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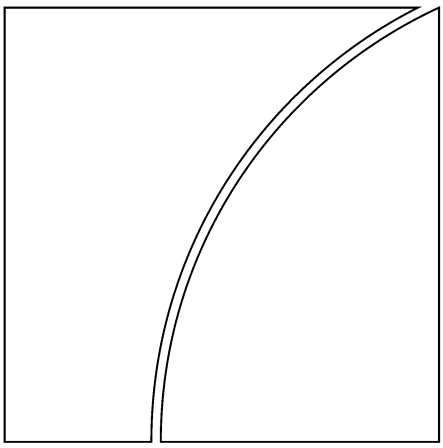

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Credit risk measurement and procyclicality

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Abstract

This paper examines the two-way linkages between credit risk measurement and the macroeconomy. It first discusses the issue of whether credit risk is low or high in economic booms. It then reviews how macroeconomic considerations are incorporated into credit risk models and the risk measurement approach that underlies the New Basel Capital Accord. Finally, it asks what effect these measurement approaches are likely to have on the macroeconomy, particularly through their role in influencing the level of bank capital. The paper argues that much remains to be done in integrating macroeconomic considerations into risk measurement, particularly during the upswing of business cycles that are characterised by rapid increases in credit and asset prices. It also suggests that a system of risk-based capital requirements is likely to deliver large changes in minimum requirements over the business cycle, particularly if risk measurement is based on market prices. This has the potential to increase the financial amplification of business cycles, although other aspects of risk-based capital requirements are likely to work in the other direction. Further work on evaluating the net effects is important for both supervisory and monetary authorities.

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1. Introduction[1]

The idea that a bank's capital should be related to the "riskiness" of its assets enjoys widespread support. This idea underlies many banks' internal decisions about capital and is central to the current proposals for reform of the Basel Capital Accord. Yet despite the appeal of the idea, its application is far from straightforward. In particular, it requires that the "riskiness" of a bank's assets be measured. This is a difficult task, and while much progress has been made on this front over recent years, much remains to be done. Amongst the challenges is to measure not only the relative riskiness of different assets at a point in time, but also to measure how the overall level of risk changes through time and, in particular, how the level of risk is related to the macroeconomy.

This latter issue is critically important, not only to banks and their supervisors, but also to central banks and other policymakers concerned with macroeconomic and financial stability. If banks misassess risk over the course of the business cycle - underestimating it in booms and overestimating it in downturns - the potential for credit booms and busts is increased. In turn this can lead to greater financial amplification of the business cycle and a heightened risk of financial instability.

At a practical level, the difficulty facing banks and their supervisors is determining exactly how the level of credit risk changes with the evolving state of the macroeconomy, and by implication how the level of required capital (either from application of a credit risk model or to meet regulatory standards) should change through time. On the one hand, there are strong arguments that capital should be built up in good times, so that when the bad times come a sufficient buffer exists so that losses can be absorbed without the solvency of the bank, or the more generally the stability of the financial system, being threatened. On the other hand, credit risk models and the proposed regulatory approach to measuring risk for purposes of minimum capital requirements may well deliver measures of credit risk that fall in good times and increase in bad times. To the extent that actual capital levels follow this same pattern, the capacity for the financial system to weather business cycle fluctuations may be affected.

The apparent tension in the ideas that risk is low in good times but that capital should be built up in good times raises three interrelated questions that are the focus of this paper. First, how is credit risk related to the state of the macroeconomy? Second, how do credit risk measurement techniques, including those proposed under Basel II, deal with macroeconomic effects? And third, are risk-based capital arrangements likely to increase financial procyclicality or, in other words, are they likely to unnecessarily increase the financial amplification of economic cycles?

These questions are difficult to answer. The issue of how credit risk evolves with the macroeconomy is inextricably linked to how one views the basic forces driving the business cycle. And on this important issue there is little consensus within the economics profession. Furthermore, the use of formal credit risk models for purposes of determining a bank's overall level of capital is still in its infancy and the implementation of risk-based capital requirements is still some way off. This means that there is limited evidence upon which to draw. Moreover, the evidence that does exist is subject to the "Lucas critique", namely that structural changes that are likely to occur after the implementation of risk-based capital requirements mean that evidence from the current regime says little about the future.

Notwithstanding these difficulties, the paper attempts to shed some light on these three questions. Its main observations can be summarised as follows.

First, while some business cycle expansions might reasonably be characterised by a relatively low level of credit risk, others might be better characterised by a relatively high level of risk. This latter characterisation is arguably more relevant where the expansion is associated with rapid credit growth, large increases in asset prices and high levels of investment. These developments are often symptomatic of the emergence of financial imbalances, and the unwinding of these imbalances can cause significant losses for financial institutions.

Second, most approaches to measuring credit risk pay little attention, at least explicitly, to the business cycle. Key parameters in credit risk models are generally assumed fixed, or at least do not

[1] I would like to thank Jose Lopez, Claudio Borio and other colleagues at the BIS for helpful discussions and comments, and Gert Schnabel for excellent research assistance. The views expressed are those of the author and do not necessarily reflect those of the Bank for International Settlements.

move with the macroeconomic environment. The main cyclical element comes from ratings migration. Typically, both internal and external credit ratings improve during economic expansions and deteriorate during contractions, so that measured risk falls in good times and increases in bad times. Allowing the parameters of credit risk models to move with the macroeconomy risks increasing this cyclical pattern in measured credit risk.

Third, given the way that risk is measured, the level of capital suggested by credit risk models and required under the proposed reforms to the Basel Capital Accord is likely to fall in economic booms and increase in downturns. Even for moderate business cycle fluctuations, the changes in required capital are likely to be significant, the more so for measurement systems that rely on market prices for risk measurement.

Fourth, to the extent that under the New Capital Accord minimum capital requirements increase in downturns it will be important that banks build up buffers over the regulatory minimum before the downturn. Both supervisors and the markets have an important role to play here. If these buffers over the regulatory minimum are not built up there is the potential for adverse macroeconomic effects.

The remainder of the paper is structured as follows. Section 2 briefly discusses the various views concerning the relationship between the macroeconomy and credit risk. Section 3 identifies the building blocks of credit risk measurement and discusses how these building blocks are treated in credit risk models and in the proposed approach for measuring the minimum level of regulatory capital, paying particular attention to if, and how, macroeconomic considerations are incorporated. Section 4 then examines the limited evidence regarding how minimum capital requirements might move through time under a system of risk-based capital, and Section 5 discusses the possible macroeconomic effects of such a system. Finally, Section 6 concludes.

