well as balance sheet data. In order to be eligible for either approach, therefore, a bank has to have actively traded shares. The quotations of these shares are taken from Datastream; the volatility of equity returns, σ_E, is calculated on the basis of 90 trading days; the balance sheet data required for the banks to which the two methods are applied are taken from the monthly banking statistics of the Swiss National Bank. As suggested by Merton (1977), we reinterpret the life of the option, T, as the time between audits and, following Marcus and Shaked (1984) and others, set it equal to one year.[9]

In order to derive the translation function for the empirically enhanced version, we used the historical default probabilities from Standard & Poor's. The balance sheet data of the international banks used to create the relationship between the distance to default and the rating are taken from the International DataBook of Thomson BankWatch. The relationship itself was built on a point-in-time basis, taking into consideration that some of the disturbing (business cycle) effects inherent in that approach are filtered out by diversifying the sample of banks used to create that relationship over several countries. Such business cycle effects occur, because, eg, a double-A rating does not have the same quality in an economic upswing as during a downturn. A translation function taking account of this, therefore, would tend to move left (downturn) and right (upswing). By choosing a point-in-time approach, such movements are prevented in favour of a stable relationship that tends to overestimate the cost of a guarantee during downturns and vice versa.

9 Giammarino et al (1989) argue that since the periodicity of audits is difficult to estimate empirically, the assumption of one year is somewhat arbitrary. However, they also point out that while increasing the time to maturity will increase the estimated option values, the cross-sectional comparison of bank performance is robust to changes in the maturity, T. For further comments on this issue, see also Ronn and Verma (1986).

By means of these data, we generate monthly estimates for the (normalised) cost of a guarantee for bank liabilities over a three-year period from July 1997 to June 2000.[10] While doing so, we implicitly assume that every month the banks receive a new put option. This means that the liabilities are rolled over on a monthly basis, so that the life of the option at the beginning of each month is always equal to one year (see Ronn and Verma (1986)).

The sample of banks used to illustrate the modified Merton-Ronn-Verma approach consists of eight Swiss banks - seven cantonal banks and one big bank. Cantonal banks have a special status within the Swiss banking system. The main feature distinguishing them from other banks is their establishment on the basis of cantonal legislation.[11] Among their other specific characteristics, the two most prominent are state control and state guarantees. The 24 cantonal banks in existence are fully controlled by the respective canton, although some of them have issued non-voting shares to the general public in recent years. In all but two cases, state ownership is accompanied by a state guarantee that covers all the liabilities of the banks.[12] Thus, the cantons are not only the owners, but also the guarantors of the cantonal banks. This is about to change though: since 1999, a state guarantee is no longer a necessary characteristic of a cantonal bank, and it is now sufficient for the canton to hold more than one third of the bank's equity and voting rights. Several cantons want to make use of that possibility and reduce their controlling interest, although most of them have no plans to change the terms of the guarantee. Despite the many common attributes, there are also substantial differences among the cantonal banks, particularly in terms of size and business activity. Most cantonal banks only operate in their respective canton, and so their size and business activities strongly depend on the canton's population and economic strength. Measured by total assets, six cantonal banks rank among the top 10 Swiss banks. Many of them are involved in business activities similar to those of the big banks, except that they are barely involved in foreign markets. Most of the seven cantonal banks that met our requirements are medium-sized. They represent varying economic areas and, to some extent, pursue different corporate policies. Unfortunately, the market for their shares is not very deep, and thus a caveat regarding the quality of the data seems appropriate.[13] There is no such problem for the big bank in our sample; its shares are among the most traded in the market. Like the other non-cantonal banks, the big bank has no third-party guarantee for its liabilities. But together with most other Swiss banks, it is a signatory of the Swiss Bankers Association's "Agreement on Depositor Protection in case of Compulsory Bank Liquidation". In the event of a bankruptcy moratorium or bankruptcy proceedings against a signatory bank, this agreement provides limited advance payment, supplied by other signatory banks, for legally privileged depositors.

4. Findings

In a nutshell, running the bank data through the two models described in Section 2 produces three major findings:

- the results are highly sensitive towards the method applied
- they show significant variations over time
- they reveal large cross-sectional differences

[10] The transition from daily to monthly data for both the equitiy price and the volatility of equity returns was made by taking the average over the respective month.

[11] Switzerland operates a three-tier system of government, with the 26 cantons placed between the Confederation and the municipalities.

[12] The two exceptions are the Banque Cantonale de Genève and the Banque Cantonale Vaudoise, both part of our sample. The former has only a limited guarantee, the latter no guarantee at all.

[13] Despite this qualification, equity prices are still the best market data available. For mid-sized firms, bond markets are generally less liquid than stock markets and indicators based on bond prices are accordingly less sound.

The results are presented below, both graphically and in tabulated form. For each of the eight banks examined, we show the estimates of the normalised cost of the guarantee, g, for both the standard model (see Table 2 and Figure 1) and the modified version (see Table 3 and Figure 2).[14]

The sensitivity of the results to the choice of method is quite astonishing. Compared with the standard Merton-Ronn-Verma approach, the modified version shows significantly higher estimates. For our sample, the numbers are at least five times higher when the empirically enhanced model is applied. Moreover, that factor becomes much larger when the estimates get smaller, ie the farther out of the money the option is (see Figures). The finding that smaller values for the cost of the guarantee are raised relatively more than larger values can be seen as an indication that the tendency of the Black-Scholes option pricing model to misprice far-out-of-the-money options is indeed alleviated by the modified approach.

It is obvious that the results depend a lot on the form of the function that translates the distance to default extracted from the standard model into default probabilities that are in line with empirical findings. The composite translation function described in Section 2b is just one of several possibilities and open to challenge. Still, the results obtained suggest that the method matters a lot and that the recalibration based on empirical data brings measures into dimensions which seem closer to what one would expect. The problem, of course, is that an empirical verification of both the Merton-Ronn-Verma approach and the modified version is hardly possible, since the central variables - the market value of assets, A, and the volatility of their returns, σ_A - cannot be observed. In order to understand the results, especially those that seem incredibly high, it is important to know exactly what they mean. The normalised cost of a guarantee for a bank's liabilities can also be seen as a rough approximation of the default probability: if the value of the guarantee is, eg, CHF 50 per CHF 1,000 of liabilities, then the probability of default is roughly 5%. Those 5% mean that, given the current values for volatilities, leverage etc the bank will default within one year with a probability of 5%. In reality, however, the parameters change continuously, basically with every transaction made. High values for the cost of the guarantee, therefore, can be the result of a short-lived overreaction of the market upon some bad news and thus need not remain.

Our results also reveal large variations over time for both methods. These variations reflect macroeconomic as well as bank-specific events. They are also in line with the anecdotal evidence. The main underlying driver of the variation over time is the share price, ie the assessment by market participants. Both models are highly sensitive towards such changes. Price variations not only affect the leverage, they also have quite a significant impact on volatilities. The sensitivity to price changes is exacerbated by a highly non-linear relationship between the volatilities and the cost of the guarantee. That market participants are the driving force behind the results generated by the two approaches is indicative of the limitations of market-based methods in general: these methods express the expectations going into the share price, but not necessarily the default risk. As a consequence of this, perverse expectations generate perverse results.

We also found large cross-sectional differences among the eight banks considered. This is not surprising, since banks differ in a number of ways (activities, geographical focus and reach, degree of diversification, leverage, quality of management, etc) and have different risk appetites. But behind the cross-sectional differences, there are also similarities - parallel movements among several banks - to be made out. These are indicative of macro shocks affecting most banks in a similar way, or even of contagion or information effects that can occur when a bank-specific shock undermines confidence in the whole banking system (the latter might indeed have been the case in late 1998).

[14] In the Figures, we set lower bounds for the value of the normalised guarantee at CHF=0.0001 for the standard approach and CHF=0.01 for the modified version.

Table 2

Normalised cost of a guarantee according to standard approach (in CHF)

	Bank A	Bank B	Bank C	Bank D	Bank E	Bank F	Bank G	Bank H
Jul 97	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
Aug 97	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009
Sep 97	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0063
Oct 97	0.0000	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	0.0089
Nov 97	0.0000	0.0000	0.0000	0.0000	0.0003	0.0001	0.0000	0.0693
Dec 97	0.0000	0.0000	0.0000	0.0000	0.0006	0.0025	0.0000	0.3240
Jan 98	0.0000	0.0006	0.0000	0.0000	0.0011	0.0032	0.0000	0.2927
Feb 98	0.0000	0.0017	0.0000	0.0000	0.0004	0.0038	0.0000	0.2555
Mar 98	0.0000	0.0007	0.0000	0.0000	0.0075	0.0006	0.0000	0.0365
Apr 98	0.0000	0.0000	0.0328	0.0000	0.1390	0.0137	0.0001	0.0034
May 98	0.0000	0.0000	0.0746	0.0000	0.4391	0.0254	0.0002	0.0074
Jun 98	0.0000	0.0001	0.2729	0.0000	0.4661	0.0148	0.0002	0.0097
Jul 98	0.0000	0.0022	0.2127	0.0000	0.4403	0.0078	0.0000	0.0970
Aug 98	0.0000	0.0328	0.0054	0.0000	0.0883	0.0001	0.0000	0.6936
Sep 98	0.0000	0.1039	0.1373	0.0000	0.0169	0.0008	0.0000	12.4808
Oct 98	0.0000	0.2577	14.5261	0.0000	0.2851	0.1790	0.0000	76.4331
Nov 98	0.0000	0.1261	20.8101	0.0000	0.2197	2.0673	0.0000	86.8817
Dec 98	0.0000	0.0449	24.7906	0.0000	0.1437	1.7521	0.0000	88.4928
Jan 99	0.0000	0.0072	29.8607	0.0000	0.0408	0.9403	0.0000	59.9656
Feb 99	0.0000	0.0000	6.7599	0.0000	0.0002	0.0926	0.0000	6.3781
Mar 99	0.0000	0.0000	2.6153	0.0000	0.0000	0.0000	0.0000	1.2769
Apr 99	0.0000	0.0000	4.0059	0.0000	0.0000	0.0000	0.0000	0.2198
May 99	0.0000	0.0000	1.1688	0.0000	0.0000	0.0000	0.0000	0.0620
Jun 99	0.0000	0.0000	0.0493	0.0000	0.0000	0.0000	0.0000	0.0149
Jul 99	0.0000	0.0000	0.0039	0.0000	0.0000	0.0000	0.0000	0.0179
Aug 99	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0929
Sep 99	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0693
Oct 99	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0538
Nov 99	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0947
Dec 99	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0272
Jan 00	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0340
Feb 00	0.0000	0.0000	0.0064	0.0000	0.0001	0.0000	0.0000	0.1531
Mar 00	0.0000	0.0000	0.0452	0.0000	0.0124	0.0000	0.0001	0.0377
Apr 00	0.0000	0.0000	0.1049	0.0000	0.0362	0.0000	0.0001	0.0096
May 00	0.0000	0.0000	0.0406	0.0000	0.0276	0.0000	0.0007	0.0025
Jun 00	0.0000	0.0000	0.0117	0.0000	0.0134	0.0000	0.0002	0.0002

