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Abstract

The 2007-8 banking crisis in the advanced economies has exposed deficiencies in risk management and prudential regulation approaches that rely too heavily on mechanical, albeit sophisticated, risk management models. These have aggravated private and economic losses, while perhaps protecting the taxpayer from bearing quite as high a share of the direct costs as in typical crises of the past. Policymakers and bankers need to recognize the limitations of rules-based regulation and restore a more discretionary and holistic approach to risk management.

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RISK MANAGEMENT AND THE COSTS OF THE BANKING CRISIS

Introduction

Given the efforts over the past decade to refining the prudential regulation of banks all over the world it could be considered astonishing that the advanced economies find themselves in 2008 the midst of a wide-ranging banking and financial crisis.

Ironically, it seems that increasing over-reliance on sophisticated but mechanical risk-management models lured bankers and regulators alike into a false sense of security. The shocking realization that these systems had failed to prevent serious losses resulted in a panicked reaction on the part of many market participants. Their revulsion has resulted in a protracted period of illiquidity in interbank and other short-term money markets and generated a credit crunch. Thus, although crystallized fiscal costs of the crisis have so far been small, official lending to distressed institutions is growing rapidly likely entailing future costs and economic activity threatens to dip well below capacity for some time.

This paper begins by placing the present crisis in the context of historic experience; there are many commonalities, and some evident novelties, but the role of mechanical risk-modelling is seen as especially distinctive this time. Section 2 takes a look at the costs, distinguishing between direct private and public costs, and overall economic costs. Section 3 considers what messages can be learnt for prudential regulation. Section 4 concludes.

1. Nature of this crisis

In order to draw the correct policy lessons, we need to understand the nature of the crisis. Recent commentary has tended to emphasize commonalities between what has been happening to the banking system in the past year with crises of the past. Classic accounts of previous crises have been dusted down.

If history explains all, how is it that the same errors were made, and in particular not detected and prevented by prudential regulation? After all, lessons were learnt from past experience and embodied in national policy structures. The US Savings and Loan debacle of the late 1980s, and the East Asian and Russian crises of 1997-8 led to a considerable effort to upgrade the policy and regulatory environment. This included the introduction of prompt corrective action in the US, adoption of the more sophisticated risk management tools of Basel 2, and the preparation of regular Financial Stability Reports by or for financial authorities in advanced and developing countries.[1] And banking has been conducted against a background of macroeconomic and monetary stability so exceptional that it has been dubbed the Great Moderation.

The background and evolution of the crisis has indeed exhibited a number of features well-known from previous bank crises worldwide (Honohan, 1997; Caprio and Honohan, 2005, 2008, Reinhart and Rogoff, 2008). Specifically, there was *over-optimism* as displayed in particular by very inexpensive risk-pricing reflected in low

[1] For example, the IMF-World Bank Financial Sector Assessment Program (FSAP) has, since 1999, conducted in depth studies of financial systems in three-quarters of the member countries, including major banking home countries such as Canada, France, Germany, Japan, Switzerland and the United Kingdom; but not yet the United States (or China).

historically risk premia (Shiller, 2005). This was especially pronounced in the *housing market* in the US, the UK and several other economies (including Ireland, which had the most pronounced run-up in house prices). To a considerable extent the over-optimism was encouraged by and embodied in *financial innovation* which has once again proved to be a source of systemic risk. Observers have stressed the extent to which financial firms have borrowed short and lent long (though *maturity transformation* is almost a definition of banking). The crisis was preceded by *rapid credit growth*—a classic danger sign both at the level of individual banks and at the level of the system as a whole. *Illiquidity and insolvency* have proved, one again, very hard to disentangle. *Principal-agent problems* have emerged in several quarters as they always do in such cases when innovation is intense. *Regulatory arbitrage* has been to the fore, as in the past (cf. Goodhart in this issue of the Review). *Depositor runs* (wholesale and retail) have precipitated dramatic reactions from the authorities.

Against this background, some of the more novel features of the recent experience can be interpreted as merely variants on previous experience. The originate-to-distribute model of mortgage finance (often accompanied by predatory lending exploitative of gullible borrowers) entailed severe agency problems that were manifested by reckless disregard of default risks. Flawed incentive structures in the relation between credit rating agencies and banks is another example of principal-agent problems and also once again illustrated the risks associated with financial innovation. The use by banks of conduits and special investment vehicles to move parts of their asset portfolio off-balance sheet (thereby escaping some mechanical rules-based capital requirements) and financed with short-term borrowings is a form

of regulatory arbitrage and an example of the perennial desire of banks to make money from maturity transformation.

But crises differ in important details and even in the character of the main driving forces. That is why they recur. "This time it will be different" is the response given by over-optimistic enthusiasts to words of caution as a bank or a banking system moves into risky territory; and indeed it usually is, though not in a good way.

