INTERNAL RATINGS, THE BUSINESS CYCLE AND CAPITAL REQUIREMENTS: SOME EVIDENCE FROM AN EMERGING MARKET ECONOMY*

Miguel Angel Segoviano
Financial Markets Group
London School of Economics
Houghton St
London WC2A 2AE
United Kingdom
tel: +44 207 955 7051
email: m.a.segoviano@lse.ac.uk

Philip Lowe
Research and Policy Analysis
Bank for International Settlements
Centralbahnplatz 2
Basel 4002
Switzerland
tel: +41 61 280 8089
email: philip.lowe@bis.org

Abstract

The concept of risk-based capital requirements enjoys widespread support. Effective implementation, however, requires that risk be measured accurately both across borrowers and across time. Under the New Capital Accord, the cornerstone of this risk measurement process is the rating of the borrower. In this paper we use the ratings assigned by individual Mexican banks' to examine how measured credit risk for these banks has changed since the financial crisis in the mid 1990s. We then examine the implications of these changes for regulatory capital under the proposed changes to the Basel Capital Accord. We find that measured risk increased after the crisis and then fell as the recovery took hold. In turn, despite the limitations of the data, we find that the proposed internal ratings approach would have generated large swings in regulatory capital requirements over the second half of the 1990s, with required capital increasing significantly in the aftermath of the crisis, and then falling as the economy recovered. Looking forward, if movements in actual bank capital were to show this same cyclical variation, then business cycle fluctuations may be amplified by developments in the banking industry.

This draft dated: 15 March 2002

* We would like to thank Guillermo Güemez, Pablo Graf and colleagues at the BIS for very helpful comments, and Gert Schnabel for excellent research assistance. The views expressed in this paper are those of the authors and do not represent the official views of the Bank for International Settlements.

1. Introduction

The idea that regulatory capital requirements should be risk sensitive is at the core of the proposed changes to the Basel Capital Accord. Over recent years, distortions in patterns of financial intermediation have emerged wherever regulatory capital requirements have not reflected the underlying risks. These distortions have efficiency costs and can have adverse effects on financial stability, particularly if the portfolios of regulated institutions become unduly concentrated in assets where the regulatory capital charges are too low relative to the risk being incurred.

At the conceptual level there is widespread support for the idea of risk-based capital charges. The successful implementation of such a system, however, poses a number of challenges. This paper is motivated by two of these challenges. The first is to accurately measure risk, and particularly to measure changes in risk through time. If bank capital is to provide the required degree of protection against credit losses over the ups and downs of the business cycle then not only does the *relative* riskiness of various assets (at a given point in time) need to be measured accurately, but so too do changes in *risk through time*. The second, and related challenge, is to ensure that risk-based capital requirements do not have unintended macroeconomic consequences in the form of an increased amplitude of economic cycles.

Another way of framing these issues is to ask whether risk-based capital requirements are likely to be unduly *procyclical*. In particular, to what extent will regulatory capital requirements increase in economic downturns because of an increased in perceived risk, and in turn, what effect will any increase in required capital have on the stability of the financial system, and on the macroeconomy more generally? These questions have recently attracted increased attention, with a number of submissions to the Basel Committee on Banking Supervision expressing a concern that the proposed changes to the Capital Accord could unintentionally increase the amplitude of business cycles.[1] While these concerns are generally expressed with reference to the wealthiest countries, they are perhaps

---

[1] See for example, Danielsson et al (2001), the European Central Bank (2001), the Federal Banking Supervisory Office of Germany (2001), the International Monetary Fund (2001) and the Spanish Banking Association (2001).

doubly relevant to emerging market economies, where assessments of risk can change quickly and by a significant degree.

Assessing the importance and relevance of these concerns, however, is a difficult task. The proposed reforms to the Capital Accord have not yet been implemented and we have little, if any, real experience with risk-based capital requirements. There is very little data available to examine how banks' assessments of the riskiness of their loan portfolios changes' over time. Many banks are only now implementing systematic risk ratings systems, and in those few cases where systems have been in place for a full business cycle, the data are normally proprietary. Furthermore, regulatory capital requirements are only one factor influencing the actual level of capital, with rating agencies and market pressures perhaps playing an even more influential role. While regulatory requirements themselves may be procyclical, it remains an open issue as to whether movements in the *actual* level of capital will exhibit the same cyclical pattern as the *required* minimum level of capital. Finally, regardless of how the levels of actual and regulatory capital move through time, changes in the way that risk is managed within financial institutions, and changes in supervisory and disclosure arrangements, may ultimately make the financial system less procyclical than has been the case in recent decades.

Rather than attempting to assess all these considerations, the modest contribution of this paper is to use a unique dataset in an effort to throw some light on the question of what variation in the *required* minimum level of capital we might see in emerging market economies following the implementation of the proposed risk-based capital requirements. In doing this we primarily use the proposals as set out by the Basel Committee on Banking Supervision (BCBS) in January 2001 (BCBS 2001a and 2000b), although we also examine the impact of the potential modifications to the proposals announced in November 2001 (BCBS 2001d). The dataset that we use comes from Mexico and contains the risk ratings assigned by a number of banks operating in Mexico to business borrowers over the second half of the 1990s. These ratings are determined internally within each bank, but according to a rating system set out by the regulatory authority. As we discuss later in the paper, this dataset is not without its difficulties, and our analysis is only partial equilibrium in the sense that we are not able to take into account the effects of any improvement in credit risk management that might arise from implementation of the New Accord. Despite these shortcomings, the dataset is one of the few that can be used for the studying loan migration and its impact on capital requirements. Moreover, the implications for emerging market economies of the proposed reforms of the Capital Accord have been

subject to relatively little study and this dataset allows us to reflect on a number of important policy issues.

Our major conclusions can be summarised as follows. First, had capital requirements in Mexico been based on internal ratings over the second half of the 1990s, the required amount of capital for the banks examined in this study would have risen steeply after the crisis in 1994 and then declined as the economy recovered. While we do not wish to place too much weight on particular numbers, it appears that under the January 2001 proposals the capital requirements for corporate credit risk would have at least doubled for some banks between the end of 1994 and the end of 1996, while for all banks the increase would have been at least 40 per cent. Under the proposals released in November 2001, the overall increase in capital would still have been substantial, but is about one third less than the increase under the earlier proposals. Second, capital requirements would have been very high for banks with poor quality loan portfolios, reflecting the high default experience even for the highest quality loans. Third, calibration and verification is likely to be difficult, particularly in emerging market economies that are subject to business cycles with relatively large amplitudes. Default rates vary considerably not only across time but also across banks for a given rating grade. This variability poses a challenge to banks, supervisors and analysts in comparing the adequacy of capital both across banks and through time. Fourth, and more speculatively, if large swings in regulatory capital requirements are not to amplify the business cycle, supervisors and markets will need to ensure that financial institutions carry large enough capital buffers in good times to enable them to meet the higher requirements when times are not so good. One step in this direction would be to require banks to undertake macroeconomic stress tests and for the results of those tests to be disclosed to the market.

The remainder of this paper is structured as follows. Sections 2 and 3 discuss how credit risk is measured under the proposed New Capital Accord for purposes of calculating regulatory capital and discusses how the proposed measurement approach might affect the procyclicality of the financial system. The first of these two sections discusses the central role of ratings in the measurement of credit risk, while the second discusses a number of other elements including the treatment of maturity, correlations, the loss in event of default and the measurement of “expected” losses. Section 4 discusses the dataset and our basic methodology, while Section 5 presents our results. Finally, our conclusions are summarised in Section 6.

2. Ratings and procyclicality

The accurate measurement of risk is obviously crucial for the successful implementation of a system of risk-based capital requirements. Under the proposals contained in the New Basel Capital Accord the cornerstone of the credit risk measurement for corporate lending is the rating of the borrower.[2] Ratings may be either internal to the bank or be provided by external credit assessment institutions. As a firm's rating changes through time so will the amount of capital required by the bank against loans to that firm.[3]

The Basel Committee expects that eventually most internationally active banks will use internal ratings. For banks that do so, the rating systems will need to meet a set of criteria specified by the regulatory authorities.[4] These include a requirement that there be least six grades of performing loans and two grades of non-performing loans and that banks must take account of all relevant information when assigning a borrower to each of these grades. For each rating grade the bank must estimate an average one-year probability of default (PD), with this estimate being based on long-run experience of the loans assigned to that grade.[5] This PD then forms the basis for determining the capital requirement for loans in that ratings class.

Where banks rely on external credit assessment institutions for risk measurement purposes these institutions also need to satisfy a number of criteria. In particular they will need to disclose their assessment methodologies (including their definitions of default and the time horizon used for measuring risk) as well as statistics on rating transitions and default rates. Supervisory authorities will determine whether these institutions satisfy the relevant criteria.