2. Credit risk and the macroeconomy

A key element in many approaches to credit risk measurement is a credit ratings system. Although these systems vary considerably in detail, they are generally recognised as being reasonably successful at distinguishing the ***relative*** riskiness of different borrowers at a given point in time. In contrast, their performance in assessing how risk changes ***through time*** is subject to less agreement.[2]

At a general level, a lack of consensus on this issue reflects different views regarding the relationship between the macroeconomy and credit risk. These different views can perhaps be best illustrated by considering two highly stylised economies. In the first economy, the evolution of economic activity is roughly described by a sine wave. Thus, a boom will almost surely be followed by a recession, and a recession by a recovery. In this economy, a forward-looking ratings system would be likely to show an increase in average credit risk around the peak of the business cycle, given the imminent recession, and perhaps a reduction in credit risk around the trough of the cycle, given the imminent recovery.

In the second economy, while business cycles may be discernable ex post they are so irregular that the economy's current performance is the best indicator of the future. Thus a boom does not mean that a recession is imminent and a recession does not mean that a recovery is likely. In this economy a forward-looking ratings system would be likely to show a decline in credit risk when macroeconomic conditions are strong - on the basis that the strong conditions are likely to continue - and an increase in credit risk when economic conditions were depressed.

Clearly, the economies in which real banks and supervisors operate do not fit neatly into either of these polar cases. A common view, however, is that economic forecasters have such a poor record that, at least to a first approximation, the current performance of the economy can be taken as the best guess of its future performance. This view leads to ratings systems that eschew economic forecasting and rely heavily on the current state of the economy and firms' current financial condition. As a general

[2] See Borio et al (2001) for further discussion of the distinctions between relative risk and changes in risk through time. See also Goodhart (2001).

characterisation this view underlies many, although certainly not all, ratings systems currently employed by banks. It leads to risk being measured as low in an expansion and high in a recession.

An alternative view is that the forces that drive economic expansions often (although not always) sow the seeds of future contractions by generating imbalances in either the financial system or the real economy. This means that while the economy does not follow a sine wave, a strong economic expansion, particularly if it is associated with the development of imbalances in the financial system, can increase the likelihood of an economic downturn. Such financial imbalances can arise from rapid and sustained growth in credit and asset prices and excessive capital accumulation, and when they are unwound they can pose considerable costs to the macroeconomy. According to this view, while these imbalances cannot be measured perfectly, they can be measured ex ante at least to some degree. Accordingly, periods of strong economic growth might, under some circumstances, be characterised by an above average level of credit risk. This view is consistent with the proposition that risk is built up in the boom but materialises in the downturn.

The distinction between these two worlds underlies much of the rest of the paper. It is more than academic. Over the past two decades, a large number of countries have experienced a banking system crisis after a period of strong economic growth, rapidly increasing asset prices and significant increases in credit.[3] During the period of strong growth, risk often appeared to be low, but in reality, serious imbalances were building up. And the unwinding of these imbalances later caused severe financial and macroeconomic stress. From a risk measurement perspective, a central issue is whether these imbalances can be measured ex ante in any meaningful way, and if they can, how they can be incorporated into measures of credit risk.

The existing empirical literature provides mixed guidance. On the one hand, there is considerable statistical evidence that GDP is a "unit root" process. In other words, most movements in GDP can be viewed as permanent, rather than as temporary fluctuations around a trend. This means that a period of strong growth need not automatically be followed by a period of weak growth. Broadly consistent with this, there appears to be little empirical support for the proposition that the longer an economic expansion runs the greater is the likelihood of an economic downturn.[4] This suggests that economic expansions do not simply die of old age, and thus there should be no presumption that simply because an expansion has gone on for a number of years, credit risk has increased. In contrast to these findings, a number of authors have recently suggested that useful indicators of banking system stress can be developed using only ex ante information.[5] This later research does not suggest that the business cycle can be forecast with any degree of accuracy, but rather makes the more modest claim that the combination of particularly fast credit growth and rapidly increasing asset prices makes an episode of financial stress more likely. An implication of this is that when such developments occur, the level of credit risk should be judged to have increased.

Unfortunately, none of this evidence is conclusive and there is plenty of room for disagreement about the use of techniques and interpretation. This is what makes the issue so difficult. Nevertheless, a reasonable interpretation of the evidence is that during a period of strong growth there need be no presumption that a period of weak growth will follow. At the same time, during some episodes of strong growth uncertainty about the future can be said to be higher than average due to the emergence of identifiable imbalances in either the financial system or the real economy. This then opens the possibility of measured credit risk being relatively high in a booming economy.

We now turn to a more practical discussion of how macroeconomic factors are dealt with in credit risk models and in the risk measurement approach that underlies the internal ratings-based (IRB) approach to determining regulatory capital proposed by the Basel Committee on Banking Supervision (hereafter the Basel Committee or BCBS).[6]

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[3] See BIS (2001).

[4] Diebold et al (1999), for example, find that for the postwar period there is no evidence that expansions in the United States become more likely to end as they grow older. In contrast, they find that contractions are more likely to end the longer that that they go on. Interestingly, in the period from 1850 to 1939 the reverse appears to be the case: expansions exhibit duration dependence, but contractions do not.

[5] See for example Borio and Lowe (2002) and Gourinchas et al (2001).

[6] For details see BCBS (2001a,b,c,d).

3. Measurement of credit risk: the building blocks and the macroeconomy

Loosely speaking, when measuring risk what we are trying to do is to obtain some measure of the dispersion of possible future outcomes. For an individual bank, it is the dispersion of future returns on its own portfolio that is of concern, while for a policymaker charged with financial stability, it is the dispersion of possible future outcomes for the system as a whole. In practice, the focus of risk measurement is on downside outcomes, rather than upside outcomes, so that measures of risk tend to focus on the likelihood of losses, rather than characterising the entire distribution of possible future outcomes.

This focus is clearly evident in the increasing use of value-at-risk (VaR) based models to measure credit risk. These models include amongst others JP Morgan's CreditMetrics, McKinsey's CreditPortfolioView, Credit Risk Financial Products' CreditRisk+ and KMV's CreditPortfolioManager. Although the various approaches have different structures, all are trying to measure the potential loss that a portfolio of credit exposures could suffer, with a predetermined confidence level, within a specified time horizon. Most often, this horizon is one year.

In measuring the range of possible future outcomes all such models can be thought of as having a number of common building blocks. These include:

- a system for rating loans (generally based on some concept of the probability of the borrower defaulting);
- assumptions about the correlation of default probabilities (PDs) across borrowers;
- assumptions about the loss incurred in the case of default (commonly referred to as the LGD); and
- assumptions regarding the correlation between the PD and the LGD.

Each of these elements can also be found in the IRB approach to calculating regulatory capital.