Table 3

Normalised cost of a guarantee according to modified approach (in CHF)

	Bank A	Bank B	Bank C	Bank D	Bank E	Bank F	Bank G	Bank H
Jul 97	0.0330	0.0123	0.0046	0.0222	0.1755	0.0178	0.0084	0.4690
Aug 97	0.0349	0.0108	0.0051	0.0281	0.1939	0.0226	0.0078	1.3249
Sep 97	0.0323	0.0118	0.0046	0.0293	0.3220	0.0311	0.0092	6.9068
Oct 97	0.0336	0.0151	0.0039	0.0226	0.6647	0.0822	0.0084	10.1136
Nov 97	0.0583	0.0265	0.0039	0.0028	0.6191	0.3203	0.0081	38.9290
Dec 97	0.0647	0.1267	0.0033	0.0028	0.8423	1.7340	0.0157	81.4728
Jan 98	0.0932	1.0228	0.0028	0.0028	1.2702	2.1901	0.0217	78.9215
Feb 98	0.0837	2.5882	0.0213	0.0051	0.7113	2.7746	0.0623	76.0511
Mar 98	0.0437	1.3499	0.0849	0.0092	8.2729	0.7412	0.1731	31.0161
Apr 98	0.0226	0.3570	20.7442	0.0287	54.4188	11.0070	0.3055	6.1351
May 98	0.0108	0.0932	34.4609	0.0408	87.9485	17.7560	0.4190	12.1686
Jun 98	0.0084	0.5544	66.0294	0.0281	89.8761	11.5534	0.4784	14.5864
Jul 98	0.0071	5.0890	58.6940	0.0164	88.1011	6.3400	0.2000	48.3826
Aug 98	0.0084	32.2470	4.1435	0.0081	43.1953	0.3429	0.1296	105.8234
Sep 98	0.0078	55.9567	45.9094	0.0060	15.5697	0.7761	0.1046	269.0045
Oct 98	0.0108	76.7553	273.1770	0.0084	72.2478	50.9360	0.0647	463.7953
Nov 98	0.0104	58.5349	307.0138	0.0084	66.3206	143.1664	0.0803	483.4771
Dec 98	0.0084	37.9735	323.6397	0.0039	55.0194	138.6418	0.0594	487.1592
Jan 99	0.0071	12.3888	342.6690	0.0019	27.9699	109.7282	0.0623	433.8823
Feb 99	0.0046	0.2414	211.3593	0.0039	0.5080	38.9401	0.0745	219.9938
Mar 99	0.0036	0.0515	151.8519	0.0189	0.1573	0.0881	0.0795	128.4346
Apr 99	0.0028	0.0572	177.0362	0.0192	0.0898	0.0293	0.0865	65.9489
May 99	0.0023	0.1003	112.8751	0.0174	0.1457	0.1559	0.0691	35.3717
Jun 99	0.0028	0.1216	23.7870	0.0100	0.1973	0.2099	0.0425	14.4969
Jul 99	0.0023	0.1036	2.2898	0.0000	0.1790	0.2022	0.0200	16.7759
Aug 99	0.0019	0.0556	0.0299	0.0000	0.1431	0.1380	0.0092	42.8121
Sep 99	0.0019	0.0113	0.0213	0.0000	0.1759	0.0178	0.0104	35.8600
Oct 99	0.0009	0.0055	0.0459	0.0000	0.1674	0.0100	0.0108	31.1975
Nov 99	0.0004	0.0084	0.0718	0.0000	0.0588	0.0133	0.0145	42.3644
Dec 99	0.0009	0.0092	0.1402	0.0000	0.0500	0.0213	0.0363	20.5136
Jan 00	0.0009	0.0145	0.3414	0.0000	0.0889	0.0226	0.0588	23.0867
Feb 00	0.0019	0.0151	3.7158	0.0009	0.4315	0.0349	0.1399	51.8753
Mar 00	0.0028	0.0123	21.9682	0.0013	14.4075	0.0311	0.3286	23.6964
Apr 00	0.0023	0.0118	36.6798	0.0013	28.1772	0.0235	0.4225	8.4864
May 00	0.0023	0.0066	20.0251	0.0019	24.1911	0.0260	0.8912	2.2371
Jun 00	0.0013	0.0028	8.0022	0.0009	15.0309	0.0204	0.04536	0.5516

Figure 1

Normalised cost of a guarantee according to standard approach (logarithmic scale; in CHF)

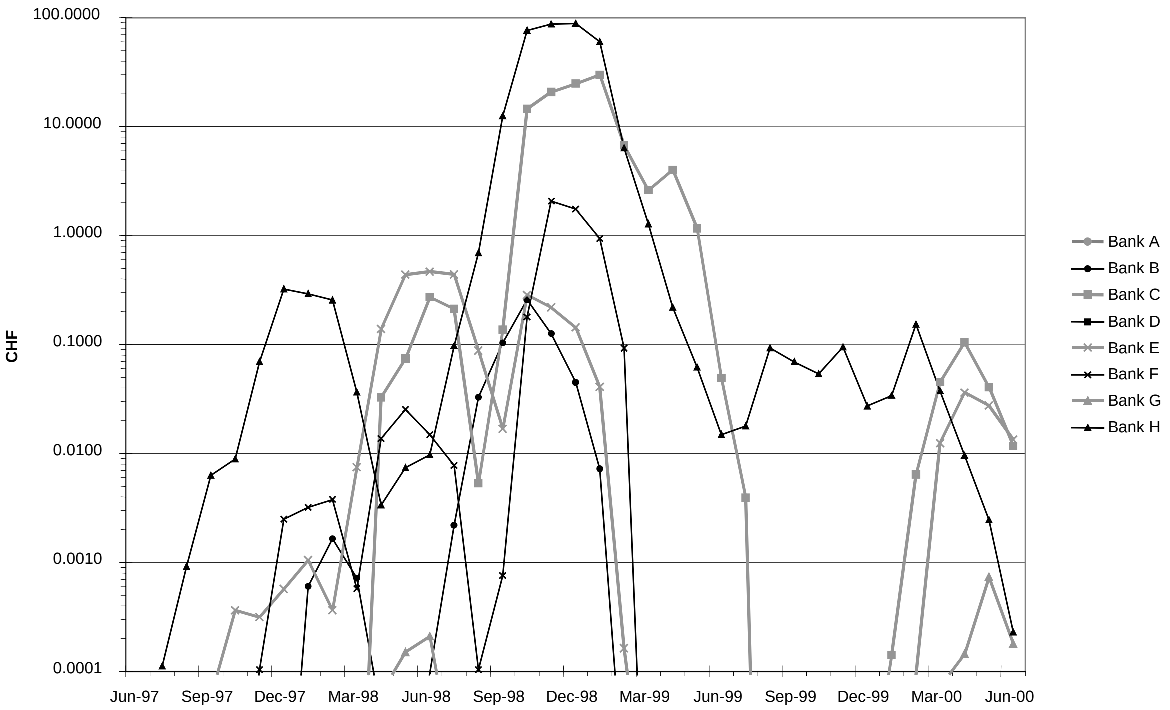
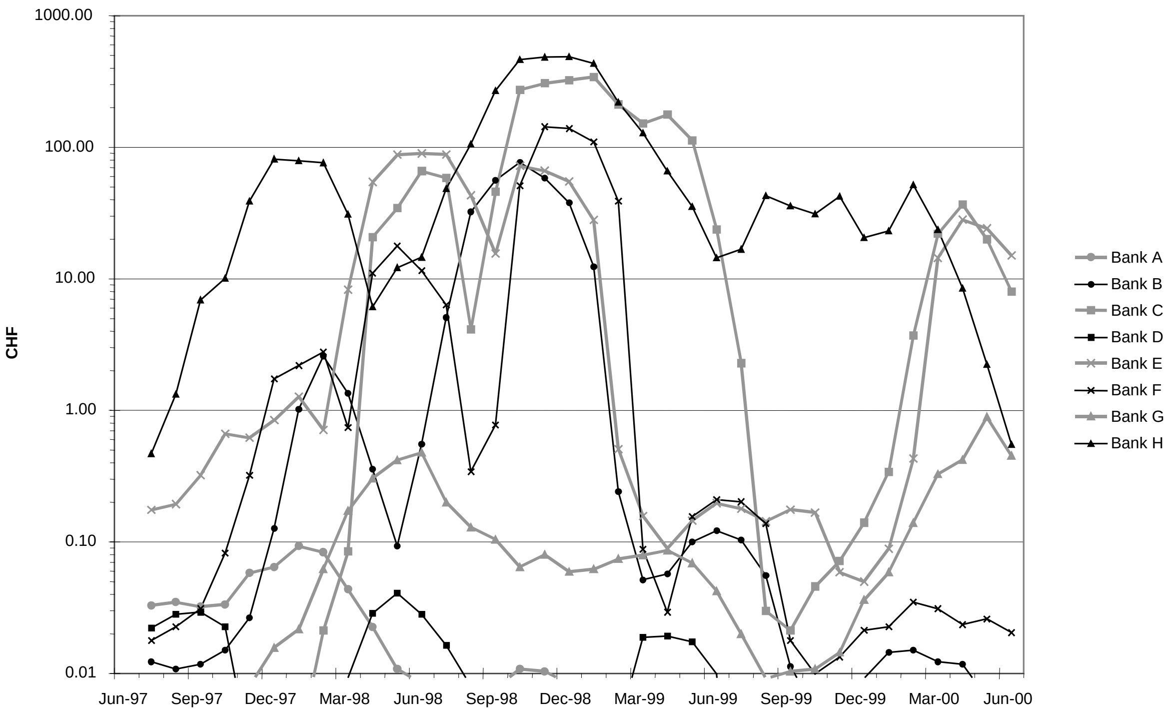