Graph 1 shows the relationship between the PD and the risk weight for loans to corporate borrowers. The graph shows the relationship under the Foundation Internal Ratings-Based (IRB) approach

---

[2] We assume the reader has some familiarity with the details of the New Basel Capital Accord, in particular the differences between the Standardised approach, the Foundation Internal Ratings-Based approach and the Advanced Internal Ratings-Based approach. In this paper our focus is on the corporate loan portfolio.

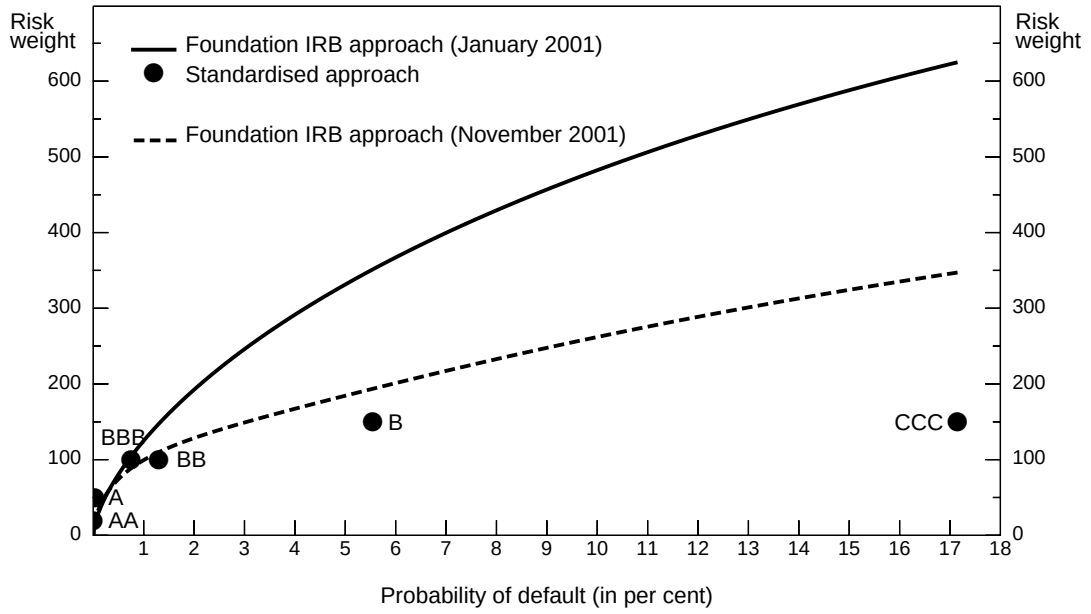
[3] In contrast, under the current Basel Capital Accord capital requirements generally do not change through time. One exception to this is where the composition of a bank's portfolio changes between government securities, mortgages and business loans.

[4] See Sections V and VI of BCBS (2000b) for a full list of the proposed minimum requirements that internal rating systems must satisfy.

(assuming the baseline maturity of 3 years) as set out in the Basel Committee's January 2001 and November 2001 proposals. The graph also shows the risk weight that will apply under the Standardised approach. As has been widely noted, the use of internal ratings makes the capital requirement considerably more sensitive to the rating of the borrower than is the case under the Standardised approach. This degree of sensitivity is, however, lower under the modified IRB proposals than it is under the original proposals.

Graph 1

Risk weights and rating grades



Where banks use their internal ratings they are expected to review the rating of each borrower at least annually and, in addition, whenever material new information becomes available. As the riskiness of a borrower changes, so too should its internal rating. Changes in risk over time should therefore be reflected in changes in the distribution of borrowers across the ratings grades. It is not envisaged that banks adjust the PDs associated with each ratings grade on a regular basis, although if the PDs turn

---

[5] The Basel Committee requires that a minimum historical observation period of 5 years and notes that ideally the observation period should cover an entire economic cycle. The PD can be estimated using the bank's own historical default experience, by mapping to external data or by the use of a statistical default model.

out to be inconsistent with experience over a run of years, a review of the PD would normally be required.

The extent to which internal ratings will be used for the purposes of determining regulatory capital in emerging market economies remains uncertain. Data are often even in shorter supply than in industrial countries, and the Basel Committee's minimum requirements for acceptable ratings systems may limit the rapid take-up the IRB approach.[6] Furthermore, in many countries supervisors may lack adequate resources to assess and approve a bank's rating system. The cyclical implications of the New Accord may also be of greater concern in emerging market economies than industrial economies because of the relatively large swings their business cycles. These considerations probably mean that the take-up will be uneven, but they need not rule out use of the IRB approach, especially for the larger and more sophisticated banks.

In making an assessment of the possible consequences of this regulatory framework for the procyclicality of capital requirements both in industrialised and emerging market countries an important consideration is the way that banks assign borrowers to individual grades.

One approach would be for banks to define each of the grades strictly in terms of their one-year PD and to assign borrowers to grades only on the basis of this PD. In effect, this would amount to the loan's one-year PD being a sufficient statistic for the loan's riskiness. This is the approach currently used by many banks.[7]

A second approach would by to assign loans to ratings classes on the basis of a broader set of information than just the one-year PD. One possibility would be for a bank to assign a rating based on the average risk of default over the entire period to maturity. If it were to do so it might assign a loan with a low one-year PD to a relatively high risk grade because it assesses that the borrower's longer-term viability is questionable. In this case, the PD associated with the rating to which the loan is assigned will exceed the bank's assessment of the one-year PD. In principle, the reverse could be true as well. Another possibility would be to rate borrowers according to their ability to withstand a recession. This is broadly the approach used by a number of rating agencies. One advantage is that it

---

[6] Powell (2001) and Griffith-Jones and Spratt (2001) make similar points.

preserves relative risk rankings across borrowers while, at the same time, (potentially) making ratings less sensitive to the business cycle.

A difficulty with using a broader information set than just the one-year PD is that it significantly complicates the tasks of backtesting individual banks' ratings systems and comparing ratings across banks. In particular, the failure of the average observed default frequencies for a given grade to equal the associated one-year PD for that grade may not point to a flaw in the ratings system or its application. Moreover, requiring ratings to be assigned on the basis of long-term prospects, or the ability to survive a recession, would require many banks to use different rating systems for internal management purposes and for regulatory capital. Many see this as problematic.

While the assignment of borrowers to ratings based on PDs alone will likely be more procyclical than using a broader set of information, both approaches are likely to see significant migration of loans over the course of a business cycle. Unfortunately, however, there is little evidence available regarding exactly how much migration one might expect to see. Many banks have only developed comprehensive ratings systems over recent years and the data are generally not available for research. One exception to this is the data provided by a large Swedish bank to the Swedish central bank. These data include the ratings of over 50 000 borrowers over the period from 1994 to 2000 and show a significant amount of loan migration (see Carling et al 2001). In particular, during the mid 1990s when the Swedish economy was recovering from recession, many loans were rerated to lower risk rating classes. Carling et al estimate that for this bank the required capital ratio under the Foundation IRB approach would have fallen from somewhere around 20 per cent in 1994 to around 1-2 per cent in 1999! However, this calculation significantly overstates the effect, as the authors use a 4-quarter moving average to determine the default probabilities for each grade. This means that low actual defaults for a given ratings class lead to low expected defaults for that class and thus low capital requirements. The reverse is the case if default rates are high.

For external ratings the extent and timing of migration has been subject to more research. Haldane et al (2001), for example, document that in 17 recent financial crises, sovereign ratings by the major rating agencies were adjusted downward prior to the crisis in less than a quarter of the cases. In most

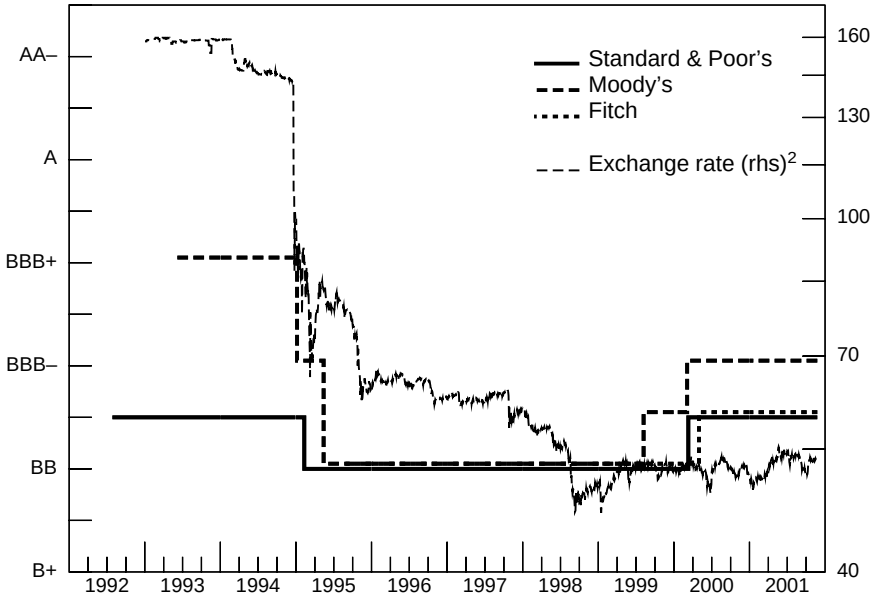
---

[7] For a review of the range of banks' practices with respect to internal ratings systems see BCBS (2000).