In the remainder of this section we consider if, and how, these various building blocks deal with cyclical or macroeconomic considerations. We do not review the various credit risk models in any detail, but instead our focus is on how these various elements of credit risk measurement affect the way in which credit risk is assessed through time.[7]

3.1 Probability of borrowers defaulting

For the purposes of this paper is useful to think of the first building block of most credit risk models as having two elements. The first is a system for rating individual borrowers according to their creditworthiness, and the second is a transition matrix which provides details of how borrowers are expected to migrate, on average, to different ratings classes (including to default) over a given horizon. With these two elements it is possible to calculate the VaR for each borrower over the relevant horizon. Given the nature of transition matrices, the lower the credit rating of the borrower the greater is the VaR on loans to that borrower.

For a portfolio of loans the VaR will change through time if the distribution of borrowers across ratings classes changes or if the transition matrix itself changes. For instance, a general downgrading of borrowers or an increase in probability of a downgrade (for a given grade) would both lead to an increase in measured credit risk. In practice, transition matrices are often treated as fixed, so it is the movement of borrowers across ratings classes that drives changes in measured credit risk. This means that in the context of the procyclicality debate the nature of the ratings system is especially important.

[7] For reviews of the various models see Saunders and Allen (2002), Crouhy et al (2000) and Gordy (2000).

Ratings systems

While a variety of ratings systems are currently used in practice, it is useful to distinguish between two broad classes: those that rely on market-based information, and those that rely on a much broader set of information. The two classes can have quite different implications for the cyclical properties of measured credit risk.

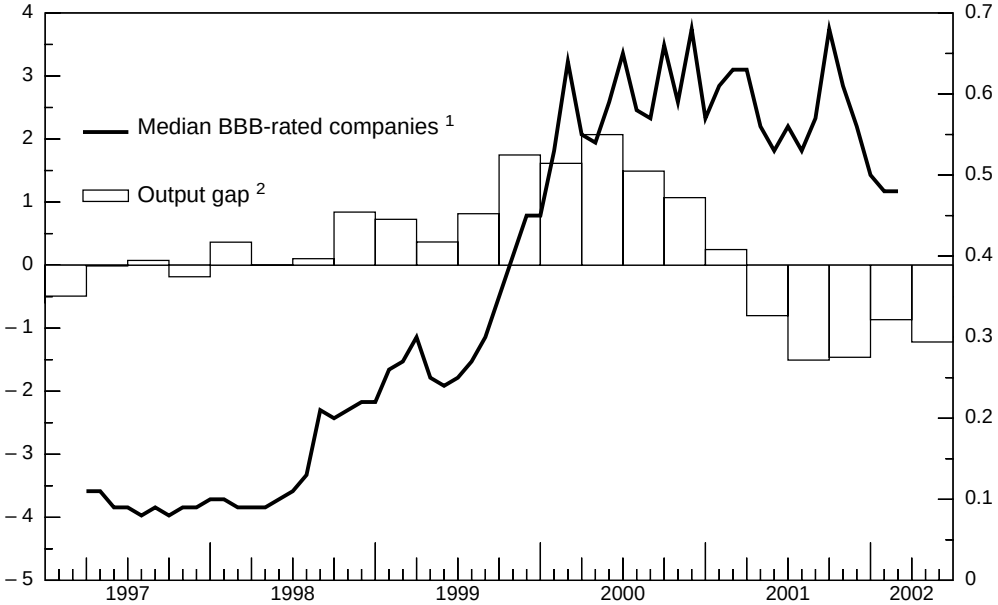
Market-based ratings systems typically rely on a version of the Merton model to derive probabilities of default (PDs) from equity prices. KMV is perhaps the best-known example of this approach. For a given firm the PD (and thus implicitly the rating) is a decreasing function of the firm's equity price, and an increasing function of the volatility of the equity price and the firm's leverage. In principle, this type of ratings system is quite forward-looking. If the market generally expects a deterioration in the macroeconomy, and as a result stock prices decline, implied PDs would rise even if current economic conditions remained robust. Similarly, if the level of uncertainty about the future increases due to the emergence of imbalances in the financial system - and this leads to an increase in volatility of the equity market - PDs would again rise.

Despite the appeal of this type of system there are a couple of potential difficulties. The first is that occasionally, equity values appear to move away from those suggested by fundamentals, distorting measures of risk. If, for example, the market is "overvalued", calculated PDs are likely to underestimate true probabilities, and perhaps suggest a relatively low level of risk. This is despite the fact that the very existence of an overvalued equity market might be symptomatic of more widespread financial imbalances and thus a relatively high level of risk.

The second potential difficulty arises from the fact that the volatility of the equity market means that changes in PDs can be reversed quite quickly and that PDs can move by a significant amount in a relatively short period of time. Figure 1 shows KMV's median expected default frequency (EDF) calculated for BBB-rated firms since the beginning of 1997. It indicates that in 1997 the EDF averaged around 10 basis points, but by 2000 this figure had increased sixfold to around 60 basis points. This is a very large change and as we discuss in the following section would have significant implications for the level of required capital.

Figure 1

Expected default frequency of US companies currently rated BBB



[1] Right-hand scale. [2] Left-hand scale; HP filter applied (BIS).

Source: KMV.

In contrast to market-based ratings, ratings provided by the major credit rating agencies are typically not conditioned on market prices or the state of the economy. Moody's, for example, states that when rating a company its aim is to measure the company's ability to meet its obligations against economic

scenarios that are reasonably adverse to the company's specific circumstances. The ratings do not incorporate a single economic forecast but rather are based on examination of a variety of scenarios. Furthermore, rating agencies are averse to reversing ratings changes within a short period of time. As a result, ratings tend to be quite "sticky". In principle, such an approach should not lead to a significant pickup in measured credit risk simply because the economy is experiencing a period of slow growth, or the stock market has declined.

The ratings systems employed by banks vary considerably, with some systems closely aligned with the approach used by credit rating agencies, while other (but fewer) systems rely on KMV-style default probabilities.[8] Furthermore, many banks use ratings systems that rate borrowers on the PD over the next year (as with KMV), but derive the probability not from market prices, but from internal models and/or the judgment of expert internal credit offices. The volatility in ratings produced by such systems is likely to lie somewhere between the volatility of the agencies' ratings and KMV's implicit ratings. However, the measures of risk produced by such systems may be quite sensitive to the current state of the business cycle, particularly if those responsible for rating borrowers are unwilling to make assessments of the implications of current macroeconomic and financial imbalances for the future.

Transition matrices

As indicated above, it is common practice to treat the transition matrix as fixed. Recent research, however, suggests that transition matrices calculated using ratings from Moody's and Standard & Poor's vary with the business cycle.[9] In particular, the probabilities of downgrade and default (for a given grade) appear to increase significantly in economic contractions, and the probability of upgrades increases in expansions.

Two approaches have been advocated for dealing with this issue. The first is to calculate transition matrices for different points of the cycle: say for a boom, for a recession, and for normal times. The second is to explicitly model the elements of the transition matrix as a function of macroeconomic and financial variables. The latter approach is adopted by CreditPortfolioView.

