Procyclicality and volatility in the financial system: The implementation of Basel II and IAS 39

Preliminary draft

Ashley Taylor and Charles Goodhart
Financial Markets Group and London School of Economics

September 22, 2004

1 Introduction

After many years of development, the implementation of two major reforms to international bank regulation and accounting practices is imminent. The Basel II Capital Accord and the accounting guidelines IAS 39, which are to be adopted from end-2006 and January 2005 respectively, are designed to provide improved accuracy in assessments of the relative riskiness of banks and their asset values.[1] However, the informational and allocative efficiency benefits of such improvements may come at the potential cost of greater real procyclicality and volatility.[2] For example, if risk-sensitive regulation requires banks to hold a higher capital ratio during economic downswings, reflecting the increased potential credit losses in their portfolios, then they may respond by reducing their loan book, or by passing on the funding costs of raising capital. The resulting rationing of credit, or its higher cost, may lead to real effects through reduced investment and consumption. Similarly, under IAS 39, losses during a market downturn on tradable assets, which are booked at fair value, could lead to greater volatility of income and profits which, due to market imperfections, may not reflect underlying fundamentals. These losses could eat into capital positions and again this could lead to a contraction in credit.

The introduction of these reforms has highlighted the potential trade-off between enhanced risk-sensitivity and transparency on the one hand and greater procyclicality and volatility on the other hand. Given their importance, the recent academic literature on the procyclicality of the financial system has focused on these policy questions, particularly those arising from the introduction of Basel II. This paper provides a road-map of this literature in critically evaluating the following key questions:

[1] See Basel Committee (2004) and Internatinal Accounting Standards Board (2004) for technical details of the reforms.

[2] In this paper we purposefully focus on the potential for such procyclicality or volatility rather than detailing the wider benefits of the two reforms.

- How far is there expected to be a rise in procyclicality and volatility due to the introduction of Basel II and IAS39?
- What, if any, is the appropriate policy response?

Addressing these interrelated questions requires an examination of the transmission mechanism between the change in regulation or accounting practice and the impact on real activity.

For Basel II, the first stage is whether the proposals lead to procyclicality in the *minimum* regulatory capital requirement under Pillar I of the Accord. Second, once the impact of the supervisory review process of Pillar II is taken into account, is there likely to be additional procyclicality of the *overall* regulatory capital requirement? Third, how do banks respond to changes in their regulatory capital requirement through adjustments to *actual capital and lending behaviour*? Fourth, how does the response of individual banks translate into the lending behaviour of the banking sector as a whole? Fifth, will any resulting additional procyclicality in bank lending lead to changes in *aggregate real activity*?

Similarly, for IAS 39, how is the reform likely to affect the volatility of banks' profits and capital? Will these effects lead to changes in lending behaviour and implications for the real economy? Splitting the process into these steps can help identify the appropriateness of the different policy responses which have been put forward to address these problems.

2 Potential procyclicality of regulatory capital requirements under Basel II

2.1 Pillar I minimum capital requirements

As the volume of credit extended by banks and the ability of borrowers to repay varies with macroeconomic conditions, so the credit risk of a bank's portfolio of assets is likely to vary with the economic cycle. If capital regulation aims to reduce the potential welfare costs of failures of individual banks then it should vary with the likelihood of such failures, ie with the relative riskiness of the banks.[3] The 1988 Basel I Accord provided a common approach to minimum capital requirements across countries, but the flat credit risk capital requirements failed to address changes in the relative riskiness of banks' credit exposures over time. Enhancing the risk-sensitivity of credit risk capital requirements, whilst maintaining the minimum 8% ratio of capital to risk-weighted assets, has thus been the primary objective of the Basel II framework.

Under Pillar I of the new Accord, this is achieved via two different options for calculating capital requirements for credit risk. The Standardised Approach assigns varying risk-weights to claims on corporates, banks and sovereigns, as in Basel I. However, in contrast to Basel I, it provides for greater risk-sensitivity by varying the weights with external rating assessments of credit risk. Under the Internal Rating Based (IRB) approach of Basel II, the greater risk-sensitivity comes from banks providing their own estimates of the risk components for

[3] As discussed in Section 3.2.2, such a micro-prudential approach to capital adequacy regulation may have unintended macro effects (see, for example, Blum and Hellwig, 1995; Summer, 2003).

an individual exposure. There are two variants to the IRB approach. Under the Foundation IRB approach the bank provides estimates of the probability of default (PD) and exposure-at-default (EAD). Those banks adopting the Advanced IRB approach will also provide estimates of the maturity of the exposure and loss-given-default (LGD) (which are set at prescribed levels under the Foundation option). Whether such approaches lead to procyclicality in Pillar I capital requirements *in principle* depends on how the key input parameters in the two approaches, namely external ratings and estimates of the various risk components, move through the cycle. Whether they will lead to procyclical requirements *in practice* depends on the exact methodology applied under Pillar I. Before reviewing the empirical literature on the potential additional procyclicality of regulatory capital requirements under Pillar I we first consider these two issues.

2.1.1 Potential cyclicality of inputs

Standardised approach

The standardised approach uses external rating assessments to determine the risk-weighting of claims on sovereigns, banks and corporates.[4] Rather than Basel I's broad risk-weights by type of claim, the standardised approach provides for greater risk-sensitivity through its multiple rating buckets (six for sovereigns and banks and five for corporates).[5] Whether such a move is likely to lead to greater procyclicality in the minimum regulatory capital requirements depends on whether the external ratings move with the cycle.

In principle, external credit ratings are said to be measured on a 'through-the-cycle' (TTC) basis.[6] However, there is evidence, as found in Segoviano and Lowe (2002) for example, that rating transition matrices (denoting the probability of moving from one rating grade to another) do seem to vary with the cycle (see Lowe, 2002, for a review of this evidence). Amato and Furfine (2003) find that, whilst in general ratings are relatively stable, when they do adjust they tend to overreact to the current conditions of a firm. Indeed, this overreaction is positively correlated with aggregate economic conditions. This evidence would seem to suggest that employing more granular risk-buckets may, in principle, lead to additional cyclicality in changes in regulatory capital requirements under the standardised approach.

IRB approach

The minimum regulatory capital requirement for a loan under the IRB approach is a function of:

[4]The Accord stipulates certain risk-weights for other non-rated claims. For example, 75% for retail claims, 35% for claims secured by residential property and 100% for claims secured by commercial property.

[5]For example, corporates rated AAA to AA receive a 20% risk-weight, A+ to A- a 50% risk-weight, BBB+ to BB- a 100% weight, below BB- a 150% weight and unrated claims generally receive a standard 100% weight.