episodes, the downgrade comes during the crisis. As an illustration, Graph 2 shows that Mexico's debt was only downgraded after the exchange rate collapsed in December 1994, and then was only upgraded in 1999 and 2000 after a run of years of good growth performance. Nickell et al (2000) and Bangia et al (2001) find a similar pattern in the ratings of corporate borrowers, noting that downgrades tend to be concentrated at the trough of the economic cycle, and upgrades are more likely when economic conditions are robust. The impact of external ratings migration on capital requirements has also received some attention recently. Carpenter et al (2001), for example, conclude that in the United States there is very little cyclical impact of the Standardised approach relative to the existing capital regime. In contrast Ervin and Wilde (2001) conclude that capital requirements would be quite volatile if banks were to use external ratings as the basis for assigning internal ratings and PDs. As an example, they calculate that capital requirements under the IRB approach would have increased by around 20 per cent between 1990 and 1991 as a result of downward migration in external ratings.

Graph 2

Mexican sovereign ratings [1]



[1] For long-term foreign currency debt; in the notation of Standard & Poor's methodology (left-hand scale). [2] US dollar/Peso end-1994 = 100 (log scale).

Sources: Datastream; Fitch; Moody's; Standard & Poor's.

The cyclical behaviour of ratings raises two important interrelated questions. The first is whether the cyclical dimension of credit risk is accurately measured, particularly by banks' internal ratings. The

second is whether linking regulatory capital requirements to these ratings will have implications for the macroeconomy. Opinions differ as to correct answer to both questions.

One line of argument is that economic booms, particularly those driven by favourable supply-side developments, tend to generate a wave of over-optimism, which in turn contributes to the underestimation of credit risk during good times. Conversely, during downturns when default rates are rising, risk tends to be overestimated. According to this view, economic expansions sow the seeds for subsequent contractions, particularly if they are associated with the development of imbalances in the real and financial sectors. These imbalances are to some degree observable, and so the increase in defaults in the downturn might better be thought of as the materialisation of risk built up in the boom rather than as evidence of an increase in risk.[8]

Indeed, it may well be the case that risk (as opposed to expected defaults) is no higher in a long-running economic expansion than it is in a recession. Arguably in such expansions the level of uncertainty about the future increases. On the one hand the boom may continue, but on the other hand, the real and financial imbalances built up during the boom may need to be unwound at the cost of considerable disruption to the macroeconomy. In this situation, the degree of *uncertainty* about future returns on a bank's loan portfolio could be relatively high, while at the same time the one-year PD could be relatively low. If this were so, the one-year PD would not provide a good summary statistic for the variability of those losses (or risk).

According to this view, a rating system in which loans are rated exclusively on the basis of their one-year PD could lead to a *reduction* in regulatory capital for the banking system as a whole just at the time when overall risk is *increasing*. The ultimate result could be an increase in vulnerability of financial institutions to macroeconomic disturbances and an amplification of the business cycle.

An alternative view is that both default rates and risk are inherently higher in downturns than in booms. Moreover, the one-year horizon for measuring risk for regulatory purposes is appropriate given that a

---

[8] See Borio and Lowe (2001) for a recent attempt to identify those combinations of events that make financial stresses more likely. See also Bank for International Settlements (2001), Borio, Furfine and Lowe (2001), Crockett (2000) and Goodhart (2001) on the assessment of risk through time.

troubled bank should be able to either raise capital or shed assets within one year. It is therefore appropriate for regulatory capital requirements to be higher in a downturn than in a boom.

Regardless of how one views risk moving over the course of an economic cycle, the proposed reforms to the Capital Accord should lead to a significant improvement in the management of credit risk. One benefit of this is that regulators, bank management, and the market should detect credit quality problems earlier. With earlier detection, remedial action can also be taken sooner, and problems can be contained before they develop to the point where they pose a threat to the stability of the financial system.

There are two other general rebuttals to concerns about the possibility of greater procyclicality arising from the use of ratings to determine regulatory capital requirements.

The first is that rating agencies, and the markets more generally, will put pressure on banks to ensure that their actual capital ratios exhibit less cyclical variation than their regulatory capital ratios. Accordingly, a bank that sought greater leverage in an economic boom simply because its regulatory capital requirement declined due to the "favourable" migration in its loan portfolio may face higher funding costs, and perhaps even a ratings downgrade. It might also be the case that banks that consistently exhibit above-average loan migration may come to be penalised by the market on the grounds that a future widely based downgrading of loans is more likely than for a bank with more stable ratings. If this were to be the case, during periods of strong economic activity banks might seek to hold larger buffers over the minimum regulatory requirement on the grounds that regulatory capital requirement are likely to increase if economic conditions deteriorate. There are, however, forces working in the opposite direction as well. If misperceptions of risk are widespread, then banks may not be penalised by the market for running with levels of capital that are too low in an economic upswing. Moreover, demands from equity holders for high returns may put pressure on banks to increase leverage during such periods, particularly if lending margins are being squeezed and measured regulatory capital ratios are rising.

The second, and related, rebuttal is that regulatory capital requirements have little effect on the macroeconomy. One reason is that markets, not regulatory requirements, are the most important influence on bank behaviour. Another is that if in a downturn the banking system is forced to restrict the availability of loans due to binding regulatory capital requirements, then other financial institutions

or markets might provide the necessary financing to soundly managed firms. The available research on these issues is mixed. The survey conducted by the Jackson et al (1999) concluded 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 of these credit constraints on the macroeconomy is, however, more difficult to establish. The available research suggests that binding capital requirements can adversely affect output in some specific sectors of the economy (most notably real estate and small business) but it has not established a robust link between binding capital constraints and macroeconomic outcomes.[9] A further complicating factor is that the experience of recent decades may say little about the future. In the past, capital constraints have become binding, not so much because of an increase in the required level of capital, but because of a reduction in the level of actual capital due to losses by banks. Looking forward, it seems probable that the level of required capital will increase at the same time that level of actual capital is declining. If this were to be so, and the increase in capital requirements were substantial, adverse macroeconomic affects appear more likely than in the past, particularly in countries where there is a heavy reliance on external finance provided by the banking system.

3. Other elements of risk measurement and procyclicality

While credit ratings form the backbone of risk measurement under the proposed changes to the Basel Capital Accord, a number of other loan characteristics affect, either implicitly or explicitly, the measurement of risk for the purposes of calculating regulatory capital. These include the maturity of the loan, the correlation of loan with other loans and the likely loss incurred if the loan defaults. For each of the elements, the particular measurement approach outlined in the New Accord could have implications for the financial cycle.

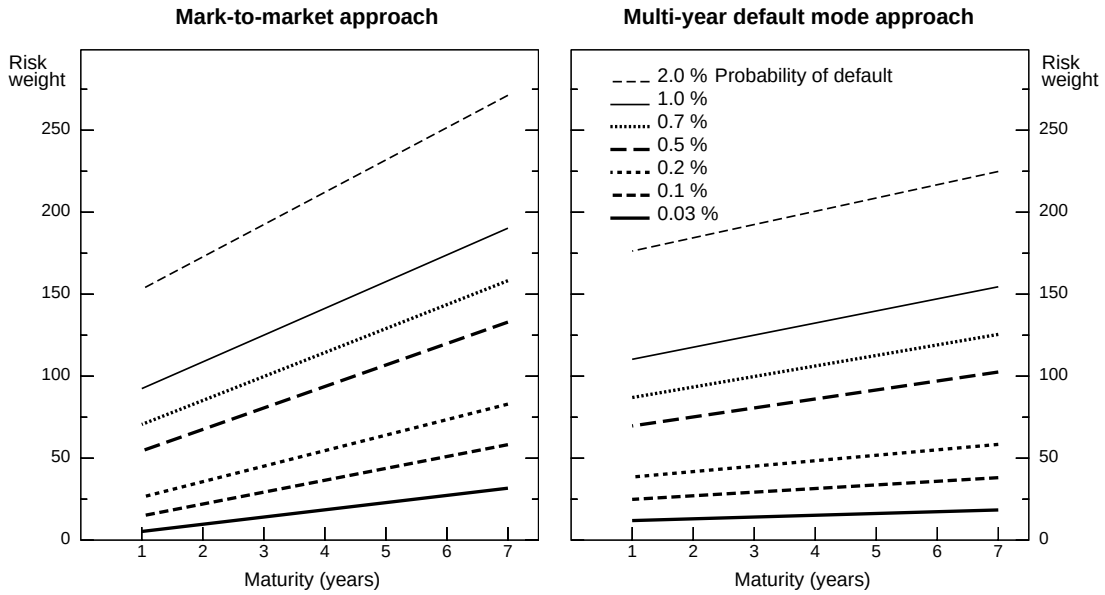
Maturity

The maturity of a loan can be an important driver of risk. Shorter maturities can allow a bank to limit losses by providing an option not to renew an exposure if the quality of the borrower deteriorates, as

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

well as providing options to require additional collateral or reprice the loan. The Basel Committee has therefore proposed that maturity be taken into account when calculating regulatory capital, at least under the Advanced IRB approach. The January 2001 Consultative Document presents two ways of doing this, with one option representing much larger maturity adjustments than the other. Graph 3 shows the two sets of maturity adjustments for various PDs.

