The Sub-prime Crisis: Causal Distortions and Regulatory Reform

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1. Introduction

Financial bubbles associated with leverage and the crises to which they give rise are always a consequence of distortions somewhere in the world economy. To be sure, there is usually more than one factor at work in the timing, location and size of a crisis. But the reform process will need to consider causality, if sensible principles are to be developed.

The economic consequences of the bursting of the sub-prime bubble are only in their early stages. The banking system is short of capital – both in the United States and in Europe (where people seem, perhaps wrongly, to be very sanguine about the likely fallout).

The crisis took policy-makers by surprise. In the second quarter of 2007, there was only mild concern about the risk of a financial storm.[2] The IMF *Global Financial Stability Report*, a good touchstone for official consensus at the time, ranked credit risk as the lowest in their Global Financial Stability Map, and wrote:

> … weakness has been contained to certain portions of the subprime market (and to a lesser extent, the Alt-A market), and is not likely to pose a serious systemic threat. Stress tests conducted by investment banks show that, even under scenarios of nationwide house price declines that are historically unprecedented, most investors with exposure to subprime mortgages through securitized structures will not face losses. (IMF 2007, p 7)

The United Kingdom's Financial Services Authority (FSA) signed off on Northern Rock becoming an early Basel II 'internal ratings-based' obligor, knowing full well that this would dramatically reduce their capital, only shortly before the crisis began.

There was also a general tone amongst policy-makers of a greater willingness to rely on the private sector's own assessments of risk and capital requirements, consistent with the push towards Basel II in its sophisticated version.

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2. Certain 'mavericks' in the official family voiced concerns, but they had been doing so for a long time in some cases, apparently 'wrongly', and did not affect the policy process in any pre-emptive way.

Notwithstanding the surprise factor in the crisis, views are divided concerning the broad paradigm in which financial policy-making is carried out. The Financial Stability Forum (FSF 2008) recommendations look to iron out various anomalies and oversights. The move to Basel II, the blueprint for which was published in June 2004, is endorsed (with some yet-to-be announced modifications). As the chairman of the Basel Committee on Banking Supervision recently pointed out, 'there is a strong consensus that the implementation of Basel II will put capital regulation on a sounder footing' (Wellink 2008). Mr Paulson, of the US Treasury, is focused on the United States, and is advocating major consolidation of the overlapping regulatory structure there.

Academic research is more critical, and points to possible major flaws in the capital regulation paradigm, not just the ineffectual Basel I system, but the evolution towards Basel II, which will be both procyclical in its current proposed form and will not systematically penalise concentration and regional risk factors, except insofar that supervisors under Pillar II choose to focus upon such concerns (see Goodhart 2007, for example). Banks, credit rating agencies and monoline insurers are ducking for cover on their past 'mistakes', but are finding a voice to argue against regulatory over-reaction.

The main risk is, with all of these cross-currents, that the US and other economies 'muddle through' again this time, and necessary reform is not put in place. Indeed, if current policy responses increase moral hazard in the banking system, then future crises may not only be likely, but possibly larger than the current one.

Understanding causality is a precondition for correct policy-making. Causality in economics usually carries the connotation of 'exogeneity': a policy distortion, a change or a shock not caused by events, but setting them in motion. Endogenous variables respond to the shock, subject to certain parameters or conditioning factors that may restrain or exacerbate outcomes – themselves often drifting and stretching over time. The reform process needs to consider the conditioning factors, and improve them. But bubbles and crises will still occur if the causal distortions are not addressed directly. Think of the analogy of a flood of running water from a badly-made and bursting dam: the gullies, rocks and branches in its way are conditioning factors that influence the speed and direction of the flow – but the excess water will always find its way around these obstacles. They only influence precisely where the inevitable damage to the landscape will occur. A bad dam is causal. The obstacles (levies etc) may moderate or exacerbate the situation, but most fundamentally we need to understand what constitutes good and bad infrastructure. So it is with liquidity, financial bubbles, crises due to excess leverage and regulation.

This paper examines the process of disintermediation that led to the current crisis, the extent to which it was an unintended consequence of capital regulation, and what the turmoil means for prospects for the financial system and how it should be regulated. The plan of the paper is as follows.

Section 2 looks at the global macroeconomic causes of the current crisis. Section 3 explores the securitisation process: the main players, trends, the nature and size of the crisis, and the case for serious regulatory reform. The Financial Stability Forum

summary of key weaknesses and recommendations is summarised in Section 4 and causal versus conditioning factors are discussed. Key elements of the Basel capital regulation framework are set out in Section 5, and Basel I is compared with the revised Basel II Framework. Problems with capital regulation under Pillar 1, the extent to which Pillars 2 and 3 might be expected to help and the problems of 'anticipation' affecting what banks did in respect to mortgage concentration in the run-up to Basel II are discussed in this section. Section 6 looks at the problem of regulatory competition and illustrates it with the controls placed on Fannie Mae and Freddie Mac, which in the view of this paper played a role in causing the crisis. Econometric techniques are used to illustrate the likely magnitude of the contribution of regulation to the sub-prime crisis in Section 7. To support the views in all the preceding analysis from a microeconomic perspective, the cases of Citi (Section 8) and UBS (Section 9) are looked at in some detail.[3] Capital regulation in the United States is compared to the situation in Europe in Section 10. Europe is shown to be very under-capitalised compared to the United States and less able to absorb financial turmoil. A summary of the key findings of the paper is set out in Section 11 and finally some observations on the key required elements of reform are set out in Section 12.

2. The Global Liquidity Bubble

Liquidity-driven bubbles have their roots in distortions somewhere in the world economy. To think about causality it helps to look at the exogenous drivers. The starting point for the sub-prime crisis in this broad context focuses on three (inter-related) distortions:

i. Low US interest rates (the federal funds rate was 1 per cent in 2003/04) following the tech bust, and the associated weakening in the US dollar from 2002.

ii. Chinese industrialisation, foreign reserve accumulation and sovereign wealth fund (SWF) growth. These are associated with: high saving and current account surpluses; a strongly managed exchange rate in the face of foreign direct investment inflows, resulting in huge foreign exchange intervention; low administered energy prices that do not permit the rising oil price to have a demand-slowing effect, and result in even higher global oil prices and unprecedented revenue to oil-producing countries and their SWFs; and the recycling of Asian and OPEC current account surpluses and reserves back into western financial markets, affecting interest rates and the cost of capital (while at the same time disguising inflation pressure as a current account deficit, with cheap manufactures causing import competition, etc).

iii. Japan's near-zero interest rate and (low) exchange rate policy, as it tries to adjust to new competitive challenges from China and other industrialising countries. This reinforces the low global cost of capital in financial markets via carry trades.

The *ex ante* excess of saving over investment and nominal flows to which these trends gave rise resulted in price responses in financial markets to equate *ex post*

3. Citi was formerly known as Citigroup.

savings and investment. The search for yield contributed to financial bubbles and excess leverage (Blundell-Wignall 2007a, 2007b). Liquidity-driven bubbles and a global cost of capital that was too low led to excess risk-taking and asset prices getting driven out of line with fundamentals based on realistic future cash flows. Excess leverage resulted from the reduction of nominal constraints on borrowers (as lower servicing burdens supported cash flows) and because collateral values, as measured at a point in time, are directly linked to loan size.

Sensible reform of the global financial system must go hand-in-hand with wider regulatory reform if periods of financial turbulence are to be avoided (exchange rate arrangements, energy price controls, and low interest rate beggar-my-neighbour policies). Regulation cannot, and should not have to, compensate for serious macroeconomic distortions that drive rolling liquidity bubbles. At the more micro level of financial markets, it has to be asked: why did this flood of liquidity, like the water analogy above, find its way into the sub-prime market in such an extreme and damaging way, in spite of the financial regulations in place to stop it? Even more puzzling, why was it so extremely concentrated in private-label residential mortgage-backed securities (RMBS) after 2004?

3. Intermediation and Securitisation

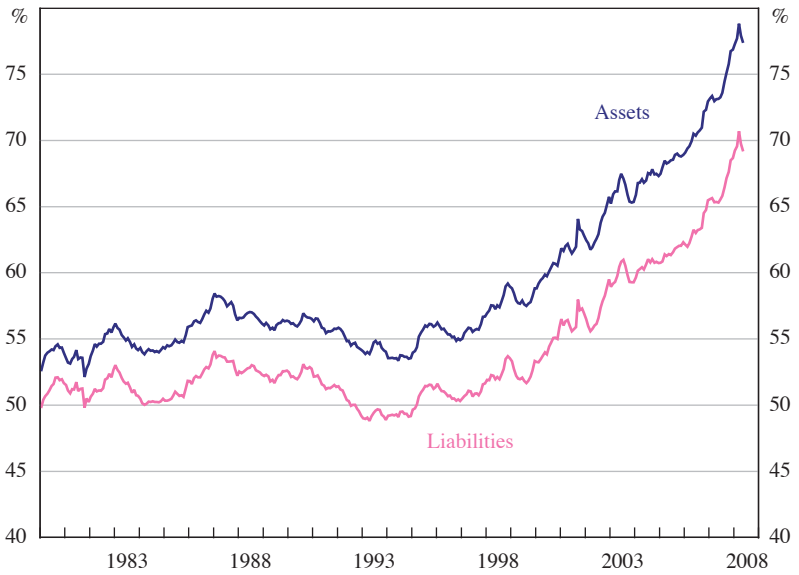
Banking is a highly-leveraged activity – it consists of borrowing from the public through deposits or via commercial paper in the wholesale markets (bank liabilities) and lending to households and businesses (bank assets). Between these two large items of the balance sheet sits a thin sliver of capital or equity (on the liabilities side of the bank balance sheet) which can disappear quickly. The gap between assets and borrowed liabilities of US commercial banks is shown in Figure 1. In the decade from January 1994 (the end of a previous major banking crisis) to January 2004, US bank assets rose from 54 per cent of GDP to 66 per cent, some 12 percentage points of GDP. From January 2004 to March 2008 (just over four years) assets rose again by 13 percentage points of GDP to a record 79 per cent of GDP.

3.1 The exponential 'take-off' in mortgages and securitisation of mortgages

The surge in assets post 2004 was driven almost exclusively by residential and commercial mortgages (Figure 2). From the end of 2004, the process of securitisation of mortgages from private-label issuers of asset-backed securities (ABS) also took off, but in a more extreme and almost exponential fashion – notwithstanding the fact that securitisation has been around for about two decades, and the conduits used to create leveraged demand for RMBS, for example, collateralised debt obligations (CDOs), have existed for at least a decade. Figure 3 shows RMBS alongside other securitised loans.

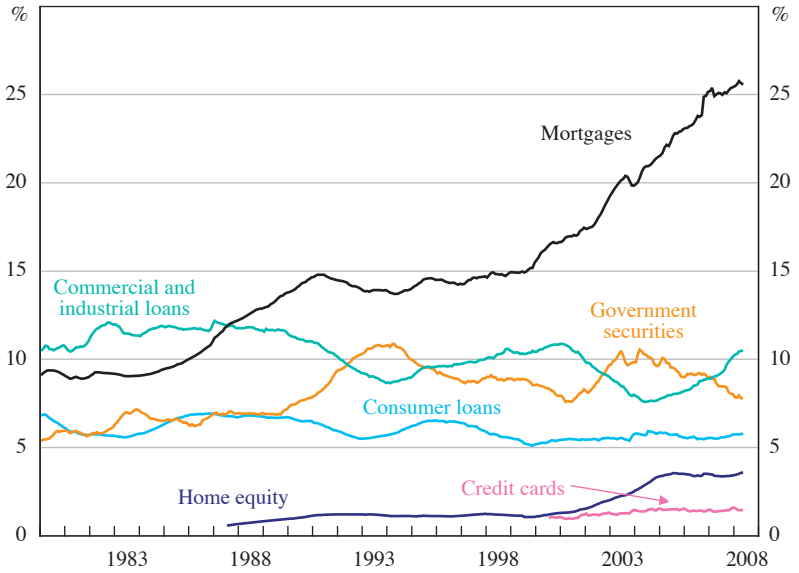
On-balance sheet bank mortgages rose by 6 percentage points of GDP from 20 per cent in January 2004 to 26 per cent in March 2008 – but RMBS from ABS issuers rose much more dramatically. RMBS and home equity loans rose from

Figure 1: US Commercial Banks – Assets and Liabilities
As a per cent of GDP



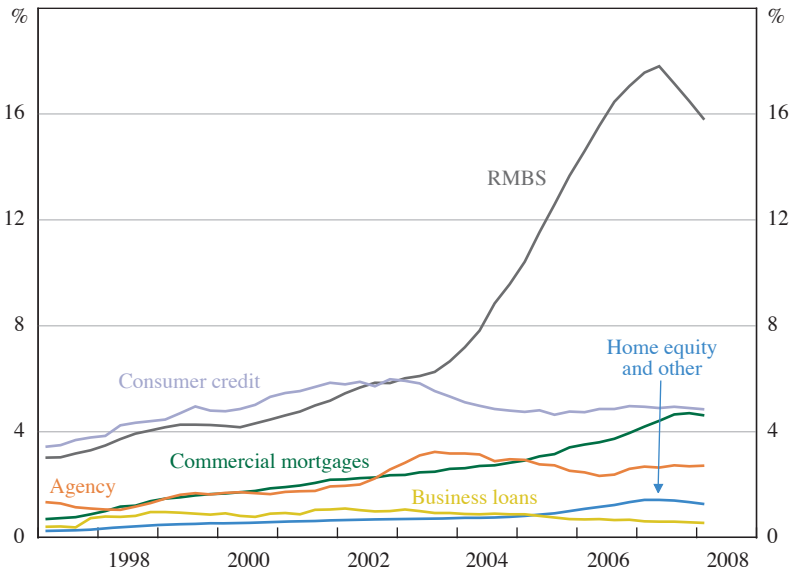
Sources: Board of Governors of the Federal Reserve System; Thomson Reuters

Figure 2: US Commercial Banks – Asset Composition
As a per cent of GDP



Sources: Board of Governors of the Federal Reserve System; Thomson Reuters

Figure 3: RMBS versus Other Securitised Assets
As a per cent of GDP



Sources: Board of Governors of the Federal Reserve System; Thomson Reuters

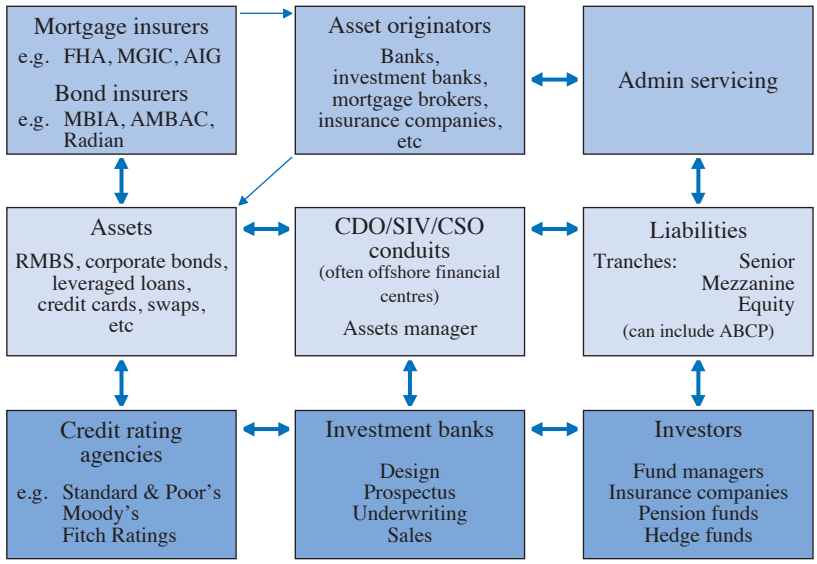
7 per cent of GDP in the March quarter 2004 to a peak of 18 per cent in the June quarter 2007, some 11 percentage points, before dropping back to 16 per cent by the end of 2007, as the crisis in these instruments began to emerge. This is quite extraordinary: from the end of 2004, RMBS accelerated more in three years than it had in the prior twenty years. This sudden and extreme move in private-label RMBS was to become the vortex of the sub-prime crisis.