The effect of using transition matrices that are conditional on the state of the economy on VaR calculations can be substantial. For instance, simulations conducted by Bangia et al (2000) suggest that for a given loan portfolio the use of a "recession transition matrix" delivers a VaR estimate that is 25-30% higher than that delivered by an "expansion transition matrix".

Introducing transition matrices that are conditional on the state of the economy could either increase measured risk in downturns and reduce it in booms, or vice versa. Much depends upon how the conditioning is implemented. In principle, one could imagine that, during a period of strong growth characterised by the emergence of financial and real sector imbalances, the distribution of borrowers across ratings classes would be unaffected, but that the weight on the diagonal elements of the transition matrix would be reduced. Such a move could reflect a view that the strong growth increased the possibility of both upgrades (if the higher growth is sustained) and downgrades (if the unwinding of the imbalances causes macroeconomic effects). In such a situation measured credit risk could increase without any change in the distribution of borrower ratings. Such an approach would tend to push up measured credit risk in the good times.

Much more likely though is that in a boom the conditional transition matrix would assign a lower than average probability to ratings downgrades. In effect, this is the outcome of the CreditPortolioView approach, which models default probabilities for a given ratings grade as a function of the expected value of macroeconomic variables at the relevant horizon. To obtain the expected value of these variables, simple econometric time-series models are used. This means that if times are good today, they are likely to be forecast as good tomorrow and thus there will be few downgrades or defaults. Once again, whether or not this is desirable depends upon one's view of the forces driving the business cycle.

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[8] For a comprehensive review of banks' internal ratings systems see BCBS (2000).

[9] See for example Nickell et al (2000) and Bangia et al (2000).

Regulatory treatment

The calculation of regulatory capital using the IRB approach also commences with borrowers being assigned to ratings classes. In particular, the January 2001 Consultative Paper requires that banks have a minimum of 6 to 9 grades for performing loans and a minimum of 2 grades for non-performing loans. It also requires that no more than 30% of the gross exposures should fall into any one grade.

The Basel Committee has not been prescriptive as to how ratings are assigned. Nevertheless, it has set out minimum requirements, with a number of these requirements being particularly relevant for the issues discussed in this paper. The first is that borrowers should be rated or reviewed at least annually, or whenever new information about the borrower comes to light. The second is that in assigning borrowers to grades, banks must assess "risk factors for the future horizon based on current information". And the third is that for risk ***quantification*** purposes the bank must assign to each grade a probability of default over the next year.

Importantly, the assignment of one-year PDs to each risk grade does not mean that loans must be rated according to these PDs. In principle, a bank could employ a qualitative ratings system whereby borrowers are rated on the basis of their long-term prospects but assign a one-year PD to each of the ratings grades for the purposes of calculating regulatory capital. Under such a system the PD over the next year might increase due to an increased probability of an economic downturn, but the rating, and thus the measurement of risk, could remain unchanged if the borrower's long-term prospects were unaffected. Such a system would be similar in spirit to that used by the credit rating agencies. In contrast, under an alternative system in which borrowers are rated exclusively according to the their one-year PDs, borrowers would be downgraded as the one-year PDs rose. From a validation perspective this latter approach may have some advantages, although it may lead to very cyclical minimum capital requirements.

The Basel Committee does not address the issue of the calculation of transition matrices. The model underlying the calculation of regulatory capital charges only requires an estimate of the probability of default for each rating grade, and not the probability of downgrade.[10]

3.2 Correlation of PDs across borrowers

The second building block in the measurement of credit risk is the correlation in asset returns across borrowers. If asset returns were uncorrelated, then for sufficiently large portfolios, the potential for unexpected losses would be essentially zero, for while some borrowers would inevitably default, there would be no uncertainty regarding the average rate of default.

All credit risk models include estimates of correlations amongst borrowers. While there are numerous ways of obtaining these correlations, they are typically derived from multi-factor models of equity returns, with the factors related to industry, sectoral and country characteristics. These various factors are re-estimated periodically, although they tend to change slowly through time. The state of the macroeconomy and the existence of imbalances in the financial system are generally not explicitly considered. Despite this there is some evidence that during periods of financial stress asset correlations tend to increase. Finger (1999) suggests that this is one reason why the distribution of credit losses through time appears to be bimodal. Either default probabilities and asset correlations are both low, or they are both high, so that actual default rates are either much lower than average, or much higher than average. Typically, credit risk models do not take this into account.

In measuring risk for regulatory purposes, the Basel Committee has also recognised the importance of correlations. Its approach, however, is somewhat simpler. In particular, it assumes that there is only a ***single*** systematic risk factor that drives correlations. While the Committee has contemplated allowing more complex correlation structures, it has argued that the difficulties of measuring and validating correlations make it premature to do so for purposes of calculating regulatory capital.

A major advantage of the single factor model is that the capital requirement assigned to a given borrower is determined solely by the characteristics of that borrower. In multi-factor models, by contrast, the marginal capital requirement depends not only on the borrower's own characteristics, but

[10] The only exception is in the calculation of the mark to market maturity adjustments.

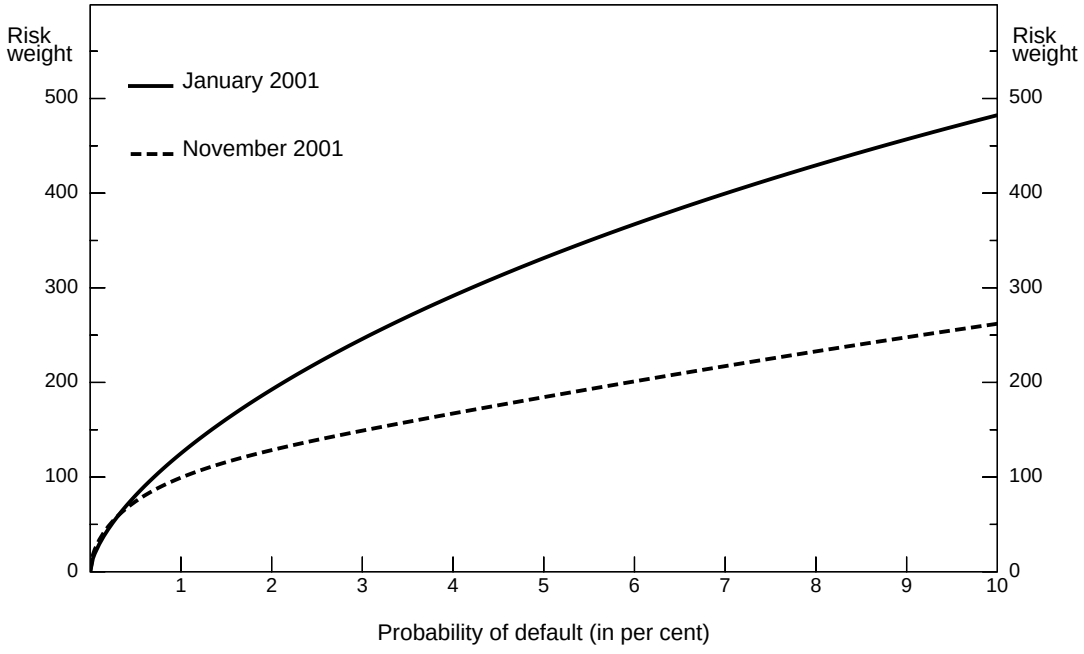
also on the characteristics of other borrowers in the portfolio.[11] For this reason, most banks still use a risk-bucketing approach for internal capital allocation on individual loans, rather than a credit risk model with full correlation structure. The use of credit risk models is often restricted to assessing the overall level of capital for a portfolio or sub-portfolio of loans.