Graph 3



As the Basel Committee notes there is not a consensus within the banking industry about the precise relationship between maturity and risk. Some have argued that while, all else constant, long-term loans are more risky than short-term loans, all else is generally not constant. Long-term loans are likely to obtain stricter covenants than short-term loans and may well involve the bank having a stronger say in the running of the firm. The difficultly for a system of risk-based capital requirements is that these forms of risk mitigation are difficult to measure and therefore difficult to build into the calculation of capital requirements.

The procyclicality of the financial system may be affected if the relationship between maturity and required capital differs substantially from banks' own assessments of the link between maturity and credit risk. In particular, if the maturity adjustment is too large, banks may have a regulatory incentive to reduce the average maturity of their loans to the corporate sector. With more short-term lending, the probability of liquidity problems developing in an economic downturn is likely to be higher. Banks might be reluctant to roll over corporate loans, particularly if the economic downturn also leads to a significant increase in capital requirements due to downward migration of borrowers. Such a response

by banks could amplify the economic downturn through a reduction in the supply of credit. If effect, efforts to make capital requirements more sensitive to risk in an individual bank would have the unintended side effect of increasing macroeconomic risk and ultimately increasing credit risk to the financial system as a whole.

On the other hand, inappropriately small maturity adjustments may have also have unintended consequences, potentially prolonging the effects of adverse economic shocks. When the macroeconomy is depressed banks may see the medium-term outlook as highly risky and be prepared only to make short-term loans. However, if the regulatory capital requirement on these loans exceeds the banks' economic capital requirement by a significant margin then banks may not be prepared to make even short-term loans. The result could be a more protracted recession with binding capital requirement preventing short-term lending and risk assessments ruling out medium- and long-term lending.

Correlations

The correlation between borrowers is obviously an important determinant of the riskiness of a bank's loan portfolio. While the Basel Committee clearly recognises this, it has argued that the difficulty of robustly estimating correlations makes it problematic to take them into account at this stage.

One place where correlations are implicitly considered is in determining the risk weights under the IRB approach. The underlying model used for the calibration of the January 2001 proposals assumes that there is a single systematic risk factor and that the relative importance of this factor is the same across all loans.[10] Accordingly, all commercial loans are assumed to have the same asset correlation of 0.2, with this value being fixed not only across loans, but also across time. In contrast, under the proposals released in November 2001 the 0.2 assumption is retained only for loans with the lowest PDs, with the asset correlation assumed to decline (to a minimum of 0.1) as the PD increases. The effect of this change is to flatten the risk weight function (see Graph 1). The reason is that a lower correlation means that systematic risk is less important relative to idiosyncratic risk, and a lower level of systematic risk implies that a lower level of capital is required to meet any given solvency probability.

---

[10] See Gordy (2000).

The proposed treatment of correlation treats correlations as fixed through time (for a given PD). If the underlying correlations are actually changing through time, this treatment has the potential to introduce cyclical biases into the level of regulatory capital. Borio et al (2001), for instance, have argued that the correlation of expected asset returns may increase during long running business cycle expansions. The reason is that such expansions are sometimes characterised by the build up of imbalances in the financial system. The inevitably unwinding of these imbalances can impose significant costs on the macroeconomy that affect all borrowers alike. If this view is correct, then (all else constant) the level of capital may be too low during such expansions relative to periods when correlations are smaller. By implication, the financial system may be insufficiently well capitalised during such periods. One difficulty is in finding a robust method of measuring how correlations change through time.

Loss Given Default

In principle, another determinant of risk is the degree of uncertainty about how much the bank will collect if a borrower defaults. This element of risk, however, is not measured explicitly under the New Capital Accord. In the Foundation IRB approach the Loss Given Default is fixed at 50 per cent for unsecured loans, while in the Advanced IRB approach banks are permitted to estimate the LGD for each loan. There is no *explicit* capital charge to cover the risk that the LGD may differ from either the fixed 50 per cent value, or the bank's estimate. Moreover, the risk weight formula assumes that the PD and the LGD are independent.

While this relatively simply treatment of LGD is largely a pragmatic response to a lack of data and the difficult of measurement and verification, it may contribute to capital requirements moving through time in a way that does not precisely match the movement in underlying risk. In particular, there is some evidence to suggest that, at least at the aggregate level, periods of high default rates are characterised by lower than average recovery rates.[11] This is hardly surprising given that periods of high aggregate defaults generally coincide with depressed economic conditions and with falling collateral values. By implication then, if aggregate default risk is higher than average then the expected recovery is likely to be lower than average. Failure to recognise this may mean that the aggregate amount of capital in the banking system is too low during periods of rising aggregate risk.

[11] See Altman el at (2002) and the references within.

The Basel Committee has recognised this point by requiring that banks use a default-weighted, rather than a time-weighted, average when calculating LGDs from historical data.

Under the Advanced IRB approach, misassessments of the realisable value of collateral could also impart a cyclical dimension into regulatory capital requirements. If during periods of rapid economic growth, the same risk assessments that can lead to default probabilities being underestimated also lead to loan recoveries being overestimated, capital requirements may decline due to a fall in estimated LGDs. The effect could be a potentially large decline in capital requirements, as loans both migrate to lower risk classes and LGDs for each risk class are adjusted downwards. The use of some form of "stress LGD" might help ameliorate this potential

Expected Losses

Regulatory capital charges have been calibrated to cover both expected and unexpected losses (with the expected loss defined as the probability of default over the next year multiplied by the loss in event of default). The Basel Committee has justified this approach on the grounds that some general loan loss provisions are included in the definition of capital, and thus excluding expected losses from the capital calculation would inappropriately allow provisions to cover both expected and unexpected losses. The banking industry has, however, generally been critical of this approach. In particular, it has noted that if loans are correctly priced, the interest margin should cover expected losses. It has also noted that the January 2001 proposals create a potential disincentive to establish general loan loss provisions, given that the current limits on the inclusion of general provisions in regulatory capital.

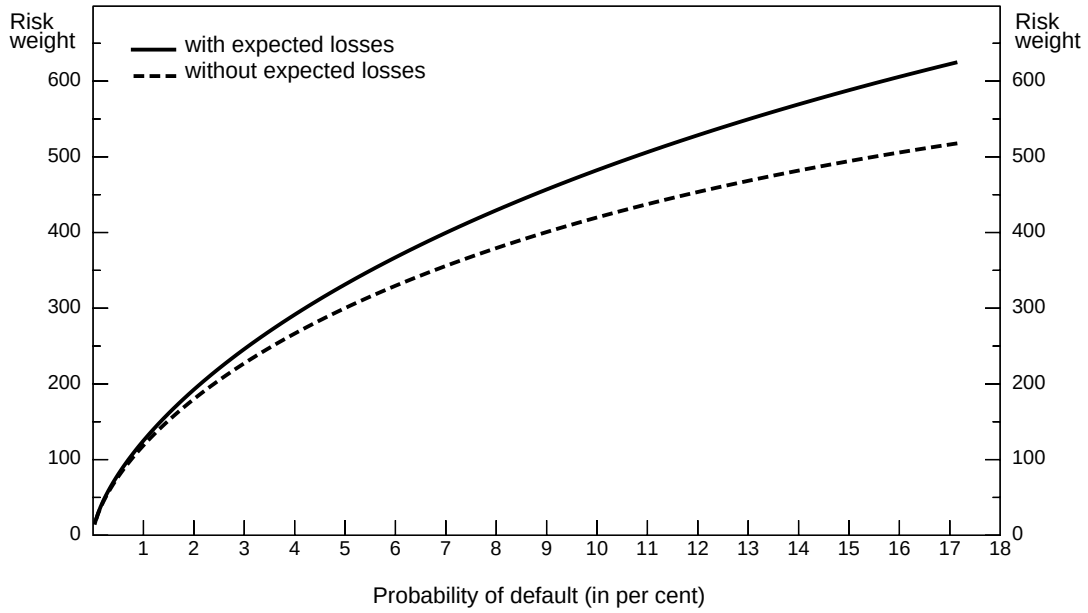
One effect of including expected losses in the capital requirement is to make capital requirements more sensitive to the probability of default. The reason is that the relationship between the capital charge for unexpected loss and the PD is concave, while that between the capital charge for expected losses and the PD is linear. The effect can be seen in Graph 4 which shows the risk weights (according to the January proposals) under the Foundation IRB approach and the calculated risk weights without a capital charge for expected losses.[12] Note that the difference in the slopes of the two

[12] We have calculated these adjusted risk weights by subtracting an amount equal to the PD*0.5*1250 from the original risk weights.

curves increase as the PD increases. At least at the margin, this treatment of expected losses increases the potential for procyclical effects.