Any causal understanding of the sub-prime crisis not only has to describe general contributing factors to securitisation and off-balance sheet activity; it must also explain the magnitude of change in such a compressed period of time (post 2004). What were the catalysts?

3.2 The securitisation players

The main players in the securitisation and structured products process are shown schematically in Figure 4. Loans are originated and then securitised by an ABS issuer – often the originator if it owns an investment bank. Mortgages are also bought from third-party issuers for this purpose. The pooled loans securitised in this way are sold to investors for a fee, thereby transferring the assets off the balance sheet. Pipelines of loans and ABS are then warehoused by the investment bank until securitised and sold. To ensure investor demand keeps up with the fee-driven securitisation process, the use of off-balance sheet special-purpose vehicles (SPV) using CDOs, asset-backed commercial paper (ABCP) conduits, and structured investment vehicles (SIVs) accelerated sharply from 2004. The conduits are not actual

Figure 4: Collateralised Debt Obligations – Market Structure and Main Players



Source: OECD

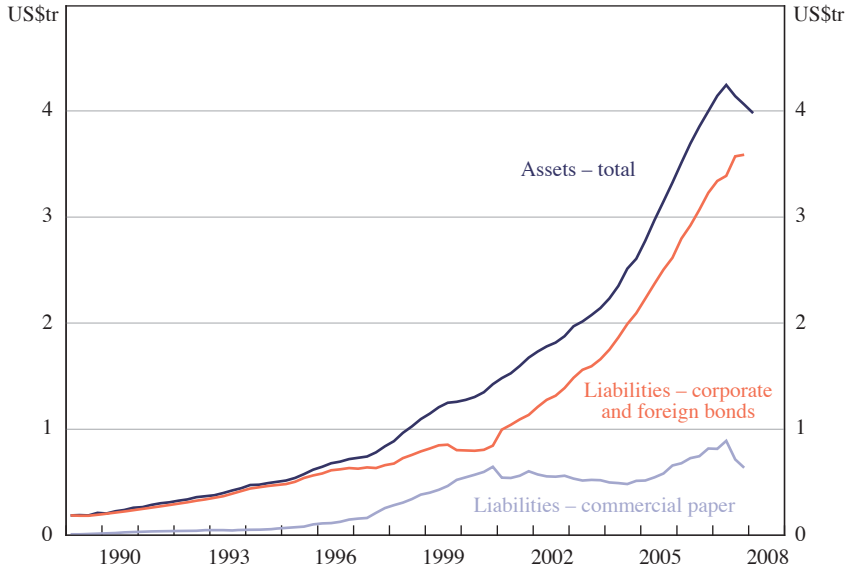
institutions in most cases, but are entities created for bookkeeping purposes – their assets and liabilities are shown schematically in the central row of Figure 4**.**

Other key players include the credit rating agencies (CRA) (bottom left in Figure 4) and 'monoline' bond insurers (top left in Figure 4). Both were critical to the securitisation process to ensure comfort levels for investors buying CDO tranches – because super senior tranches would have AAA ratings attached, and interest payments would be insured (see the discussion below). The whole edifice also requires servicing (usually a fee channel kept by the originator to continue to look after the loan servicing; top right in Figure 4) and investment banks to do the underwriting (middle of the bottom row).

Total assets of ABS issuers in the United States are shown in Figure 5, alongside the commercial paper and bond funding liabilities. Fortunately the lion's share of the funding is of longer duration, but there was US$890 billion in short-term commercial paper funding at its peak in June 2007, just prior to the crisis. Short-term notes are rolled over at the discretion of the holder and as the crisis unfolded such funding dried up. This meant that banks had to bring conduit assets back onto the balance sheet of the originator or extend credit (via pre-arranged credit lines). Reputational considerations sometimes came into play when arm's-length relationships were supposed to be in effect between the bank and the conduit.

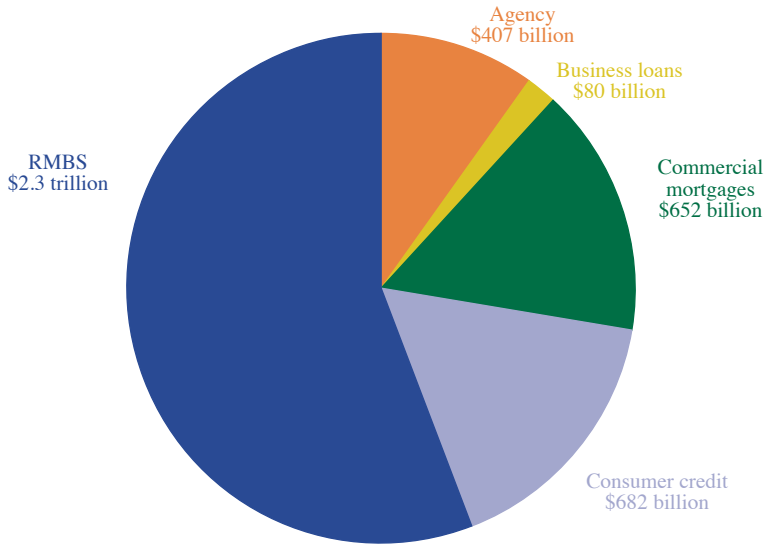
The breakdown of the assets of private ABS issuers is shown in Figure 6. Of the US$4 trillion, more than half is accounted for by mortgages and home equity loans

Figure 5: Issuers of Asset-backed Securities – Assets and Liabilities



Sources: Board of Governors of the Federal Reserve System; Thomson Reuters

Figure 6: Issuers of Asset-backed Securities – Asset Composition
2007:Q4



Sources: Board of Governors of the Federal Reserve System; Thomson Reuters

(US$2.3 trillion), followed by consumer and commercial real estate mortgages at nearly US$0.7 trillion each.

3.3 Securitisation and the capital market: sub-prime and the 'lemons' issue

The central idea of financial intermediation is that banks produce information about borrowers that is not known to outsiders in the wider capital market; they allocate credit and then monitor borrowers. If problems arise, banks can restructure loans to try to control borrower behaviour prior to delinquency, default and foreclosure action. If they do this well, with appropriate diversification, then with lender-of-last-resort central banking and the presence of deposit insurance in most jurisdictions (and certainly in the United States), they produce securities that should be almost riskless on the liabilities side of the bank balance sheet (at least where depositors or buyers of notes are concerned). Bank loans should not be saleable to capital markets because of the information asymmetry implicit in this form of intermediation – 'if a bank wants to sell me this loan, then there must be something wrong with it' (Akerlof 1970). Yet this is exactly what happened in the genesis of the sub-prime crisis – indeed it happened on a scale that proved that it was quite easy to sell 'lemons' into the capital markets.

This transformation was made possible by the role of bond insurance and CRAs. The CRAs worked with the issuer to provide a credit default rating on the bond (an assessment of its underlying assets), essentially taking over the role of the bank in assessing credits. As the CRA would receive a fee for this task, so that its own corporate revenue would benefit, a natural moral hazard existed: top-rated securities give comfort to investors, and the more generous the rating the more sales volume would go through.

The average rating of a CDOs underlying bond pool is BBB – this is needed to make the spread profitable, as returns have to be paid to investors – the bulk of which is typically rated as AAA in the super senior tranche. This seemed sensible on the basis of past mortgage history, because the non-investment grade and equity tranches of the CDO should absorb 'normal' losses, and because the interest payments could be insured by the bond insurers (often referred to as 'monolines', such as MBIA, AMBAC, etc). The AAA ratings obviously helped to sell the super senior tranches to investors. Risks, being based on past price history, were massively mispriced in the new edifice. A 10-standard-deviation price event before the sub-prime crisis is very different to what it would be measured at today. This is a sobering point that bears on the likely effectiveness of the revised Basel II approach (discussed below). The ultimate losses are likely to be large, and bank capital is small in comparison.

3.4 The crisis

Delinquencies in sub-prime mortgages underlying RMBS and leveraged off-balance sheet conduits began to rise in early 2007, causing their prices to fall and generating losses on securities. With mark-to-market accounting rules in

place these losses had to be recognised under corporate reporting requirements. This was followed by downgrades to the securities by the CRAs, and there was a general loss of confidence. Money market investors in ABCP refused to roll over their investments in bank conduits and SIVs. By August 2007, sponsoring banks with liquidity commitments to their off-balance sheet vehicles sought to raise cash and refused to provide loans to others in the interbank markets. As these markets dried up, central banks became the major providers of 'crisis liquidity', and price discovery in illiquid markets became a major problem. No-one was sure what these assets were worth, and hence how large losses and potential bankruptcies might be, so the liquidity crisis extended.

The root of the problem should be thought of as a solvency crisis of underlying mortgages and of banks without sufficient capital to absorb the losses. Where banks had been warehousing mortgages and bonds in the securitisation process, this was a direct hit on their assets. Where they were forced to bring conduit assets back onto their balance sheets, at mark-to-market prices, there was a further hit. These hits led to write-offs and the destruction of bank capital. As the sliver of capital is so thin, some institutions failed, while others became desperately short of equity – if not falling below regulatory minima, certainly impacting their 'well-capitalised' status and credit ratings, which led to problems associated with banks' dealings with each other. Loss of bank capital is precisely the situation that leads to 'deleveraging' (a 'credit crunch') by banks, and capital markets also dry up as a source of funds. These are the key channels that generate recessionary pressures. Mark-to-market accounting and the liquidity crisis should be thought of as exacerbating factors.

Financial institutions across the globe, most notably Europe, were drawn into the crisis for the simple reasons that: first, their global banks operate in the United States; second, about one-third of the securitised sub-prime-related products were sold to offshore investors; third, the business model used all over the globe that saw longer-run assets financed out of the commercial paper market came under extreme pressure as the liquidity crisis unfolded; and fourth, because asset price 'beta effects' across the globe affected the value of assets under mark-to market accounting rules (under conditions of extreme volatility, the correlations of all risky assets rise).

The worst moment of the crisis to early July has been the collapse and rescue of an investment bank, Bear Stearns, with significant amounts of public money put at risk. Overall, the likely deleveraging process that will accompany the sub-prime and related mortgage losses will cause major headwinds to the economy and will take time to work through – the risk to inflation, if liquidity policies go too far for too long, also raises the spectre of stagflation.

3.5 Size of losses, deleveraging and the economy

When a bank loses that thin sliver of capital, or goes below the regulatory minimum, it has three basic choices. It can:

i. raise capital, which dilutes shareholdings with new equity or subordinated debt issuance. These are often taken up in a crisis situation by risk-takers such as SWFs and hedge funds;

ii. retain earnings and cut the dividend, so that capital is built internally – but this takes more time; or

iii. cut back on lending and reduce its balance sheet, so that the smaller capital base is consistent with asset size and capital requirements. This latter route can give rise to a 'credit crunch'. If banks do not lend and call in loans, there will be a recession – which is exactly what happened in the 1991 crisis.

In 2007, the OECD was the first to put out a big estimate of the likely ultimate losses (after collateral is sold) on the assets underlying RMBS (mainly US sub-prime, Alt-A and jumbo loans) – US$300 billion, based on prices derived from ABX indices.[4] International organisations and private firms have since used these techniques to come up with some truly alarmist numbers.[5] There is a massive problem of distortion and exaggeration when ABX prices are used to estimate losses, precisely because of the illiquidity problems discussed above. For this reason, in 2008 the OECD built a credit default model, which works independently of market prices (Blundell-Wignall 2008).[6] This requires modelling delinquency and default rates, and combining these with scenarios about the economy (GDP, employment and, most importantly, house prices). It also requires assumptions to be made about recovery rates as property collateral is repossessed and sold. The latest number for ultimate losses calculated this way is between US$370 billion and US$440 billion; the mid point of around US$400 billion is a bit up on last year, but not by too much.

A US$400 billion loss is a significant problem because those 'thin slivers of capital' are so 'thin'. Of this, about US$90 billion is estimated to accrue as ultimate losses (not mark-to-market writedowns) to the US banks and investment banks (about US$130 billion is in Europe and US$180 billion is split between non-bank US investors – insurance, hedge funds and fund managers).[7] This US$90 billion of losses will be difficult to raise as new capital – about half this amount was raised on a recent count – but initial SWF investors were so burned they will not be back for a while. More importantly, US$90 billion is not enough, as covering the ultimate losses only allows banks to maintain a flat balance sheet, which is exactly what happened in 1991.[8] This would still give rise to a credit crunch, as the economy needs rising intermediation in order to grow. To grow by the average balance sheet growth rate of 7 per cent per annum would require more than double this amount of capital to be raised over a full year. If banks attempt to respond via retained earnings alone,

4. The prices of credit default swaps used to insure the risk of default in the underlying sub-prime mortgages.

5. The IMF (2008) has an estimate of US$1 trillion, but this includes losses on all loans in the global economy and is not comparable to our modelling of the component of key policy interest.