Figure 2

Normalised cost of a guarantee according to modified approach (logarithmic scale; in CHF)



5. Summary and conclusions

This paper makes use of the analogous relationship between a put option and the guarantee for a bank's liabilities in order to estimate the cost of such a guarantee for eight Swiss banks. Because of the direct connection between the cost of such a guarantee and the default risk of the bank, estimates of that cost can be used to both fix actuarially fair insurance premia and assess a bank's condition. Starting with the standard Merton-Ronn-Verma approach, we develop a modified version of the original model that incorporates empirical findings on default probabilities and thereby attempts to remedy an empirical deficiency - the "holes in Black-Scholes" - of the standard approach. Comparing the results generated by the two models shows that the (normalised) cost of the guarantee is at least five times higher when the modified version is employed. In line with the rationale of the modification, these differences become bigger the farther out of the money the option is. Apart from the significant difference in level, both methods show similar patterns of variation over time. These variations are mainly driven by the share price and can be quite large. Not surprisingly, the variations across banks are large too; they reflect different orientations and different risk appetites. But behind these variations there are also similarities, indicating macro shocks hitting many banks in a similar way or even contagion and information effects. Which of the two methods has better explanatory power for real-world data is ultimately an empirical question. Unfortunately, that question is difficult to resolve since the central variables cannot be observed. However, the deficiencies of the standard approach are known, and the modifications we suggest try to overcome them. At the end of the day, this should result in an improvement.

The findings of this paper may be of interest for any supervisor, deposit insurer or central banker who would like to use market information to quantify the value of any explicit or implicit exposure towards bank creditors or the financial condition of a bank in general. A major impediment to the implementation of contingent claims models like the ones presented is the fact that most (Swiss) banks, especially the smaller ones, do not have publicly traded shares. This, however, is a necessary condition for these models to be applicable in a useful way. But since those banks that do have publicly traded equity are usually the bigger ones and are therefore more important from both a systemic and a depositor protection point of view, the option-based approach we suggest can still be a helpful tool.

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Pragmatic monitoring of financial stability

William Nelson and Wayne Passmore[1]

1. Introduction

Early identification of a financial crisis is, almost by definition, difficult. Financial markets are forward looking and, to the degree events can be foreseen, these markets react to the anticipation of a crisis, often defusing or solving the possible crisis in the process. Forward-looking financial markets make it unlikely that a central bank will predict a financial market crisis before, or independently of, financial market participants. However, certain conditions - reduced liquidity, overly restrictive lending policies, increased debt burdens carried by firms or households - are associated with a heightened potential for a financial crisis, and more severe or prolonged financial crises. Thus, both central banks and participants in financial markets have an interest in monitoring these conditions. In addition, some crises might require action by the central bank even when markets are fully informed about the nature and scope of the crisis.

In this paper, we review recent theoretical models of how financial crises can unfold, even when capital markets function well. These different theories suggest the conditions under which such crises are more likely, and which policy responses available to central banks may prove most effective. We then relate these recent theories to the monitoring currently undertaken by the Federal Reserve of financial market activity in the US domestic economy for indications of an elevated potential for a financial crisis.[2] In the final section we review several episodes of heightened risks of financial instability in the United States during the past decade, relating these periods to the types of crises identified by the formal models, and describing the sources of information the Federal Reserve used to judge the condition of financial markets and the steps the Federal Reserve took in response.

2. Recent theoretical innovations

Before turning to modelling a financial crisis, we should focus first on a definition of a financial crisis. We define a financial crisis, in contrast to an economic crisis, as one where financial institutions associated with the extension of credit to households and businesses are no longer willing to provide credit to investments with positive net present value (as calculated prior to the crisis). For example, if investors rapidly withdraw from the stock market because they no longer have confidence in their ability to model future earnings, then many profitable projects may go unfunded because of this financial market uncertainty. In contrast, if investors withdraw from the stock market because they foresee that future earnings are declining due to a negative economic shock, then only projects with negative present value go unfunded. In this case, the economic crisis may be associated with a stock market collapse, but it is not a financial crisis because the collapse was driven by a lack of profitable investments.

Of course, disentangling a “financial” from an “economic” crisis may well be impossible during a time when the financial markets are in turmoil. However, the role of the central bank is different depending on whether the crisis is economic or financial. In the former case, the central bank is concerned with aggregate demand management, and would probably pursue a policy of monetary easing. In the latter, the central bank is focused on the troubles of particular financial markets or institutions, which may be met by easing monetary policy, but also might be handled by more targeted actions.

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1 The views expressed here are those of the authors and do not necessarily represent those of the Board of Governors or the staff of the Federal Reserve System.

2 While the Federal Reserve also monitors international financial developments, we choose to focus exclusively on US domestic markets, both because the literature related to foreign exchange markets is voluminous and somewhat separate from the literature discussed here, and because domestic financial markets are our area of expertise.

In theoretical models the causes of financial crisis fall into three broad groups: investor uncertainty, financial linkages and moral hazard. These divisions are somewhat arbitrary, as many models incorporate elements of all three. However, each suggests a different focus to central bank monitoring.

2.1 Investor uncertainty

The research on financial crises during the 1980s and early 1990s focused on the consequences of the ability of investors to withdraw on demand certain types of bank deposits. This focus arose mainly because the moral hazard associated with deposit insurance had played a major role in the United States' savings and loan debacle.[3] Diamond and Dybvig (1983) developed a much lauded model of depositor behaviour, based on depositors' uncertainty about their own need for liquidity. Because of this uncertainty, depositors demand a financial instrument that can be converted to cash on demand. Bank borrowers, meanwhile, desire longer-term loans to finance fundamentally illiquid capital projects. This mismatch in horizons creates both a need for a financial intermediary and the possibility of a financial panic because if many depositors liquidate their deposits early, other depositors who come to the bank later will not receive their promised return.

The possibility of a financial panic in the Diamond and Dybvig model depends on the assumption that banks service each customer in the order they arrive at the bank. Banks promise a certain return in each period of a depositor's life and fulfil this promise for each depositor that comes to the bank and demands early redemption, until the bank's resources are exhausted. If the price of the deposit contract immediately adjusted to reflect the value of the underlying assets as depositors withdrew funds, then a bank run could not materialise.[4] In addition, as shown by Diamond and Dybvig, with deposit insurance bank runs are eliminated, suggesting that, if bank runs are key to a financial crisis, deposit insurance has solved the problem.

In the Diamond and Dybvig model, bank runs are a "sunspot" phenomenon, meaning that the financial crisis can take place without any reference to and perhaps without any consequence for, economic activity.[5] If depositors can simply be convinced that their deposits are safe, regardless of the true state of the world, there can be no financial panic. To the degree that a banking crisis is key to financial instability, then this theory would suggest that a central bank can add little in financial crisis management, once a country has a deposit insurance programme. However, the fact that deposit insurance is commonplace among industrialised countries, yet financial crises still occur, suggests that models of bank runs are insufficient for understanding modern financial crises. In addition, as long as illiquid depository institution assets are allowed to be funded with short-term, and in many cases uninsured, liquid instruments, then the traditional role of the central bank as lender of last resort has economic import, regardless of the availability of deposit insurance or other liability guarantees.

Furthermore, households in the United States hold a significant fraction of their portfolios in deposit-like mutual funds. The government cannot credibly guarantee the value of all financial instruments that are similar to demand deposits. One solution, advocated by proponents of "narrow banking" and also by those who desire to extend government guarantees to liabilities beyond deposits, would be to require that investments funded by demand-deposit-like instruments be restricted to short-term assets with readily identified market values. However, under fairly general conditions, the loss of economic output from not funding longer-term, illiquid investments would exceed gains associated with absolute safety (Wallace, 1996). There are significant gains from trade that occur when illiquid assets are financed by the savings of uncertain (and, therefore, risk-averse) investors who desire liquid assets.

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3 Of course, bank runs by depositors have been postulated as a source of financial crisis in the United States since the Great Depression of the 1930s. However, some of the empirical evidence seems to weigh against such an interpretation of the causes of the Great Depression (Cole and Ohanian, 1999).

4 Furthermore, if depositors are convinced that other depositors will not find it in their interest to withdraw funds from the bank, a bank run cannot develop. Green and Lin (2000) demonstrate that in Diamond and Dybvig's model, the design and maintenance of such an optimal arrangement is straightforward.

5 Empirically, banking crises do seem to occur with reference to the macroeconomy, and the effect of banking crises on macroeconomies seems to be mixed, with most such crises seeming to have little effect on the economy, while a few have major consequences (Boyd et al, 2000).

Investors' uncertainty over their needs for liquidity is only one type of uncertainty. If investors have other forms of uncertainty, then other constraints in the Diamond and Dybvig model - particularly the sequential service constraint - may not be needed to generate sunspot equilibria. One example is Lehnert and Passmore (1999), where investors lack full information about the likelihood of investment outcomes. This uncertainty over the probability distributions of investment returns implies investors are pessimistic, meaning that investors are cautious about investing in risky assets. If investors become more pessimistic, they will tend to invest less in risky, productive assets and invest more in safe assets. If the increase in pessimism is sufficient, then a "flight to quality" can develop, resulting in positive expected net present value investment projects being left unfunded.