Graph 4

Risk weights with and without expected losses



The Basel Committee has responded to these concerns by proposing in July that capital requirements can be met by the sum of capital, specific provisions and general loan loss provisions not already included in regulatory capital.[13] For banks that have high levels of general provisions this effectively unwinds the additional capital requirement resulting from the inclusion of a capital charge for expected losses. The Basel Committee has also suggested that for some retail portfolios, it may permit future margin income to be used to offset the capital charge for expected losses. Both these possible modifications have potentially their largest effects in lowering capital requirements in emerging market economies in which high levels of general provisions are required and interest margins are high, partly reflecting high average borrower default probabilities. Recognition of future margin income on other portfolios would also likely have the largest effect in these countries.

4. Dataset and methodology

Undoubtedly, the proposed changes to the Capital Accord will more closely align relative capital requirements with relative risk. However, the above discussion has touched on a number of reasons why the risk measurement process used for purposes of calculating regulatory may not deliver measures of risk that change through time precisely in line with changes in the underlying level of true risk. As we have already noted, a full evaluation of these cyclical elements of risk measurement is quite difficult. Here we set ourselves the rather more modest goal of examining how actual capital requirements might have moved through time had the Foundation IRB approach been in place in Mexico over recent years. Our attention is restricted solely to the issue of ratings migration, and we ignore the elements of risk measurement discussed in Section 3. As we discuss below, such a counterfactual exercise is subject to many qualifications. Nevertheless, it provides one of few quantitative analyses of possible implications of the New Capital Accord in an emerging market economy.

4.1 Dataset

Our dataset contains the risk ratings assigned to business borrowers by a number of banks operating in Mexico. The database contains, for each bank, summary details for the vast majority of business loans outstanding, including those to small and medium-sized businesses. For each loan the recorded information includes, amongst other things, the amount due, the rating of the borrower, the repayments that are overdue, the state in which the borrower is located and the industry of the borrower.

The ratings are made by each bank according to a five-point scale specified by the regulatory authorities. The definition of each rating and the relevant quantitative and qualitative criteria that apply are, however, specified by the Comisión Nacional Bancaria y de Valores (CNBV).[14] In assigning a rating, banks need to consider a range of factors including the borrower's payment record, current financial situation and current business environment. In all, seven different criteria are evaluated with

---

[13] See BCBS (2001c) for more details.

[14] See Comisión Nacional Bancaria y de Valores (1991). The ratings system that forms the basis of the ratings used in this paper has recently been revised. The new system was introduced in 2001.

specified points being assigned to each of these criteria. The number of points then determines the grade. The five grades are "A" (minimum risk), "B" (low risk), "C" (medium risk), "D" (high risk) and "E" (highest risk and defaulted loans).[15]

The data are available quarterly from March 1995 to December 1999 for a group of banks operating in Mexico both before the mid 1990s crisis. The names of the banks cannot be disclosed for confidentiality reasons.

The full database contains, in aggregate, at least 50 000 loans per quarter. In 1995, the number of loans exceeds 100 000 per quarter, but this number falls subsequently as borrowers default and loans are restructured. We use this full database to construct the relevant transition matrices (see below). Unfortunately, while we have access to the rating on every loan in the database, we only have access to the loan's full details for the 250 largest loans for each bank. In value terms, these 250 loans account for over half the banks' total loans outstanding, and their distribution across the ratings grades is broadly similar to that of the entire portfolio. We calculate the capital requirement on these loans, but using the transition matrices calculated using the entire loan portfolio.

Using this dataset for investigating the issues of interest in this paper has both pluses and minuses. On the positive side, obtaining any data at all on the evolution of banks' ratings over time is difficult. Many banks, even in the industrialised countries, have only recently introduced ratings systems, and where such systems have been in place for some time, the data are normally proprietary. In emerging market economies things are more difficult still. External ratings are relatively rare, and few banks have had comprehensive internal ratings systems in place for more than a couple of years. The main advantage of this dataset, therefore, is that it provides a perspective on how internal ratings have changed through time in an important emerging market economy.

The dataset is, however, not perfect for our purposes for a number of reasons. First, under the proposed New Capital Accord, banks that use the IRB approach are required to use their *own* rating system and this system must have a minimum of least six performing grades. In contrast, the rating

[15] The definition of default does not match that set out in BCBS (2001a). One consequence of this is that loans could be many months behind in repayment and assigned ratings other than E. In an effort to achieve some standardisation, we overrode the banks rating (and assigned an E) for loans that were more than 180 days overdue and not already rated an E.

system used in this paper is specified by the authorities and the rating grades are courser than those required under Basel II. Second, it is unclear whether the rating system has been applied consistently over time. Following the crisis at the end of 1994, the regulatory authorities significantly increased their scrutiny of the banking system and this may have led to a more stringent review of how banks rated loans. Similarly, as part of the package of measures to resolve the problems in the Mexican banking system there may have been an incentive to rerate loans. One consequence of these factors is that loans may have been rerated (usually downwards) even if the level of risk had not changed. If this is the case the degree of loan migration might be artificially inflated, leading to an overstatement of the movements in capital. Third, we do not have access to the full portfolio of loans for each bank, or to details of any credit risk mitigation, such as collateral or third party guarantees, which might reduce the calculated capital requirements. Fourth, and perhaps most critically, had the IRB system and the associated standards been in place for the entire 1990s, many of the problems in the second half of the decade might have been avoided through better risk management in the first half of the decade. If this is the case, our assessment will be biased, given that an important underlying rationale for the changes to the Capital Accord has been to make such crises less likely in the first place!

Notwithstanding these difficulties we view this dataset as useful in providing a general guide as to how regulatory capital requirements might evolve in an emerging market economy subject to a significant financial crisis. The above qualifications, however, mean that the results should be considered illustrative of the possible magnitude of the effects rather than as definitive evidence.

4.2 Methodology

Our primary goal is to calculate how the average risk weight would have moved in Mexico over the second half of the 1990s under both the Standardised approach and the Foundation IRB approach. For purposes of comparison we also calculate the capital requirements suggested by a full credit risk model that takes account of correlations between borrowers. In doing so, we treat the correlations as fixed through time. We have no data on the losses experienced on individual defaulted loans and so do not consider the Advanced IRB approach.

Central to the exercise is the calculation of annual transition matrices. These matrices tell us the likelihood of a borrower having a specific rating in one year's time, conditional on its current rating.[16] We calculate three different types of transition matrices. The first is a separate matrix for each bank for each quarter. The second is a matrix averaged across the entire sample period for each bank; we refer to these as the bank-specific matrices. The third is a single transition matrix for the banking system as a whole, calculated using data from all banks and across all years; we refer to this matrix as the group-wide transition matrix.[17]

From these various transition matrices we obtain default frequencies for each grade. We interpret these frequencies as the *ex ante* probabilities of default (PDs).

To calculate the amount of capital required under the Standardised approach we assume that all loans had an external rating. This is clearly at odds with actual practice with few corporate borrowers in Mexico having external ratings. To overcome this difficulty, we derive pseudo ratings by mapping our calculated ex ante probabilities of default into Standard and Poor's (S&P) ratings. We do this by comparing the default frequencies for each grade with the default frequencies for each of S&Ps grades. For example, if a particular ratings class has a PD of around 1 per cent, we assign all loans in that class a BB rating. Having derived these pseudo external ratings we calculate the weighted-average risk weight for the entire portfolio (with the weight attached to each loan equal to that loan's share in total loans). We conduct this exercise using both the group-wide transition matrix and the bank-specific matrices.