6. See Greenlaw *et al* (2008) for a detailed look at alternative approaches.

7. Ultimate losses are what bond markets should price, that is, after foreclosure and sale of collateral. It is highly unlikely that this is happening, so ultimate losses are likely to be smaller than initial write-downs.

8. Implicit here is the assumption of some regulatory forbearance if mark-to market write-downs are greater than ultimate losses. Alternatively, banks would have to raise more capital in the near term than they would ultimately need, intensifying the credit crunch.

with no lending, Blundell-Wignall (2008) estimates that it will take five quarters to adjust fully – and certainly through all of 2008.

These numbers are 'first-round' estimates, and there is a risk that the credit crunch could lead to a worse economic scenario than assumed.[9] If this proves to be so, not only will the sub-prime losses be larger, but there will be a greater risk of flow-on effects to other sectors and assets (for example, with corporate defaults adversely affecting corporate bonds, equities and their investors).

3.6 Moral hazard and the urgent need for better regulation

This is the third major banking system crisis since the early 1990s, and maybe the biggest. The risk of a credit crunch is large. Europe is lagging behind the United States, but similar forces are in play. In the case of Bear Stearns, taxpayers' money has been used to guarantee the Bear Stearns portfolio beyond a certain amount of loss – and it can by no means be assumed that this is the end of it for Bear Stearns' or any other firm's toxic assets. Few people realise that had the Federal Reserve and JPMorgan Chase weekend rescue not happened in mid March 2008, then during the following week at least two more investment banks would have been at grave risk: and the world would have been on the verge of an even less manageable crisis. At that point there was no choice. Similarly, the rescues of IKB and WestLB in Germany have large implications for German taxpayers, as does the nationalisation of Northern Rock for taxpayers in the UK (following the first bank run in the UK in over 140 years). In principle, taxpayers' money should not be used in this way.

After such a crisis, with public money on the line, it is reasonable to ask: can the effectiveness of markets as an allocator of capital amongst competing ends be relied upon in the future, when the trade-off between risk and return is now so asymmetric, and banks know they are too big to fail? As the memory of this current crisis fades, we will be straight back into a process that leads to the next one.

It is like the space traveller about to pass into a black hole, asking a Martian the way back to Earth – he replies: 'if you want to get to Earth, you shouldn't be starting from here'. But the regulatory debate is starting from here! There needs to be some new thinking about reform of the regulatory and policy-making paradigms for the longer run.

It is important to ask: what went wrong? Is the problem one where a combination of better short-term liquidity management and some improvements to the existing rules and regulations will be sufficient to right the situation and put the global economy on an even keel for the next few decades? Or is there something more fundamentally wrong with the structure of the market and the current paradigm of thinking about how to regulate it?

9. That is, a small recession, like the 2001 period, and house price falls of no more than 4 per cent using the Office of Federal Housing Enterprise Oversight (OFHEO) measure.

4. The Financial Stability Forum (FSF) Analysis of the Crisis and the Issue of Causality

At the global level the body charged with analysing the crisis and recommending reform is the FSF. It brings together top-level central bankers and supervisors as well as representatives of international organisations (IOSCO, IMF, World Bank, OECD, etc). This group can draw on all of the resources of institutions around the world to do some thorough analysis. The FSF published their findings in April 2008. A summary of the findings is presented in Table 1 (FSF 2008). There are nine key underlying weaknesses on the left-hand side and five sets of key recommendations shown on the right-hand side of the table. The weaknesses taken together presumably should explain the sudden explosion of RMBS after 2004 – in other words, there should be causal factors amongst them. Effective reform, as argued earlier, should attach more weight to causal as opposed to conditioning factors.

Taking the nine weaknesses as hypotheses about causality, in turn:

1. Poor underwriting standards. Their presence is indisputable. But does this factor cause the explosion in RMBS and levered conduits? It is equally arguable that it is a facilitating aspect of the process and not a cause. Loan officers did not decide exogenously to become lax after 2004. Rather, the pressure to securitise may have forced them in that direction.
2. Poor risk management. Again, this is tautologically correct for the institutions that made bad loans. But did risk management models switch to inferior types from 2004? Did management deliberately or inadvertently decide to downgrade/ignore the role of risk management after 2004? It is argued below (in the discussion of UBS) that cultural factors embedded in bank strategy – and driven by revenue pressures from other causes – led some boards to give a lower weight to risk before the crisis.
3. Poor investor due diligence. Again a tautology. Investors are always likely on average to take excessive risks in a boom when liquidity is ample and interest rates are low. This is a part of the procyclicality debate. No one is going to disagree with a recommendation that they should try to do better. But will human nature, given the evidence of all past cycles, really be likely to change in an effective way in future decades? This is highly unlikely.
4. Credit rating agencies. It is indisputable that they did a poor job, as has been evidenced by the extent of recent downgrades. What is less clear is whether they independently decided to reduce the quality of their analysis after 2004. As with risk control, ratings become procyclical and that will always be a feature of the financial landscape. Of course improvements in practices are desirable, and this will at minimum avoid future exacerbating behaviour. But it is not going to remove procyclicality. What is very important, and not a focus of the FSF report, is the competitive structure of the market. The oligopoly of the 'issuer-pays' model, with only a few ratings firms, is likely to be a causal factor through the fee incentives and moral hazard issues that arose. If institutional investors in securities on the 'buy side' were required to obtain an independent

Table 1: Report of the Financial Stability Forum on Enhancing Market and Institutional Resilience

Underlying weaknesses

(1) Poor underwriting standards (high LVRs, verification income, etc)
Due to risk transfer/weak oversight/the house price boom and low rates

(2) Poor risk management practices in firms: couldn't estimate 'tail-risks' for CDOs etc (default, concentration and liquidity risk). Due to lack of history on returns and correlations.

(3) Poor investor due diligence/excess reliance on CRAs

(4) Poor CRA performance
Due to: (i) inadequate models; (ii) lack of due diligence on collateral pools; (iii) insufficient transparency; (iv) insufficient education on meaning of a rating (credit only); (v) conflict of interest (especially where consulting and rating businesses are mixed)

(5) Incentive distortions
(i) Originate-to-distribute → no ongoing information on quality/performance of assets
(ii) Basel I encourages securitisation via off-balance sheet conduits with low capital charges
(iii) Compensation schemes in financial firms that encourage excess risk taking

(6) Weaknesses in disclosure (unclear risks), especially off-balance sheet/inaccessible presentation

(7) Thin market feedback loop with sharp price falls → losses/capital falls/more selling
There is a major 'price discovery' issue with absent markets

(8) Weaknesses in regulatory frameworks pre-Basel II (unregulated exposures and liquidity risk)

(9) Originate-to-distribute model itself
(i) Leveraged off-balance sheet conduits with liquidity risk
(ii) Bank still 'connected' via credit lines/reputational issues/counterparty credit exposure
(iii) Conduit liquidity assumptions wrong
(iv) Warehousing pipeline assumptions wrong (large ongoing demand did not eventuate)

Solutions

Improve transparency and valuation on CDOs etc
- Require reporting of exposures: total; before and after hedging and writedowns
- Pillar 3 guidance on all this to be improved after consultation
- IASB to lead a convergence push on accounting standards on all this
- Focus on valuation at fair value in illiquid markets; strengthen models and procedures for marking to market on trading books
- IAASB and national standard setters to enhance audit guidance
- Regulators to look at scope for post-trade transparency (prices/volumes)

Change the role and use of credit ratings
- Separate rating from other business and strengthen internal oversight and methods
- IOSCO will strengthen codes on conflict and methods
- Separate rating scale for structured products encouraged
  CRAs must insist on better data from underwriters/publish performance of ratings
- Investors and regulators to be less reliant on CRAs (own assessments)

Move quickly to a (strengthened) Basel II where capital is required for:
- Market risk on trading book (stop regulatory arbitrage with banking book)
- Credit risk on banking book
- Liquidity for off-balance sheet conduits (to be proposed in 2008)

and where supervisors will:
- Update risk parameters and study Basel II cyclicality issues in 2008
- Encourage insurance supervisors (especially monolines) to follow

Dealing with stress in the financial system
(FSF liquidity management guidelines to be released by July 2008)
- Focus on risks/stress tests/intraday/cross-border

Improve supervisory oversight of risk management including off-balance sheet
- BCBS Pillar 2 guidance in 2008–2009 to ensure capital 'buffers', including for: concentration risk (individuals/sectors/regions/economy); stress testing of capital cushions;
- guidance on managing securitisation (including warehousing/trading/syndication);
- issue guidance on exposure to leverage of counterparties; and
- encourage company boards and investors to do better

Improve infrastructure for OTC derivatives
- Standard documentation and cash settlement obligation
- Automate trade to remove crisis spike backlogs
- Dealer/investor standards for netting, reconciliation and valuation of trades

Responsiveness of authorities/international bodies to be strengthened
- Improve responsiveness, techniques, coordination domestically; and
- coordination across borders and currencies
  For crisis management and dealing with weak banks (including deposit insurance)

Source: authors' summary of FSF (2008)

appraisal, for example, then a competitive market would develop. Groups like Morningstar, with the right in-house expertise, could move into debt rating for the buy side, putting pressure on fees, reducing moral hazards and improving the rating process itself.

5. Incentive distortions via Basel I regulatory arbitrage and financial market compensation schemes – the former had been in play since 1992, and the latter for much longer. Basel weights are exogenous, and more causal in the sense of this paper. The more interesting question is what caused these mechanisms to be taken advantage of from 2004 onwards.
6. Disclosure (valuation, fair value accounting, audit, etc) – did it deteriorate in 2004, or did pre-existing weaknesses come to light as other causal factors accelerated the securitisation process? The FSF focuses on strengthening models and procedures. This has to be supported as an important 'conditioning factor'. A more structural concern is the audit market itself. There are only four audit firms (post Arthur Anderson) who work closely with complex financial institutions, for substantial fees. This closeness is a concern and creates the risk of reduced independence. These firms are protected by a legal restriction in key jurisdictions: that only audit partners can own shares in audit firms. This precludes someone like Warren Buffett setting up competitor firms by raising funds on the stock exchange. This issue is surely worthy of further consideration in the reform process.
7. Thin markets and price discovery – this liquidity issue was exposed by the solvency crisis in mortgages and under-capitalised banks. It is unlikely to have been a cause of the crisis, but clearly exacerbated it. The FSF intends to issue guidance on dealing with leveraged counterparties (like hedge funds), warehousing and the like. What remains unclear, at least to the authors of this paper, is a set of clear definitions for those institutions that should fall with the regulatory framework for 'safe-and-sound banking' and those that should not.
8. Weaknesses in the regulatory structure pre-Basel II – this area is a key focus of this paper because regulatory changes were signalled and some changes did occur at the critical time that needs explanation. The 'mid-year' Basel II text for the revised framework for capital standards was released in June 2004 (BCBS 2004), and the Quantitative Impact Study 4 (QIS-4) Basel II simulations revealed the extremely favourable likely weighting for mortgages, and the freeing up of capital that would arise for banks. At the same time, the OFHEO, which was the Fannie Mae and Freddie Mac regulator, began a series of strong measures that constrained the balance sheets of these institutions. These events fit with the timing of the surge in RMBS issuance and are exogenous events. They have to be considered as potentially causal factors.
9. The originate-to-distribute model – was this a causal factor? Or was its increased use quite logical, flowing from the incentives set up by other distortions after 2004?

As noted in the introduction, causality carries with it some notion of exogeneity in economics and econometrics, while other factors condition the outcome of the causal influences and may even restrain them. Regulatory factors are causal in this sense and deserve special attention. Private-sector practices need to be improved, to be sure, but if regulators set distortions, then problems will follow just as surely as if a poorly made dam were to burst.

5. Capital Regulation and the Basel System[10]

Sudden changes in asset quality and value can quickly wipe out bank capital. Where short-term wholesale liabilities fund longer-term assets, failure to roll over short-term financial paper, or a 'run' on deposits, can force deleveraging and asset sales. Banking crises associated with such changes are often systemic in nature, arising from the interconnectedness of financial arrangements: banks between themselves, with derivative counterparties, and with direct links to consumption and investment spending decisions. In history, banking crises have been associated with major economic disruption and recessions. It is for this reason that policy-makers regulate the amount of capital that banks are required to hold, and require high standards of corporate governance, accounting, audit and lending practices.

Capital regulations under Basel I came into effect in December 1992 (after development and consultations since 1988). The aims were: first, to require banks to maintain enough capital to absorb losses without causing systemic problems; and second, to level the playing field internationally (to avoid competitiveness conflicts). A minimum ratio of 4 per cent for Tier 1 capital (essentially, equity less goodwill) to risk-weighted assets (RWA) and 8 per cent for Tier 1 and Tier 2 capital (certain subordinated debt etc).[11] The Basel I risk weights for different loans are shown on the left side of Table 2.

A 'revised framework' known as Basel II was released in June 2004 (see BCBS 2004) after many issues with Basel I, most notably that regulatory arbitrage was rampant (Jackson 1999). Basel I gave banks the ability to control the amount of capital they required by shifting between on-balance sheet assets with different weights, and by securitising assets and shifting them off balance sheet – a form of disintermediation. Banks quickly accumulated capital well in excess of the regulatory minimum and capital requirements, in effect, had no constraining impact on bank risk-taking. The evolution of US commercial bank capital (goodwill included) versus a calculation of the regulatory minimum under Basel I is shown in Figure 8.[12]

The revised framework is based on three pillars, which we will now examine and discuss in turn.

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10. Both Basel I and II are only frameworks for capital regulation. Actual regulations reflect national modifications to Basel in different countries.

11. A third tier of capital is defined in the Market Risk Amendment to the original accord.

12. This is calculated by weighting all of the assets of the banking system by their corresponding weight shown in Table 2.