[6]For example, Standard & Poor's claim that "[T]he ideal is to rate 'through the cycle'. There is no point in assigning high ratings to a company enjoying peak prosperity if that performance level is expected to be only temporary. Similarly, there is no need to lower ratings to reflect poor performance as long as one can reliably anticipate that better times are just around the corner." (as quoted in Amato and Furfine, 2003).

- the probability of default (PD);
- the exposure-at-default (EAD);
- the loss-given-default (LGD);
- the effective maturity (M);
- the correlation in asset value (ρ) with the common risk factor.[7]

The importance of these components in determining changes in the regulatory capital charge has stimulated a substantial literature analyzing their cyclical behaviour.[8] The key features of this literature are summarized below.

For probability of default, the Basel II framework allows banks to use three estimation techniques:[9]

- **internal default experience:** As with an external ratings approach this can lead to cyclicality in PD estimates through either a level effect or a transition effect. Under the former the average default rate changes within an individual credit grade whilst under the transition effect credits migrate between rating grades. Whether the level effect leads to substantial cyclicality in the PD estimates depends on the time period of estimation. Adjusting this time period, as in the Basel II requirement that a long-run PD estimate should be used (see Section 2.1.2), can thus mitigate the cyclicality of the level effect. Indeed, for this reason, Corcóstegui et al. (2003) consider the transition effect to be the more significant of the two in their analysis of a simulated internal rating system for data on Spanish non-financial private sector loans over the period 1993-2000.
- **mapping of internal grades to external ratings and using the default probabilities from the external ratings data:** To the extent that external ratings are not perfectly TTC this approach may suffer from the same potential cyclicality as discussed in relation to the standardised approach.
- **statistical default models:** A variety of statistical models have been developed and are employed within the banking sector to estimate probabilities of default (see Allen and Saunders (2003) and Borio et al. (2001) for reviews). Models based on market prices, which use a Merton-type option-based approach, estimate default probabilities which rise with the firm's level of debt and its equity price volatility and fall with its equity price level. Such models, for example those developed by KMV, are likely to lead to cyclical estimates of PDs, for example through the procyclicality of asset prices. Other types of models, such as CreditMetrics, use rating transition matrices to calculate default probabilities as inputs to Value-at-Risk (VaR) measures. This returns us to the problem of cyclicality

[7] Formally, the regulatory capital charge as a share of the investment book value is equal to $LGD \cdot V(PD, \rho, q) \cdot h(PD, M)$ where q is the target one-year solvency level (set at 99.9%), $V(PD, \rho, q)$ is the Vasicek distribution and $h(PD, M)$ is the adjusted maturity. The risk-weighted asset value is then calculated from the capital charge and the EAD. For more details see Gordy and Howells (2004) and para 272 of Basel Committee (2004).

[8] Allen and Saunders (2003) and Lowe (2002) provide comprehensive recent surveys.

[9] See para. 461-62, Basel Committee (2004). Note, unless stated, all future para. references relate to this document.

of rating transition matrices discussed above. Some of the models, such as CreditPortfolio View or CreditRisk+, do explicitly incorporate cyclical factors. However, the usual emphasis of statistical default models on a one-year horizon and the mechanical adjustments they require to provide longer-run estimates, can be argued to lead usually to cyclical estimates of default probabilities (Borio et al., 2001).

The other parameters within the regulatory capital charge formula also appear to show some cyclical effects. For example, Gordy and Howells (2004) note that, although the evidence is limited, maturity tends to fall in recessions. As detailed in Allen and Saunders (2003), there is also some anecdotal evidence of cyclicality in exposure-at-default. This may particularly be the case for loan commitments which are more likely to be drawn upon during recessions. Similarly, cyclical behaviour may be a feature for the correlation in asset values with the risk factor summarising general economic conditions. Lopez (2004) finds, for US, EU and Japanese portfolios, this correlation to be a negative function of the probability of default (as in the Basel II framework) and an increasing function of the asset size. To the extent that PDs fall in upturns, the asset value correlation is therefore also likely to be cyclical.

Evidence on the cyclicality of loss-given-default is somewhat more complex. Altman et al. (2002) find that the weighted average loss-given-default for securities is higher during recessions. Recent work by Acharya et al. (2004) qualifies this view. They find that industry conditions are the primary driver of LGDs – whilst aggregate recovery rates on defaulted debt are negatively correlated with aggregate default rates and the aggregate supply of defaulted bonds these aggregate variables become insignificant once industry conditions are included. Nevertheless, in a recession many industries are likely to be in weak condition and a bank, with exposure to a range of sectors, is thus likely to experience cyclical movements in LGD levels. Gordy and Howells (2004) also highlight that studies based on bond data may not be representative of LGD for loan portfolios. The conditions of loan contracts may allow banks to renegotiate contractual terms once the debtor breaches certain financial ratio triggers. There is some evidence that suggests that this renegotiation may include enhanced collateral provision which would imply that, for loans, it may be the case that LGD falls when PD rises, ie the movement in LGD may counteract the cyclicality of the PD estimates. However, this feature may be specific to certain banks and legal frameworks.[10]

2.1.2 Methodology of Pillar I

The methodological details of Pillar I are considerable. Indeed they account for almost 150 pages of the text of Basel Committee (2004) compared to around 15 pages for Pillar II and 25 pages for Pillar III. Since available evidence suggests that point-in-time calculations of the above parameters are likely to lead to cyclicality in the calculated regulatory capital charge, one of the main methods which can act as a offsetting factor is the requirement that the parameters be estimated over a longer-time period. This mitigant has been taken up in the Basel II proposals, for example:

[10]The studies that Gordy and Howells cite are based on the loan portfolios of individual banks, such as the analysis of JP Morgan Chase found in Araten et al. (2004).

- **PD estimates - rating assignment horizon:** "The range of economic conditions that are considered when making assessments must be consistent with current conditions and those that are likely to occur over a business cycle within the respective industry/geographic region." (para 415.). "Irrespective of whether a bank is using external, internal, or pooled data sources, or a combination of the three, for its PD estimation, the length of the underlying historical observation period used must be at least five years for at least one source. If the available observation period spans a longer period for any source, and this data are relevant and material, this longer period must be used." (para. 463). A similar requirement holds for the Standardised approach.

- **Own-LGD estimates:** For corporate, sovereign, and bank exposures, estimates of "LGD must be based on a minimum data observation period that should ideally cover at least one complete economic cycle but must in any case be no shorter than a period of seven years for at least one source. If the available observation period spans a longer period for any source, and the data are relevant, this longer period must be used." (para. 472).