For the Foundation IRB approach we follow a broadly similar path. In particular we map our calculated ex ante PDs into the regulatory risk weights, assuming a maturity of 3 years and a loss given default of 50 per cent. Again we use both the group-wide matrices and the bank-specific matrices.

In performing the calculations we treat "E" rated loans (those in the bottom risk category) in two ways. The first is to treat them like other loans and assume that their default probability is given by the historical default frequency (almost 100 per cent). Given the LGD assumption of 50 per cent, the

---

[16] As is common practice we do not compute the transition matrices by following individual borrowers, but rather by comparing the distribution of borrowers at the two different points in time.

[17] In calculating this average matrix we treat all loans across banks and across time as if they were part of one large portfolio.

resulting capital charge under the Foundation IRB approach is then 50 per cent of the exposure (or alternatively a risk weight of 625). Given that these are essentially defaulted loans, we assume that the 50 per cent capital requirement also applies under the Standardised approach. This treatment essentially assumes that capital is held to cover the losses on loans that have defaulted but remain on the bank's books. In practice, provisions, rather than capital should cover such losses, so that the numbers we report might be better thought of as the sum of the capital and provisioning requirement. The second approach is to exclude all "E" rated loans from our calculations on the grounds that the losses on these loans are covered by provisions. We then calculate the capital requirement on the portfolio of A, B, C and D rated loans.

We also calculate the amount of capital required under a full credit risk model. This model is similar in spirit to that developed by Creditmetrics, and, in particular, takes account of the correlation of returns between borrowers. Given the relative lack of data we assume that the correlations are time invariant and that all borrowers in a particular industry and state share the same correlation with any given other borrower. In all we have data for 32 different industries and 32 different states, so that there are 1024 different correlations. Using these correlations and the group-wide transition matrix we simulate the credit losses. In conducting these simulations, we use 10,000 draws and calculate the distribution of losses assuming an LGD of 50 per cent. Having calculated this distribution, we then select the level of capital that is needed to cover these losses in 99.5 per cent of cases.[18]

5. Results

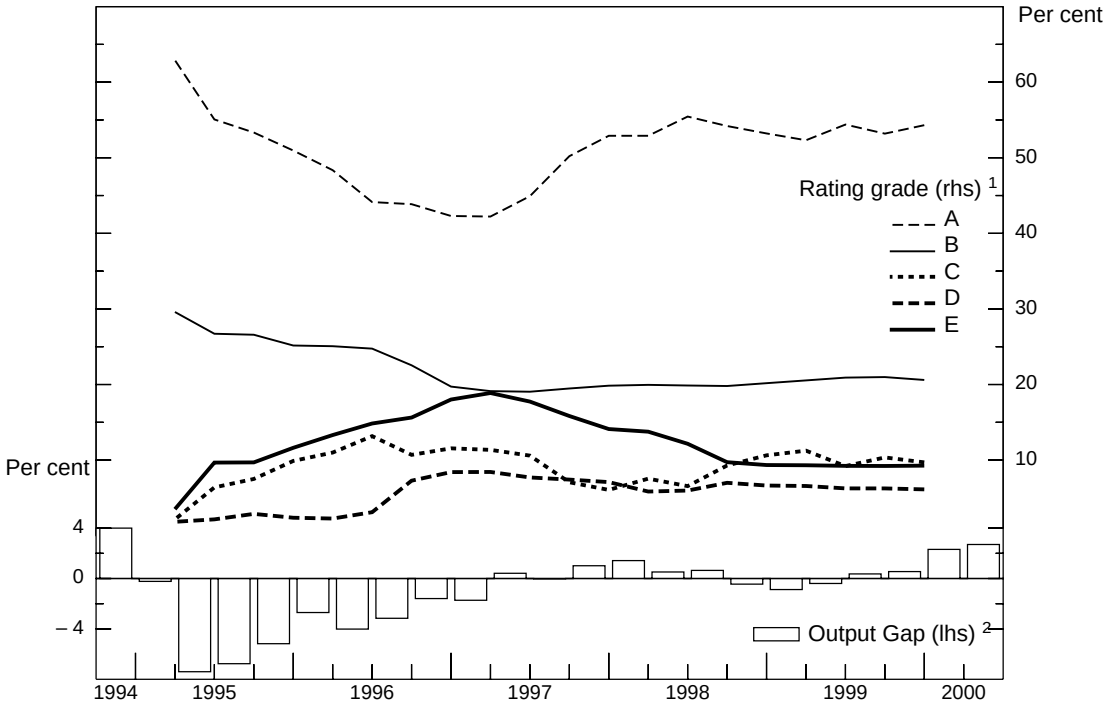
5.1 Ratings and transition matrices

Graph 5 presents the distribution of borrowers across the five grades, as well as the evolving cyclical position of the Mexican economy, as proxied by the output gap. The graph shows that the share of borrowers rated in the least risky categories (A and B) declined throughout 1995 and 1996, and that

[18] Further details are provided in a technical appendix that is available from the others upon request.

conversely the share of E rated loans increased, peaking at around 20 per cent in early 1997.[19] As the Mexican recovery become more firmly entrenched in the later years of the decade, the average quality of the loan portfolio gradually increased, although at the end of 1999 the average grade remained below that in March 1995.

Graph 5
Distribution of ratings and Mexican output gap



1 Share of loans in total. 2 HP filter applied.

The group-wide transition matrix is shown in Table 1. Our immediate interest is in the probability that a loan with a given rating will default over the coming year. This is given by the last column of the table; for example a loan rated A has a probability of default of 0.89 per cent over the next year, while a loan rated B has a default probability of 5.79 per cent. As one would expect, the default probabilities are higher for loans with poor ratings. One interesting feature of this matrix is that the default probabilities for all ratings classes are relatively high. For example, the estimated PD for an A-rated loan is roughly

[19] In addition to the limitations on our dataset discussed in Section 4, the ratings are more concentrated than has been proposed by the Basel Committee. Specifically, the Committee has proposed that no more than 30 percent of exposures

equivalent to the PD associated with a BB rating from Standard and Poor's. This would make even A-rated loans sub-investment grade. Another related feature is that the diagonal elements of the matrix tend to be much smaller that the diagonal elements of the bond transition matrices published by Standard and Poor's and Moody's. This is perhaps not surprising, given that our sample period contains a financial crisis. It does, however, raise the issue of whether the bond transition matrices are appropriate for bank loans, and particularly bank loans in emerging market economies.

Table 1: Group-wide Transition Matrix

	A	B	C	D	E
A	76.55	15.18	4.94	2.43	0.89
B	9.31	45.81	26.10	12.99	5.79
C	1.99	2.65	60.38	27.17	7.80
D	1.37	0.62	3.17	84.66	10.17
E	0.13	0.08	0.15	0.74	98.89

Variation across time

As one would expect, the transition matrices calculated using just one year's worth of data vary considerably from year to year.[20] For example, for A-rated loans the one-year PD varies from as low as 0.02 per cent to a high of 2.0 per cent. For C-rated loans the variation is larger still; from 0.6 per cent to 13 per cent. These are large differences indeed, and point to the potential difficulties of calibration, especially in countries that have been, or are likely to be, subject to large business cycles.

The large time variation in default frequencies is explained primarily by the crisis Mexico experienced in late 1994 and 1995. One could argue that this crisis episode should be excluded from the calculation of default frequencies for the purposes of assigning one-year PDs to the various rating grades on the grounds that the crisis represents a one-off event that has an extremely small probability of being repeated. By excluding this period we might then get a better estimate of future

should fall in any single grade.

[20] If there were no variation across years then there would be little need for capital as the actual default rates would equal expected default rates and the bank's credit losses would be entirely predictable.

average default rates. Counterbalancing this view, it could be argued that ignoring the episode amounts to ignoring the type of events for which capital really needs to be held. Accordingly, if large crisis events are excluded from the sample when calculating ex ante default probabilities from historical data, banks are likely to be systematically undercapitalised.

Regardless of the merits of these two views, we chose to use all available data largely because cutting our sample would reduce an already fairly short sample period even further.

Variation across banks

The banks in our sample have loan portfolios of distinctly different quality. For the bank with the highest quality portfolio, the average default rate over the full sample is less than half of 1 per cent, while for the bank with the poorest quality portfolio the rate is over 9 per cent.[21] This variation is accounted for by both variation in the distribution of loans across rating classes, and variation in the default experience for a given ratings class. This second source of variation is particularly important. For example, for A-rated loans the default rates vary across the banks (for the sample as a whole) over a range of almost 2 percentage points, while for B rated loans the range is almost 10 percentage points! This very large variation across banks arises despite the fact that all banks are supposed to assign borrowers to grades using the same criteria.