In its January 2001 proposals, the Basel Committee made the further simplifying assumption that all borrowers share the same sensitivity to the single risk factor. This assumption is reflected in the assignment of an asset correlation of 0.2 to all borrowers. In contrast, in its November 2001 proposals the Basel Committee raised the possibility of allowing the sensitivity to the common risk factor to be a decreasing function of the probability of default.[12] One justification for this is that, at least in a cross section of borrowers, as PDs rise, the importance of idiosyncratic risk, relative to systematic risk, also appears to rise (ie the asset correlation falls). In operationalising this approach, the Committee has proposed that an asset correlation of 0.2 be retained for the highest-quality borrowers, but that the correlation be allowed to fall to a minimum of 0.1 for high-risk borrowers. This change has the effect of reducing the measured risk associated with high PD loans. This can be seen in Figure 2.

An important consequence of this proposed change is that during periods in which borrowers are, on average, being rated downwards (to grades with higher PDs), the implicit average asset correlation across the portfolio will decline. To the extent that loans are downgraded in downturns, average asset correlations will implicitly be lower in a downturn than in an expansion. In turn, the increase in measured credit risk in downturns will be lower than it would have been with the assumption of a constant asset correlation. Simulations suggest that this effect is potentially substantial, with the increase in measured credit risk in a typical downturn being reduced by perhaps 30%.

Figure 2

Proposed risk weights for corporate loans



3.3 The loss experienced in the event of default

The third building block in credit risk measurement is the loss incurred in the event of default (the LGD). If a bank were guaranteed to receive all monies owed even in the event of a borrower

[11] See Gordy (2001) for an extensive discussion of this point.

[12] See Lopez (2002) for empirical evidence in support of this assumption. Lopez also presents evidence that the sensitivity to the common factor is an increasing function of firm size.

defaulting, credit risk would be zero regardless of the probability of default and the asset correlation. Another potentially important factor in the measurement of credit risk is the uncertainty about LGDs, with the greater the uncertainty the greater the risk.

Most credit risk models treat the LGD as either a stochastic variable independent of the PD, or as a parameter that must be specified for each exposure. LGDs are generally not treated as being a function of the state of the macroeconomy. Further, where LGDs are modelled as stochastic variables, the degree of variability is not modelled as a function of the macroeconomy.

The approach adopted by the Basel Committee is broadly similar. In the Foundation IRB approach the LGD is set at 50% for unsecured loans, while for loans secured with real estate the figure is between 40 and 50% depending upon the value of the collateral relative to the loan. For loans secured by some other types of physical collateral, the Committee is considering the use of an LGD of 45%. These various LGD values do not move with the state of the economy. They are also treated as known variables, so that any uncertainty about the future losses in the event of default is ignored when quantifying credit risk.

In the Advanced IRB approach banks are able to use their own estimates of LGD, subject to the estimation process meeting minimum standards. Whether or not banks will adjust their estimates based on cyclical factors remains to be seen. When asset prices are very strong, one approach would be to recognise that higher collateral values mean lower LGDs. A contrasting approach would be to recognise that (at least in some cases) if prices have increased substantially, a correction is likely, and that the correction is likely to occur during a period of weak economic activity. The result might be an increase in LGD estimates, particularly on newly issued loans. Again, it all depends on how the bank views the business cycle and the sustainability of movements in asset prices.

3.4 Correlation between PD and LGD

The fourth building block is the correlation between PDs and LGDs. As the correlation between these two variables increases, so does the level of credit risk.

Generally, credit risk models treat the PD and the LGD as independent variables. The Basel Committee makes the same assumption.

In contrast, there is considerable empirical research showing a reasonably strong positive correlation between these two variables.[13] The basic intuition for this result is not hard to understand. Aggregate default rates are usually higher than average in economic downturns. Such periods also tend to be associated with depressed asset values and thus higher than average losses when loans default. While the empirical results are broadly consistent with this intuition, Altman et el (2002) argue that the story is a little more complicated. Although they find a strong positive correlation between PDs and LGDs they question whether the economic cycle is the sole reason for this. They suggest that LGDs are influenced independently by supply and demand considerations for defaulted securities. In particular, they argue that an increase in defaults leads to an increase in the supply of defaulted securities, and correspondingly to a reduction in their price and to larger losses for investors.

Altman et al (2002) also explore through simulation analysis what effect incorporating the positive correlation between PDs and LGDs has on the VaR for a broadly representative loan portfolio. For their particular simulations they find that setting the correlation between the PD and LGD to zero (as is usual practice), rather than to its estimated value, leads to a reduction in the VaR of at least one quarter.

As above, the implication of the zero correlation assumption for how measured risk evolves with the business cycle depends upon the stage of the cycle at which ratings deteriorate. If ratings decline when economic conditions are depressed, the increase in measured risk in the downturn will be larger if a positive correlation is assumed. On the other hand, if ratings deteriorate as financial imbalances emerge in the good times, recognising the positive correlation will contribute to the increase in measured risk when the economy is strong.

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[13] See for example Altman et al (2002), Frye (2000) and Hamilton et al (2001).

Finally, the Basel Committee has indirectly attempted to address the correlation issue by requiring that when banks calculate LGDs from historical data they use a default-weighted average, rather than simply taking the LGD for each year and then averaging the yearly LGDs. Since most defaults occur when economic conditions are weak, the default-weighted estimate is likely to be close to the estimate that applies when PDs are high. Thus it could be viewed as a conservative approach, in that it does not recognise a fall in the LGD when the PD declines.

3.5 Summary

Significant advances have been made in the measurement of credit risk over recent years. Despite this, macroeconomic considerations still play only a small role in most measurement approaches. This is despite the fact that, in the past, the development of macroeconomic imbalances has often been at the root of major credit quality problems.

Whether or not a more thorough treatment of macroeconomic factors would improve the measurement of credit risk depends, in part, upon how one views the business cycle and the forces that drive the evolution of economies.