Table 2: Basel and Basel II Risk Weights and Commentary

Selected risk weights under Basel I and Basel II (Pillar 1); per cent

Security	Basel I	Basel II		Basel II advanced : internal ratings-based (IRB) for the United States		
		Simplified, standardised	Standardised based on external ratings	2004–05 QIS-4 Average percentage change in portfolio MRC	2004–05 QIS-4 Median percentage change in portfolio MRC	Commentary
Most government/central banks	0	0		0	0	Comes close to letting banks set their own **Pillar 1** capital, with supervisory oversight. Risk weights depend on internal estimates of a loan's probability of default; loss given default; and exposure to loss. These are based on the banks' own complex risk models, relying on subjective inputs and often on unobservable (e.g. OTC illiquid securities) prices.
AAA to AA-			0			
A+ to A-			20			
BBB+ to BBB-			50			
BB+ to B- (& unrated)			100			
Below B-			150			
Other public (supervisors' discretion)	0–50	0		0	0	
Claims on MDBs	20	0		–21.9	–29.7	
Most OECD banks & securities firms	20	20	<90 days	–21.9	–29.7	
AAA to AA-			20			
A+ to A-			20			
BBB+ to BBB- (& unrated)			20			**Pillar 2** provides for supervisory oversight. With stress testing, and guidance from supervisors, banks can be made to hold capital for risks not adequately captured under Pillar 1.
BB+ to B-			50			
Below B-			150			
Residential mortgages – fully secured	50	35	35	–61.5	–72.7	
Retail lending (consumer)	100	75	75	(–6.5 to –74.3)	(–35.2 to –78.6)	
Corporate & commercial real estate	100	100		(–21.9 to –41.4	(–29.7 to –52.5)	**Pillar 3** is disclosure and market discipline which relies on some notion of market efficiency. Rational markets punish poor risk managers.
AAA to AA-			20			
A+ to A-			50			
BBB+ to BB- (& unrated)			100			
Below BB-			150			

Notes: QIS-4 – Fourth Quantitative Impact Study; MRC – minimum capital requirement; MDBs – multilateral development banks
Sources: BCBS (1988, 2004, 2006); FDIC (2005); author commentary

5.1 Basel II Pillar 1

Pillar 1 defines minimum capital to buffer unexpected losses. Total RWA are based on a complex system of risk weighting that applies to 'credit', 'market' (MR) and 'operational' risk (OR), which are calculated separately and then added:

$$RWA=\{12.5(OR+MR) + 1.06\text{SUM}[w(i)A(i)]\}$$

where: $w(i)$ is the risk weight for asset I; and $A(i)$ is asset I; OR and MR are directly measured and grossed up by 12.5 for 8 per cent equivalence; and credit risk is the sum of the various asset classes, each weighted by its appropriate risk weight. A scaling factor applied to this latter term, estimated to be 1.06 on the basis of QIS-3 data (but subject to change), was envisaged for the transition period, which was supposed to start for most countries in January 2008. Banks were to be able to choose between: first, a simplified approach (for smaller institutions without the capacity to model their business in risk terms) by using the fixed weights shown in Table 2; second, an approach based on external ratings (shown in Table 2); and third, an internal ratings-based (IRB) approach for sophisticated banks, driven by their own internal rating models (see Table 2).

The simplified approach is more 'granular' than Basel I, but retains its basic features. It is striking in light of the sub-prime crisis that the simplified approach shows the Basel Committee cutting the risk weight to mortgages by some 30 per cent (from 50 per cent to 35 per cent).

The IRB approach requires banks to specify the probability of default for each individual credit, its loss given default, and the expected exposure at default. This requires highly complex modelling and aggregation, and offers banks with the necessary expertise the possibility of deriving more risk-sensitive weights. This approach requires the approval of the bank's supervisor.

5.2 Problems with Basel capital regulation and Pillar 1

5.2.1 Portfolio invariance and linear weights

The risk-weighting formulas in the Basel capital regulations are based on a specific mathematical model, developed by the Basel Committee, which is subject to the restriction that it be 'portfolio invariant'; that is, the capital required to back loans should depend only on the risk of that loan, not on the portfolio to which it is added (Gordy 2003). This is convenient for additivity and application across countries. But it has an important disadvantage: it does not reflect the importance of diversification as an influence on portfolio risk. Thus the minimum capital requirements associated with any type of loan due to credit risk simply rise linearly with the holding of that asset type, regardless of the size of the exposure (that is, appropriate diversification is simply assumed). This means, in simple terms, that it does not do the most basic risk management function of penalising portfolio concentration (as might occur, for example, under a quadratic rule).

Furthermore, the problems of regulatory arbitrage under Basel I are not solved within Pillar 1 of Basel II, and the new rules may even introduce new problems. For example, the problem of moral hazard is stronger with the IRB approach, as risk inputs are subjective. Some prices are of the over-the-counter variety and are not observable, nor do they have appropriate histories for modelling purposes. Banks can manipulate inputs to reduce required capital. Sheila Bair, Chair of the FDIC, puts it this way:

> … the key risk inputs that drive the advanced approaches are subjective … unreliable and unproven … Regulators have taken appropriate care not to micro-manage internal rating systems. But the resulting wide latitude in capital requirements could lead to inconsistency across banks. And it could lead regulators to accept capital requirements that are too low. (Bair 2007)

For these sorts of reasons, the Basel Committee envisaged that Pillar 2 would deal with risks not appropriately covered in Pillar 1.[13]

5.2.2 Regional and sector risk factors

For the mathematical model underlying the Basel approach (I or II), each exposure's contribution to value-at-risk (VAR) is portfolio invariant only if: (a) dependence across exposures is driven by a single systemic risk factor – a global risk factor, since it is supposed to apply to global banks operating across countries; and (b) each exposure is small (Gordy 2003). What we know of the sub-prime crisis is that it originated in the US housing market (regional sector risk in this framework) and exposures were quite large.

Of the two conditions for invariance, by far the most important is the requirement of a single risk factor that applies to all participants. Almost prophetically, Gordy says:

> A single-factor model cannot capture any clustering of firm defaults due to common sensitivity to these smaller-scale components of the global business cycle. Holding fixed the state of the global economy, local events in, for example, France are permitted to contribute nothing to the default rate of French obligors. If there are indeed pockets of risk, then calibrating a single-factor model to a broadly diversified international credit index may significantly understate the capital needed to support a regional or specialized lender. (Gordy 2003, p 222)

If 'France' was replaced by 'the United States' and 'sub-prime' was mentioned as the pocket of risk, the story of the current turmoil was pretty much told in a rather technical paper four years before the crisis.

The Chair of the FDIC commented on US mortgages versus global banking risk after the US QIS-4 that showed banks reducing their weights for mortgages by up to 90 per cent, in the following way:

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13. Kane (2006) points out that the whole process of negotiating Basel II in the United States has been made especially difficult due to disagreements between complex financial institutions and the various regulatory groups. In this process, the banks are always going to seek the least burdensome system where any choice is involved.

> To me, one of the most troubling aspects of Basel II is that a purely historical look at mortgage data might have justified such numbers … These kinds of results are simply unacceptable. Redefining capital requirements sharply downward in this way under the advanced approaches, risks increasing the fragility of the global banking system. (Bair 2007)

5.2.3 The procyclicality of the Basel system

The Basel system is known to be procyclical. There are many reasons for this. The most basic reason is that judgments tend to underestimate risks in good times and overestimate them in bad times. More specific factors include:[14]

i. leverage ratios that depend on current market values (and are therefore high in good times and low in bad times). If asset values do not accurately reflect future cash flows, procyclicality results. This, of course, would be amplified by the distortions of excess liquidity and low interest rates discussed above;

ii. banks' risk measurements tend to be point-in-time and not holistic measures over the whole cycle (see Section 8 below, for discussion of this point relating to UBS);

iii. counterparty credit policies are easy in good times and tough in bad; and

iv. profit recognition and compensation schemes encourage short-term risk-taking, but are not adjusted for risk over the business cycle.

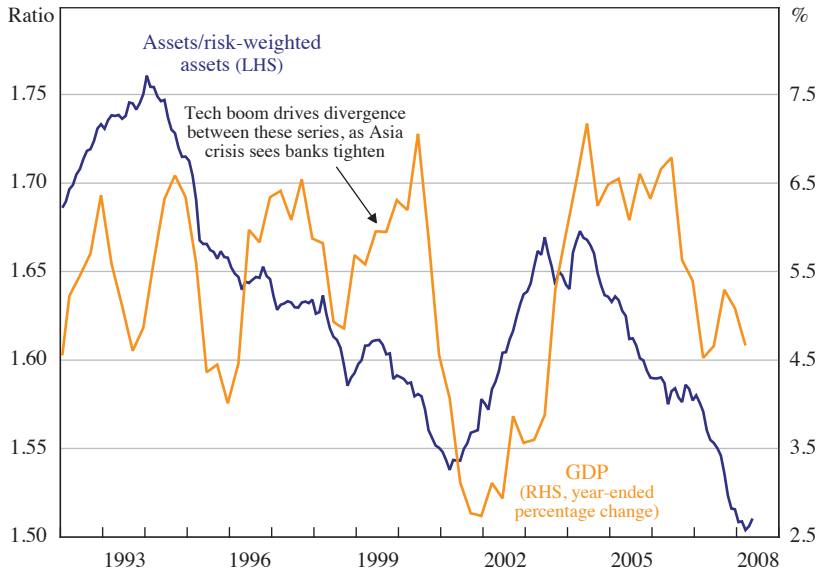
Capital regulation under Basel does nothing to counter this procyclicality. Banks can control their RWA via regulatory arbitrage and by varying bank capital more directly via dividend and share buyback policies (high dividends and buybacks in the good times and vice versa).

Figure 7 shows US GDP growth and a constructed series of aggregate total assets as a ratio to RWA, over the Basel era. This simple variable leads the broad trend in the nominal business cycle.

The IRB approach of the revised framework actually institutionalises this procyclicality by making banks themselves responsible for estimating probability of default, loss given default and exposure at default, which are all a function of the cycle, and are led by the stock market, asset values and other financial variables. Private bankers cannot predict future asset prices and future volatility events. The simplified system would change nothing, relative to Basel I, and the external ratings-based approach uses credit ratings, which are notoriously procyclical.

14. See Bernanke, Gertler and Gilchrist (1999).

Figure 7: US GDP and Total Assets/Risk-weighted Assets



Sources: OECD; Thomson Reuters

5.3 Basel II Pillars 2 and 3

Pillar 2 relates to the supervisory review process. With stress testing and guidance from supervisors, banks can be made to hold capital for risks not appropriately captured under Pillar 1. Building buffers in this way requires supervisors to be forward-looking, that is, to keep up with changes in market structure, practices and complexity. This is inherently difficult. Supervisors are even less likely to be able to predict future asset prices and volatility than private bankers. Furthermore, supervisors have smaller staff (per regulated entity) and are less well paid. If supervisory practices lag (as in the sub-prime crisis) the policy-makers will be ineffective in countering defects in Pillar 1.[15] Pillar 2 is not likely to be effective in a forward-looking way.

The Chair of the FDIC is highly sceptical about the ability of supervisors to play the role asked of them in compensating for all the deficiencies in the basic capital rules:

> In response to such criticisms, many argue that supervisory diligence under Pillar 2 will somehow protect against inadequate capital under Pillar 1. More specifically, they say required stress testing by banks will take care of any shortages under Pillar 1 … Despite the best of intentions … banks and supervisors may be ill-equipped to mitigate deficiencies in the advanced approaches. If the basic capital standards are unreliable, how can we have confidence that supervisory add-ons will be sufficient or consistent? (Bair 2007)

15. A former very senior member of the Basel Committee mentioned several times in discussions that banks are very effective at driving their agenda and influencing outcomes.

In this respect it is worth noting (see below) that the United Kingdom's FSA, which is one of the best staffed and most sophisticated of supervisors, signed off on Northern Rock to be one of the first banks to go to the Basel II IRB approach, understanding fully that this would reduce their capital massively, immediately prior to the sub-prime crisis.

Pillar 3 relies on disclosure and market discipline to help enforce sound risk management practices by punishing bad banks. Underlying this is an efficient markets notion that markets will act in a fully rational way.

At the level of markets, the bubble at the root of the sub-prime crisis, and those before it, suggest the systematic absence of informational efficiency. The whole procyclicality debate concerning the Basel system is premised on the idea that asset prices do not reflect future cash flows accurately.

At the reporting level there is room for even greater scepticism. In March 2008, KPMG conducted research amongst 1 080 audit committee members of public companies (150 from the United Kingdom and the rest globally). Of the respondents, 46 per cent were satisfied that their company had an effective process to identify the potentially significant business risks facing the company; and only 38 per cent were very satisfied with the risk reports they received from management (KPMG's Audit Committee Institute 2008).

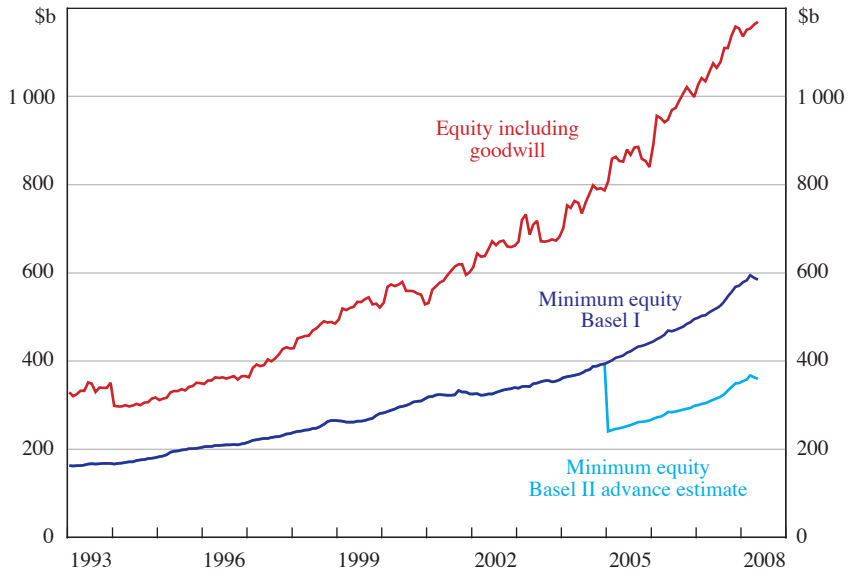
The reality is that even insiders have difficulty in measuring and reporting risk to themselves. For banking, in a mark-to-market reporting world (particularly in a universal bank that incorporates an investment bank alongside a commercial bank), risk management and reporting systems are extremely complex and require enormous resources. The ability of supervisors to follow any of this in anything other than a superficial way and to act pre-emptively is a daunting task.

5.4 The sub-prime crisis and the role of regulation

The revised framework was published in June 2004, after years of consultations and negotiations with financial institutions. In 2004 the QIS-4 was conducted in a number of countries to see how risk weights would change in practice. These studies were completed by the start of 2005. The results were surprising, and some of the average and median changes in minimum regulatory capital are shown in Table 2 for the United States. Of telling importance, for the purposes of this paper, is that the average minimum risk weight for fully-secured mortgages would fall by 61.5 per cent and the median weight by 72.7 per cent (for some individual institutions the fall was closer to 90 per cent).