There are a number of possible explanations why default rates for a given ratings class might vary so much. The first is that not all banks strictly followed the ratings criteria set out by the regulatory authority. The second is that some banks fundamentally misassesed the risk in their loan portfolios. And the third is that the variation reflects the relatively short period over which the averages are calculated, and that it would disappear if we had a longer sample period. Unfortunately, we are not able to distinguish between these explanations, although given the size of the differences we find it improbable that the short sample period is the full explanation. Again, these differences are likely to pose challenges to regulatory authorities in validating and comparing banks' rating systems.

---

[21] These figures are calculated by dividing the number of loans that are rated A B C or D that migrate to an E rating, by the total number of A B C and D rated loans.

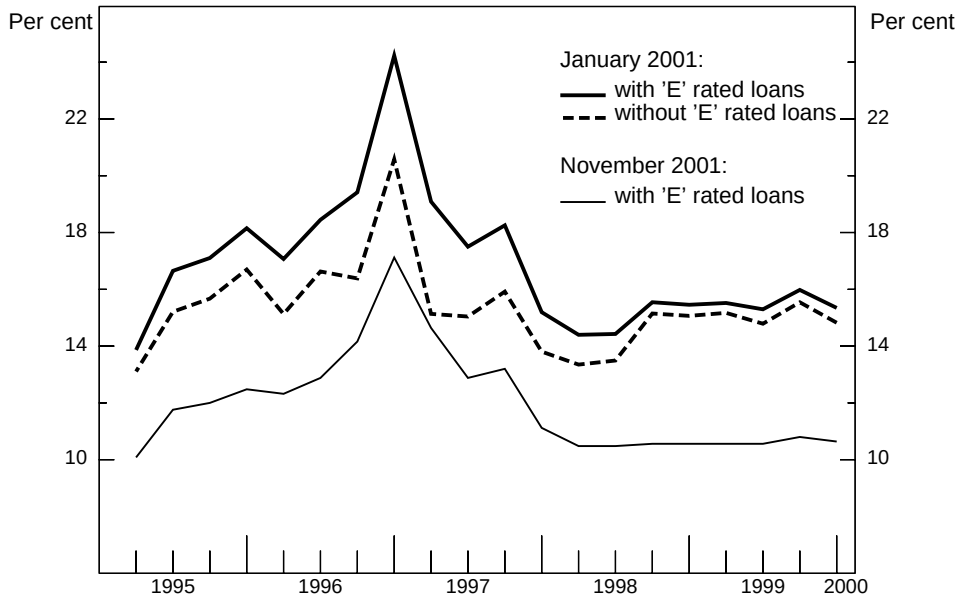
5.2 Capital requirements

Table 2 presents the calculated average risk weights using the group-wide transition matrix. The first half of the Table reports results including the "E" rated loans calculated using both the January 2001 and the November 2001 proposals. The results in the second half of the Table exclude these loans. The capital ratios implied by these risk weights for the Foundation IRB approach are shown in Graph 6. These ratios are calculated by multiplying the average risk weight by 0.08 per cent.

[Table 2 is at end of document]

Graph 6

Capital requirements, Foundation IRB



The main points can be summarised as follows.

- Capital requirements under the IRB approach are volatile. Using the January 2001 proposals and including "E" rated loans, the average risk weight rises from around 170 per cent in March 1995 to over 300 per cent in December 1996, before falling back in 1997 towards the March 1995 level. When "E" rated loans are excluded, the variation is smaller, but still large. Regulatory capital requirements are clearly highest during the period of highest loan defaults and when economic conditions are most depressed, although the requirements increase only gradually after the devaluation, rather than in one large step.

- The potential modifications to the risk weight function announced in November 2001 significantly reduce the procyclicality of the IRB approach, although substantial movements in regulatory capital remain. Under the modified proposals the absolute increase in the capital requirement between March 1995 and December 1996 is roughly 30 less than the increase under the January proposals.

- The inclusion of a capital charge for expected losses adds to the volatility in required capital under the IRB approach. The effect is particularly pronounced when we include the "E" loans in the calculation, although it remains even if these loans are excluded. To some extent this volatility will be mitigated by allowing, in some cases, the use of general provisions to offset the expected loss capital charge.

- The average risk weight under the IRB approach is high. For much of the period under review the IRB capital requirement (using the January 2001) would have been double the current 8 per cent minimum (or that required under the standardised approach where no external ratings exist). These high capital requirements reflect the relatively high default frequencies over the period as a whole. The November 2001 proposals not only reduce the cyclicality of the capital requirements, but they also significantly reduce the required level of capital. The effect is particularly large in this current exercise because the default frequencies that we use to calculate ex ante PDs are high, and it is at high PDs that the largest differences in the two sets of proposals are evident.

- The standardised approach with pseudo risk weighting produces capital requirements that are lower and less cyclical sensitive than those under the IRB approach. The difference is particularly pronounced when the "E" rated loans are excluded.

- The credit risk model produces lower capital charges than the Foundation IRB approach using the January 2001 proposals, but slightly higher capital charges than the November 2001 proposals. The cyclical pattern evident for the other proposals, is also evident here, although it is slightly muted.

Variation across banks

Capital requirements differ considerably across the banks used in this study reflecting the differences in the distribution of loans across the ratings grades and the historical default frequencies for each of

the grades. As an illustration of the differences, the average capital requirement across the five years for individual banks ranges from 3 per cent to over 18 per cent (these calculations are based on bank-specific transition matrices and the January 2001 proposals).

The pattern of time series variation in the capital requirement is, however, broadly similar across all banks. In all cases, capital requirements peak in December 1996. Required capital then subsequently declines, so that by December 1999, the capital requirements for most of the banks in our sample have returned to the levels broadly consistent with those in March 1995. For one bank, however, the capital requirement is roughly 20 per cent higher than it was in 1995, while for another it is roughly 20 per cent lower.

The two banks with the largest percentage swings in their capital ratios are those with the highest quality loans portfolios, and thus the lowest absolute capital requirements. As a result, while the proportionate increase in the requirements for these two banks in 1996 is larger than that for the other banks, the absolute increase in smaller. For the bank with the worst quality loan portfolio, the average risk weight increases by 150 per cent between March 1995 and December 1996.

6. Interpretation and Conclusions

Under the New Basel Capital Accord, measured risk is likely to increase in economic downturns and decrease in economic booms. This same pattern is likely to be translated into regulatory capital requirements, with minimum requirements increasing when times are bad and decreasing when times are good. Whether or not this is desirable depends, in part, on whether changes in risk over the course of the business cycle are measured accurately. On this score, a question mark remains.

While one-year probabilities of default may be higher in a recession than in a boom, *uncertainty* about future default rates may actually be higher, or at least not lower, in the boom. This is especially the case if the boom is associated with the development of imbalances in the financial system or the macroeconomy. These imbalances increase risk by increasing the uncertainty about the financial strength of individual borrowers, by making default probabilities more highly correlated, and by making future collateral values more uncertain.

Measuring this type of risk or uncertainty is difficult and is beyond the scope of this paper. Instead our general focus has been on the question of much how regulatory capital requirements might move

through time, particularly in an emerging market economy. To explore this issue we use data on internal ratings from banks operating in Mexico over the second half of the 1990s. This period is particularly interesting given the financial crisis in Mexico in the middle of the decade.

Our main finding is that had the IRB approach been in place in Mexico over this period, capital requirements for corporate credit risk would have increased considerably over the two years following the December 1994 devaluation. While our results are subject to numerous qualifications and we do not wish to place too much weight on the precise numbers, the numbers are unambiguously large, although reduced somewhat by the potential modifications to the proposals announced in November 2001. For a number of banks, capital requirements for corporate credit would have doubled, while for others, capital requirements would have risen by around 40 per cent. Our results also indicate that from around early 1997, the requirements would have fallen as the Mexican economy recovered from the crisis.

Whether or not this pattern in capital requirements reflects the underlying pattern of credit risk in Mexico is a debatable. One plausible view is that risk was actually greater in late 1994, before the devaluation, than it was at the end of 1996 when the recovery had already commenced. If this were the case, capital requirements should reasonably have been higher in 1994 than in 1996, although provisions should almost certainly have been higher in 1996. According to this view, imbalances in the Mexican financial system were evident in 1994 and an appropriately forward-looking assessment of risk should have recognised that these imbalances could be unwound in a potentially costly way. An alternative view is that problems were not predictable, and that given the high level of impaired loans in 1996, the level of risk was indeed higher in 1996 than it was in 1994 before the devaluation.