Like bank runs due to depositor concerns about the liquidity of their deposit, the flight to quality can be a sunspot phenomenon. Investors' fears that investment in the productive sector will be insufficient to generate adequate returns can become self-fulfilling. In the Lehnert and Passmore model, the central bank can offset flights to quality by lowering the return on short-term, safe assets by reducing real interest rates (by lowering nominal rates in the short run, and in the long run by generating inflation). This strategy succeeds in reversing the flight to quality as long as the underlying economy is healthy.

A different way to model investor uncertainty is to assume that investors may have full knowledge of possible investment outcomes, but have poor signals of those outcomes. In traditional theories, investors determine stock prices by discounting cash flows. However, if investors use stock market prices as signals of future cash flows, then positive or negative feedback loops (referred to as "cascades") can be created, where some investors watch and react to the actions of other investors (Subrahmanyam and Titman, 2000). If important sectors of the economy are characterised by increasing returns to scale and large spillover effects (for example, the manufacture of computer software has high fixed costs and low marginal costs, and the profitability of producing the software may be dependent on its acceptance by other software manufacturers), then a drop in a stock price can create a negative cascade, as uninformed investors see the drop as a signal of poorer future returns. As these uniformed investors withdraw their investments, informed investors realise that the industry will suffer negative spillover effects and may fail to maintain needed scale for production. As more investors withdraw, a "race for the exit" is created, and a financial panic ensues.

Models based on investor uncertainty suggest that all financial markets, not just the banking system, should be monitored by the central banks. These theories suggest that investor uncertainty may be measured by studying the spread between the interest rates on risky and risk-free assets and the volatility of asset prices. If the spread between interest rates widens sharply because of either a decline in the risk-free rate or an increase in the rate on the risky asset (or both), these models suggest that investor uncertainty has increased. If so, productive investment may be hindered and, if such spreads are not reversed, economic activity may slow. The "race for the exit" models focus on stock market valuations. Both types of models suggest that financial asset price volatility, to the degree that it reflects underlying investor uncertainty, is an important indicator of financial market stability.

2.2 Financial linkages and contagion

Many economists find sunspot models, such as those described above, unsatisfactory because they fail to link the bank run or the flight to quality to a real economic shock. In such models, small shocks become big problems only because investor views about the economy are changed, not because investors are rationally reacting to an economic shock that might spiral out of control. (Indeed, in Lehnert and Passmore, the probability of a bad economic outcome without an investor flight to quality is zero.)

With a desire to move away from sunspot models, Allen and Gale (2000a) propose a model of an economy composed of different regions. A small real economic shock can cause agents in a particular region to unexpectedly demand additional liquidity. When regions are separated from each other, a small shock might cause a financial crisis in a given region. To the degree regional shocks are imperfectly correlated, banks can insure each other against small regional shocks by holding claims on other banks in other regions. But while cross-holdings can provide insurance against most regional shocks, they cannot increase liquidity in the banking system as a whole. Thus, the use of bank cross-holdings as insurance against a financial crisis in a particular region lessens the probability of a crisis in that region, but creates a way regional shocks can be transmitted to other regions and increases the possibility of a system-wide crisis when multiple regions each attempt to use their cross-holdings in response to an economic shock.

Another way to link investor actions and real economic shocks is through investors' use of leverage and their desire to diversify portfolios (Lagunoff and Schreft, 1998; Kodres and Pritsker, 2000; Pritsker, 2000). These models generate contagion without explicitly modelling a banking sector. Instead, the mechanism of transmission is investor efforts to reallocate (for diversification) their portfolios after some projects in the real economy default (because of some exogenous and random shocks). These efforts by investors to regain their optimal asset mix may have the effect of causing other projects in the economy to default, causing a chain reaction that results in a financial crisis (as well as a significant contraction in real economic activity).

Even though the initial reactions of banks or investors in these financial contagion models are prompted by a default in the real economy, these so-called defaults are not formally modelled and enter these models exogenously. One could easily interpret them as defaults of specific firms or liquidity crises in particular regions created purely by investor reactions. In this sense, these models are also sunspot models. In contrast to sunspot models, however, these models explicitly model a transmission mechanism for the propagation of shocks, suggesting the channels the monetary authority might monitor to beware of developing financial problems.

2.3 Moral hazard and financial crises

In contrast to the models described so far, most theories that link moral hazard to financial crises focus on government actions. In general, these models begin with government actions or guarantees encouraging "excessive" lending, either by banks or by government enterprises.[6] Such lending encourages a boom in economic activity, which usually ends because private borrowers invest in projects with low probabilities of success and then default. These defaults create the fear that banks are insolvent or cause government lending programmes to contract. In either case, lending to solvent, profitable borrowers is crimped as lending institutions struggle to recover.

The savings and loan crisis in the United States during the 1980s is often cited as the archetypical crisis created by moral hazard. Here, government guarantees of deposits were used by privately managed but undercapitalised thrifts to aggressively raise funds and extend loans in commercial real estate and residential housing development. With little of their own money at risk, US savings and loan extended credit to projects that depended on rapid real estate price appreciation to be viable (because the savings and loan lent more than 100% of the current value of the collateral, creating negative equity). When such price appreciation did not materialise, these institutions went bankrupt, leaving the US government with about $150 billion of losses (in 1989 dollars) on insured deposits (what little capital private shareholders had in these institutions was lost was well).

The macroeconomic effects of crises generated by moral hazard problems, even for relatively large ones like the US savings and loan crisis, are often small. In the case of the savings and loan crisis, there was little financial market reaction and, beyond commercial real estate and speculative housing development, little macroeconomic consequence. Thus, while the source of the crisis may have been government guarantees, the failure of the crisis to propagate to other sectors suggests more is needed to call such events a systemic failure. Indeed, as long as there is a diversity of financial intermediaries in the economy, the failure of any one group seems to have limited consequences.

Indeed, an event in the United States that perhaps had more macroeconomic consequence was the so-called "credit crunch" in the early 1990s. In this episode, banks sharply contracted lending at the beginning of a recession, as economic prospects for borrowers dimmed and as investors and regulators encouraged banks to build up their capital, partly in response to the earlier problems associated with the savings and loan industry. However, whether moral hazard caused this problem is less clear, as there is little evidence that banks had taken advantage of deposit insurance or other government guarantees to overextend credit. In fact, during the credit crunch period, some bank regulators pushed banks to lend more, and the banks resisted these calls for easier credit.

More recently, several large studies of banking crises have called into question the link between banking crises and macroeconomic problems (Boyd et al, 2000; Gourinchas et al, 1999). Generally, other elements beyond the banking crisis must be present to create more systemic crises. However,

[6] While government guarantees usually provide the clearest cases of moral hazard, other government actions, such as those that create uncertainty about the availability of credit, can have similar effects (Allen and Gale, 2000b).

the quality of lending by banks is one element of a central bank's prudential monitoring of possible financial problems.

3. Monitoring financial stability

The Federal Reserve monitors a broad range of financial indicators to assess the susceptibility of the economy to financial disturbances and, when financial disturbances occur, to judge the implications of those disturbances for the non-financial sector. Many of these indicators are measures of financial strength, that is, measures of the ability of households or businesses to weather a financial shock without greatly contracting their spending. Other measures focus on market participants' assessments of, and tolerance for, risk.

The measures used by the Federal Reserve are taken from a variety of sources, and are available at a wide range of frequencies. Some, such as asset prices, are market-based and can be calculated daily, if not even more frequently. Others, such as financial stocks and flows, are aggregated from individual institutions on a weekly, monthly or quarterly basis. Finally, some measures are based on surveys, both formal and informal, of market participants, and are gathered on an ongoing basis. The Board of Governors is provided with updates about financial market developments often (at least weekly and sometimes more frequently). The Federal Open Market Committee, which sets the overnight interbank (federal funds) rate in the United States, is provided with information on financial conditions before each FOMC meeting, although many measures are provided to the Committee members on a more frequent basis. Of course, financial market commentary and statistics are available to the public (and thus the Board and other policymakers) on an almost continuous basis from many different private sources.

3.1 Asset prices and interest rate spreads

The models of investor uncertainty outlined above highlight the importance of asset prices and interest rate spreads. Because these prices and rates are determined by the supplies and demands of forward-looking investors and savers, they react nearly instantaneously to judgments about financial conditions. And because many prices and rates are available virtually instantaneously and continuously, the Federal Reserve monitors a broad range of rates and asset prices for prompt information on market liquidity and market participants' attitudes towards risk.