- **Own-EAD estimates:** The minimum observation period for corporate, sovereign, and bank exposures is similar to that for own-LGD estimates. Furthermore, "for exposures for which EAD estimates are volatile over the economic cycle, the bank must use EAD estimates that are appropriate for an economic downturn, if these are more conservative than the long run average." (para. 475).

- **Validation of internal estimates:** "Banks must demonstrate that quantitative testing methods and other validation methods do not vary systematically with the economic cycle" (para. 503).

Whilst the text aims for a TTC methodology, it would seem unlikely that cyclicality in the calculated minimum capital requirements will be eliminated completely. First, there is the question of whether the time periods prescribed do actually fit with the length of cycles. Second, there is the issue of whether TTC methodologies will be adopted by the industry. Many existing systems tend towards PIT and market anecdote suggests that commercial banks are likely to continue to use PIT under Basel II.[11] In response to this feature, an FSA consultation paper indicated that, given the gap between current practices and the Basel methodologies and also the presence of other ways to deal with procyclicality, there would likely be some accommodation of current PIT practices, at least for a transitional period (see para 3.247, Financial Services Authority, 2003).

2.1.3 Estimates of additional procyclicality in minimum regulatory capital charges

The Basel II reforms have stimulated, and been informed by, a growing empirical literature which has attempted to estimate the potential additional procyclicality in the Pillar I regulatory capital charge. The IRB approach, with its greater

[11] Catarineu-Rabell et al. (2003) provide a rationale for the use of PIT. In their theoretical model the greater volume of profitable loans in good times from such procyclical ratings outweighs the lower profits during recessions.

risk-sensitivity and greater variation in regulatory capital charges, has been the focus of much of the literature.[12] The overall message which can be drawn from this literature is that there does appear to be an economically significant rise in the cyclicality of minimum regulatory capital charges under the IRB approach. For example, Gordy and Howells (2004) find that the new approach could lead to volatility in the capital charge relative to the mean of 0.1-0.26 (depending on the simulation methodology). To give an indication of the scale of the rise in charges during a downturn, Kashyap and Stein (2003, 2004) estimate that during the period 1998-2002 capital charges would have risen by around 70-90% on an investment grade portfolio if a KMV model is employed, or around 35% if an S&P ratings model is used to calculate default probabilities. These numbers are of similar magnitude to those of other studies (Figure 1 reproduces Kashyap and Steins' summary of these studies).

This literature also highlights the higher volatility of capital charges for better quality credits. This is explained by the fact that such credits have further to migrate down the ratings scale and face a steeper risk curve. As suggested in the discussion in Section 2.1.1, the default probability methodology also plays an important role. The PIT-focused KMV approach produced greater procyclicality than a ratings-based approach for investment grade portfolios but less for non-investment grade portfolios (see, for example, Kashyap and Stein, 2004; Catarineu-Rabell et al., 2003).

Despite this consistency in broad findings there are, unsurprisingly given the complexity of the topic, some caveats to the literature. Perhaps most importantly, there is the obvious question of whether the Lucas critique holds. This applies both to studies based on historical data (such as those included in Kashyap and Stein, 2003; Segoviano and Lowe, 2002; Corcóstegui et al., 2003) or simulation analyses (for example, Gordy and Howells, 2004; Kashyap and Stein, 2003; Peura and Jokivuolle, 2004). In addition, a number of interesting specific methodological issues much be taken into account when interpreting the results.

A first such issue is the portfolio management rules assumed in simulations. Gordy and Howells (2004) make a persuasive argument that these have a first-order effect on the resulting estimates. For example, a cyclical reinvestment rule (where bank lending 'leans against the wind') leads to a capital charge which is less volatile and with a lower mean compared to that from a passive portfolio.[13] The latter approach, as used, for example in Kashyap and Stein (2004), assumes that new loans do not change the rating distribution in the portfolio. But, is it realistic that banks can attract borrowers of higher credit quality at a time when the economy is in a downturn? As reported in Goodhart (2004), Gordy and Howells' response suggests that the assumption may be a particular feature of the level of development of the US financial markets. In the US, large companies, with sound credit quality, use bond and commercial paper finance in good times. However, when markets close in downturns these

[12] On the standardised approach Zakrajsek et al. (2001) find, for the US, that whilst the average level of capital would be lower under the standardised approach than Basel I they do not find evidence of any substantial additional procyclicality in required capital levels relative to the current regime. They conclude that the rating changes over the period were insufficient to lead to significant changes in the risk-weighted portfolio of loans

[13] The cyclical reinvestment rule produced a mean capital charge of 5.9% with volatility to mean of 0.102. The passive rule delivered a mean charge of 8.8% with volatility over mean of 0.255.

Study	Country	Time Period	Capital Charge Basis	Max Change in Capital	Notes
Ervin and Wilde (2001)	U.S.	1990-1992	?	20%	All BBB borrowers
Segoviano and Lowe (2002)	Mexico (Customers of main large banks)	3/1995-12/1999	Foundations, 11/01	69.8%	Includes E rated loans, peak losses are in 12/96 Capital changes inferred from their Table 2
			Standardized	57.1%	
Segoviano and Lowe (2002)	Mexico (Customers of main large banks)	3/1995-12/1999	Foundations, 11/01	56.7%	Excludes E rated loans, peak losses are in 12/96 Capital changes inferred from their Table 2
			Standardized	15.7%	
Catarina-Rabell, Jackson, and Tsomocos (2003)	U.S. high quality banks' customers	1990-1992	QIS 3, 10/02	15.2%	Based on Moody's ratings transitions of 5,022 non-defaulting corporate borrowers, using different initial borrower distributions described in column 2
	U.S. ave. quality banks' customers			17.9%	
	Same quality customers as Deutsche Bank			15.3%	
Catarina-Rabell, Jackson, and Tsomocos (2003)	U.S. high quality banks' customers	1990-1992	QIS 3, 10/02	53.2%	Based on Merton model PD transitions of 282 borrowers, using different initial borrower distributions described in column 2
	U.S. ave. quality banks' customers			8.8%	
	Same quality customers as Deutsche Bank			47.1%	
Jordan, Peek and Rosengren (2003)	U.S.	1996-2001	11/01	S&P: ≈ 20%	Shared National Credit borrowers, all loans exceed $20 million
				KMV: ≈ 280%	
Rosch (2002)	U.S.	1982-2000	11/01	+15%	Multiple 1 year swings of this size, based on S&P transitions
Corcostegui, Gonzalez-Mosquera, Marcelo, and Trucharte (2002)	Spain	1993-2000	QIS 3, 10/02	-6.1 percentage points of capital	No base level given, +3.1 p.p. the year before this swing
Carling, Jacobson, Lindé, and Roszbach (2002)	Sweden	1994-2000	1/01	-11.23 percentage points of capital	No base level of capital given, two methods of gauging PDs, either historical default experience (top) or based on one bank's internal model (bottom)
				-20.37 percentage points of capital	

Figure 1: **Selected research on capital charge cyclicality, reproduced from Table Four of Kashyap and Stein (2003)**

companies can then turn to banks for back-up finance. Clearly, for less developed capital markets without this feature, assuming such reinvestment rules may not therefore be appropriate.