If one takes the view that major system-wide credit quality problems arise from the unwinding of imbalances, there is a case for incorporating measures of these imbalances, however imperfect, into the risk measurement framework. This is particularly the case if this framework is used for decisions about bank capital. On the other hand, if one takes either the view that these imbalances cannot be measured ex ante, or that they have little effect on credit quality, there is little point in moving in this direction.

Within the context of the current measurement approaches, business cycle considerations have the potential to enter in a number of ways. For example, ratings transition matrices, asset correlations and LGDs can all be made a function of macroeconomic variables, and there is reasonable evidence to support doing so. But there are risks in proceeding in this direction. In particular, there is the potential for larger increases in measured risk in downturns, and declines in booms. For example, if, when the economy enters into a recession, a recession transition matrix is substituted for an expansion matrix, higher asset correlations are used and assumed LGDs are increased, measured credit risk is likely to increase by considerably more than if these changes were not made. To repeat a theme, whether or not this is desirable depends upon how one views the forces the drive the macroeconomy. If one has the “imbalances” perspective, then such changes are probably undesirable. Rather, they should be made during the boom if it is judged that risk is increasing, rather than being made when bad loans begin to materialise in the downturn. If one has the alternative view, such shifts in the key parameters of credit risk measurement during economic downturns are probably desirable.

4. Movements in capital requirements through time: some limited evidence

We now turn to a review of the existing evidence on how minimum regulatory capital requirements are likely to change through time under a system of risk-based capital. Our interest is in two questions. The first is how large the changes in minimum requirements are likely to be. And the second is at what point of the cycle the changes are likely to take place.

The above two questions are difficult to answer with any degree of precision. They are particularly difficult for risk measurement systems that rely on internal ratings. This largely reflects the relative lack of publicly available data about the migration properties of these systems. Many banks are only now developing ratings systems and in the relatively few cases in which they have been in place for some time, the data are normally proprietary and often do not cover a full business cycle. It is also unclear whether the introduction of capital requirements linked to these ratings will change the nature of the ratings process and the migration properties of the ratings.

Despite these difficulties a number of studies have recently been conducted which throw some light on these questions. One of the most comprehensive is that undertaken by Jordan et al (2002). They examine how hypothetical capital requirements would have moved between 1996 and 2001 on a portfolio of 339 loans in the shared national credit programme in the United States. The loans in the portfolio are, on average, relatively high-quality, they are all large (exceeding US$ 20 million) and they

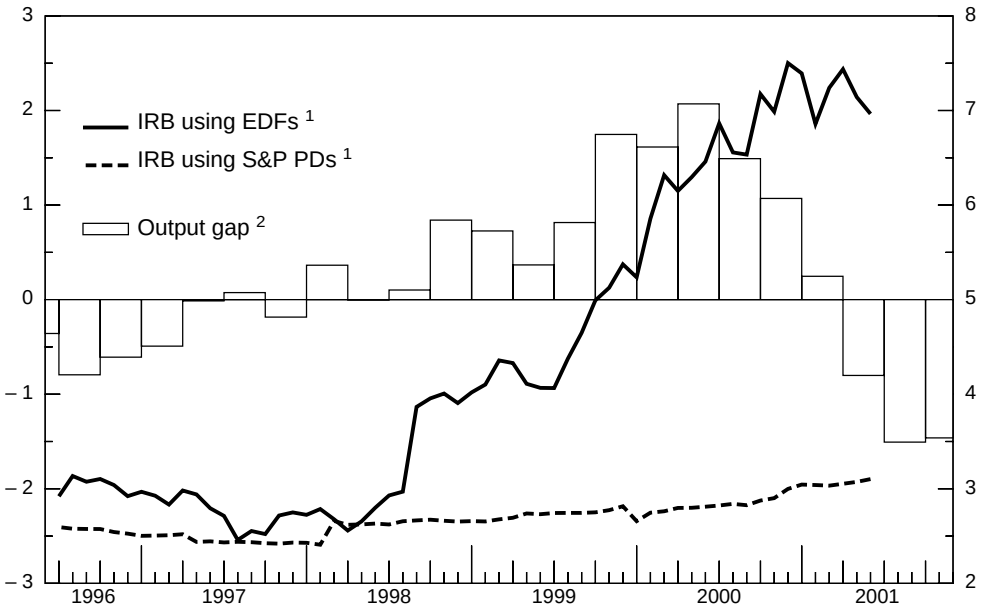
all have at least three participating banks. The capital requirements are calculated using the formulae set out in the Basel Committee's January 2001 Consultative Paper, and the relevant PDs are calculated in two separate ways: the first uses KMV's expected default frequency for each borrower, and the second uses the PD associated with the borrower's Standard & Poor's rating.

The main findings are reproduced in Figure 3, which also shows a measure of the output gap in the United States. Perhaps the most striking aspect of the results is the large increase in hypothetical capital requirements over recent years generated by using KMV's EDFs. In 1996-98, the capital requirement was around 2½-3% of the loan portfolio, but by mid-2000 this had risen to around 7%! Using S&P's default probabilities, capital requirements also increase, but the change is much smaller; in 1996 the requirement was around 2½% and this increased to just over 3% by 2001. This marked difference reflects the much greater stability of external ratings discussed in the previous section.

Another interesting aspect of the results is the timing of the increase in capital requirements. Using KMV's EDFs the big increase took place between mid-1998 and early 2000. This was a period of strong expansion in the United States as evidenced by the positive output gap. While Jordan et al (2002) only report the hypothetical capital requirements up to mid-2001, an examination of average EDFs over the rest of the year does not suggest that requirements would have increased further, despite the recession in the United States. This highlights another of the points made in the previous section. Ratings systems based on market information will lead to capital requirements increasing in good economic times if the equity market becomes more volatile, or if equity prices decline in anticipation of a downturn. The capital requirements derived from S&P's ratings also increase before the onset of the US recession, although the increases appear to be delayed relative to those generated by KMV's EDFs.

Figure 3

Capital ratio using EDF and S&P rating PDs for the probability of default



[1] Right-hand scale. [2] Left-hand scale; HP filter applied (BIS).

Source: Jordan et al (2002), Figure 1.

