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

[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.

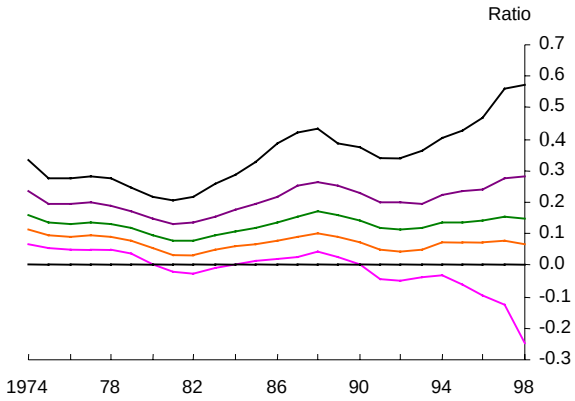
(c) Assessing the cross-section distribution of corporate sector risks

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

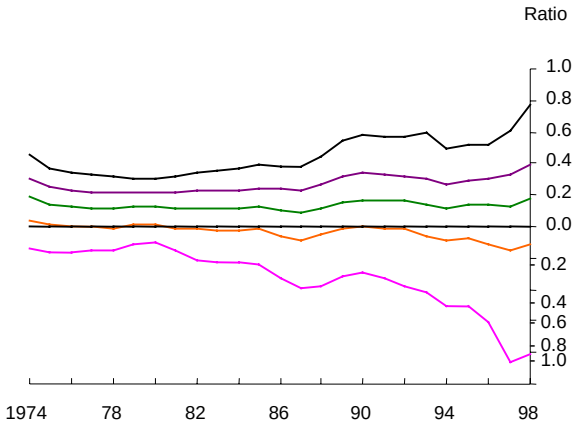


Note: As defined by profit before interest and tax divided by replacement cost of capital. Percentiles are, from top to bottom, 90th, 75th, 50th (median), 25th, 10th.
Sources: Bank of England; Primark Datastream.

[12] See Benito and Vlieghe (2000) for more details.

Figure 2

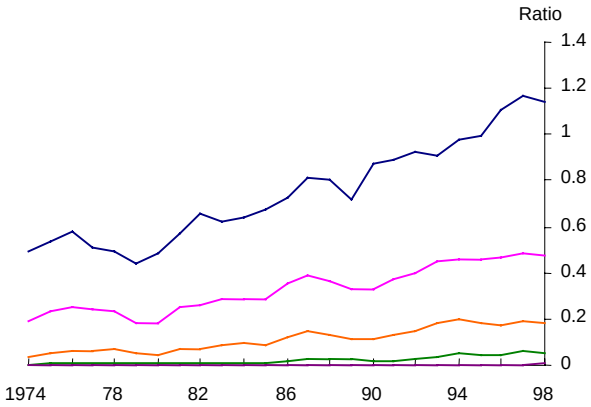
Percentiles of distribution of capital gearing



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.

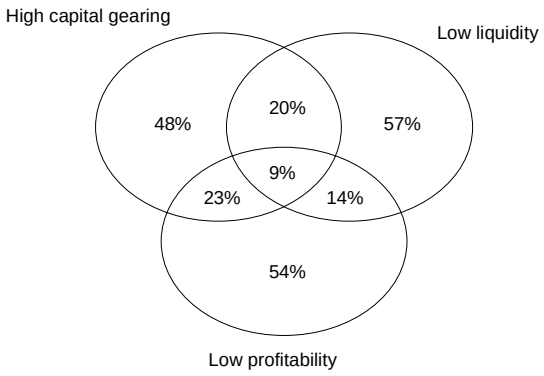
Sources: Bank of England; Primark Datastream.

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	Floatation of the Thai baht 2 July 1997	0	3 changes -6 notches	0	-1
	S&P's	"	0	6 changes -8 notches	0	-2
Korea	Moody's	"	0	3 changes -6 notches *3 watches* *- downgrade* *2 watches* *- confirm &* *1 watch* *- upgrade*	0	-2
	S&P's	"	0	5 changes -7 notches	0	-3
Malaysia	Moody's	"	0	3 changes -5 notches *1 watch* *- downgrade and* *1 watch* *- confirm*	0	-1
	S&P's	"	0	4 changes -5 notches	0	-1
Philippines	Moody's	"	1 change +1 notch *Watch – upgrade*	0	0	0
	S&P's	"	1 change +2 notches	0	0	0
Thailand	Moody's	"	1 change -1 notch *Watch – downgrade*	3 changes -4 notches *5 watches* *- downgrade, 1 watch* *- no direction*	0	-2
	S&P's	"	0	3 changes -4 notches	0	-1
Russian Sovereign Default						
Russia	Moody's	Devaluation of the rouble 17 July 1998	2 changes -2 notches	2 changes -2 notches	0	0
	S&P's	"	1 change -1 notch	4 change -8 notches	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)

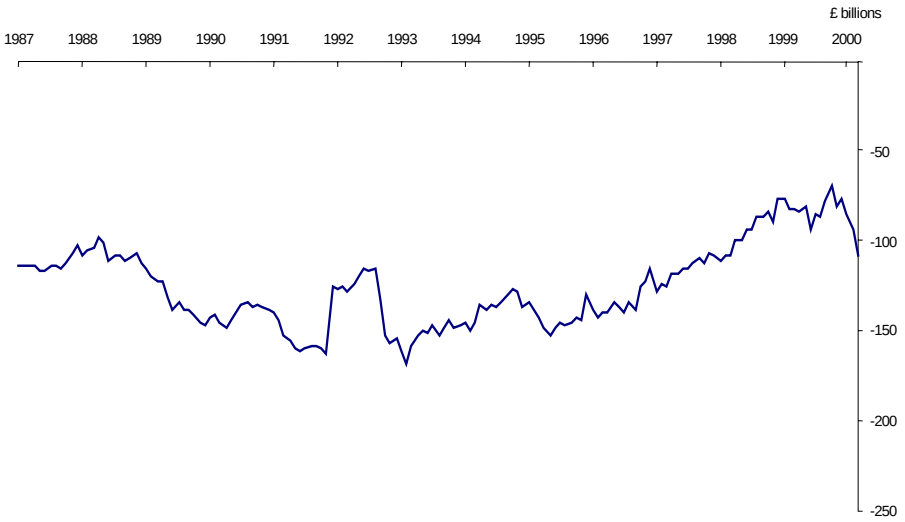
	Reserves/Debt
UK	0.02
Japan	0.21
France	0.13
Italy	0.16
Germany	0.20
Luxembourg	0.0007

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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