Although some studies have used actual loan data, for example, Corcóstegui et al. (2003), Kashyap and Stein (2003) and Segoviano and Lowe (2002), much of the literature has employed the ratings from bond data to extract probabilities of default. This raises the question of the extent to which such results transfer across to loans given the different characteristics of such financing. Other variations between models which are worth noting are the exact formulation of the Basel II proposals used, the different samples employed, and the approach to filling in missing observations and survivorship bias. On the latter, the consensus approach to measuring the additional procyclicality due to Basel II is to exclude defaulted loans.

2.2 Stress testing and Pillar II

Pillar I sets a lower bound on the regulatory capital requirements that a supervisor may place on a bank. As with Basel I there is an expectation that the actual required regulatory capital will be higher than this minimum.[14] Thus in the context of Basel II "[R]egulatory capital requirements should be properly viewed as a composite of formulaic Pillar I rules and judgmental Pillar 2 buffers, so the volatility of regulatory capital over the business cycle will depend in practice on whether supervisors guide Pillar 2 buffers in a manner that offsets or augments changes in Pillar I requirements" (Gordy and Howells, 2004). This ability of regulators to adjust required capital levels under Pillar II is the second major element of the proposals which can be used to mitigate procyclicality (with the first being the time frame for calculation of the parameters specified under Pillar I).

The results of stress testing of capital adequacy levels can play a crucial role in such adjustments. Such stress tests are required under Principle 1 of Pillar II with Principle 2 outlining supervisory responsibility for reviewing the test results (as part of oversight of banks' overall internal capital adequacy assessments). Indeed the Accord explicitly states that "The results of the stress test will thus contribute directly to the expectation that a bank will operate above the Pillar 1 minimum regulatory capital ratios. Supervisors will consider whether a bank has sufficient capital for these purposes. To the extent that there is a shortfall, the supervisor will react appropriately. This will usually involve requiring the bank to reduce its risks and/or to hold additional capital/provisions, so that existing capital resources could cover the Pillar 1 requirements plus the result of a recalculated stress test" (para. 765).

Whilst the general principles relating to the stress tests are clear the details on their actual form are limited (in part reflecting a desire to leave further guidance to local supervisors). Pillar I identifies generic scenarios which should be considered in general stress tests, for example economic or industry downturns, market-risk events or changes in liquidity conditions. Whilst the credit risk stress test does not require banks to consider worst-case scenarios it should

[14]For example, under Basel I the FSA considers the basic 8% regulatory minimum as only appropriate for well-diversified firms with strong business management, systems and controls and where the risks it is exposed to are captured adequately by the existing capital model (Alfon et al., 2004).

"consider at least the effect of mild recession scenarios". The example of such a scenario is "to use two consecutive quarters of zero growth to assess the effect on the banks PDs, LGDs and EADs, taking account on a conservative basis of the banks international diversification" (para 435).

Although the details are lacking at present, they are key to whether the stress tests can indeed play a meaningful role in addressing the procyclicality problem. Stress tests are not usually adjusted for market or cyclical conditions. For example, a flat 30% fall in house prices may be considered as a stress test for housing market exposures. However, on the one hand, if house prices have just risen rapidly in the recent past then the stress test may be meaningless. On the other hand, a flat test will become more and more stringent if housing prices are falling. The importance of adjusting stress tests for market conditions was highlighted by the solvency tests for insurance companies during the unwinding of equity prices over recent years. The increased likelihood of breaches of the solvency stress tests led insurance companies to sell equities, exacerbating the market trend. Thus, depending on their form, stress tests could potentially contribute to the deterioration in market conditions rather than offsetting any potential procyclicality.

In summary, whilst the required buffers arising from stress tests can clearly play a potential role in addressing the procyclicality problem, *ex ante* the significance of this mitigant is unclear and it is likely to depend crucially on the form of the tests. It also may lead to competitiveness issues through uneven application either across firms within a given jurisdiction or across supervisory bodies. Further analysis of different approaches to stress-testing and its linkage with the regulatory capital requirements may shed light on these issues.[15]

3 Impact of changing capital requirements on real activity

The discussion above highlighted that the available evidence points to the application of Pillar I leading to cyclicality in the minimum regulatory capital requirement. Whilst stress testing and regulatory capital adjustments under Pillar II can be used to address this problem, in the absence of greater detail on their application, and, given the potential measurement issues and adjustment lags faced, it appears unlikely that additional cyclicality of regulatory capital requirements will be eliminated. This leads on to the question of whether such cyclicality will be transmitted through the next stages of the linkage to procyclical real effects:

- Will changes in regulatory capital requirements lead to changes in actual capital levels?
- Will resultant changes in capital lead to changes in individual bank lending behaviour?
- How will changes in individual bank behaviour affect aggregate lending?
- Will such changes in bank lending lead to real effects?

[15] Peura and Jokivuolle (2004) provide one of the first papers to used simulation-based modelling of stress tests to the capital buffers.

In analysing whether cyclical changes in regulatory capital requirements do lead to variation in actual capital levels it is worth first to consider regulatory capital requirements in the context of the other determinants of a bank's actual capital levels.

3.1 Determinants of bank capital levels

Perhaps the key stylised fact on bank capital since the 1990s, particularly in the US and the UK, is the extent to which actual levels have exceeded the regulatory requirement. For example, Flannery and Rangan (2002) find that none of the largest 100 banks were constrained by *de jure* capital standards in the period 1982-2000. For the UK, regulatory returns from 1998-2002 indicated that the average capital level was 50% above the individual requirements set by the FSA (Alfon et al., 2004).

Alfon et al. (2004) provide the follow typology of reasons why actual capital levels may be greater than the regulatory minimum:

- *Internal capital drivers:* There are a wide variety of such factors. For example, a bank may consider that the regulatory risk assessment does not adequately reflect all the risks of the bank, for example the risk of loss of franchise. Alternatively higher capital levels may be motivated by the bank's management. For example, there may be a desire to retain capital for future acquisitions. Of more interest to the procyclicality debate is evidence on the role of adjustment costs in raising capital. Such costs, including time lags and transaction costs, may vary with the cycle. If downturns are accompanied by market perceptions of a deterioration of the credit risk of the bank then the cost of raising extra capital is likely to rise. In order to avoid this extra cost, which occurs at the very time when additional capital may be required for internal solvency or regulatory purposes, banks may choose to raise capital in good times and hold it as a buffer. Indeed, in an FSA survey of major UK banks (as detailed in Alfon et al. (2004)), 9 out of 13 respondents considered that the cost of raising extra capital is the main reason for holding a buffer. 11 out of 13 viewed the cushioning effect of additional capital against the impact of a downturn as either important or very important.