Regardless of how one assess these two views, a sizable increase in capital requirements during a crisis or a period of depressed economic activity could cause stresses in the financial system, particularly given the difficulties that banks are likely to experience in raising private capital during such periods. In turn, these stresses could have macro effects through a reduction in the supply of bank credit. While the extreme nature of the Mexican crisis provides perhaps an upper bound on the likely increase in capital requirements in a downturn, much smaller increase might also conceivably cause stresses and a reduction in credit supply. One way of avoiding such problems is for banks to hold adequate buffers above the regulatory minimum in good times, so that deterioration in the economy does not mean that new capital needs to be raised. For this to occur, banks need to take a

multi-year view in decisions about capital levels and integrate macroeconomic considerations into their risk assessments. Supervisors can play a role here, by requiring banks to undertake sensitivity tests to see how their regulatory capital ratios might move with a changes in economic conditions.

Our results also highlight a couple of other points.

First, given the relatively high default rates in emerging market countries, IRB based capital requirements are likely to be quite high on average. As has been widely noted, this could discourage the implementation of the IRB approach in these countries.

Second, calibration and verification of the IRB approach is likely to prove difficult, especially in countries that have experienced large swings in economic activity. We find large variations through time in default rates for a given grade. Moreover, we also find large variations in default rates across banks for a given grade. These variations will complicate the task for supervisors in assessing the validity and comparability of rating systems. They will also complicate the task of investors in assessing the financial strength of banks.

Finally, it is important to recall that the way in which minimum capital requirements move through time is only one of the many influences that will determine the success of the New Capital Accord. By more closely aligning relative capital charges with relative risk, by increasing the focus on risk-based supervision, by enhancing disclosure of information and by improving the credit management processes in many banks, the New Accord should contribute to a more efficient and stable financial system. These benefits are, however, more likely to fully realised if the time dimension of risk is measured well, and appropriate safeguards are in place against the risk that, from time to time, the overall level of credit risk in the banking system may be misassesed by the banks themselves.

References

Altman, E and A Resti and A Sironi (2002): "The Link Between Default and Recovery Rates: Effects on the Procyclicality of Regulatory Capital Ratios", paper prepared for "the conference on "Changes in Risk Through Time: Measurement and Policy Options", BIS, 6 March.

Bangia, A, F Diebold and T Schuermann (2001): "Ratings Migration and the Business Cycle, with Applications to Credit Portfolio Stress Testing", mimeo.

Bank for International Settlements (2001): *71th Annual Report*, June.*

Basel Committee on Banking Supervision (2001a): *The New Basel Capital Accord*, Consultative Document, January.*

Basel Committee on Banking Supervision (2001b): *The Internal Ratings-Based Approach*, Consultative Document, January.*

Basel Committee on Banking Supervision (2001c): *Working Paper on the IRB Treatment of Expected Losses and Future Margin Income*, July.*

Basel Committee on Banking Supervision (2001d): *Potential Modifications to the Committee's Proposals*, 5 November.*

Basel Committee on Banking Supervision (2000): *Range of Practice in Banks' Internal Ratings Systems*, Discussion Paper No. 66.*

Borio, C and P Lowe (2001): "Asset Prices, Financial and Monetary Stability: Exploring the Nexus", paper prepared for the conference on Asset Price Bubbles: Implications for Monetary, Regulatory and International Policies, cosponsored by the Federal Reserve Bank of Chicago and the World Bank Group, April 22-24, 2002.

Borio, C, C Furfine and P Lowe (2001): "Procyclicality of the Financial System and Financial Stability: Issues and Policy Options" in Marrying the Macro- and Micro-prudential Dimensions of Financial Stability*, BIS Papers*, No 1, pp 1-57.*

Carling, K, T Jacobson, J Linde and K Roszbach (2001): "The Internal Ratings Based Approach for Capital Adequacy Determination: Empirical Evidence from Sweden", paper prepared for the Workshop on Applied Banking Research, Oslo, 12-13 June *

Carpenter, S, W Whitesell and E Zakrajšek (2001): "Capital Requirements, Business Loans, and Business Cycles: An Empirical Analysis of the Standardized Approach in the New Basel Capital Accord", Board of Governors of the Federal Reserve System.

Comisión Nacional Bancaria y de Valores (1991): *Circular 1128*.

Crockett, A (2000): "Marrying the Micro- and Macro-prudential Dimensions of Financial Stability", remarks before the Eleventh International Conference of Banking Supervisors, Basel, 20-21 September.*

Danielsson, J, P Embrechts, C Goodhart, C Keating, F Muennich, O Renault and H S Shin (2001): "An Academic Response to Basel II", Special Paper No 130, London School of Economics Financial Markets Group.*

Ervin, W and T Wilde (2001): "Capital Volatility and Pro-Cyclicality in the New Accord", Credit Suisse First Boston.

European Central Bank (2001): "The New Basel Capital Accord: Comments of the European Central Bank".*

Federal Banking Supervisory Office of Germany (2001): comments to Basel Committee on the New Capital Accord.*

Goodhart, C (2001): "The Inter-Temporal Nature of Risk", mimeo.

Gordy, M (2000): "A Comparative Anatomy of Credit Risk Models", *Journal of Banking and Finance*, 24, pp 119-149.

Griffith-Jones S and S Spratt (2001): “Will the Proposed New Capital Accord Have a Negative Effect on Developing Countries?”, mimeo, Institute of Development Studies, University of Sussex.

Haldane, A, G Hoggarth and V Saporta (2001): “Assessing Financial Stability, Efficiency and Structure at the Bank of England” in Marrying the Macro- and Micro-prudential Dimensions of Financial Stability, *BIS Papers*, No 1, pp 138-159.*

Hancock, D and J Wilcox (1998): “The “Credit Crunch” and the Availability of Credit to Small Business”, *Journal of Banking and Finance*, 22, pp 983-1014.

Hancock, D and J Wilcox (1997): “Bank Capital, Non-bank Finance, and Real Estate Activity”, *Journal of Housing Research*, 8, pp 75-105.

International Monetary Fund (2001): “IMF Staff Comments on the January 2001 Proposals of the Basel Committee on Banking Supervision for a New Capital Adequacy Framework for Banks”.*

Jackson P, C Furfine, H Groeneveld, D Hancock, D Jones, W Perraudin, L Radecki and M Yoneyama (1999): “Capital Requirements and Bank Behaviour: The Impact of the Basel Capital Accord”, Working Paper No. 1.*

Nickell, P, W Perraudin and S Varotto (2000): “Stability of Rating Transitions”, *Journal of Banking and Finance*, No 124, pp 203-28.

Peek, J and E Rosengren (1997): “Collateral Damage: Effects of the Japanese Real Estate Collapse on Credit Availability and Real Activity in the United States”, *Federal Reserve Bank of Boston Working Paper*, No 99-5.

Powell, A (2001): “A Capital Accord for Emerging Economies”, mimeo.

Spanish Banking Association (2001): “New Basel Capital Accord: Comments by the Spanish Banking Association”.*

Table 2: Risk Weights

	Including E-rated loans					Excluding E-rated loans		
	Standardised	Foundation IRB			Credit risk model	Standardised	Foundation IRB	
		January 2001		November 2001			January 2001	
		UL + EL	*(EL)*	UL + EL			UL + EL	*(EL)*
Mar. 95	119	173	*(24)*	126	131	109	164	*(12)*
June 95	142	208	*(40)*	147	154	114	190	*(15)*
Sept. 95	136	214	*(41)*	150	159	115	196	*(16)*
Dec. 95	119	227	*(44)*	156	160	117	209	*(18)*
Mar. 96	139	213	*(49)*	154	157	114	189	*(15)*
June 96	142	231	*(51)*	161	166	117	208	*(18)*
Sept. 96	162	243	*(72)*	177	186	116	205	*(17)*
Dec. 96	187	303	*(98)*	214	221	126	257	*(24)*
Mar. 97	171	239	*(84)*	183	189	114	189	*(15)*
June 97	149	219	*(58)*	161	174	113	188	*(15)*
Sept. 97	150	228	*(58)*	165	179	115	199	*(17)*
Dec. 97	130	190	*(36)*	139	185	110	173	*(13)*
Mar. 98	124	180	*(30)*	131	171	109	167	*(12)*
June 98	123	180	*(28)*	131	153	110	169	*(13)*
Sept. 98	122	194	*(23)*	132	145	113	189	*(16)*
Dec. 98	119	193	*(22)*	132	147	113	188	*(16)*
Mar. 99	118	194	*(22)*	132	150	113	190	*(16)*
June 99	117	191	*(24)*	132	153	112	185	*(15)*
Sept. 99	120	200	*(24)*	135	159	114	194	*(16)*
Dec. 99	119	192	*(24)*	133	151	112	185	*(15)*
Mean	136	211	*(43)*	150	165	114	192	*(16)*
Std. Dev.	20	30	*(22)*	23	20	4	20	*(3)*