3.1.1 Liquidity spreads

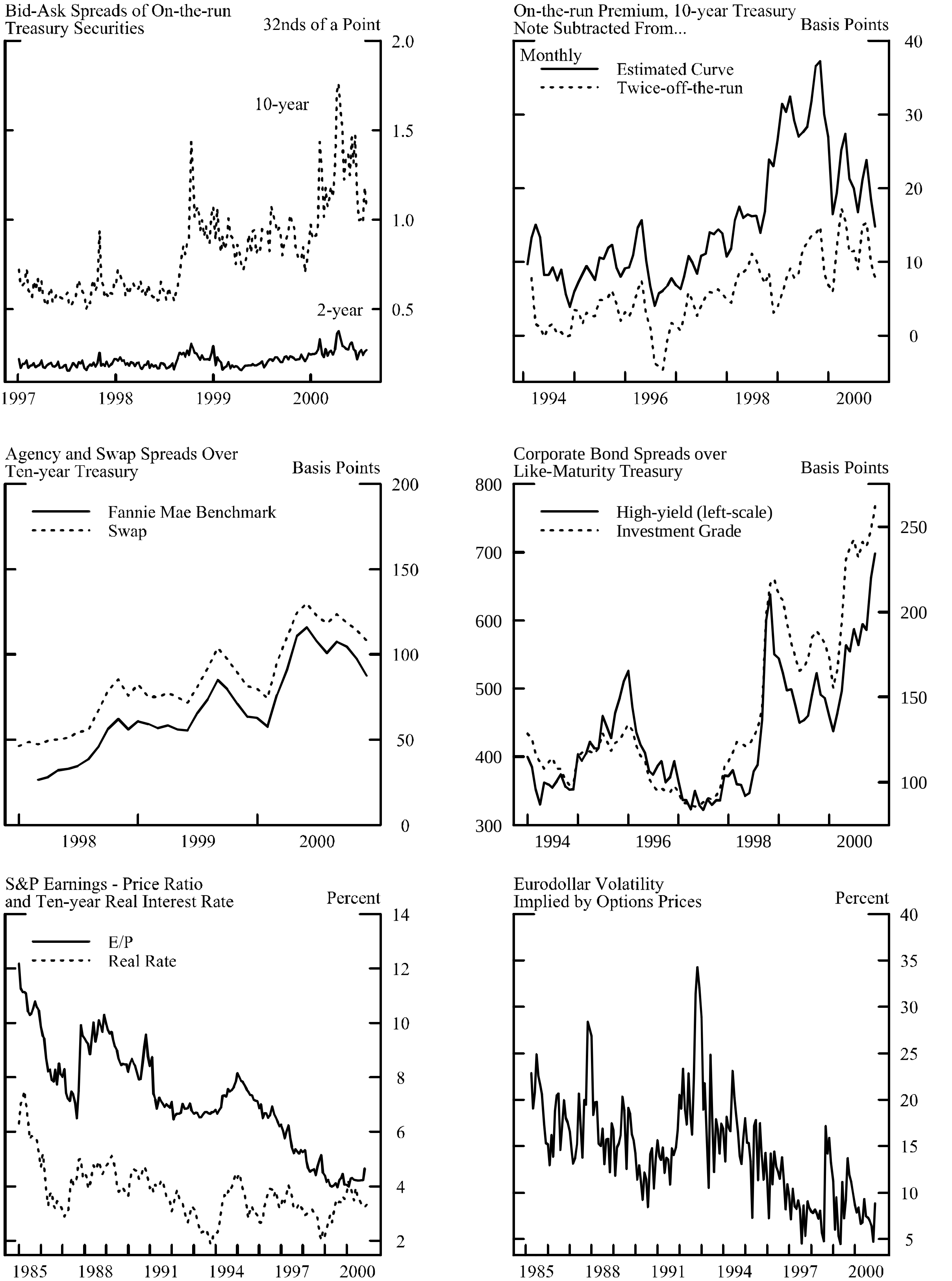
Measures of market liquidity provide information on the ability of financial markets to process large transactions without large changes in prices, and also on the premiums investors are willing to pay to hold more liquid assets. Federal Reserve staff assess the liquidity of the market for US Treasury securities in part using bid-ask spreads (Figure 1, upper-left panel).[7]

However, during the financial turmoil in late 1998, and over the century date change, the Federal Reserve augmented these data with surveys of primary securities dealers. The surveys provided a sense of the market not completely measured by the bid-ask spreads. For example, at times in 1998 the dealers were not willing to make a market at all in certain securities.

In addition to bid-ask spreads, Federal Reserve staff also follow liquidity premiums, defined as the yield on a highly liquid security minus the yield on a less liquid but otherwise similar security. Highly liquid securities - those traded in liquid markets, with unquestioned credit quality, and often with short maturities - provide investors with the confidence that, if necessary, they can be sold rapidly and at a known price. The amount investors are willing to pay for that comfort in the form of lower yields relative to other rates may rise rapidly during financial market difficulties, particularly when the source of such difficulties is heightened investor uncertainty. Because these spreads may react rapidly to financial difficulties, and are available at high frequency, Federal Reserve staff review them often.

[7] Fleming (2000) provides an assessment of the performance of various measures of the liquidity of the markets for Treasury securities.

Figure 1: Asset-Price Based Measures



The theories of investor uncertainty outlined above suggest that liquidity spreads are important, but do not deal directly with the difficult problem of how to construct measures of such spreads. Liquidity spreads measured using Treasury securities have the advantage of being uncontaminated by premiums charged for default risk. The most recently issued of any given type of security - the on-the-run-issue of that security - are much more liquid than other Treasury securities. Securities that are not the most recently issued - off-the-run issues - are less liquid but otherwise nearly identical, so the off-the-run, on-the-run spread is often considered a good measure of a liquidity premium (Figure 1, upper-right panel). However, this value of this measure often varies with the choice of off-the-run security. To mitigate this problem, staff also construct an estimate that compares the yields of on-the-run securities to the yields implied by a smoothed yield curve estimated from less liquid Treasury securities.

Federal Reserve staff track a number of other spreads that are influenced in part by liquidity. These include the spreads between the yields on less liquid but still relatively low-risk instruments, such as the yields on agency securities or swap yields, relative to yields on Treasury securities (Figure 1, middle-left panel). However, in the past year, upward revisions to the outlook for federal budget surpluses have raised the prospect that Treasury securities will be in increasingly short supply in coming years. As a result, investors have become willing to pay premiums to acquire Treasury securities. The movements in Treasury yields arising from variations in these scarcity premiums have reduced the information content in spreads calculated relative to them about liquidity demands and, as mentioned below, about attitudes towards risk.

3.1.2 Risk premiums on market debt instruments

As suggested by economic theory, expected yields on debt instruments and equities relative to those on riskless assets vary with investors' assessments of risk and willingness to bear risk. The spreads between the yields on riskier and less risky securities widen when investors judge their relative risks to have increased, and also when investors demand a higher premium for a given amount of risk. Thus, these spreads will increase when investor uncertainty increases or financial conditions worsen, and a sharp widening of these spreads has often been a component of financial turmoil.

Like liquidity spreads, measurement of investors' risk premiums is not straightforward. The Federal Reserve follows risk spreads on a variety of forms of business debt. The spread between the most highly rated commercial paper and the next most highly rated varies importantly with investors' perceptions of risk, as does the spread between US corporations' investment grade bonds and like-maturity Treasury bonds (Figure 1, middle-right panel). The Federal Reserve also follows closely the spread on high-yield bonds over Treasury bonds or high-grade corporate bonds because the appreciable risk on these securities makes this spread particularly sensitive to changes in the economic outlook for less creditworthy corporations and to changes in investors' attitudes towards risk. Riskier securities are also generally less liquid than safer securities, so a widening of the risk spreads on corporate debt also often indicates a reduction in the relative liquidity of the market for the riskier instruments. More recently, staff have also monitored the spreads of corporate bond yields over swap rates and yields on US agency debt, as opposed to the spreads over Treasury securities, because of the distorting effect of scarcity premiums paid for Treasury securities.

3.1.3 Equity prices

Equity prices vary with changes in investors' appetite for risk; in investors' expectations for, and uncertainty about, future economic outcomes; and in the clarity of information available to investors. To invest in equities, investors demand a premium over bond yields because the return on bonds is generally more predictable. Federal Reserve staff assess the equity premium in a number of ways, including by comparing the earnings-price ratio of the S&P 500 to the real level of the 10-year Treasury rate (Figure 1, lower-left panel). The earnings-price ratio is calculated using analysts' expectations for earnings during the upcoming year. The real 10-year interest rate is calculated by subtracting a survey-based measure of long-term inflation expectations from the nominal 10-year Treasury rate. The real rate is difficult to measure precisely because the survey measure is only an approximate estimate of inflation expectations and, recently, because scarcity premiums have distorted the nominal rate.

Unfortunately, interpreting changes in this measure of the equity premium is difficult. For example, a decline in the earnings-price ratio relative to the real interest rate may reflect new economic information that raises investors' expectations of future earnings growth. Or it may reflect that investors have better information or greater certainty about economic outcomes or an enhanced appetite for risk. Comparisons of analysts' expectations about longer-term earnings growth to the staff's forecast of earnings permit some judgments about reasons for changes in the earnings-price ratio, but such analysis embodies a great degree of uncertainty.

Economic crises, as well as financial crises, might be assessed, in part, by changes in equity prices. To the degree that stock prices reflect future earnings, negative economic shocks that lower the net present value of future projects and that might be difficult to observe directly, such as a slowing in the rate of growth of productivity enhancements, might be first reflected in stock prices. Similarly, stock prices of financial intermediaries, such as bank stock price indices, are leading indicators of financial institution performance, and thus are sensitive to concerns about financial turbulence to the degree such concerns affect future earnings.

3.1.4 Option prices and implied volatilities

The Federal Reserve uses option prices to measure investors' assessment of the likely volatility of interest rates and equity prices. These measures have proven to be useful and timely indicators of investor uncertainty and information precision, as well as of the probability distribution of underlying economic outcomes. For example, options on eurodollar futures provide a measure of the expected volatility of the interest rate on eurodollar deposits, which rises when investors become more uncertain about the future path of near-term monetary policy (Figure 1, lower-right panel). This measure of eurodollar volatility has risen significantly in recent periods of financial stress, probably because during those periods investors have placed increased odds on the possibility of a financial crisis and therefore placed an increased value on insuring against extreme outcomes.

Options-based measures of equity price volatility, which provide information on the odds that corporate cash flows will be lower than expected, have proven to be useful for forecasting default rates on corporate debt. These forecasts, in turn, help Federal Reserve staff judge, albeit imprecisely, how changes in risk premiums have been affected by changes in expected default rates.

3.2 Depository institutions

As outlined earlier, some theories of financial crises argue that the banking sector plays a key role in the evolution of financial crises. In particular, banks can act as transmission mechanisms of crises because they may sharply contract credit in response to depositor demands for early and quick redemption of funds. On the other hand, with deposit insurance, depository institution liabilities might rise with heightened demand for safety and liquidity.