- *Effect of market discipline:* Investors in a bank may consider the regulatory capital charge to be insufficient to compensate them for the risks they bear and so banks may hold additional capital to offset the impact of this on their funding costs. Additional levels of capital may also be necessary to allow banks to access certain capital markets. Furthermore, a desire to maintain a certain external credit rating could discipline banks to retain certain stable levels of capital, a point also emphasised by Segoviano and Lowe (2002) and Lowe (2002).

- *Regulatory framework:* Non-capital charge regulatory requirements may also motivate higher capital holdings. This could include, for example, a desire to avoid greater regulatory scrutiny or intervention should the actual capital levels approach the minimum.

3.2 Impact of changes in regulatory requirements on actual capital, lending and real activity

The extent to which observed buffer capital stocks will dampen the transmission of changes in the regulatory minimum through to actual capital levels and potentially bank lending is a central question in the procyclicality debate.

3.2.1 Impact on actual capital

As Segoviano and Lowe (2002) succinctly state: "[W]hile 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." (emphasis in original). On the one hand, as noted above, evidence suggests that the regulatory requirements are non-binding.[16] Reviewing this feature for US banks, Flannery and Rangan (2002) consider that the rise in capital ratios over 1982-2000 reflected an enhanced role of market discipline, rather than changes in regulatory requirements.[17] On the other hand there is evidence of the co-movement of actual capital ratios with the regulatory requirement. For the UK, Alfon et al. (2004) find that 50% of changes in individual capital requirements over 1998-2002 were translated into movements in actual capital ratios in the short-term.[18] This response was asymmetric, with a greater adjustment in capital levels to an increase in the regulatory requirement than to a decrease. For Spanish banks over 1986-2000, Ayuso et al. (2004) find that, controlling for other potential determinants of surplus capital, the capital buffer is negatively related to the position in the cycle but that the buffer does not absorb all the cyclicality. Based on a model calibrated to US data for large commercial banks from 1989-1997, Furfine (2000) concludes that the working assumption should be that banks will optimally respond to the economic incentives arising from a change in regulation with actual capital levels adjusting with capital requirements.

There are a number of caveats to the above studies which are worth noting. First, the evidence of substantial capital buffers above regulatory requirements in the US and UK may well not transfer over to less profitable banking sectors in other countries. The latter banks will consequently have a lower ability to smooth the impact of changing regulatory requirements. Second, caution must be taken in drawing on past data given the potential for structural changes with the introduction of Basel II. Despite these caveats, the balance of evidence appears to suggest that any additional cyclicality in regulatory capital requirements is likely to lead to some movement in actual capital (albeit of an unknown magnitude).

[16] For example, Jackson et al. (2002) calculate the implied survival probability under Basel I at 99-99.9% (with Basel II taking the higher value of this range). This does not appear binding for most developed banks whose solvency standards are generally above this level.

[17] However, Jackson (2004) turns this argument on its head in relation to Basel II. Under the new framework, the disclosure of capital requirements should provide additional market information on credit risk. As a consequence, changes in the required capital level may lead to adjustments in these market disciplining forces which in turn impact on the actual capital levels.

[18] As would be expected banks with smallers buffers, generally the larger banks, react more to changes in the capital requirement.

3.2.2 Impact on aggregate lending and real activity

Micro versus macro As alluded to earlier, there is an important distinction to be made between the macro and micro implications of capital adequacy regulation. Whilst it may reduce risk-taking by individual banks and hence their likelihood of failure, a number of papers have emphasised that such regulation may have potential adverse effects at the aggregate level which could, in certain circumstances, lead to an increased likelihood of systemic problems. For example for Blum and Hellwig (1995) the aggregate effects come through a simultaneous need across banks to recapitalise or reduce lending following an adverse macro shock. As emphasised in Daníelsson and Zigrand (2003) and Daníelsson et al. (2004), this effect may be exacerbated through a rise in 'endogenous risk' due to the common adoption of similar risk management techniques. Thus, if Basel II leads to enhanced procyclicality in lending at the individual bank level, the effects at the aggregate level, which may not be envisaged in the capital adequacy regulation, may be greater.

As emphasised by Summer (2003), the linkages between capital adequacy regulation and systemic stability have received relatively little attention in the academic literature. Blum and Hellwig (1995) were one of the first to consider this linkage. In their model, if an undiversifiable macro shock hits then, assuming banks do not recapitalise in the downturn due to the high costs, all banks will individually choose to reduce lending. At the aggregate level this will reduce investment and demand. The creditworthiness of individual banks' portfolio will then decrease further, amplifying the effect of the initial shock. In the model of Eichberger and Summer (2004) the overall impact of the capital adequacy regulations is ambiguous but could worsen the risk of systemic failures. Daníelsson and Zigrand (2003) and Daníelsson et al. (2004) focus on the interaction of the widespread usage of market sensitive risk-management tools, as encouraged under Basel II, with capital adequacy regulation. They find that in a regulated economy, if the regulatory constraint arising from such models, for example VaR models, is binding then this acts in the same way as an increase in the risk aversion of traders. Downturns may lead to a binding VaR constraint under the capital adequacy regulation. This in turn could lead to an increase in market price volatility and a potential endogenous rise in the correlation of asset prices which adds to the severity of the downturn.

Empirical findings The introduction of Basel I in 1988 stimulated a variety of studies examining the impact of the new capital requirements on bank lending and real activity. Jackson et al. (1999) provide a comprehensive survey of this literature breaking the process down into two steps: did the change in capital requirements lead to a change in lending? did changes in bank lending affect real activity? On the first question they show that there is some evidence for the US and Japan, particularly for certain sectors such as real estate, that capital pressures during recessions may have restricted bank lending. For example, in the calibrated model of Furfine (2000) for the US from 1989-1997, simulations of a one percentage point rise in the risk-based capital requirement point to an immediate 5.5% fall in loan growth. Again for the US, Goodhart et al. (2004) find that the rise in capital adequacy ratios following the introduction of Basel I involved both a rise in regulatory capital and a fall in risk-weighted assets suggesting that the rise in capital requirements *may* have led to a reduction in

the supply of credit.[19] On the second question, Jackson et al. make the important point that a restriction in bank credit will only have real effects if it is not replaced by other substitute forms of finance.[20] With respect to this empirical question, they find evidence consistent with changes in bank lending influencing output. Clearly this effect would appear to be most likely in bank-dominated economies and sectors without a ready substitute method of financing.