As a simple illustration, the Basel II advance estimate line in Figure 8 shows the implied changes to the minimum regulatory capital where the 'average' percentage changes from the QIS-4 results are applied to the Basel I weights (using the more granular categories of Basel II) in the US commercial banking system. By the end of 2007, just prior to the supposed introduction of the revised framework, this would amount to a reduction in minimum regulatory capital of around

Figure 8: US Commercial Bank Equity, Basel I Minimum Capital, Basel II Advance Estimate



Sources: Board of Governors of the Federal Reserve System; OECD

US$220 billion. Of course supervisors in many jurisdictions recognised this effect and provided for various transition arrangements to avoid such an immediate large drop – the argument here, however, is that banks would nevertheless anticipate the freeing-up of capital and take advantage of changing weights to optimise their future position.

From 2005 to 2007, a frequent theme in broking research notes was the question of what banks would do with the excess capital to which the revised framework would give rise. Banks could either expand their portfolios and take more risk, or return the money to shareholders via dividends and buybacks. Banks could not assume with certainty what the final risk weights would be, or the overall fall in total capital that might be permitted by supervisors, particularly during the first few years of transition. The United States, for example, flagged in September 2005 that there would be a three-year transition period with: no cuts in minimum capital in 2008, a floor of 95 per cent in 2009, falling to 90 per cent in 2010 and 85 per cent in 2011, before a possible full removal thereafter. Nevertheless, bank strategy would inevitably have to take into account the changes that had been clarified, and the extremely favourable cut in the risk weights that would in any case apply to mortgages.[16]

16. See 'Banking Agencies Announce Revised Plan for Implementation of Basel II Framework', joint press release of Board of Governors of the Federal Reserve System, Federal Deposit Insurance Corporation, Office of the Comptroller of the Currency, and Office of Thrift Supervision, PR-98-2005, 30 September 2005.

5.5 Off-balance sheet treatment

Under Basel II, off-balance sheet exposures are converted to balance sheet equivalents by 'credit conversion factors' (CCF) which vary depending on the type of exposure (as with Pillar 1 weights). Exposures unconditionally cancellable by the bank without prior notice carry a CCF of 0, while others range up to 100 per cent. Risk weights are applied to the converted amounts.

Under the standardised approach, structured products are treated like corporate exposures as long as they carry an investment grade rating of BBB- or above. The better end of the junk ratings carry a 350 per cent risk weight and exposures that rate B+ or below and unrated securitisations must be fully deducted from capital. Where banks use the IRB approach, the risk weights depend on external ratings, with weights ranging from as low as 7 per cent to very high weights and, in the limit, are full deductibility from capital. Originating banks can exclude certain securitised product exposures where risk is fully transferred – but otherwise they generally require a CCF (usually 100 per cent). This is undoubtedly the most positive and important aspect of the revised framework.

Given that Basel II would deal explicitly with off-balance sheet exposures in this way, and that the time line for its introduction was clear, a rational financial organisation would not take advantage of the anomalies under Basel I by rapidly growing its off-balance sheet exposures, only to find that it had to deleverage massively or to raise capital as Basel II came into force – unless, of course, Basel II was to free up capital anyway, and off-balance sheet exposure could be concentrated in products with weights much lower than Basel I. This, of course, was exactly the situation that banks became aware of by 2005, and fits with the explosion of private-label RMBS at that time. Basel II implied:

i. mortgages risk weights would be cut to 35 per cent under the simplified system, and much less than 35 per cent under the IRB approach, encouraging the expansion of on-balance sheet mortgages from 2004 onwards (see Figure 2);

ii. increased scope for banks originating securitisations to reduce their exposures, or exclude them altogether, as well as the low risk weights (7 per cent to 35 per cent under IRB) for senior tranches rated BBB+ or above; and

iii. banks would be fully encouraged to arbitrage differences in risk weights by shifting to real estate and securitised assets due to the additive nature of required capital without penalty for concentration – other than Pillar 2 requirements being imposed after the fact (see the RMBS acceleration after 2004 in Figure 3).[17]

It would be very naïve to believe that banks did not begin to incorporate these changes into their growth strategies. The following quote from a senior investment banker not wishing to be named, sums up the situation:

17. Under Basel I, credit lines to off-balance sheet identities required capital to be held for credits of duration of one year or more. In effect, this required no capital at all, as credit lines could simply be structured to be 364-day loans or contingent credit lines.

> We started looking at the implications of Basel II from the day it was published back in 2004. Changes like these have huge implications for our business, so you can't just leave it to one side until the system is up and running. Internal seminars and meetings began even before the 2004 publication. We have been looking at this and adopting anticipatory strategies for at least four or five years. What you have to understand about complex regulations that affect our business is that we work intensively to minimise the impact they have on our bottom line. It is exactly the same as with taxation. The more complex the structure the more scope there is for finding ways around it! It amazes me that regulators asked us to set our capital regulation weights, given the way the incentives are. Of course our managers want to participate in the process, for all the obvious reasons. But good luck to any supervisors who want to find out what is going on inside businesses – that is difficult for insiders to know fully and impossible for outsiders. In our country the supervisors are thought of as excellent on a global comparison, and we think they are very smart. It is just that the scope to choose how you report and measure things is so huge. Our internal processes and resources are enormous, and we work only on our own bank. The supervisors can never match this with the best will in the world.

5.6 Northern Rock and the 'anticipating Basel II' factor

Northern Rock is another good on-the-record example of the anticipation of Basel II affecting the structure of the portfolio. They were one of the first banks to get up and running under the Basel II IRB approach. The collapse of Northern Rock was preceded by a few years of aggressive expansion (with assets rising at a rate of over 25 per cent per annum) funded by borrowing heavily in wholesale markets (requiring rollovers and refinancing). They also concentrated their assets in mortgage products (75 per cent of assets) which reduced their capital requirement as they progressed.

Here is the response of the CEO in the UK Treasury Committee Evidence:[18]

> **Mr Fallon**: Mr Applegarth, why was it decided a month after the first profits warning, as late as the end of July, to increase the dividend at the expense of the balance sheet?
>
> ***Mr Applegarth***: Because we had just completed our Basel II two and a half year process and under that, and in consultation with the FSA, it meant that we had surplus capital and therefore that could be repatriated to shareholders through increasing the dividend.

In this two-and-a-half year preparation period, the balance sheet of Northern Rock grew rapidly (in the year to June 2007 by a very fast 28.3 per cent) using funds from the wholesale market. It is implicit here that the well-resourced FSA became critical of Northern Rock only after the crisis; they had approved the Basel II IRB approach for Northern Rock in June 2007, knowing full well that it would reduce their required capital.

By June 2007, just as the crisis was to break and liquidity was to dry up, Northern Rock had total assets of £113 billion and shareholders equity of £2.2 billion. Their RWA under Basel II was a mere £19 billion (16.7 per cent of total assets), compared to £34 billion under Basel I (30 per cent of assets). Under Basel II they had Tier 1

18. House of Commons Treasury Committee (2008), Ev 48.

capital of a healthy 11.3 per cent of RWA, but only 2 per cent of total assets. When the crisis started, and liquidity dried up, they suffered the first run on a British bank since 1866, and their regulatory capital was less than 10 per cent of the £23 billion that the authorities used to support it.

The mechanisms involved in preparing for Basel II and concentrating in mortgages played a key role in some of the banks that suffered huge losses. The Basel II transition was a necessary if not sufficient condition to explain the sudden nature of the acceleration of RMBS after 2004.

In the United States a second factor, or catalyst, also played a role and curiously enough was also a result of actions within the complex US regulatory structure.

6. The Regulation of Fannie and Freddie (The Dominant RMBS Enterprises)

The main regulatory players in US banking are the: Board of Governors of the Federal Reserve (for federally-chartered banks), Federal Deposit Insurance Corporation (FDIC, deposit insurance banks and thrifts), Office of the Comptroller of the Currency (national and foreign bank branch regulation and supervision), and Office of Thrift Supervision. Another important regulator which deals with the largest mortgage players, Fannie Mae (Federal National Mortgage Association) and Freddie Mac (Federal Home Loan Mortgage Corporation) is the Office of Federal Housing Enterprise Oversight (OFHEO).

The complex and overlapping regulatory structure in the United States is another key part of the puzzle for the behaviour of RMBS post 2004. Two specific factors were at play.

First, from early 2004 OFHEO imposed an ongoing requirement on each enterprise to maintain a capital level at least 30 per cent above the statutory minimum requirement. This was implemented because of the financial and operational uncertainties regarding Fannie Mae and Freddie Mac's past problems, which had been associated with operational control and audited financial statements. When capital has to be raised like this, deleveraging mechanisms lead to balance sheet contraction and constraint.

Second, balance sheet caps were subsequently imposed (post the capital-induced deleveraging effect). For Fannie Mae the cap was the end of the 2005 balance sheet level, with any increase above this to be approved by the OFHEO. For Freddie Mac, the cap was set at ½ per cent per quarter growth above the mid-2006 level. These were to remain in place until the Generally Accepted Accounting Principles (GAAP) audit issues were solved. Removal occurred on 1 March 2008 (partly to help alleviate pressures from the sub-prime crisis).

Fannie Mae and Freddie Mac were dominant in the mortgage securitisation business in large measure because they benefited from an implicit government guarantee and insurance. After the Savings and Loan (S&L) crisis, Fannie Mae and Freddie Mac expanded their balance sheets rapidly, filling the gap left by the

S&L associations that were shut down. Private-label securitisation also proceeded, but at a much slower pace. Banks and mortgage lenders, however, sell mortgages to Fannie Mae and Freddie Mac, and this was a significant revenue generator. When the constraints were imposed, this did two things:

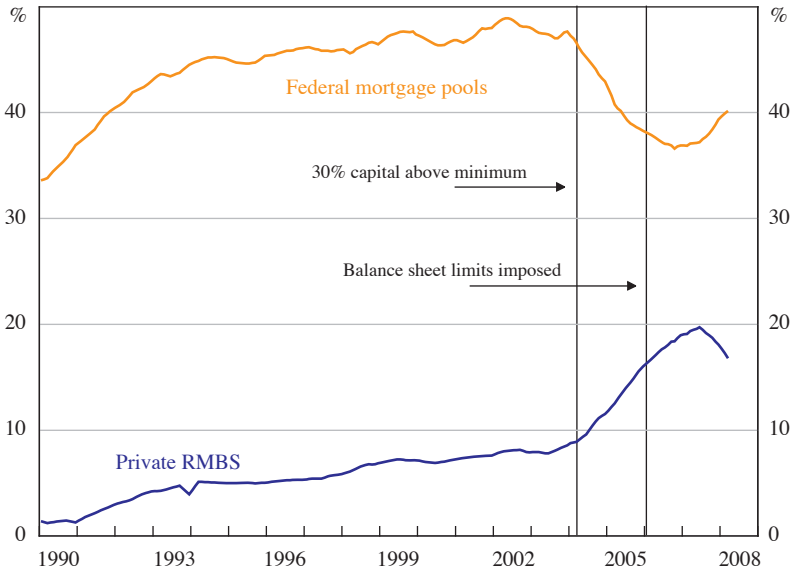
i. the potential for a large *revenue gap* opened up, with no sales to Fannie Mae and Freddie Mac, hurting bank share prices if it was not filled; and

ii. it caused the contraction and subsequent 'hobbling' of the major players in securitised mortgages, which had previously had the unfair advantage of competing with perceived government guarantees. This had the effect of opening a new market for banks, helping them to move more quickly into the RMBS business, which they had always thought should have been theirs in the first place.

For an analogy, think of a patchwork balloon. If you apply inflexible strips to it, then the hot air just forces its way into the flexible parts. At the micro level, bonus remuneration and the profit motive set in train incentives to focus hard on the new growth areas. As there were no government guaranteed competitors, and the flexible conditioning factors like credit ratings, bond insurance, lending standards, corporate governance, risk control, etc could adjust, RMBS exploded (encouraged by the prospect of even more favourable weights for mortgages under Basel II).

Figure 9 shows Federal mortgage pools as a share of total mortgages, with the periods of regulatory activity shown by the vertical lines, alongside the private-label RMBS as a share of total mortgages. The inverse pattern is clear.

Figure 9: Federal Mortgage Pools versus RMBS
As a per cent of total mortgages



Sources: Board of Governors of the Federal Reserve System; OECD; Thomson Reuters

7. An Illustrative Econometric Analysis of RMBS Structural Change: Basel and OFHEO

Table 3 sets out an econometric analysis of the various influences on private-label RMBS based on a simple co-integration model, where major structural change is expected as a consequence of changes in Basel I rules and the OFHEO constraints imposed on Fannie and Freddie.

In the model's simplest form, mortgage securitisation is related to GDP, the spread between the mortgage rate and money market rates (the federal funds rate) – which is a proxy for the profit margin to be split between the various players – the level of the mortgage rate as a nominal demand constraint on the mortgage borrower, excess capital over the Basel I minimum, and the rate of growth of house prices as a speculative demand variable. A dummy variable is included for the massive disruption caused by the S&L crisis of the early 1990s (calculated as the dollar value of write-offs of the assets of S&L associations that were formally closed down between January 1989 and December 1993, scaled by total assets of the banking system, and zero elsewhere).

The monthly model is first estimated for the period 1990–2003, prior to the structural change. The model has the expected signs and appears to be co-integrated (see the bottom rows of Table 3). Over the full sample, through the period of structural change to 2007, the model breaks down (with wrong-signed coefficients on house prices and an implausible jump in the Basel I excess capital variable). The Durban-Watson statistic of 0.06 and the wrong sign and insignificance for the restricted error correction coefficient both indicate that the first model is not co-integrated over the full sample period. Including a simple dummy variable for the Fannie and Freddie balance sheet constraints period (Table 3) has the expected effect on the coefficient; it is positive and highly significant. All the correct signs for the other coefficients are restored, and the model again becomes consistent with weak co-integration. If structural change is allowed to shift the Basel I coefficients in the direction of the QIS-4 changes (greatly favouring mortgages and reducing expected required capital) from the beginning of 2005 (refer to Table 2 and Figure 8), then most of the old pre-structural change coefficients are restored to be similar to their old values. The dummy variable for Fannie Mae and Freddie Mac and the redefined excess capital (Basel I prior to 2005 and QIS-4 adjusted after) are both highly significant. The model is again consistent with strong co-integration.