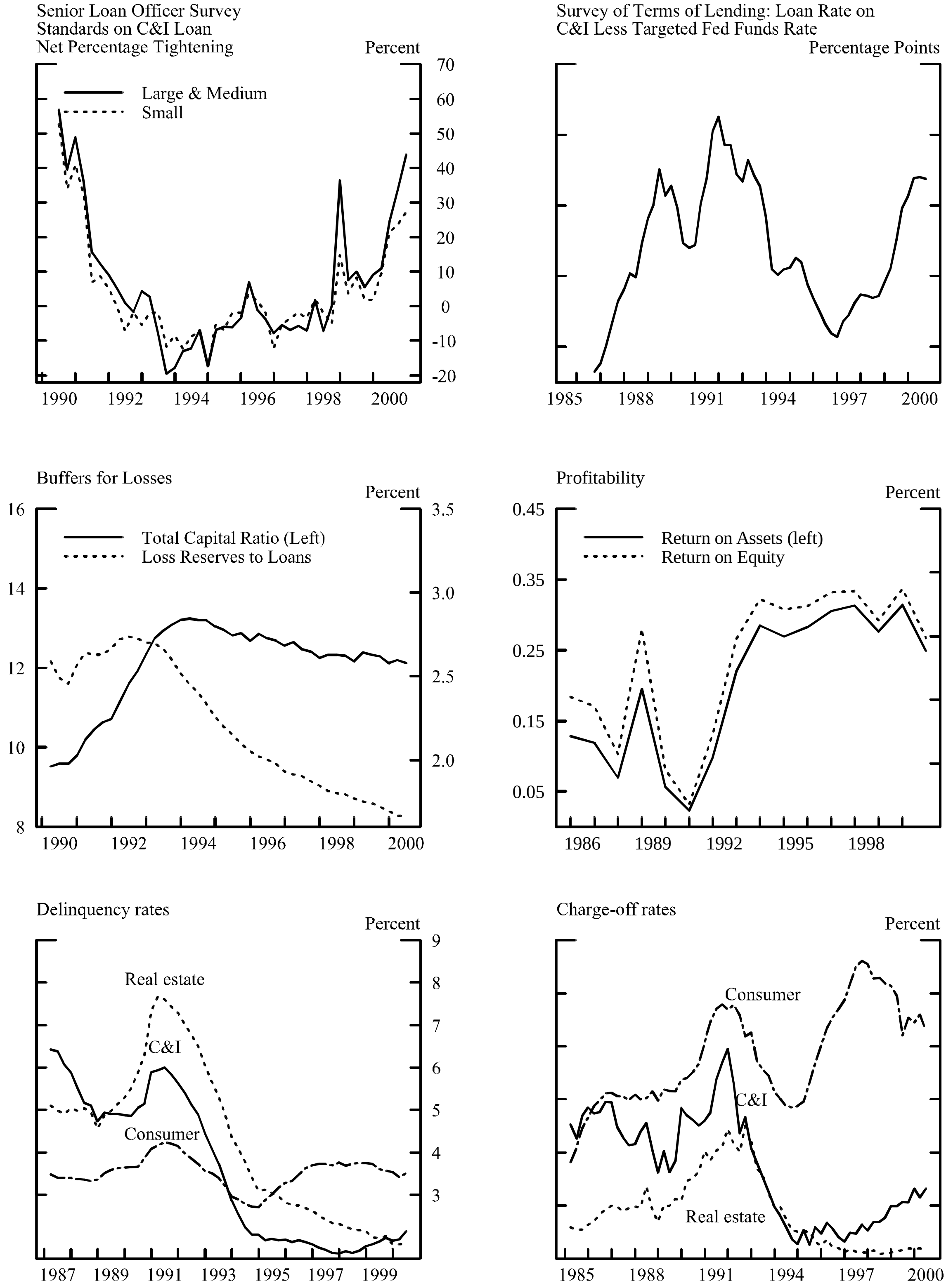
3.2.1 Data on bank credit and monetary aggregates

The Federal Reserve collects weekly data on bank credit and the monetary aggregates. To some extent, these data can be used to monitor financial problems. For example, rapid growth in bank business loans may indicate substitution away from unreceptive capital markets. Similarly, the monetary aggregates may grow more rapidly when investors shift funds out of bond and stock mutual funds and into safer and more liquid bank deposits or money funds.

3.2.2 Senior Loan Officer Survey on Bank Lending Practices

In the past, both aggressive lending practices and the contraction of lending at banks have been cited as the mechanism for transmission of financial problems to non-financial businesses and households. The Federal Reserve collects information from commercial banks before every other FOMC meeting on the standards and terms on, and demand for, loans to businesses and households in its Senior Loan Officer Survey on Bank Lending Practices. The Senior Loan Officer Survey poses a broad range of questions to loan officers at 60 large domestic banks and 24 US branches of foreign banks. On the topic of banks' tolerance for risk, the survey asks about changes in risk premiums on business loans, and about changes in business loan standards (Figure 2, upper-left panel).

Figure 2: Depository Institutions



Although these surveys are not frequent enough to use for monitoring a quickly unfolding financial crisis, the core set of questions have been asked on each survey since 1990, and the responses to those questions, expressed as the net percentage of respondents tightening standards or terms, have proven to be a useful measure of financial conditions and a correlate of economic activity. In addition, the responses to specific, targeted questions during periods of financial stress have helped the Federal Reserve gauge the degree of difficulties and their implications. Finally, although the surveys are typically conducted quarterly, the Federal Reserve has authority to conduct up to six surveys a year, and has done special surveys when warranted by financial conditions, most recently in autumn 1998.

3.2.3 Quarterly bank data

Federal Reserve staff also use the quarterly balance sheet and income statements of commercial banks to monitor capital, profitability, asset quality and loan loss reserve adequacy (Figure 2, middle panels). Each variable measures both the health of the banking system and the propensity for moral hazard problems to arise. In addition, data on loan delinquency and charge-off rates relate to both the financial condition of banks and the financial health of the borrowers (Figure 2, bottom panels). However, at a quarterly frequency and with long reporting lags, these data are of limited value for monitoring a quickly unfolding financial crisis, but may provide information on the susceptibility of the banking sector to shocks.

Similarly, the Federal Reserve collects data on the rates banks charge for business loans with the Survey of Terms of Bank Lending (Figure 2, upper-right panel). About 300 domestic banks and US branches of foreign banks participate in the survey. Each bank provides a number of details on the terms of every commercial and industrial loan it makes for one week out of each quarter - a total of about 40,000 for each survey. The terms include, among other things, the loan size, rate, maturity and, since 1996, the level of risk. The average rates for each risk rating allow for an estimate of the risk premiums on bank loans. These data are useful for monitoring possible moral hazard problems or shifting views of the riskiness of bank borrowers, but, like balance sheet data, are not sufficiently timely to provide contemporaneous information in a financial crisis.

3.2.4 Bank supervision and regulation

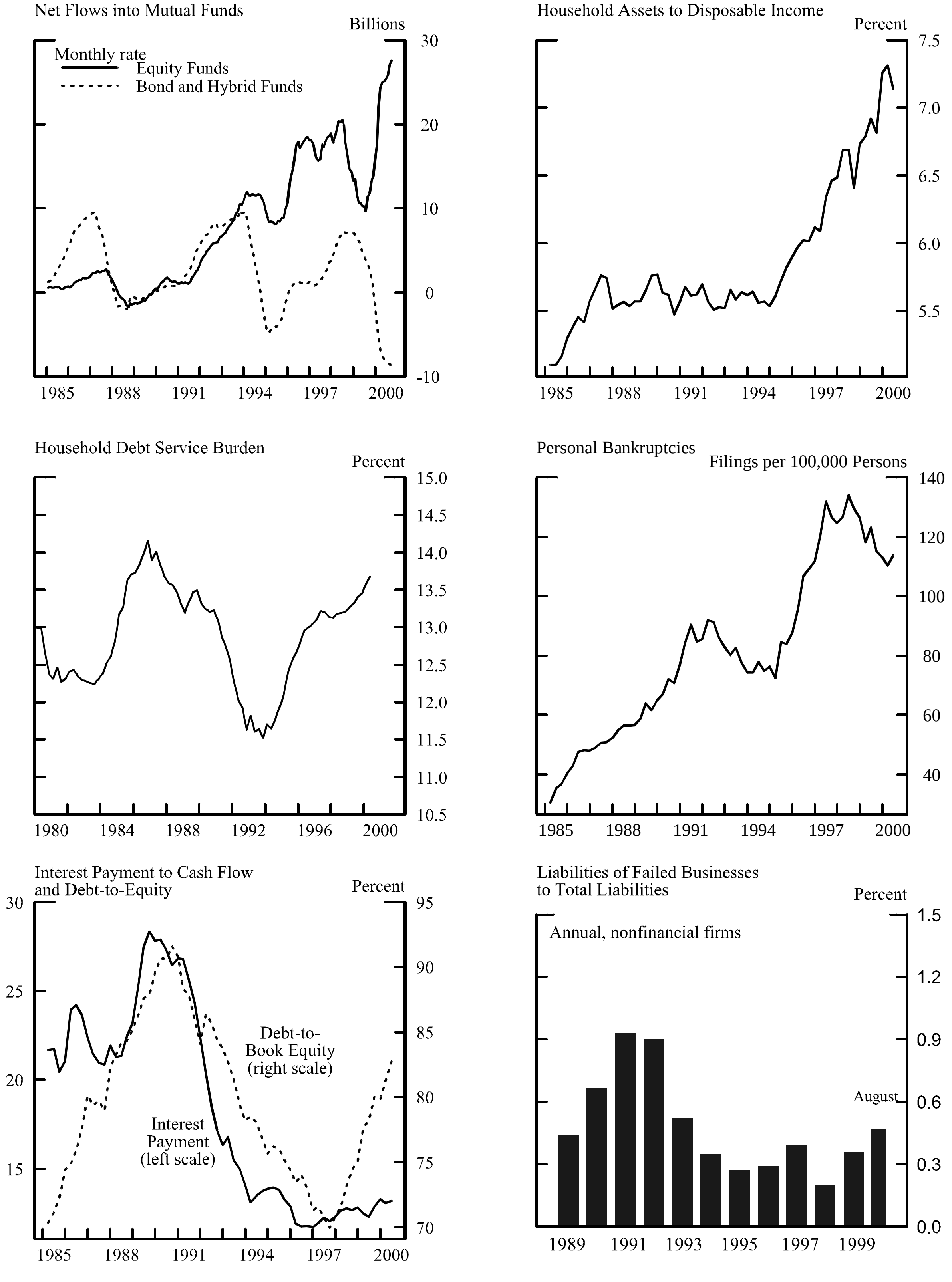
The Federal Reserve is the umbrella regulator for financial services holding companies, the primary regulator of bank holding companies, US branches of foreign banks, and state-chartered banks that are members of the Federal Reserve System. Federal Reserve regulatory staff also maintain close contacts with the other regulators of financial institutions. Through its supervisory role, the Federal Reserve learns about the condition and behaviour of commercial banks, and acts to maintain the soundness of these institutions. During periods of financial turmoil, the familiarity with these intermediaries deepens the Federal Reserve’s understanding of developing conditions. In addition, the supervisory staff provide a lever through which the Federal Reserve can act when it needs to respond quickly to developments during a financial crisis.