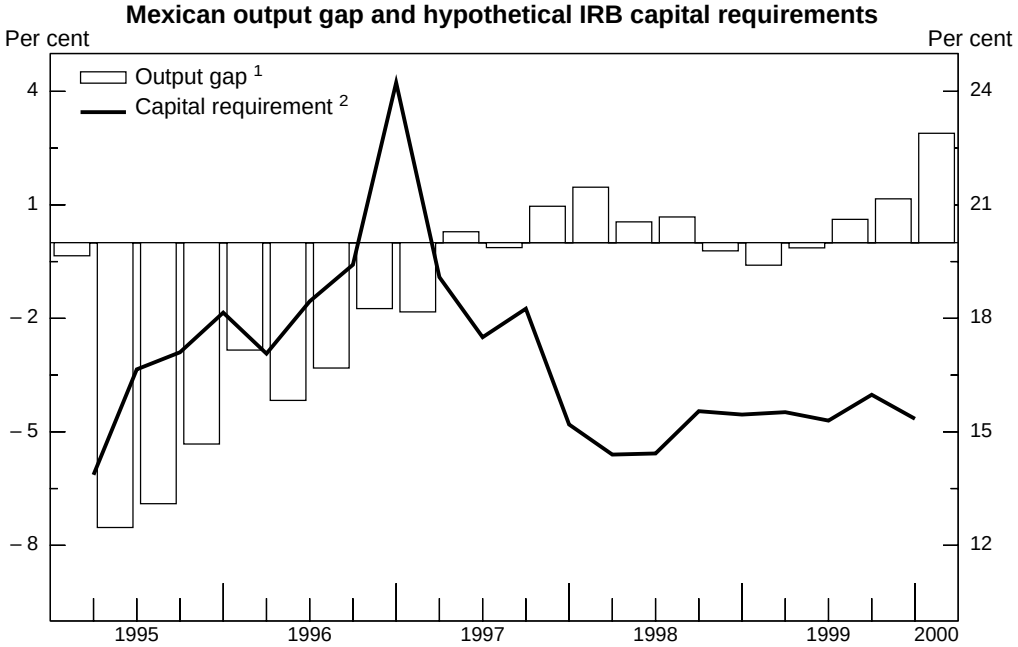
In another study, Catarineu-Rabell et al (2002) also find large, albeit somewhat smaller, changes in capital requirements through time. The authors use data on the actual distribution of loans across ratings classes (at one point in time) for a selection of banks in G10 countries. They combine these data with transition matrices calculated using data from the early 1990s recession. Using the January 2001 proposals and a transition matrix calculated based on KMV-style ratings, they find that the capital requirement on non-defaulted loans for high-quality portfolios might increase by up to 80% in an early 1990s-style recession. Under the November 2001 proposals, the figure is around 50%. Once again, using transition matrices calculated from Moody's data the increases are considerably smaller.

Neither of these two studies has access to data on the evolution of banks' internal ratings through time. In contrast, Carling et al (2001) use data on the internal ratings of a large Swedish bank over the period since 1994. Their results are striking. They find that the capital charge for this bank would have fallen from around 20% in 1994 to around 1% by the end of the decade. This decline largely reflects the gradual improvement in the Swedish economy after the financial problems of the early 1990s. However, the decline is significantly overstated, as the authors use a four-quarter moving average to determine the default probabilities for each grade. This means that unexpectedly low actual defaults for a given ratings grade (because the economy has performed better than expected) lead to low expected defaults for that grade and thus low capital requirements. In contrast, the Basel Committee requires that the PDs associated with each grade be determined on the basis of long-term averages.

Segoviano and Lowe (2002) also use time-series data on internal ratings, having access to the ratings assigned by a number of Mexican banks to business borrowers. Their data cover the period from the mid- to the late 1990s, and so encompass the crisis-driven peso devaluation of December 1994 and the recovery of the late 1990s. Once again, the authors find large swings in required capital. This can be seen in Figure 4, which shows the hypothetical capital requirements, together with the Mexican output gap.

Figure 4

Mexican output gap and hypothetical IRB capital requirements



[1] Left-hand scale; HP filter applied (BIS). [2] Right-hand scale.
Source: Segoviano and Lowe (2002).

The aggregate capital requirement (including the provisioning requirement on defaulted loans) almost doubles after the devaluation, before returning close to the original level. The authors find similar results using a credit risk model similar in spirit to the CreditMetrics model. In terms of timing, loans migrate downwards relatively slowly after the devaluation, so that it takes around two years for the capital requirement to reach its peak. Then as the economy recovers the capital requirements fall as loans migrate to lower risk classes.

Overall, while each of these studies has its own shortcomings, collectively they suggest that risk-sensitive regulatory capital requirements are likely to lead to quite large changes in capital requirements through time.[14] Risk measurement systems that rely on market prices will almost certainly deliver the largest changes. These systems, however, may lead to earlier increases in required capital than would systems based on external ratings or ratings methodologies similar to that

[14] For other studies see Carpenter et al (2001) and Ervin and Wilde (2001).

used by the rating agencies. Clearly though, more work is needed before robust conclusions can be drawn. We now turn to a discussion of the potential macroeconomic consequences of large changes in minimum capital requirements.

5. Possible macro consequences?

The banking industry is inherently procyclical. Economic expansions are supported by an increased willingness of banks to take on risks, by increased competition in credit markets, by lower credit spreads, and by easier access to credit as collateral values rise. In downturns the process can work in reverse, with the banking industry acting as a drag on recovery.[15]

Whether or not a system of risk-based capital will add to, or attenuate, these procyclical forces is subject to much debate. A number of submissions to the Basel Committee, for example, have expressed a concern that the proposed changes to the Capital Accord could unintentionally increase the amplitude of the business cycle.[16] The fear is that a decline in capital requirements in a boom will fuel the boom, and that an increase in capital requirements in a downturn will lead to credit supply constraints as banks suffer capital shortages and perhaps even fail as a consequence of having earlier run down the level of capital. On the other hand, others have argued that a system of risk-based capital will contribute to a more stable financial system, and while it may not attenuate normal swings in the business cycle, it will help avoid the type of financial crises that occasionally have very large macroeconomic effects.

The existing literature is of relatively little help in resolving the debate. While it is suggestive of the fact that binding capital requirements can have macroeconomic effects, the evidence is largely inconclusive. In surveying this evidence, Jackson et al (1999) conclude that reductions in bank lending in some countries following financial stresses do not appear to have been fully offset by increases in lending from other intermediaries or markets. The impact on the macroeconomy is, however, more difficult to establish. In particular, the existing research suggests that binding capital requirements have adversely affected output in some sectors - most notably real estate and small business - but it has not established a robust link between binding capital requirements and macroeconomic outcomes.[17]

The existing studies, however, probably provide little guide to the future. Under the current Basel Accord minimum capital requirements, on a given portfolio, are fixed through time. Thus capital requirements typically become binding through a fall in a bank's capital following the recognition of credit losses. In contrast, under a system of risk-based capital, requirements could become binding not only through a decline in capital due to credit losses, but also through an increase in minimum requirements as loans migrate to higher risk classes. Indeed, the above discussion suggests that just at the time that banks are most likely to be recording losses, the minimum capital requirements could themselves be increasing, perhaps substantially so. Indeed, the increase in the minimum requirements may pose more of a difficultly than the reduction in capital.