Figure 10 sets out the results of the econometric dissection of the various influences on private-label RMBS.

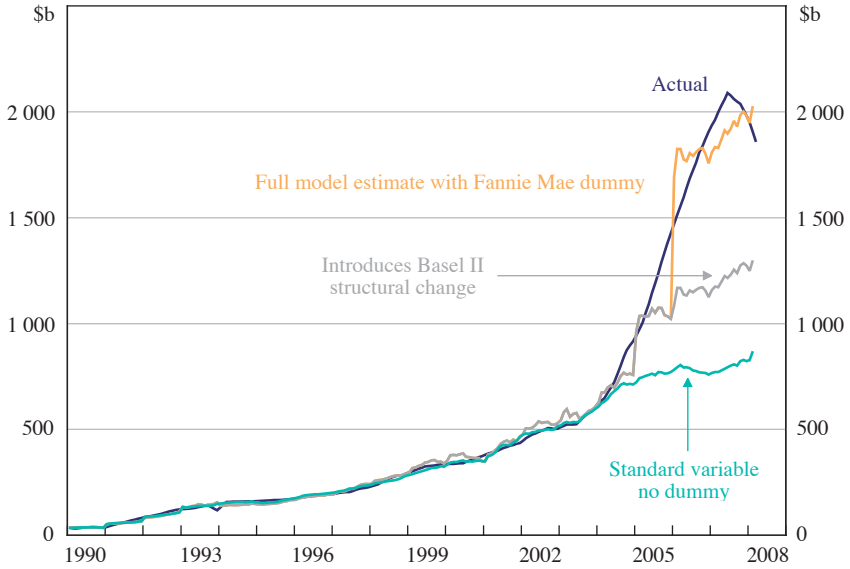
In February 2008, off-balance sheet private-label RMBS totals around $US2 trillion. Of this, about US$0.8 trillion is explained by the standard variables from the old model prior to 2004 (GDP, the interest rate terms, house price inflation and excess Basel I capital). Allowing for the Basel I coefficients to change following QIS-4, and assuming this leads to anticipatory behaviour as discussed earlier (for example, Northern Rock etc), adds US$0.5 trillion, taking the total to US$1.25 trillion. The rest, some US$0.8 trillion, is estimated to have been due to the regulations placed on the balance sheets of Fannie Mae and Freddie Mac.

Table 3: RMBS (Monthly) Model and Major Regulatory Structural Change

Dependant variable is the log of RMBS	**1990–2003**		**1990–2007**					
	Coeff	*t*-value	Coeff	*t*-value	Coeff	*t*-value	Coeff	*t*-value
Constant *c*	–16.94	–27.62	–25.32	–25.34	–18.47	–23.24	–18.26	–27.82
Log GDP	2.46	35.92	3.39	31.87	2.65	31.18	2.58	37.16
Fixed mortgage rate	–0.024	–2.55	–0.027	–1.21	–0.044	–2.94	–0.021	–1.75
Spread to federal funds rate	0.046	9.91	–0.014	–1.38	0.032	4.44	0.029	5.07
12-months-ended house price inflation	1.81	3.09	–2.45	–3.92	2.21	4.32	1.24	2.87
S&L crisis dummy 1989–1993	–0.24	–22.81	–0.079	–3.89	–0.184	–12.41	–0.18	–15.11
Basel I excess capital/total assets	2.65	2.32	14.01	5.37	4.58	2.48	na	na
Basel II adjusted excess capital/total assets	na	na	na	na	na	na	10.91	10.24
Fannie/Freddie balance sheet constraint dummy	na	na	na	na	0.675	16.02	0.444	10.63
Durban-Watson statistic		0.37		0.06		0.27		0.36
Restricted error correlation test for co-integration	–0.096	–3.87	0.011	0.99	–0.022	–1.77	–0.038	–2.58

Source: OECD

Figure 10: Model-based Contributions to the RMBS Explosion



Source: OECD

8. Citi: Illustrations of Capital Regulation and Off-balance Sheet Activity

Too often macroeconomic policy-makers focus on broad aggregates and analyses including econometrics that may or may not be consistent with *firm-specific* developments. Two institutions with the highest profile write-offs in the sub-prime crisis are Citi and UBS. Both combine investment and commercial banking. This section looks at developments in Citi in light of the above aggregate analysis. Table 4 shows Citi's balance sheet and capital management and Table 5 summarises its use of securitisation vehicles, most of whose assets are off-balance sheet. These are used to answer some key questions.

i. Is there evidence of capital arbitrage and absence of constraints on the Citi balance sheet? From the beginning of 2003 to June 2007 (just before the crisis), after distribution of US$39 billion in cash dividends, gross additions to equity in the form of retained earnings and new stock issues amounted to US$54 billion (Table 4). At the same time Citi returned US$23 billion to shareholders with share buybacks, for a net addition to equity from these sources of US$30 billion. This is approximately equal to the increase in Tier 1 capital, which rose by 57 per cent. Notwithstanding the large return of cash to shareholders, total assets on the balance sheet more than doubled (Table 4), implying only 2.7 per cent equity backing for the total asset increase of US$1.1 trillion, as excess regulatory capital was absorbed. This understates the degree of evident comfort in terms of capital adequacy, because the analysis up to this point ignores off-balance sheet transactions.

Table 4: Citi Balance Sheet – Management and Capital
US$ billion, except where indicated

	2002	2003	2004	2005	2006	2007				2008
						31 Mar	30 Jun	30 Sep	31 Dec	
Balance sheet (end of period)										
Total assets[(a)]	1 070	1 236	1 452	1 461	1 851	1 987	2 182	2 318	2 146	
Risk-weighted assets (BIS)	696	750	852	885	1 058	1 107	1 168	1 262	1 253	
Risk-weight adjustment (%)	–35.0	–39.3	–41.3	–39.4	–42.8	–44.3	–46.5	–45.6	–41.6	
Equity[(a)]	60	70	77	79	86	88	89	87	72	
Tier 1 capital (BIS)	59.0	66.9	74.4	77.8	90.9	91.4	92.4	92.4	89.2	
Memo: mortgages	152.2	161.0	205.5	237.0	275.9				313.5	
Memo: total loans	447.8	478.0	548.8	583.5	679.2				778.0	
Capital ratios (end of period)										
Equity ratio (%)	5.61	5.66	5.30	5.41	4.65	4.43	4.08	3.75	3.36	
Leverage ratio (%)	5.67	5.56	5.20	5.35	5.16	4.84	4.37	4.13	4.03	
Tier 1 capital ratio (BIS, %)	8.47	8.91	8.74	8.79	8.59	8.26	7.91	7.32	7.12	
Cash impact on capital (flow)										
Dividends	3.7	5.8	8.4	9.2	9.8	2.7	2.7	2.7	2.7	
Stock repurchases	5.5	2.4	0.8	12.8	7.0	0.3	0.0	0.0	0.0	
Cash returned to shareholders	9.2	8.2	9.2	22.0	16.8	3.0	2.7	2.7	2.7	
Retained earnings	9.7	12.1	8.6	10.6	11.4	2.3	3.5	–0.5	–12.5	
Stock issues	0.0	0.7	0.9	1.4	1.8	0.0	0.5	0.1	0.0	
Gross additions to equity	9.7	12.8	9.5	12.0	13.2	2.3	4.0	–0.4	–12.5	
SWF convertible stock purchases									7.5	6.88
Write-offs cumulative to 2008:Q1										41.9

Memo:
Cash returned to owners 2003–2007:Q2 – US$61.9b, of which: dividends US$38.6b, return of capital US$23.3b
Gross additions to equity 2003–2007:Q2 – US$53.8b; additions net of return of capital US$30.5b

(a) Net of goodwill
Source: Citi, Form 10-K filings with Securities and Exchange Commission

Table 5: Citi Off-balance Sheet Activity
Securitisation and special-purpose entities, US$ billion

	2002	2003	2004	2005	2006	2007
Balance sheet (end Dec)						
Assets in consolidated VIEs[a]		36.9	35.6	50.4	42.1	121.8
Assets in unconsolidated VIEs (*significant* involvement)		116.6	135.8	191.4	388.3	356.3
Sub-prime in securities and banking						37.3
of which – CDOs of ABS						29.3
– direct exposure						8.0
Maximum loss exposure to unconsolidated VIEs		50.0	78.0	91.0	109.0	
As reported and revised in 2007 financials					*147.9*	*152.2*
of which – funded						38.5
– unfunded						113.7
Assets in QSPEs: all involvement[a]		653.9	971.9	1 203.5	1 505.7	
QSPEs (Citi acting as 'principal')					*541.2*	*766.0*
of which – retained interests in mortgages					8.8	18.4
– other retained interests					10.4	13.9
– transferred mortgage exposures					394.4	582.5
– other transferred interests					127.6	151.2
Cash flows during the year						
Proceeds from new mortgage securitisation	40.1	70.9	66.4	85.2	99.4	147.3
of which – US consumer				58.9	67.5	107.2
– markets and banking				26.3	31.9	40.1
Commissions and fees		15.7	16.0	16.9	19.2	21.1
of which – investment banking		3.5	3.5	3.5	4.1	5.2
– credit cards and bank cards		4.2	4.5	4.5	5.2	5.1
– Smith Barney (GWM)		2.1	2.2	2.3	3.0	3.3
– markets and banking trading-related		1.6	2.0	2.3	2.5	2.7
Principal transactions	4.5	4.9	3.7	6.7	8.0	–12.1
of which markets and banking				*5.6*	*6.9*	*–15.0*
of which – fixed income	2.3	2.4	1.8	3.9	5.6	4.1
– credit products[b]	0.0	–0.1	0.1	0.0	–0.8	–21.8
– equities	0.2	0.2	–0.3	0.3	0.9	0.8
– foreign exchange	1.9	2.2	1.8	0.6	0.7	1.2
– commodities	0.1	0.1	0.4	0.8	0.5	0.7

(a) Securitisation vehicles used by Citi are generally accounted for as 'variable interest entities' (VIEs) or 'qualifying special purpose entities' (QSPEs). VIEs are vehicles that either must supplement their equity with additional subordinated financial support, or whose equity investors lack the characteristics of a controlling financial interest. Under FIN 46-R the primary beneficiary of a VIE is obliged to consolidate it. Maximum exposure to loss where a 'significant involvement' in an unconsolidated VIE exists must also be disclosed. QSPEs are passive entities generally exempt from consolidation by the transferor, here Citi.

(b) Includes structured products, including sub-prime related.

Source: Citi, Form 10-K filings with Securities and Exchange Commission

ii. Was the off-balance sheet activity substantial? Yes. Citi's securitisation activities are largely carried out using two types of special purpose entities (SPEs), most of whose assets are *not consolidated* onto Citi's balance sheet. Variable interest entities (VIEs, see Table 5 for a definition) amounted to US$478 billion at the end of 2007, US$356 billion of which was not consolidated. This figure, which represents a tripling from the end of 2003, is nevertheless a decline from the previous year, due to the large consolidation of previously off-balance sheet assets due to the sub-prime crisis. In Table 4, assets of qualifying special purpose entities (QSPEs, see Table 5 for a definition) – predominantly mortgages – add a further US$766 billion, only US$32 billion of which reflects 'retained interests'. A continuous series for QSPEs is not available, but expansion of these assets seems to have proceeded in line with those in VIEs. Altogether, assets in unconsolidated SPEs are equivalent to an additional 52 per cent of the balance sheet. In principle, the risk associated with these assets has been largely transferred, justifying non-consolidation, even though exposure to losses in the unconsolidated VIEs could be as high as 43 per cent, or US$152 billion (see Table 5). Some commentators continue to argue that Pillar 2 of the revised framework can be relied upon to save the flaws in Pillar 1. This episode suggests that pre-emptive supervisory intervention is at best very difficult.

iii. Is the Citi evidence consistent with procyclicality of the Basel capital regulation process? During the four and a half years from the end of 2002 to mid 2007 – essentially the upswing that followed the tech bust – Tier 1 capital rose by 57 per cent. At the same time, risk weight adjustments, that is, assets not requiring capital backing, rose from 35 per cent to 46.5 per cent of total assets, allowing an overall balance sheet expansion of more than 100 per cent. Securitised off-balance sheet assets – mostly real estate related – rose even faster. During this period, OFHEO house prices rose by 41 per cent. As the crisis emerged, Tier 1 capital and the risk weight adjustments both declined, resulting in a small balance sheet contraction during the second half of 2007, even as off-balance sheet assets were repatriated to the balance sheet, reinforcing the cyclical slowdown that was under way.

iv. How long will it take Citi to recapitalise via earnings? So far Citi has announced US$42 billion of write-offs related to sub-prime and off-balance sheet exposures. The fiscal authorities will necessarily absorb a significant part of this, but retained earnings and external capital will be required to restore Citi's capital base, and resumption of normal operations involving balance sheet expansion will require further capital backing. On the basis of analysis similar to the aggregate work on the size of losses and time required to rebuild in Blundell-Wignall (2008), summarised earlier, it would take until mid 2010 for Citi to rebuild the equity backing for its balance sheet to 2003 levels while supporting balance sheet expansion of 6 per cent (in line with nominal GDP growth in the United States). This assumes an underlying earnings rate 'norm' somewhat over 1 per cent of assets, elimination of the dividend and no external capital injections. In fact Citi has already raised US$7.5 billion from the Abu Dhabi Investment Authority and

US$6.9 billion from the Government of Singapore Investment Corporation, so recovery could come somewhat earlier.

v. Is there evidence that accounting is an 'art' not a 'science', that is, that firms have scope to recognise and model potential losses and risks in different ways that can lead to massive revisions? The maximum loss exposure for Citi's unconsolidated VIEs was reported as US$109 billion for 2006, in the 2006 filings. In the 2007 filings, Citi revised its definition of 'significant' involvement in VIEs and restated its 2006 disclosure data to be consistent with this. The number was raised to US$148 billion for the 2006 accounts, a 35 per cent increase (see Table 5). In 2007, the maximum loss exposure rises only modestly to US$152 billion. Similarly, the assets in QSPEs reported in 2006 covered 'all' involvement and amounted to US$1.5 trillion. In 2007, coverage of mortgage securitisations was more restricted and the number reported was cut to US$541 billion for the 2006 year (see Table 5). The ability of internal audit committees, external auditors and bank supervisors to keep track of consistency with accounting standards and to avoid such arbitrary outcomes – presumably at least one of the many key requirements for the success of Basel II – seems questionable.

vi. Is Citi's off-balance sheet activity consistent with the view that an unintended consequence of the likely reduction in weightings for mortgages in Basel II, and the balance sheet caps on Fannie Mae and Freddie Mac, was to stimulate private-label securitisation? Table 5 shows proceeds from new mortgage securitisations. The Basel II framework was published and QIS-4 testing conducted in 2004, and it was then that Fannie Mae and Freddie Mac had to raise 30 per cent more capital and stopped buying mortgages. In 2003, Citi's proceeds from mortgage securitisations were US$71 billion. In 2004 they actually fell. Subsequently, however, these proceeds accelerated sharply; from US$66 billion in 2004, they rose 122 per cent to US$147 billion by 2007. A revenue gap opened up in 2004 and was subsequently closed via off-balance sheet VIE and QSPE securitisations (or private-label RMBS as these activities have been referred to throughout this paper). While these numbers are not operating revenues, they incorporate fees and contribute importantly to the commissions and fees reported in Table 5. As with Northern Rock, increasing concentration of mortgages was also a feature. Citi's on-balance sheet mortgages were 34 per cent of total loans in 2003, and rose to 41 per cent by the end of 2006 (see Table 4). The share of mortgage-backed assets in unconsolidated VIEs is not available, but the far larger and rapidly increasing QSPE assets are dominated by mortgages.