In summary, estimating the additional procyclicality of real activity due to the Basel II proposals is a complex process. Dissecting the transmission mechanism into sequential stages illustrates a number of key features. Empirical studies take the view that the new IRB proposals are likely to lead to greater cyclicality of the minimum capital requirements under Pillar I. Whether this is translated into greater cyclicality of overall regulatory requirements depends crucially on the application of Pillar II and how stress tests will inform additional required capital above Pillar I levels. Assessment of this linkage will depend crucially on the form of the stress tests. Assuming that overall regulatory capital requirements are more cyclical, then this could well affect individual bank capital and lending (either directly or potentially via a market disciplining effect). The magnitude of this linkage is unclear. Furthermore, it is possible that the micro effects could lead to amplified effects at the macro level. If cyclical changes in aggregate bank lending do arise, then for countries with bank-dominated financial sectors a restriction in bank credit could well have procyclical real effects. Before considering the policy options which have been put forward to address this issue in relation to Basel II, we turn to the potential additional sprocyclicality and volatility related to the IAS 39 accounting reform.

4 IAS 39: Volatility, procyclicality and interaction with Basel II

At the same time that the Basel Committee has been drafting the revised framework for capital regulation, the accounting standard setters have been considering whether to move towards uniform reporting of all financial assets at fair value (compared to the current mixed system whereby usually only traded assets are held at fair value, ie marked-to-market). This process, as documented in Jackson and Lodge (2000) and Michael (2004), has resulted in a number of revised international accounting standards including IAS 39 *Financial Instruments: Recognition and Measurement*. After fifteen years of development, the IAS 39 proposals, which were first published in 1998, were issued in December 2003.[21] Whilst maintaining a mixed accounting approach, with loans and held-to-maturity investments held at amortised historic cost, the proposals extend the scope of fair value accounting. In particular, all derivatives, even those not

[19] The authors emphasis the simultaneity issues that need to be addressed in such empirical analysis.

[20] In their theoretical model making this assumption, Blum and Hellwig (1995) illustrate this point. Once the capital adequacy requirement becomes binding they find a greater variance in real output and prices in response to demand shocks.

[21] See International Accounting Standards Board press release, 17 December 2003, available at http://www.iasb.org/news/iasb.asp.

part of a trading portfolio, must be marked-to-market and available-for-sale financial assets are also to be fair valued.[22] The IAS 39 guidelines are scheduled to be applicable for reporting periods from January 2005, ie just before Basel II is scheduled to be ready for implementation from end-2006 (with more advanced approaches from end-2007).

On the one hand the potential advantages of greater use of fair value accounting include greater transparency and market discipline which may provide advance warning of potential problems.[23] It may also lead to improved marketability of currently illiquid assets. However, on the other hand, it may also lead to potential costs, such as higher short-term volatility of income, profits and balance sheet positions, or the introduction of informational distortions if the models used to estimate fair-value for non-marketable assets differ across firms or are inaccurate.

Enria et al. (2004) provide simulation analysis of the volatility of the balance sheets of major EU banks under a move to full fair value accounting compared to the current approach. For example, they find that a 'typical' real estate crisis would, under full fair value accounting, lead to a 3.2% fall in assets and a 53.8% fall in capital and reserves. The comparable estimates under the current accounting approach (after taking into account default or impairment of assets) are falls of 1.6% and 26.1%. If such volatility in balance sheet items does not reflect changes in fundamentals but is 'artificial', in the sense that it is due to agency problems or market imperfections (Plantin et al., 2004), then this can erode the informational content of prices. Plantin et al. highlight that this 'artificial' volatility can lead to real effects if the resultant price changes affect agents' payoffs and hence behaviour.[24] Furthermore, this distortion is greater, the more long-term, illiquid, and senior the claim (ie the majority of loans held by banks or outstanding claims of insurance companies).

Whilst procyclicality has not been as dominant a feature within the debate over IAS 39 as in Basel II (reflecting both the other contentious issues at stake and the different institutional background to the reforms) there does nevertheless appear to be the potential for such effects. During economic downturns falls in asset prices may feed through to either the profit or loss account or equity levels, which may have knock-on effects on lending which could exacerbate the downturn. The simulation analysis of Enria et al. (2004) of the extension of full fair value accounting to European banks finds the potential for such procyclical effects.

[22] There has been much debate on how the accounts should reflect fair value adjustments. Under the proposals, changes in the valuation of instruments used to hedge cash-flows are first reflected in adjustments in equity and then transferred to profit or loss to match the recognition of the offsetting gains and losses on the hedged transaction (a similar approach is taken for available-for-sale financial assets). For so-called fair value hedges, when market prices lead to a change in the fair value of the item being hedged then the changes in the fair value of both the hedging instrument and the hedged item are reported in profit or loss. See IASB press release 17 December 2003 and Michael (2004) for more details.

[23] Although, as noted by Jackson and Lodge (2000) and Freixas and Tsomocos (2004), these market discipline and information effects could potentially be achieved through fair value disclosure without the need for fair value accounting. For reviews of the pros and cons of fair value accounting see Enria et al. (2004), Jackson and Lodge (2000) and Freixas and Tsomocos (2004).

[24] In a related paper, Sapra and Shin (2003), the same authors illustrate the conditions under which marking-to-market of derivative hedges, as required under new accounting standards, can also lead to real effects in terms of a firm's risk management strategies.

Enria et al. (2004) also highlight that the interaction of the introduction of greater fair value accounting and Basel II could lead to a 'double squeeze' with a cumulative procyclical effect. There are a number of other potential linkages with the Basel II proposals. First is the treatment of provisioning. Under IAS 39 provisioning is based on incurred losses rather than forward-looking provisions based on expected losses which is supported under Basel II.[25] Second, IAS 39 could affect the calculation of regulatory capital. The Basel Committee on Banking Supervision is undertaking ongoing reviews of such implications and has issued guidance on whether regulatory capital should be adjusted in line with IAS 39.[26] Third, for non-marketed assets the calculation of fair values may involve the same credit risk models used to calculate default probabilities. If this is the case, any cyclicality in these models will be reflected in both the Pillar I regulatory capital charge and the valuation of the assets.