In particular, it is important to recognize that the banking problems that have now emerged are not simply a by-product of a generalized macroeconomic adjustment or exogenous repricing of risk. It is true that some banking crises of the past have happened as a result of an economy-wide correlated wave of generalized euphoria that inevitably ended in disappointment and revulsion.[2] And the coincidence of other adverse shocks and necessary adjustments to large and deep-seated international macroeconomic imbalances this time too is aggravating the home-grown problems of the banking sector itself.

For, this time, much of the euphoria has actually related to the innovation in banking risk-management technology itself. This is most spectacularly evidenced in the relaxation of mortgage lending standards (Dell'Ariccia et al., 2008) driven by misplaced confidence in the overall effectiveness of risk management techniques based on automated credit-scoring of primary borrowers and on rated securitization.

[2] See Čihák and Schaeck (2007) for a characterization of the literature categorizing this dynamic into five generations of models.

The seemingly sophisticated regulatory framework so recently evolved also turned out not to be robust to the latest variations. Its complexity lulled both regulator and regulated into a false sense of security. It proved just as prone to arbitrage as the simpler protections of old – more so indeed because of its apparent rules-based sophistication which actually encouraged leveraged arbitrage on a vast scale.

At the heart of the crisis, at least in its first year, were problems with complex structured securities which packaged and repackaged the streams of servicing payments on primary loans, especially US relatively low grade residential mortgages.

As discussed in greater detail below, many of the mortgage-backed securities have proved much less valuable than they seemed at issue. This was not just because of falling house prices, but also partly because the mortgages had been missold to people who couldn't afford to service them and partly because the propensity to default increased. But especially important was the extent to which the officially-authorized rating agencies used risk models to assign what proved to be overoptimistic ratings to these securities. Trusting the ratings, banks and other investors acquired these over-rated securities in great volume. Alas, not only did the assigned ratings underestimate the probability of loss (because of optimistic assumptions[3] fed into the risk models), but many of the top-rated securities, carefully structured to be compatible with a model-generated AAA rating, had built-in fragility. Even small deviations in average default rates on the underlying mortgages or in assumed correlations had a drastic and unforeseen impact on the value of some of the tranches.

[3] Calomiris (2008) shows how a plausible but fatal misinterpretation of previous US default experience could have seemed to justify the assumed average default rates.

The mechanical risk models in use allocated insufficient risk capital to protect against these risks. Available capital was leveraged too far.

The sudden downgrading and fall in market price of even senior tranches of many of these securitizations during 2007 not only imposed losses on banks directly, but increased the cost of funds for banks generally. Not knowing where the location of all of the losses, and shocked by the scale of the failure of rating models, banks scrambled to ensure their own liquidity and became reluctant to assume counterparty risk. Three-month interbank rates jumped above the equivalent risk-free contracts and the spread has remained high now for over a year. It was curtailed access to funding liquidity that triggered the failures of Northern Rock, Sachsen, IKB, Bear Stearns and Lehman Brothers—institutions that had built their business model around assured access to the short-term money markets. Here too, reliance an over-simplified model that neglected hard-to-quantify dimensions of risk meant that these institutions had not hedged the risk of losing access to funding liquidity. Available liquidity was also leveraged too far—a dimension which has become virtually unregulated in recent times

As banks increased lending standards across the board, house prices fell back and economic slowdowns set in across many of the advanced economies at the time of writing a new wave of credit losses of a more familiar kind, not related to complex instruments, seemed in prospect. Currently, this further wave is hard to quantify, but it is already clear that substantial losses have been made and costs imposed on governments and on the economy more widely.

2. **Costs**

Different concepts of cost have been employed in past comparative studies of banking crises.[4]

Banking losses

A natural starting point is to look at actual credit-related losses suffered by banks and other intermediaries. Nonbank investors including hedge funds, insurance companies and others, have also been involved, and their interactions with the banking system have have been quite important. However, the present discussion will be confined to banks. Such estimates can be obtained from (a) write-downs; (b) modelled assumptions into the future for credits that have not yet been written-down; (c) mark-to-market losses on asset-backed securities. This is essentially the approach adopted by the International Monetary Fund (IMF) (2008), who estimated total credit losses to banks and other financial intermediaries as of March 2008 at around US$1 trillion. Banks are estimated to account for about half of these losses. This estimate has been criticized by the Bank of England (2008) for its important reliance on market prices of credit derivatives; the Bank of England argued that these markets were suffering

[4] Honohan (2002) distinguishes between three components of the cost of a banking crisis: (i) the stock component is the accumulated waste of economic resources (this would include the costs incurred by those to whom unaffordable mortgage were mis-sold); (ii) the public finance component of the true economic costs (which importantly is not the same as the fiscal bill); (iii) the flow component of the economic cost arising from the subsequent output slumps caused by the banking crisis. The quantifications discussed below: total banking losses, fiscal costs and the dip in economic activity can be thought of as crude approximations to these three components respectively.

from an asymmetric information bias (lemons effect) and did not provide a good approximation to an expected value of losses.[5] Although the Bank of England's argument is plausible, it seems fair to say that, in the months since these two benchmark estimates were published, emerging information makes the IMF's pessimism seem less extreme. Some commentators argue that it will prove an underestimate.