This line of argument, by itself, suggests that risk-based capital requirements may lead to greater financial amplification of the business cycle. Such an outcome would, at the least, be ironic, particularly given that a central underlying motivation for reform of the Capital Accord and the improvement of credit risk measurement is to increase the resilience of both individual banks and the financial system as a whole. The likelihood of such an outcome though depends in large part on what else changes with the implementation of risk-based capital requirements. At least three such changes are possible.

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[15] For a fuller discussion of this issue see BIS (2001) and Borio et al (2001).

[16] See for example, Danielsson et al (2001), ECB (2001), FBSO (2001), IMF (2001) and SBA (2001).

[17] See for example Hancock and Wilcox (1997, 1998), Peek and Rosengren (1997) and the references in Jackson et al (1999).

Improvements in credit risk management

The first, and arguably most important change is that the increasing use of credit risk models and ratings systems is contributing to a revolution in the measurement and management of credit risk in financial institutions. Until recently, many banks did not have formal ratings systems or a metric for measuring changes in credit quality, short of default. This is now clearly changing. And when risk is formally measured, arguably this leads to better management reporting and a more structured decision-making process. One significant benefit of this is that credit quality problems should be recognised earlier in the business cycle, and with earlier recognition should come earlier corrective action by management, supervisors and the market. In turn, earlier corrective action is likely to increase the probability that difficulties are contained before they reach the point where they threaten either the health of the bank, or the banking system more generally.

Buffers over regulatory minimum

The second change is that the capital buffers over the regulatory minimum are likely to become much more cyclical than is currently the case. In particular, buffers are likely to increase when economic conditions are strong and fall when they are weak.

Under the current Capital Accord banks typically hold more capital than required, although the relative size of the buffer does not appear to co-vary in a consistent way with the business cycle.[18] Over the second half of the 1990s, for example, when most countries experienced reasonably strong economic growth, capital ratios fell in some countries, while they rose in others. Looking forward, we are likely to see a much more consistent pattern.

The reason is as follows. As a bank rerates its loans upwards in good times, its risk-weighted assets will fall and its capital ratio calculated for regulatory purposes will increase (all else constant). In response, the bank could undertake additional lending (or a share buyback), and in so doing increase its leverage and reverse the rise in its regulatory capital ratio. If this were to occur, it would contribute to the procyclicality of the financial system. However, if the bank were to behave in this way, it would be likely to suffer adverse consequences either in the capital markets or from the rating agencies. Its counterparties would be rightly concerned that if the cycle turned, and the favourable migration had to be reversed, the bank could find itself with a capital shortage given that it might be unable to quickly undo the increase in lending. As a result, during good times the rating agencies and the markets may well be intolerant of banks that use favourable ratings migration to support additional lending. Consequently, when times are good banks may be required by the market, and/or by their own management, to hold larger buffers over the regulatory minimum. Over time, markets may also impose some form of penalty (in terms of higher funding costs, a discount in equity valuations or lower ratings) on banks that exhibit “excessive” loan migration. This may encourage banks to use ratings systems that more closely resemble those used by rating agencies than market-based systems.

For this type of market discipline to work effectively, at least two conditions need to be satisfied. The first is that disclosure is comprehensive, for without adequate disclosure analysts will have difficulty in judging the source of any change in a bank’s reported capital ratio. The second is that the market as a whole does not treat favourable loan migration due to business cycle considerations as likely to persist. If it were to do so there might be no penalty for banks that used favourable loan migration to increase their leverage.

Changes in supervisory practices

The third change is to supervisory practices. Here there are two important elements.

The first is the recognition that supervisors must assess whether a bank is adequately capitalised even if it is meeting the minimum requirements as set out under Pillar 1 of the Accord. In making this assessment, the Basel Committee states that supervisors should take into account “external factors”, and this could include business cycle effects. Furthermore, the Basel Committee requires that when

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[18] For a cross-country comparison see BIS (2001). See also Ayuso et al (2002), who present evidence that in Spain under the current Capital Accord capital buffers over the regulatory minimum are substantially eroded during upturns.

banks and their supervisors are assessing the adequacy of capital they are "mindful of the particular stage of the business cycle in which the bank is operating" (BCBS 2000c, p 3). Presumably, if the supervisory authority thought that the bank was inadequately capitalised for the particular point in the cycle, it would suggest, or even require, that the bank raise more capital.

While the possibility of such action might help limit downward pressure on capital in good times, it remains an open question as to whether supervisors will be prepared to act in this way. The difficulty is that for them to do so they need to take a view about future macroeconomic developments, and this can be difficult to do. One way of strengthening their hand is to require banks to undertake and then publish some form of macroeconomic stress test. This could at least form the basis of a dialogue between the bank and its supervisors and strengthen the market discipline discussed above.

The second element is that a system of risk-based capital requirements limits the ability of the supervisory authority to engage in undisclosed forbearance. As noted above, credit quality problems should become evident much earlier, not only because of better measurement but also because of more comprehensive disclosure. This will make it difficult for supervisors to ignore deteriorations in the quality of banks' portfolios, and help overcome the problems that arise from distorted incentives when banks in very poor condition are allowed to continue operating.

Evaluating the impact of these various potential changes in the behaviour of banks and their supervisors is difficult. Yet these changes are probably the most important consequences of the New Basel Capital Accord. If they were not to take place and the actual level of capital that banks hold was to move in line with changes in the minimum level of required capital under Pillar 1, then the potential for adverse macroeconomic effects would be increased. In ensuring that these changes take place, the use of macroeconomic stress tests and the increased disclosure of information are both of considerable importance.

6. Summary

Measuring the cyclical dimension of credit risk is fundamentally difficult. Yet, as the recurrence of banking crises suggests, it is fundamentally important.

One reason for the difficulty is that the economics profession is divided over the forces that drive business cycles and whether financial imbalances can be identified ex ante in any meaningful way. Without agreement on these important issues, it is difficult for banks and for their supervisors to incorporate business cycle considerations in a mechanical fashion into their risk measurement approaches. Attempts to do so could even be counterproductive, particularly if during a period of weak economic growth they led to changes in key parameters that amplified the increase in measured risk, and in turn accentuated the increase in required capital.

This difficulty, however, does not mean that progress is impossible. Good credit risk measurement cannot be blind to developments in the macroeconomy and to the evolving nature of the balance of macroeconomic risks. Even if the balance of risks cannot be easily quantified and incorporated into formal risk measurement approaches, an assessment of the full range of possible macroeconomic outcomes needs to be made when judging the appropriateness of a bank's capital. When imbalances appear to be developing in the economy, it would seem undesirable for the level of capital in the banking system to decline, irrespective of the outcome of formal risk measurement approaches. Both markets and supervisors have an important role to play in ensuring that the difficulties in formally measuring the evolution of risk through time do not, under a system of risk-based capital, translate into larger macroeconomic fluctuations.

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