5 Policy response

The potential volatility in accounting measures arising from the introduction of fair value accounting has been a primary issue in the debate over the scope and details of its application, for example which assets or liabilities should be marked-to-market and which can remain at historic cost. Rather than enter the details of this technical accounting debate, in this final section we set out the policy proposals of broader interest which have been put forward to address the potential problem of additional procyclicality arising from Basel II.

Embodied within such proposals is the premise that the current mitigants within the Basel framework, namely the longer time horizon for calculation of the inputs to the Pillar I requirement and the ability of regulators to smooth required capital under Pillar II, are insufficient. The policy responses put forward can be split into those concentrating on the narrow issue of the regulatory capital requirement and those with a broader objective of reducing the procyclicality of bank lending. The focus of the preferred policy response depends on an assessment of the importance of the different elements of the transmission mechanism discussed above; on the practicality and credibility of the policy; and, on any potential offsetting effects on other policy objectives. For example, on the latter point, Kashyap and Stein (2003, 2004) highlight the policy trade-off between reducing bank defaults and ensuring the efficiency of lending behaviour whilst Gordy and Howells (2004) focus on the trade-off between reducing procyclicality under Pillar I and ensuring enhanced informational efficiency under Pillar III.

5.1 Focusing on the regulatory capital requirements

As emphasized, the Pillar I requirements are a lower bound on regulatory capital levels. Under Pillar II individual supervisors have the power to require banks to hold higher levels of capital. Smoothing such regulatory capital requirements so

[25] The IRB approach removes the Basel I allowance for banks to include general provisions (or general loan-loss reserves) in Tier 2 capital. Banks using IRB for general loans are required to compare their eligible provisions to calculated expected losses. If total expected losses exceed total provisions then banks must deduct the difference from their regulatory capital (see para 43). In other words regulatory capital is for unexpected losses.

[26] See http://www.bis.org/press/p040608.htm.

as to mitigate procyclicality has been a key area for policy suggestions. These may take the form of formula-based or discretionary adjustments. The pros and cons of the two approaches are familiar from, for example, the monetary or fiscal policy rules versus discretion literature.

In terms of the formulaic adjustments, Gordy and Howells (2004) outline three broad options:

- Smooth inputs via through-the-cycle ratings.[27]
- Flatten the capital function.
- Smooth the output of the capital function.

On the one hand, smoothing the inputs may have the advantage of forcing banks to adopt a longer-term perspective in their risk assessments. On the other hand, as argued by Gordy and Howells (2004), it could act against the market disclosure benefits of Basel II since it would reduce comparability of relative riskiness across time. There is also a tension between such smoothing and the move towards greater transparency and fair value approaches (Goodhart, 2004). The second option of flattening the capital function has already been included in the Basel proposals. The third option can take a variety of forms with Gordy and Howells (2004) considering a time-varying multiplier on the output from the formula (so-called counter-cyclical indexing); an AR1 adjustment to the output from the formula; and, time-varying target solvency levels which lead to a family of risk curves depending on the position in the cycle. In terms of the basis for the counter-cyclical indexing, one intuitive option is to relate the change in the additional capital charge to the first difference of the risk-weighted factor (see Goodhart et al., 2004). For example, movements in the regulatory capital charge adjustment for commercial property exposures should be related to changes in commercial property prices; similarly, for equity exposures it should be related to changes in equity prices.

Any of these adjustments raise a variety of questions on the ease of implementation and, if they are to be applied only in certain circumstances, on the nature of the trigger and input for any adjustments. In particular, there are measurement issues in relation to counter-cyclical indexing since it requires there to be an identifiable cycle or long-run equilibrium (Goodhart et al., 2004). Other important factors in any cost-benefit analysis of such adjustments include cross-sectional equality of treatment and how such rules might affect banks' incentives. For example, Borio and White (2004) raise the question of whether counter-cyclical indexing could be viewed as inconsistent with moves towards making banks more reliant on internal risk management.

5.2 Broader policy responses

If adjustments to the regulatory capital requirement are thought unnecessary or unfeasible, then there are a variety of broader policy options which could

[27] Corcóstegui et al. (2003) provide an illustration of this approach. When average ratings over four years are used as the input to their simulated internal ratings model for Spanish banks, the regulatory capital charge rose by 1.3% during the GDP contraction of 1994 compared to a rise of 3.1% in the non-smoothed model.

mitigate against procyclical effects.[28] These can be broadly distinguished between policies to reduce the procyclicality of bank lending behaviour *ex ante* and measures to deal with such procyclicality *ex post*.

Reducing procyclicality of lending *ex ante* has been particularly emphasised by Borio et al. (2001). Potential policy measures they advocate include promotion of better understanding of risk to improve the response of market participants to changes in risk over time. However, as noted by Goodhart et al. (2004), if improved awareness of risk leads to banks holding higher quality portfolios then this could in fact exacerbate any procyclical effects since, as mentioned in Section 2.1.3, higher grade credits face a steeper regulatory capital risk-curve. Supervisory practices can potentially play an important role in this learning process, for example through promotion of forward-looking provisions. Another option is rule-based counter-cyclical changes in supervisory policy to prevent procyclical pressures, for example through changes in loan-to-value ratios. Such policies face similar problems to the counter-cyclical indexing discussed above in terms of the design of practical and credible rules and since, as Daníelsson et al. (2001) note, any forward looking adjustment is inevitably beset by forecasting problems.

Alternatively, policy makers may attempt to deal with lending procyclicality *ex post*. Again this could include discretionary adjustments in supervisory rules. It could also include, in extreme times, adjustments to monetary or fiscal policies although any such proposal faces particular problems in terms of the clarity of purpose, potential spillover effects and political economy constraints (see, for example, Borio and White, 2004).

References

Acharya, V. V., Bharath, S. T., and Srinivasan, A. (2004). Understanding the recovery rates of defaulted securities. London Business School, paper in progress available at http://faculty.london.edu/vacharya/wp.htm.

Alfon, I., Argimon, I., and Bascuñana-Ambrós, P. (2004). What determines how much capital is held by UK banks and building societies? Financial Services Authority Occasional Paper 22.

Allen, L. and Saunders, A. (2003). A survey of cyclical effects in credit risk measurement models. BIS Working Paper No. 126.

Altman, E. I., Resti, A., and Sironi, A. (2002). The link between default and recovery rates: effects on the procyclicality of regulatory capital ratios. BIS Working Paper No. 113.

Amato, J. D. and Furfine, C. H. (2003). Are credit ratings procyclical? BIS Working Paper No. 129.

Araten, M., Jacobs Jr., M., and Varshney, P. (2004). Measuring LGD on commercial loans: An 18-year internal study. *The RMA Journal*, 86(8):96–103.