9. UBS Report to Shareholders

It is difficult to understand the complexity, the incentives for revenue generation, the influence of personalities, and the culture for growth and beating the competition that the factors discussed above breed in an investment bank. Containing those forces is difficult for management, and their willingness to do so is also cyclical. The history of UBS in the lead-up to the crisis (which for them can be dated as

when a write-down was forced on them by the Swiss regulator) gives a rare insight into some of this.

9.1 Corporate governance, risk control and funding

On paper UBS looks to be 'state of the art' in corporate governance and risk control. Overarching principles include: managerial responsibility; independent checks and controls; the requirement for transparent risk disclosure internally; earnings protection for shareholders; and the protection of UBS's reputation. There is a specialist risk sub-committee of the board, an audit committee and internal and external audit reviews. There is also an internal funding process run by a centralised Group Treasury, with group-level governance oversight.

Risk control included explicit frameworks for 'market' and 'credit' risk, and all new business initiatives and significant transactions required prior approval by management. The 'market risk framework' explicitly favours VAR and stress-loss analysis (as favoured by the Basel Committee). These cover concentration issues, exposure to related parties and operational limits. Credit risk covers limits and monitoring (country, sector and products). In 2006 and 2007, UBS chose to allocate the bulk of their VAR limit and group stress loss limit to the investment bank, around which the growth strategy was centred.

UBS Group Senior Management identified the sub-prime issue as a major risk in September 2006, but the investment bank management did not act until July 2007, when it was too late. What is striking about the UBS story is that the complexity and the very nature of investment bank culture make it difficult to manage capital and risk even for highly-sophisticated organisations. No internal rules appear to have been broken, but the losses piled up quickly to around 50 per cent of stockholders equity.

9.2 The damage

At the time of writing, UBS has taken US$19 billion in write-downs. In December 2007, total balance sheet assets were US$1 828 billion (versus Citi's US$42 billion write-down with assets of a similar size at US$2 146 billion, net of goodwill). These losses were heavily linked to the investment bank and Dillon Read Capital Management (DRCM). These losses came from businesses within the investment bank (84 per cent of write-downs, or about US$16 billion), or from DRCM (16 per cent of the losses and about US$3 billion). At December 2007, UBS had US$38 billion in capital compared to Citi's $114 billion in stockholders equity.

The main contributor to UBS write-downs within the investment bank was the CDO trading desk in the Securitized Products Group (66 per cent of write-downs, or US$12.7 billion). This business grew rapidly through 2006. The rest of the losses in the investment bank came from foreign currency and cash collateral trading (10 per cent, US$1.9 billion) and the Proprietary Trading and Credit Fixed Income businesses (8 per cent, US$1.5 billion).

With good governance, new business and transaction approval rules in place, Basel capital requirements being met, and oversight from supervisors all over the world, it interesting to see just what went wrong.

9.3 Primary causation: the revenue gap/growth catch-up factor

As discussed earlier, by June 2005 the financial boom and liquidity bubble underpinned by global carry trades was in full swing, and it was argued that US mortgage originator/investment banks were developing new strategies for private-label RMBS and leveraged conduits for structured products to meet demand. UBS is not a major US sub-prime loan originator, and could not have been impacted much by the new regulations on Fannie Mae and Freddie Mac. However, UBS saw the rapid growth of these new businesses, and perceived that it was falling behind. At this time UBS management launched DRCM, with the precise aim of establishing a new alternative investment business.

An external consulting firm (Mercer Oliver Wyman) was also appointed to recommend strategy. This consultant pointed out that of all the businesses, fixed income was the area where the investment bank lagged the three leading competitors the most. The investment bank had its biggest gaps in the credit, securitised products and commodities businesses – product gaps in credit, high yield, mortgage-backed securities, sub-prime and adjustable-rate mortgages were singled out. In March 2006, the investment bank presented its conclusions and key initiatives to close revenue gaps. These included expanding its: securitised products via a new Securitised Products Group; global structured finance and high-yield loan business; structured credit; and the development of trading strategies for these products.

The three biggest players in fixed income revenue in 2005 and 2006 were Goldman Sachs (about US$8¾ billion and rising to US$10.4 billion in 2006), Citi (about US$9¼ billion and rising to US$10½ billion in 2006); and Deutsche Bank (about US$9 billion and rising to US$11½ billion in 2006). These numbers were presented by the UBS Head of Fixed Income in March 2007 as the 'gap' that had to be closed – UBS was a mere ninth at around US$6 billion in 2005 and about US$6¼ billion in 2006.[19] UBS developed a 'me too' revenue gaps strategy – a 'growth at any cost' mentality – at exactly the wrong time from a macroeconomic prudential risk perspective. This is classic investment banking (from the Latin American Debt crisis to the sub-prime crisis, modern bankers continue a long tradition). Market share, revenue gaps and beating the key competition is the topic of every morning meeting at all levels in the bank, and for senior management it can be a question of holding your job.

The corporate governance and risk control functions in many firms will adjust (this is as much a cultural issue within the firm) but it is very hard for these functions

19. Simon Bunce, UBS Fixed Income Businesses Investor Day, 28 March 2007. He identifies a US$4.6 billion revenue gap to the top three competitors as the most significant opportunity to increase revenue.

to stand in the way of growth. The idea of a 'crisis' is not on the 'sell team's' mind before a crisis breaks, and all the incentives are aligned to make money for the company and for the key personalities to be seen to be driving this. This certainly appears to have been the case in UBS, where departing top managers were replaced by people from a sales background (consistent with growth), not a risk management background. Key internal risk controllers do *not* hold sway at this point, and they simply have to adjust, or risk their own jobs – this is how it works. Only once a crisis hits does the relative power begin to shift in favour of the risk controllers.

9.4 Funding, hard limits and staff remuneration incentives

UBS has a centralised treasury able to raise funds efficiently in the open market, and it chose to distribute funds internally within the normal external spread:

> … i.e. internal bid prices were always higher than the relevant London Inter-Bank Bid Rate (LIBID) and internal offer prices were always lower than relevant London Inter-Bank Offered Rate (LIBOR). (UBS 2008, p 25)

The businesses were able to fund themselves at prices better than in the market. No attempt was made to take account of liquidity in this process (to match term funding to liquidity). A stricter funding model was seen as a 'constraint on the growth strategy'. There was strong resistance from the investment management to hard limits on the balance sheet and RWAs. Such limits were quickly installed only in the second half of 2007, once the crisis was under way.

Staff compensation incentives did not differentiate between the creation of genuine 'alpha' versus the creation of returns based on low-cost funding, nor the quality (risk attributes) of staff earnings for the company. The relatively high yield from sub-prime assets made this an attractive candidate for long-position carry trades, (even with thin margins) via leverage (and the use of derivatives). This encouraged concentration in the higher carry mezzanine tranches of CDOs. It also encouraged minimal hedging of super senior positions (in order to be more profitable).

9.5 Corporate governance stretching

Notwithstanding the fact that UBS Group Senior Management (GSM) identified the sub-prime issue as a major risk in September 2006, the investment bank management did not adjust until July 2007 (the way this works internally is that GSM and the Board would not have felt strongly enough about the possibility of a crisis). Growth and revenue are in the interests of the shareholders and the Board would not have been able to act forcefully: in complete contrast to their actions once the crisis became clear. Investment bank management held sway and GSM and the Board went along with it. The report states that GSM took comfort from the main exposures being AAA CDOs, and that they were prepared to rely on investment bank assurances that the risk was well managed. Revenue growth and catching up to competitors was the dominant culture. All of the focus of the management within the investment bank on 'processes' for new business initiatives and prior approval of transactions was:

> … on speeding up approvals as opposed to ensuring that the process achieved the goal of delivering substantive and holistic risk assessment of the proposals presented. (UBS 2008, p 41)

The report also states that internal reporting of risk positions was complex, even across the 'silos' within a business line. A holistic picture of the risk situation within investment bank business lines was not presented to management or the Board, and there was no serious internal challenge to the overall strategy.

9.6 How the losses occurred in DRCM

DRCM (16 per cent of losses) implemented their strategy late, just as the market turmoil was beginning. This 'bad luck' led to reviews of the reporting line and control issues; but the shareholder report states quite clearly that no internal rules were broken (UBS 2008). The report suggests that problems arose because of:

i. staff changes – leadership and technical 'key person' risk played a role and is not captured in regulations;
ii. the relative autonomy of the team, with cross-reporting lines.[20] This contributed to a doubling-up of fixed income strategies in the investment bank and DRCM – when DRCM was closed in 2007 the exposures still existed in the investment bank; and
iii. the inability of management to focus on all aspects of the complex growth in their business.

9.7 The investment bank

The investment bank was anointed as the key driver of the growth strategy. This strategy, together with the cheap funding and lack of hard limits on RWA, ensured that the investment bank would play a key role in the losses. The investment bank did not have the incentive to assess and prioritise between businesses, from the perspective of allocating resources, when setting strategy.

The CDO desk within the investment bank was responsible for 66 per cent of write-downs. UBS-sourced RMBS were held in a CDO warehouse (on UBS's books, thus exposing the investment bank to market risk). Once securitised, the RMBS were transferred to a CDO SPV and structured into tranches. Higher fees caused the desk to focus on mezzanine tranches (the structuring fee was 125 to 150 basis points on the notional value of the deal, whereas super senior was only 30 to 40 basis points). The report also states clearly that the growth in the structuring business was hugely accelerated by the development of the CDS market, because this avoided cash ABS being sourced for inclusion (the cash plus synthetic 'hybrid' CDOs became 75 per cent of the total CDO exposure). The warehouse was responsible for one-quarter of the CDO desk losses.

20. DRCM reported to Global Asset Management, but the investment bank was exposed to the risk and returns of DRCM managing its proprietary capital via UBS finance companies.

In 2006 and 2007 there were no notional limits on the warehouse pipeline and retained pipeline positions, but they were subject to VAR limits and stress testing and were identified by Market Risk Control, as early as late 2005, as the main source of market risk in the investment bank. That there were no notional limits and all deals were approved is very consistent with the growth culture dominating the risk control culture until mid 2007. This relative 'cultural sway' within an organisation is the most basic source of 'procyclicality', and is almost impossible to regulate against.

UBS at first sold the super senior AAA CDO tranches to third-party investors, but then began to retain them for their own book (and buy them from third parties). This (with cheap funding) was seen as an easy source of profit. Some of these were fully hedged (via CDS) with monoline insurers as counterparties. There was no breakdown in risk controls or the setting and monitoring of counterparty limits. The losses here simply came from the widening of margins in anticipation of expected severe downgrades. They simply 'got it wrong'.

The amplified mortgage portfolio also became a part of this business. Here the super senior tranches were only partially hedged to improve their expected profitability: a few per cent of the notional value was believed to be sufficient to hedge even a major negative event, based on historical statistical analysis. There were no notional limits on the size of these positions. The partial hedges were quickly exhausted as the crisis unfolded, leaving UBS fully exposed, with the actual volatility well outside of historical experience. When decisions were taken to exit positions from mid 2007, it was too late as liquidity had disappeared.

Of the US$50 billion super senior tranches held by UBS at December 2007, US$21 billion was bought from third parties, of which US$15 billion was fully hedged and the remaining US$6 billion was only partially hedged. Super senior tranches contributed three-quarters of the CDO desk losses and 50 per cent of the total write-downs.

Because of illiquidity, the crisis dramatically changed what a 10 standard deviation event looks like – 2–4 per cent hedging looked adequate before the crisis, but for some AAA tranches we now know that 50 per cent losses or worse are possible. This of course highlights one of the great weaknesses of the Basel II IRB approach, which relies on internal bank modelling. The VAR methodologies also rely on the AAA ratings of the super senior tranches. There was no attempt to look through these to analyse the underlying collateral; there was a belief that the sub-prime crisis would not impact on AAA assets. (Once again this calls attention to the role of CRAs.)

10. The Situation in Europe versus the United States and the Leverage Ratio

US banks are much better capitalised than their European counterparts. It has been argued above that the US sub-prime crisis is a regional/sectoral crisis that the Basel RWA approach is ill-suited to deal with. It was also argued that the problems in the United States were compounded by proposed changes to the Basel weights.

The crisis was centred in the United States and not elsewhere, because: first, at the macroeconomic level the US growth cycle was not synchronised with other countries; the Federal Reserve had 1 per cent interest rates (following the bursting of the tech bubble) and international reserves from Asia were mainly pouring into the United States, flattening the yield curve, both of which helped generate a housing boom; and, second, a regulatory catalyst stimulated the private mortgage securitisation and sale process, where the crisis was to become focused. Were US banks not as well capitalised as they are, the impact of the crisis would have been much worse than it is currently.

Table 6 shows the leverage ratios for a selection of major European and US banks – measured here as Tier 1 capital divided by the bank's total assets. The average leverage ratio for the European banks shown is 2.68 per cent, while that for US banks is 5.15 per cent, and 5.88 per cent if investment banks are excluded. European banks, in other words, typically have around half the capital of US banks as a share of assets.