Taking the IMF number, should we regard US$1 trillion as large? This depends on the relevant scaling factor. Previous crises have been measured in terms of national GDP of the affected country. With the losses concentrated in the US and Europe, one natural reference would be aggregate GDP of the US and the EU, which in 2007 exceeded US$30 trillion, of which 1 trillion represents just 3 per cent.

Using another approach to scaling, the IMF's US$1 trillion represents the sum of 2½ per cent of US risk-weighted banking assets *plus* 1½ per cent of European risk-weighted banking assets.

Interestingly, as they crystallize, the vast bulk of the credit losses is being absorbed by shareholders of these institutions leaving relatively little to be picked-up by government, let alone depositors and other creditors. The largest banks reporting big writedowns have been able to cope. Although the net profits of UBS for the four years 2003-6 totalled CHF 40 billion, this is about the same as the total credit losses

[5] The Bank of England's own much lower estimate of the likely total costs of the crisis was based instead on a projection of future losses based on assumptions about the migration of loans from non-performing into loss status.

that bank has reported to date in 2007-8. Citigroup's reported credit losses in 2007-8 to date were enough to wipe out almost all of the previous three year's profits. But these and other large banks did not fail.

Fiscal costs

Of course the losses have not been distributed equally: some institutions have been hit much harder and some have become insolvent; in those cases, official support, whether in the form of depositor compensation, nationalization, loss-making emergency lending, or official support to distressed bank borrowers, have come into play.

Box

Estimates of fiscal costs for 56 crises in the past 50 years are provided by Caprio et al. (2005), updating Caprio and Klingebiel (1996) (CK). The median fiscal cost for these was 10.0 per cent of GDP (mean 14.3). Looking just at the crises deemed systemic by CK, the median cost was 13.1 (mean 16.8). Using these data, Honohan and Klingebiel (2003) showed that these costs were systematically higher the more accommodating and lenient was crisis-management policy.

The number of cases can be augmented by mapping known data on the proportion of non-performing loans (NPLs) at the time of official intervention to fiscal losses. By fitting a least squares regression between NPLs and losses for the countries for which both is available, we obtain a relationship that can be extrapolated to the counties for which only NPL data is available This was done for Honohan (1997) and is updated here. For the 93 countries in the augmented series the median fiscal cost is estimated at 13.2 per cent of GDP (mean 16.7); confining ourselves to the 78 crises deemed "systemic" by CK lifts the median percentage to 15.5 (mean 19.1). (Table 1)

Such direct fiscal costs have imposed a heavy burden in numerous systemic banking crises over the past half-century. Based on an extension of previous work to 93 crises I estimate that the median systemic crisis may have generated a fiscal cost as high as 15.5 per cent of GDP (see Box).

So far, then, fiscal costs this time around have been remarkably small, relative to total credit losses. If we are to accept official estimates and projections at face value, US$75 billion would seem to cover net fiscal costs from the sums so far committed. This would include the bailouts of Bear Stearns, Northern Rock, and the two state-owned German banks Sachsen and IKB, and the depositor compensation for IndyMac and other closed banks in the US, combined with the US Congressional Budget Office' s expected cost estimate of the decision to have the US Treasury support the two big Government-sponsored financial agencies Fannie Mae and Freddie Mac, and for the loan to the insurance company AIG (based on the interest premium charged). (Thus this represents net costs; the gross sums being lent or available for lending are much greater).

Such a figure – about ¼ per cent of the sum of national GDPs in the US *plus* the European Economic Area – is quite low by the standards of previous crises (see Figure 1). But that figure is quite likely to increase, perhaps by a lot. It is only a fraction of the gross sums that are being lent. It only counts recognized solvency-related interventions, and previous experience shows that the need for such interventions only becomes clear over several quarters; the full costs are rarely evident at first.

Aggregate economic costs

If it is hard to obtain reliable data on the fiscal cost of banking crises, it is even more difficult to pinpoint the other dimensions of cost. Attempts have been made to capture a rough estimate of the additional flow economic costs in previous crises, typically by comparing actual aggregate output (GDP) with some hypothetical ‘‘no crisis’’ output path. One version of this approach to estimating the cost of the subsequent output dip was proposed by the IMF in its 1998 World Economic Outlook, and has been widely employed (cf. Hoggarth et al., 2002). Using this measure, output dip is quite strongly correlated with measured fiscal costs and intriguingly is of the same order of magnitude on average (Honohan, 2002).