[28] These options are discussed in depth in, for example, Borio et al. (2001) and Borio and White (2004).

Ayuso, J., Pérez, D., and Saurina, J. (2004). Are capital buffers pro-cyclical?: Evidence from Spanish panel data. *Journal of Financial Intermediation*, 13(2):249–264.

Basel Committee (2004). Basel II: International convergence of capital measurement and capital standards: a revised framework. Basel Committee Publications 107.

Blum, J. and Hellwig, M. (1995). The macroeconomic implications of capital adequacy requirements for banks. *European Economic Review*, 39(3-4):739 –749.

Borio, C., Furfine, C., and Lowe, P. (2001). Procyclicality of the financial system and financial stability: issues and policy options. In *Marrying the macro- and micro-prudential dimensions of financial stability*, volume 1 of *BIS Papers*, pages 1–57.

Borio, C. and White, W. R. (2004). Whither monetary and financial stability? the implications of evolving policy regimes. BIS Working Paper No. 147. Paper presented at Monetary Policy and Uncertainty: Adapting to a Changing Economy, Jackson Hole Symposium, August 2003 (Federal Reserve Bank of Kansas City).

Catarineu-Rabell, E., Jackson, P., and Tsocomos, D. P. (2003). Procyclicality and the new Basel Accord - banks' choice of loan rating system. Bank of England Working Paper No. 181.

Corcóstegui, C., González, L., Marcelo, A., and Trucharte, C. (2003). Analysis of pro-cyclical effects on capital requirements derived from a rating system. Paper presented at Banking and Financial Stability: A Workshop on Applied Banking Research organised by the Basel Committee on Banking Supervision.

Daníelsson, J., Embrechts, P., Goodhart, C., Keating, C., Muennich, F., and Shin, H. S. (2001). An academic response to Basel II. LSE Financial Markets Group Special Paper No. 130.

Daníelsson, J., Shin, H. S., and Zigrand, J.-P. (2004). The impact of risk regulation on price dynamics. *Journal of Banking and Finance*, 28(5):1069–1087.

Daníelsson, J. and Zigrand, J.-P. (2003). What happens when you regulate risk? Evidence from a simple equilibrium model.

Eichberger, J. and Summer, M. (2004). Bank capital, liquidity and systemic risk. Oesterreichische Nationalbank Working Paper No. 87.

Enria, A., Cappiello, L., Dierick, F., Sergio, G., Haralambous, A., Maddaloni, A., Molitor, P., Pires, F., and Poloni, P. (2004). Fair value accounting and financial stability. European Central Bank Occasional Papers No. 13.

Financial Services Authority (2003). CP 189: Report and first consultation on the implementation of the new Basel and EU capital adequacy standards. www.fsa.gov.uk/pubs/cp/189/index.html.

Flannery, M. J. and Rangan, K. P. (2002). Market forces at work in the banking industry: Evidence from the capital buildup of the 1990s. AFA 2003 Washington, DC Meetings; EFA 2002 Berlin Meetings Presented Paper.

Freixas, X. and Tsomocos, D. P. (2004). Book vs fair value accounting in banking, and intertemporal smoothing. mimeo, Said Business School, University of Oxford.

Furfine, C. (2000). Evidence on the response of US banks to changes in capital requirements. Bank for International Settlements Working Paper No. 88.

Goodhart, C. (2004). Some new directions for financial stability? Per Jacobsson lecture, BIS Annual General Meeting, Zurich, 27 June 2004.

Goodhart, C., Hofmann, B., and Segoviano, M. (2004). Bank regulation and macroeconomic fluctuations. *Oxford Review of Economic Policy*, forthcoming.

Gordy, M. and Howells, B. (2004). Procyclicality in Basel II: Can we treat the disease without killing the patient? Paper presented at a joint workshop on Accounting, Transparency and Bank Stability hosted by the Basel Committee on Banking Supervision, the Centre for Economic Policy Research (CEPR), and the Journal of Financial Intermediation, Basel, 17-18 May 2004.

Internatinal Accounting Standards Board (2004). International financial reporting standards 2004.

Jackson, P. (2004). What impact will Basel II have on the banking system by 2010? *The Financial Regulator*, 9(1).

Jackson, P., Furfine, C., Groeneveld, H., Hancock, D., Jones, D., Perraudin, W., Radecki, L., and Yoneyama, M. (1999). Capital requirements and bank behaviour: the impact of the Basel Accord. Basel Committee on Banking Supervision Working Papers 1.

Jackson, P. and Lodge, D. (2000). Fair value accounting, capital standards, expected loss provisioning , and financial stability. *Bank of England Financial Stability Review*, 8:105–125.

Jackson, P., Perraudin, W., and Saporta, V. (2002). Regulatory and "economic" solvency standards for internationally active banks. *Journal of Banking and Finance*, 26(5):953–976.

Kashyap, A. K. and Stein, J. C. (2003). Cyclical implications of the Basel II capital standards. University of Chicago, Working paper available at http://post.economics.harvard.edu/faculty/stein/papers/basel-final-two-authors1.pdf.

Kashyap, A. K. and Stein, J. C. (2004). Cyclical implications of the Basel II capital standards. *Federal Reserve Bank of Chicago Economic Perspectives*, 28(1):18–31.

Lopez, J. A. (2004). The empirical relationship between average asset correlation, firm probability of default, and asset size. *Journal of Financial Intermediation*, 13(2):265–283.

Lowe, P. (2002). Credit risk measurement and procyclicality. BIS Working Paper No. 116.

Michael, I. (2004). Accounting and financial stability. *Bank of England Financial Stability Review*, 16:118–128.

Peura, S. and Jokivuolle, E. (2004). Simulation based stress testing of banks' regulatory capital adequacy. *Journal of Banking and Finance*, 28(8):1801–1824.

Plantin, G., Sapra, H., and Shin, H. S. (2004). Marking-to-market: Panacea or Pandoras Box? http://www.nuff.ox.ac.uk/users/Shin/PDF/MTM10.pdf.

Sapra, H. and Shin, H. S. (2003). Do derivatives disclosures impede sound risk management? http://www.nuff.ox.ac.uk/users/Shin/PDF/deriv8.pdf.

Segoviano, M. and Lowe, P. (2002). Internal ratings, the business cycle and capital requirements: Some evidence from an emerging market economy. BIS Working Paper No. 117.

Summer, M. (2003). Banking regulation and systemic risk. *Open Economies Review*, 14:43–70.

Zakrajsek, E., Carpenter, S. B., and Whitesell, W. C. (2001). Capital requirements, business loans, and business cycles: An empirical analysis of the standardized approach in the new Basle Capital Accord. FEDS Working Paper No. 2001-48.