The main reasons for this are the explicit use of the leverage ratio in requirements set by the Federal Reserve (a minimum of Tier 1 capital to adjusted total assets of 4 per cent is required for most banks regardless of RWA) and the *Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991*, enshrining 'prompt corrective action' in law. The aim of the latter is to minimise the exposure of the deposit insurance fund to losses. Five categories have been established:

i. 'well-capitalised', meaning 'significantly exceeds' the Federal Reserve's minimum and, more precisely, by 25 per cent or more (that is, a leverage ratio of 5 per cent or more);

ii. 'adequately capitalised' means meeting the minimum;

iii. 'undercapitalised' means failing to meet the minimum;

iv. 'significantly undercapitalised' means failing by a significant amount in view of FDIC; and

v. 'critically undercapitalised' means failing to meet any of the capital requirements, and this is specified as no less than 2 per cent. At 'significantly undercapitalised' levels, banks are forced by law to raise capital or resolve the issue in other ways (for example, merge, etc), whereas the worst category makes it mandatory for the relevant regulator to appoint a receiver.

On the basis of the US FDIC Act, none of the European banks shown in Table 6 would be 'well capitalised', two would be adequately capitalised, eight would have to adjust and three would be closed down. In the US case, only the investment banks (Goldman Sachs, Lehman Brothers, Merrill Lynch and Morgan Stanley) would not meet the minimum requirement. This is because investment banks were not supervised as banks, but fell under the supervision (voluntarily) of the Securities and Exchange Commission. It is interesting in this regard that Bear Stearns, an investment bank, has been the main casualty of the sub-prime crisis thus far.

The FDIC has analysed the implications of the US QIS-4 results (some of which are reported in Table 2) for prompt corrective action. All 26 institutions in the

Table 6: Bank and Investment Capitalisation
Europe versus United States

	Currency	Assets (A)	Tier 1 capital (B)	Leverage ratio (B/A) %
Europe				
Deutsche Bank	EUR	2 020 349	28 320	1.40
Crédit Agricole	EUR	1 414 223	28 000	1.98
Commerzbank	EUR	616 474	16 333	2.65
Barclays	GBP	1 227 361	27 408	2.23
BNP Paribas	EUR	1 694 454	37 601	2.22
UBS	CHF	2 272 579	32 811	1.44
Société Générale	EUR	1 071 762	21 616	2.02
Crédit Suisse	CHF	1 360 680	34 737	2.55
HBOS	GBP	666 947	24 388	3.66
Lloyds TSB	GBP	353 346	13 952	3.95
BBVA	EUR	502 204	20 659	4.11
Banco Santander	EUR	912 915	39 725	4.35
Royal Bank of Scotland	GBP	1 900 519	44 364	2.33
Total	EUR	**15 673 605**	**351 950**	**2.68**
United States				
Banks				
Citi	USD	2 187 631	89 226	4.08
U.S. Bancorp	USD	237 615	17 539	7.38
Wells Fargo	USD	575 442	36 674	6.37
Bank of America	USD	1 715 746	83 372	4.86
JPMorgan Chase & Co	USD	1 562 147	88 746	5.68
SunTrust	USD	179 574	11 425	6.36
Washington Mutual	USD	327 913	22 406	6.83
BB&T	USD	132 618	9 085	6.85
National City	USD	150 374	9 367	6.23
Countrywide Financial	USD	211 730	8 754	4.13
Investment banks				
Goldman Sachs	USD	1 119 796	42 728	3.82
Lehman Brothers	USD	691 063	23 103	3.34
Merrill Lynch	USD	1 020 050	31 566	3.09
Morgan Stanley	USD	1 045 409	32 074	3.07
Total		**11 157 108**	**506 065**	**5.15**
US banks		7 280 790	376 594	5.88
US investment banks		3 876 318	129 471	3.33

Source: annual reports

study experienced a drop in capital based on RWA, and nine became significantly undercapitalised – three critically so, if capital were determined under the revised IRB approach. In effect, the results imply that the leverage ratio would become the binding constraint in capital regulation.[21]

Because of these issues the debate is shifting. Countries that rely relatively more heavily on RWA and the Basel system, as in Europe, have relatively weak capital positions. A financial crisis in the European Union, along the lines of the US crisis, would have much more devastating economic consequences through the deleveraging mechanisms referred to earlier. If banks were asked to double their capital in Europe pre-emptively this too would be disruptive (extremely so for rapid adjustment). This argues in favour of changes and reform.

Given compliance costs, abandoning the RWA would be the natural outcome if a leverage ratio was always to be the binding constraint (that is, requiring more capital than the RWA approach), particularly if the IRB approach were not altered to address concentration issues.[22]

If some reformulation of RWA was thought necessary – one that avoided all of the above criticisms – then combining it with a leverage ratio would have the advantages of: first, supervisors and banks focusing on broader metrics which reduces the scope for regulatory arbitrage (banks could no longer arbitrage to maximise profits against a single metric); and second, increasing the scope for dealing with regional/sectoral risk factors, as opposed to the global risk factor upon which the RWA approach is based.

11. Summary and Overview of Some of the Key Issues

11.1 Causal versus conditioning factors

Mixing causal and conditioning factors risks coming up with an impressive list of reforms without weighting them – that is, it risks giving insufficient attention to causal structural factors. To continue the earlier water analogy, better levies, building location restrictions and warning signs should be encouraged, but are not a substitute for sound dam infrastructure.

The key causal (more exogenous) factors identified in this report include:

i. Global interest and exchange rate distortions: leading to rolling excess liquidity-driven bubbles.

ii. A sub-optimal Basel II (Pillar 1) capital regulation framework: that can lead to undercapitalisation of banks via regulatory arbitrage and by handing the setting of capital standards to private banks via their modelling and other assumptions. Sophistication and complexity increases the scope for reducing capital

21. See Powell (2005), former chair of the FDIC.

22. There is no point in imposing compliance costs, which can be very high, if they have no binding influence.

requirements. This distorts asset allocation decisions, leads to procyclicality and fails to address regional/sectoral risks. Anticipatory behaviour has already influenced mortgage concentration and wholesale financing in some institutions and contributed to the sub-prime crisis. Sheila Bair puts it very well:

> **Risk number one**: The advanced approaches come uncomfortably close to letting banks set their own capital requirements. That would be like a football match where each player has his own set of rules. There are strong reasons for believing that banks left to their own devices would maintain **less** capital – **not** more – than would be prudent. (Bair 2007)

iii. Problems with multiple independent regulatory authorities for interdependent financial firms – with changes by one regulator leading to problems for others. The controls on Fannie Mae and Freddie Mac, for example, caused revenue gaps and created incentives for a rapid expansion of private-label RMBS.

iv. Regulating investment banks differently to banks and bank holding companies that include investment bank subsidiaries. In the US, this has left investment banks with capital ratios that are half those of the commercial banks, yet many of the sub-prime problems (and the need for capital) have involved the activities of investment banks. 'Consolidated' capital rules are unlikely to resolve this issue. The 'revised framework' of Basel II states that capital requirements should be 'applied on a consolidated basis to internationally active banks … to ensure that it captures the risk of the whole banking group' (BCBS 2006, p 7). However, wide scope exists for parent groups to meet capital requirements simply by shifting funds within the group. Balance sheets can expand without requiring subsidiaries to add capital for the group as a whole.[23]

v. Procyclical incentive structures. The 'revenue gap' and 'market share' focus of bank strategy are both inherently procyclical. They lead to 'copycat' behaviour with respect to new innovations in competitor banks and compensation incentives that are geared to short-term return recognition, and are not risk-adjusted (see the UBS discussion above). Tools that measure risk at a point in time, rather than through-the-cycle and counterparty credit policies that vary with the cycle are also procyclical. Reliance on credit ratings, which in practice tend to be cyclical variables, and leverage linked to asset values which vary with the investment cycle and do not necessarily reflect future cash flows accurately are another key cause of procyclicality.

vi. The competitive structure of rating agency and audit markets. Both of these markets have oligopolistic structures, at least as it applies to dealings with complex financial institutions, leading to high fees and the potential for reduced independence (see the discussion of the FSF conclusions above).

vii. Bailouts that create moral hazard: associated with 'too-big-to-fail' risk-taking by lenders and borrowers (see the Bear Stearns, Northern Rock and IKB discussions above).

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23. See Atkinson (forthcoming) for an exposition of this and examples from Citi, Merrill Lynch, E-Trade and Northern Rock.

In sum, if these problems are not addressed, they will push the job of supervisors to the limits of difficulty and occasionally beyond it.

11.2 Conditioning factors for which little or no improvement is likely

It is impossible for financial firms and supervisors to predict the future level and volatility of asset prices, nor their correlations at different points in time. This means that business strategies for the future, and the ability to control risk in the face of unexpected shocks, are always going to pose major challenges. Risk models fail, not because firms are not sophisticated enough, but because the inputs cannot be predicted, and the past is a guide only for situations where extreme market breaks, panic and liquidity problems are absent. Internal systems can be improved, but it is a case of 'garbage in, garbage out'. If you do not anticipate a crisis in risk analysis, the best model in the world will not help much in the presence of an 'a-historic' risk event that is not normally distributed.[24] The United States has the deepest and most active financial markets, and it still experiences major risk events. There is no 'magic pudding'. At the board level, corporate governance will always have a procyclical element to it because directors are no better at predicting the future than anyone else.

It is impossible to change human nature as it operates in a broker-dealer or investment bank. Job tenure is limited and remuneration depends on how well you do while you are in the position. It is possible to change remuneration formulae to encourage longer-run thinking and risk-adjusted rewards. But this is only likely to have limited results. Job tenure cannot be guaranteed in the face of adverse outcomes. Key employees understand this, and will still seek and achieve rewards for successful rapid moves up the risk curve in apparent good times, and *vice versa* in bad times. Employers adjust because key people will go to other employers or (even more likely these days) leave to set up their own boutique or hedge fund (note the discussion of key person risk in the case of DRCM).

12. Ten Elements for a Sound Global Regulatory System

The observations and analysis in this paper suggest at least 10 elements that need to be thought about in the context of regulatory reform.

i. Recognition that regulatory policy needs to proceed hand-in-hand with reform to the international monetary system. Systems of fixed/managed exchange rates (especially in the presence of price controls on energy) across the major developing economies, particularly in Asia and the Middle East, have contributed to excess demand and worked to destabilise the global financial system. Without progress on this front, the task of financial regulation in individual countries is made more difficult, and regulatory policies themselves will always be subject to more lobbying from domestic financial firms with respect to their competitiveness.

24. All of the mathematics of VAR models depends on asymptotic normal distributions of volatility and error terms.

ii. Recognition that monetary policy in advanced countries should take more account of the international global financial implications of their policies. Extremely low interest rate policies, pursued with domestic objectives in mind, cause carry trades and asset price effects that influence leverage.

iii. Simple rules should be favoured over complex ones based on unrealistic models. The theoretical underpinning of the Basel framework, based on the assumption that only one global risk factor exists, is not a sound basis on which to base any binding model for capital requirements in each jurisdiction. Allowing banks to set their own capital standard, via complex internal modelling of risk outcomes, is likely to generate too little capital and concentration distortions. Complex weighting rules that discriminate between assets in terms of capital penalties create an industry of avoidance which is both costly in terms of productivity and likely to distort asset mixes. A simplified and more transparent system of *ex ante* requirements, like the leverage ratio with prompt triggers for corrective action, allows greater scope to take local and global factors into account and gives supervisors *ex ante* tools that do not rely on judgment and predicting the future.

iv. Recognition of the need for a framework that is more sensitive to the concentration of risk and duration mismatch. Penalising or limiting deviations from a 'benchmark' is common in pension fund oversight and should also have a role in capital regulation with respect to the assets and liabilities of banks. At the consolidated portfolio level, penalties for concentration need built-in *ex ante* capital rules (which are not reliant on supervisory oversight in Pillar 2). A quadratic (as opposed to linear) capital rule penalising increasing portfolio concentration in Pillar 1 is worth considering. Asset and liability duration mismatch is linked to concentration risk. Northern Rock, for example, used wholesale funding to build rapid concentration in mortgages. The necessity to roll over short-term commercial paper also contributed to a liquidity crisis.

v. Consolidation of on- and off-balance sheet bank exposure. This is an important advance under Basel II. But it will require very clear and uniform definitions for what constitutes an 'arm's-length' relationship or entity. This is critical for the effective operation of internal and external auditors. In this context, it is probably unwise to allow consolidation of investment bank and commercial bank capital requirements within a holding company context.

vi. Recognition that competitive structures increase efficiency and independence in the role of rating and audit firms. There needs to be some thought about requiring the 'buy side' to obtain an independent ratings assessment (to increase the independence and quality of ratings, and reduce the monopoly element of the issuer-pays model). A removal of the legal restrictions that enhance audit firm monopoly is also worth considering, as a means to encourage the entry of new (and listed) capital.

vii. A clear definition of what the bank/financial regulated sector is, rather than endless debates about how much hedge funds should or should not be regulated or self-regulated. There is interconnectedness between banks and hedge funds,

as there is between banks and corporate borrowers, and banks' dealings with corporate treasuries. The line between banking and certain other financial activities that warrant regulation for safety and soundness needs to be made clear. For example, if a hedge fund begins to issue notes in its own name to raise capital; begins to employ market-making traders in derivative markets; or begins to take on reinsurance activities, then it may have to come inside the regulatory net for banks, investment banks and/or insurance companies. This is quite different from a hedge fund that borrows from a bank or deals in derivatives with a bank, as most large corporate treasuries also do. According to this view, the line for prudential supervision turns on what the firm actually does. Of course, all firms fall within the market integrity and consumer protection regulations.

viii. A single overarching regulator for prudential standards across all financial institutions; and a single overarching regulator for market integrity and consumer protection (the so-called 'twin peaks' model used in Australia is a good starting point). This should not be the central bank, where monetary policy should focus on inflation objectives and not risk conflicts in policy objectives in a solvency crisis.

ix. A lender-of-last-resort facility and comprehensive market liquidity provisions for maintaining the stability of the financial system in the event of periods of turmoil (which can only be run out of the central bank).

x. Recognition of the moral hazard effects of bailouts and government guarantees on assets. This creates asymmetry in risk-taking. The threat of bankruptcy and the loss of shareholders' equity and at least some non-deposit debt needs to be made more 'credible'. A resolution regime including protection for depositors (to avoid Northern Rock situations), and clear receivership processes for the closing down of banks (in jurisdictions where these elements are absent) would help in this respect.

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