3.3 Mutual fund flows

Investors’ feelings about risk and demand for liquidity are reflected not just in the prices of financial assets, but also in change in the holdings of those assets. When confidence increases, households tend to move assets from more liquid, less volatile assets such as deposits and money funds into less liquid assets such as stock and bond mutual funds and direct holdings of securities (Figure 3, upper-left panel).

Mutual funds can provide timely data about such flows. The Federal Reserve reviews weekly data on investments in money market and stock and bond mutual funds. The data, which are provided by private vendors, contain details on the type of fund, including, in the case of stock mutual funds, whether the funds are oriented towards growth or income and whether the investments are in domestic or foreign equities. Bond funds are broken out by high-yield corporate bonds, investment-grade corporate bonds and municipal securities. Flows into relatively higher-risk funds tend to fall off quickly when investors’ confidence or appetite for risk declines. Similar changes in flows occur at pension funds, insurance companies and hedge funds, but data for such institutions are either not readily available, or only available with a long delay.

Figure 3: Household and Business Balance Sheets



3.4 Household and business financial health

The ability of a financial crisis to spread depends in part on the financial wherewithal of economic agents. The Federal Reserve constructs and monitors measures of financial soundness for both households and businesses. For households, indebtedness is tracked, in part, using debt-to-asset ratios and debt burden ratios (Figure 3, upper-right and middle-left panels). The latter are calculated as the ratio of quarterly payments of interest and required principal to household disposable income.

Federal Reserve staff measure business leverage in terms of the ratio of debt to the book value of equity (Figure 3, lower-left panel) and debt to the market value of equity. Staff evaluate businesses' capacity to meet payments, in part, using the ratio of interest payments to cash flow. The financial stress on businesses is also evaluated using the payment performance of business debt. Data for these measures are quarterly and come from the Federal Reserve's flow of funds accounts, the national income accounts, regulatory reports and private vendors.

The Federal Reserve also examines delinquency and charge-off rates on bank loans to businesses and households, default rates on corporate bonds, upgrades and downgrades of corporate bonds, and household and business bankruptcy rates (Figure 3, middle-right and lower-right panels). Payment problems in one sector of the economy can spill into other sectors for a variety of reasons. Such problems may reflect underlying economic problems, may provide noisy signals to investors about the economic outlook, or may simply spread because of poorly designed or reckless financial contracts. Data on payment problems with specific corporate securities are available relatively quickly. In contrast, aggregated statistics on business and household financial conditions are often available only with a substantial delay. For households, balance sheet information is often supplemented with more timely surveys of household sentiment.

3.5 Federal Reserve Banks

Financial contagion can be contained if short-term liquidity is provided to fund profitable but illiquid assets. The Federal Reserve provides credit to depository institutions through the 12 Federal Reserve Banks. In recent years this credit has almost exclusively been extended to meet short-term liquidity needs or seasonal borrowing needs and has not had much bearing on financial stability. However, during periods of financial instability arising from depository institution difficulties, the discount officers (the Reserve Bank staff in charge of lending) gather information about the liquidity and solvency of borrowers and potential borrowers.

Actual or potential discount window lending to depository institutions has also been a channel through which the Federal Reserve, in its role as lender of last resort, assuages financial crises. That channel was narrowed somewhat by the FDIC Improvement Act of 1991, which established guidelines for Federal Reserve discount window assistance to troubled institutions. While not prohibiting lending to troubled institutions, the guidelines are designed to place any such lending under greater scrutiny, and deviations from the guidelines can make the Federal Reserve Board liable for a portion of any consequent increases in FDIC insurance costs. The Federal Reserve also has the statutory authority in unusual and exigent circumstances to be a lender of last resort to entities other than depository institutions, although no such loans have been made since the 1930s.

As suggested above, the timeliness of data is often a problem, particularly for the management of financial problems. The Federal Reserve Banks provide assessments of regional conditions in advance of each FOMC meeting that are compiled in the Beige Book. These assessments are based on informal surveys of business leaders in the private sector, as well as on available regional data.

3.6 Other financial market regulators

Regulation of financial markets in the United States is fragmented, and thus the Federal Reserve consults regularly with other depository institution and financial market regulators. An important venue for such contacts in recent years has been the President's Working Group on Financial Markets, a group initially established to study the October 1987 stock market crash. Since then, the Working Group has been a primary vehicle for sharing information and coordinating policy responses to financial disturbances. Its membership includes the Secretary of the Treasury, the Chairman of the Federal Reserve Board, the Chairman of the Commodity Futures Trading Commission and the Chairman of the Securities Exchange Commission. Other supervisors of financial institutions and financial market policymakers also attend meetings of the Working Group. The principals meet a few times each year to discuss financial policy issues that cross lines of responsibility. In addition, the staffs of these organisations meet biweekly to discuss financial market developments.

3.7 Market contacts

Again, in an effort to obtain more timely information, the Federal Reserve draws extensively on the views of market participants for information on the condition of financial markets and intermediaries. The anecdotal information gleaned from these contacts is often as important as more structured measures in forming the Federal Reserve's assessment of financial market fragility.

There are several different regular meetings between the Board of Governors and leaders in various financial sectors: the Bond Market Association for investment banks, mutual funds and other fixed income investors; the Federal Advisory Council for commercial banks; and the Thrift Institution Advisory Council for savings institutions and credit unions. Each of these groups consists of chief executive officers or other high officials from institutions of each type, who meet quarterly to discuss recent developments of significance for their sector. The Board members also meet frequently with trade associations for banks and other financial institutions to discuss issues of concern for their members.

The staff of the Federal Reserve Bank of New York (FRBNY) collect information on the conditions of financial markets from the primary dealers, the 29 financial firms with which the Federal Reserve conducts its open market operations. A willingness and ability to contribute such information is one condition of becoming a primary dealer. The FRBNY also speaks regularly with contacts in the money market and the markets for other securities that it maintains as the executor of Federal Reserve open market operations. Similarly, the staff of the Federal Reserve Bank of Chicago maintain close contacts with participants in the derivatives markets located in Chicago. The staff of the Board of Governors also talk regularly with a broad range of financial market participants.

4. Prudential monitoring in practice

4.1 The credit crunch of the early 1990s

During the 1980s, aggressive lending policies by savings and loan associations, which had little of their own money at risk, and by commercial banks allowed households and businesses to accumulate large amounts of debt. Throughout the 1980s, balance sheet measures concerning depository institutions that are now taken to indicate increased moral hazard, such as a depository institution's capital-to-asset ratio, were at low levels.

With the onset of the 1990-91 recession, the optimistic nature of borrower expectations concerning asset price appreciation (particularly for real estate) became apparent, and many borrowers defaulted. Real estate prices had initially declined in the southwestern United States in the late 1980s and, with the onset of recession, in California and the northeastern United States. US economic growth was then retarded by the efforts of depository institutions, businesses and households to rebuild their balance sheets strained by high levels of leverage and defaults. Measures of debt burdens (for both household and businesses) reached record highs during the early 1990s, and then fell rapidly as delinquencies and bankruptcies increased.

The period might be described as one with financial difficulties (it is difficult to use the word crisis for such a prolonged period) because efforts to stimulate growth through monetary policy were hindered by what was referred to as "financial market headwinds". Investors seemed unwilling to take on risk and depository institutions to extend credit, even though it appeared to many economists that economic conditions had improved markedly by 1992. Part of this resistance by investors and banks may have reflected a heightened uncertainty, and associated pessimism, about future economic prospects arising, in part, from inconsistent behaviour of political leaders, both during the savings and loan crisis and during efforts to trim the federal budget deficit. These "headwinds" manifested themselves, in part, through sluggish growth in M2, contributing to the assessment of the FOMC that the economic recovery remained anaemic. To overcome this pessimism, the Federal Reserve engaged in an aggressive monetary easing that continued almost two years beyond the formal end of the economic recession.

4.2 The policy tightening of 1994

By 1994, however, these headwinds had largely disappeared - both the Senior Loan Officer Survey and anecdotal reports pointed to eased lending standards, albeit from fairly tight levels. Furthermore, major equity indices rose 10 to 20% in 1993, risk spreads on corporate bonds narrowed considerably, and issuance of equities and bonds occurred at a record pace. This issuance was supported in part by strong inflows into stock and bond mutual funds. This evidence, as well as other indicators, suggested that financial markets and depository institutions were once again providing adequate funding to promising investments.

In February 1994, the FOMC began a series of policy tightenings that, over the course of the year, raised the targeted federal funds rate to 6% from 3%, where it had stood for 17 months. At the outset of the tightening, the FOMC was concerned that, after such a long period of low and declining interest rates, any increase in rates would provoke heightened uncertainty and rapid unwinding of investors' positions. Largely for these reasons - as well as the difficulty of discerning the size of the increase in interest rates needed to slow economy activity - the FOMC opted to raise the federal funds rate gradually even while recognising that additional tightening would probably be required.

Initially, the Committee raised short-term rates 75 basis points in three moves over a three-month period. In reaction, longer-term interest rates rose substantially and major stock price indices declined sharply. Inflows into stock and bond mutual funds fell off or reversed, as investors reacted to the greater uncertainty by seeking safer or more liquid investments. Corporate issuance of securities also fell off, with credit demands met in part by more rapid growth in bank loans. However, by May the FOMC, by reviewing many of the measures discussed above, judged that market participants had made the needed adjustments to the new environment, and that it could take more aggressive steps to tighten policy without destabilising markets. Consequently, it raised the federal funds rate by 50 basis points in May and August, 75 basis points in November, and another 50 basis points the following February.

The rise in interest rates that occurred in 1994-95 created stresses on some organisations, particularly those that had made substantial - and incorrect - bets on the direction of interest rates. Several large mutual funds that specialised in holding mortgage-backed securities went bankrupt, and the mortgage-backed securities market was in turmoil most of the year. In addition, Orange County, a large suburban county in California, filed for bankruptcy protection after its investment fund lost money on leveraged investments in the debt of federally sponsored agencies. But in these cases, the unwinding of the assets following these bankruptcies proceeded in an orderly manner and financial market turmoil was minimal.

4.3 Credit spreads and lending standards in the mid-1990s

Many financial measures indicated that, in the middle of the 1990s, US investors judged the amount of risk to be low or had increased appetites for bearing risk. Measures of the equity premium expected by stock market investors suggested that, even while large amounts of household savings flowed into stock markets, the additional returns from holding stocks compared to Treasury securities were declining rapidly. Similarly, anecdotal and supervisory reports raised concerns that depository institutions were significantly lowering their lending standards. From the Federal Reserve's perspective, the problem was determining whether or not this apparent investor confidence reflected difficult-to-observe changes in the economy that would boost future corporate earnings or Pollyannaish behaviour by investors inappropriately extrapolating forward the gains that had accumulated over the preceding years. As stated by Chairman Greenspan in 1996:

"Clearly, sustained low inflation implies less uncertainty about the future, and lower risk premiums imply higher prices of stocks and other earning assets. We can see that in the inverse relationship exhibited by price/earning ratios and the rate of inflation in the past. But how do we know when irrational exuberance has unduly escalated asset values, which then become subject to unexpected and prolonged contractions as they have in Japan over the past decade? And how do we factor that assessment into monetary policy? We as central bankers need not be concerned if a collapsing financial asset bubble does not threaten to impair the real economy, its production, jobs, and price stability. Indeed, the sharp stock market break of 1987 had few negative consequences for the economy. Thus, evaluating shifts in balance sheets generally, and in asset prices particularly, must be an integral part of the development of monetary policy." [Greenspan, 1996]

Using such evaluations, the Federal Reserve pursued a course of action that relied mainly on "jawboning" lenders and financial markets to exercise prudence when extending credit. The Federal Reserve did raise interest rates in early 1997 in response to heightened macroeconomic activity and the potential for the acceleration of inflation. To the degree that stock market valuations were influencing households and businesses to spend more, one might argue that the Federal Reserve did respond indirectly to the run-up in stock valuations. However, the Federal Reserve did not, contrary to the wishes of many outside observers, use monetary policy to deflate or "prick" a so-called asset bubble. Internally, the Federal Reserve made intensive efforts to determine if an asset bubble was actually occurring or whether investors were assessing future corporate earnings rationally, evaluating many of the measures discussed above and discussing market perceptions and decisions with a wide variety of market participants.

By spring 1998, risk spreads had widened somewhat and lending standards, reportedly, had tightened to some extent. While equity prices remained elevated by many measures, it was increasingly clear that the US economy was undergoing a profound shift in the direction of a "new economy" including an acceleration of productivity, and that many investors had foreseen the potential for these developments to raise future corporate earnings. This episode highlights the risks of conditioning monetary policy on an assumption that market participants are acting irrationally. With hindsight, it appears that, had the Federal Reserve acted to lower asset prices, it could have unnecessarily risked interrupting the current expansion.

4.4 Financial turmoil in autumn 1998

In August 1998, amidst lingering concerns about the previous year's difficulties in many Asian economies, the default by Russia on certain government obligations and the devaluation of the rouble led to sharp declines in the market value of the debt of many emerging market economies, resulting in substantial losses for some investors. Many investors appeared to revise upwards their assessments of the riskiness of various counterparties and investments and to become less willing to bear risk. The reduced willingness to bear risk manifested itself in several ways. Yields on US Treasury securities declined to levels not seen for many years. Spreads of corporate bonds, particularly high-yield bonds, over Treasury yields widened sharply. High-yield bond mutual funds and equity mutual funds posted strong outflows, and there were inflows into government bond funds. Many financial institutions, including several large commercial banks, posted large losses, and trimmed their risk exposures. As a result, liquidity in many markets declined sharply. Bid-ask spreads widened in many markets, and on-the-run premiums on Treasury securities increased.

Conditions in US financial markets deteriorated further following the revelation in mid-September of the magnitude of the positions and the extent of the losses of Long-Term Capital Management (LTCM). With world financial markets already suffering from heightened risk aversion and illiquidity, a precipitous unwinding of LTCM's portfolio following a default might have imposed potentially large losses, not just on LTCM's creditors and counterparties, but also, through spillovers to asset prices, on other market participants not directly involved with LTCM. In an effort to avoid these difficulties, the Federal Reserve Bank of New York facilitated a discussion among LTCM's creditors that led to an agreement by the private sector parties to provide additional capital in return for a 90% equity stake in the firm.

Even though the arrangement allowed for the positions of LTCM to be reduced in an orderly manner, the actual and anticipated unwinding of LTCM's portfolio, and of the portfolios of other similarly placed investors, itself seemed to contribute to the tremendous financial market volatility in mid-October. Many of the indicators of illiquidity and an unwillingness to bear risk discussed above - bid-ask spreads, liquidity and risk premiums - worsened further, and expectations of future volatility as measured by option prices rose appreciably.

To cushion the US economy from the effects of the financial strains, and potentially to help reduce those strains as well, the Federal Reserve, in mid-October, decided to ease monetary policy and communicated to the markets that it would work to stabilise market conditions. Overall, the Federal Reserve eased monetary policy on three occasions in the autumn, reducing the targeted federal funds rate by a total of 75 basis points. Despite concerns about financial difficulties in Brazil in November, and some heightened year-end pressures, financial markets became more orderly. Nevertheless, by many measures, market liquidity and risk tolerance have still not returned to their levels before autumn 1998.

Throughout this time, the Federal Reserve intensified its monitoring of financial market conditions. Beginning in October, staff distributed to Board members a daily package of charts and tables summarising a broad range of risk and liquidity premiums. Weekly measures of capital market issuance and bank credit evinced the crucial role played by banks as providers of credit to businesses temporarily shut out of the securities markets. In addition, the Federal Reserve conducted a special Senior Loan Officer Survey in October to provide more qualitative information on the lending stance of commercial banks. Staff also spoke daily with market participants about the condition of the markets in which they were active.

4.5 Y2K

In the months leading up to the century date change, the behaviour of financial market participants and households was similar to that in other episodes of financial instability. Uncertainty about the future rose, demand for liquid assets increased, and some markets became relatively illiquid. Even while judging that the risks of significant computer-related problems were slight, the Federal Reserve, along with many others, was concerned that fears about financial turmoil could become self-fulfilling (a sunspot equilibrium). Consequently, there was a heightened potential for a financial crisis. In response, the Federal Reserve acted to increase financial market liquidity and monitored the condition of financial markets closely.

The demand for liquid assets took its most primitive form in increased household demand for currency, prompted by concerns that other payment mechanisms could be disrupted. In anticipation of that demand, the Federal Reserve printed and shipped an additional $100 billion in currency. The prospect also existed that even a few depositories running out of currency might prompt a run on other depositories. To address this possibility, special currency inventories were strategically placed around the country, to be delivered rapidly if the need arose. In the event, demand for currency rose less than expected and most of the additional currency remained in bank vaults.

The Federal Reserve also took several steps to increase depository institutions' readiness and willingness to use the discount window as a backstop source of funds. Streamlined procedures for pledging collateral, an expanded range of acceptable collateral, and outreach efforts by Federal Reserve Bank staff resulted in many depository institutions filing the documents necessary to borrow, and a significant rise in the amount of collateral pledged. In addition, during the period around the rollover, the Federal Reserve added a discount window lending facility charging an above-market rate, but placing few restrictions on reasons for borrowing or use of funds. The facility was offered in part to increase depository institutions' willingness to extend lines of credit by raising their confidence that funding would be available if such lines were drawn down.

The Federal Reserve made changes to its open market operations to increase market liquidity. The maximum maturity on repurchase agreements was lengthened from 60 to 90 days, and the collateral accepted for those agreements was extended to include mortgage-backed securities. The Federal Reserve also sold options on overnight repurchase agreements for the days around year-end, to help further build confidence that funding would be available at reasonable rates.

In addition, Federal Reserve officials made frequent public statements to increase confidence in the financial system. In these, officials described the efforts to enhance liquidity, and also reported the high degree of readiness of financial institutions. While the FOMC tightened policy in November, it adopted a symmetric directive at that meeting. The FOMC left rates unchanged at its December meeting and again adopted a symmetric directive, indicating in its accompanying statement that it did so to make clear that the immediate focus of policy was ensuring a smooth transition into 2000.

The monitoring efforts of the Federal Reserve took many forms. Internally, staff prepared daily updates on market indicators of financial stress, including many of the same indicators evaluated during autumn 1998. In addition, staff monitored term premiums that widened out as financial institutions sought to lock in funding over year-end. The Senior Loan Officer surveys in 1999 concentrated on banks' assessments of their, and their customers', readiness for the century date change, and banks' willingness to extend funds and lines of credit into 2000. Staff also followed the readiness of depository institutions to use the discount window and, on rare occasions, the actual borrowing of funds.

The Federal Reserve also communicated regularly with financial market participants, with other domestic financial regulators, and with the central banks and regulators of other countries. Such communication became hourly, and indeed around-the-clock, in the final days of December.

5. Conclusion

A pragmatic approach to monitoring financial stability seems appropriate given the many different types of financial stress illustrated by theoretical models and experienced in recent history. In the United States, policy responses to episodes of heightened risks of financial instability have taken a variety of forms, depending on the nature of the risks. On rare occasions, such as in 1994, interest rate adjustments may have been moderated or delayed because of concerns about financial fragility. More commonly, public statements or procedural adjustments were directed at increasing market participants' confidence in the soundness of the financial system. Regardless, the use of a wide range of measures seems to be needed, both on theoretical and practical grounds, to monitor financial stability adequately.

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