Not all of these output slumps will have been caused by the accompanying banking crisis – often a latent banking crash only becomes evident when it is triggered by an exogenous economic shock that also directly contributed to recession. By examining the sectoral pattern of previous economic downturns, Dell’Ariccia et al. (2005) show that banking crises do tend to have an independent effect on output, and they provide a ranking of credit crunch-induced economic downturns by comparing the dip in activity of sectors that are more and less bank-dependent.

The credit losses are having knock-on effects depressing the macroeconomy this time also. Reductions in bank capital (even though partly made good with new equity issues), the liquidity premia and generalized uncertainty about counterparty risk are

all contributing to a re-pricing of risk which has the effect of restricting or shutting down credit access to a large range of borrowers throughout the economy.[6]

The ability of banks to recapitalize is of central importance in determining the extent and depth of credit crunch. Greenlaw et al. (2008) stress the multiplier effect on credit (and thereby on GDP) of reductions in bank capital due to credit losses. There is some empirical evidence for this; bank capital is generally included as a control in bank-level modelling of changes in lending (cf. Cetorelli and Goldberg, 2008). The links in this chain are not all immutable ones, though. Capital can be replenished, and there is some elasticity in leverage employed by banks and other financial intermediaries. Indeed, the recent study by Adrian and Shin (2008) showed the way in which investment banks can and do manage their portfolios very actively. When their risk appetite increases, they both build up their capital and their total assets, and vice versa. This proactive behaviour is quite unlike the generally passive asset management strategies followed by households, for which losses impacting their total assets and net equity position result in a negative correlation between changes in assets and in leverage. (Although there has been some convergence of behaviour between commercial and investment banking, according to Adrian and Shin the behaviour of commercial banks – which tend to target a given leverage ratio – and of non-financial corporations is intermediate). This suggests that changes in risk appetite, not in intermediary capital, are the main drivers of credit availability. Of course, credit losses can dent confidence as much as capital; but capital can be replenished, and it will be if confidence is restored. Indeed, major banks have raised

[6] Numerous sources document the reduction in credit availability including surveys of borrowers and of lenders as documented by the Bank of England, ECB and US Federal Reserve.

upwards of US$ 300 billion in new capital in the past year. Ensuring the background conditions that facilitate the raising new capital is where macroeconomic and regulatory policy can help.

Falling house prices in several major economies and the high oil prices make growth in the relevant economies rather sensitive to the credit crunch; and the sharper the growth slowdown, the more likely are further credit losses. Indeed the worsening position of Fannie Mae and Freddie Mac leading to their nationalization in September 2008 seems to reflect this general worsening of credit conditions rather than financial engineering deficiencies. Current macroeconomic projections suggest that the output dip in the US *plus* EU relative to what was expected in July 2007 will be well over 1 per cent in 2008 alone—much higher than the figure given above for fiscal costs from recognized interventions. And the process is unlikely to have worked itself out for another couple of years.

An interesting feature of the distribution of costs here is the degree to which *international* risk transfer has been prominent, reflecting the now well-established globalization of finance.[7] Although the figure is not weighted by asset quality, it seems that European financial institutions have absorbed a sizable share of the risk embodied in credit risk transfer instruments such as securitized mortgages (Figure 2).[8] This reflected in the prominence of non-US banks among the league table of the

[7] In many previous crises, international banks have often—though not always—escaped the worst of the crisis (cf. the striking discussion by Díaz-Alejandro, 1985).

[8] The figure illustrates the statement by Joint Forum (2008, p. 10) that US credit risk transfer products (CRTs) were distributed roughly equally between US, European and Asian investors; European CRTs—which formed a sizable minority of the total, were sold about 60-40 to Europe and Asia. (This

banks with the biggest reported credit losses to date; 15 of the 24 banks in Table 2, which shows reported credit losses by major banks since start of the crisis, are headquartered outside the US.

3. **Implications for regulatory style: rules vs. discretion**

"More regulation" is the cry, but what should the priorities be and are there pitfalls here too? The following discussion will be selective, concentrating on how to reduce credit-related losses.

One dimension – not dealt with here – relates to liquidity. Is it enough to rely on the lender of last resort to deal with the kind of systemic drought of funding liquidity that has been observed? But the alternatives are problematic. After all, the social costs of a drastic reduction in maturity transformation could be considerable, yet that is what would be needed to preclude what happened to Bear Stearns, who ran through US$20 billion of cash in a week.

Another dimension is consumer protection: the need to avoid mis-selling of unaffordable mortgages. Many unsophisticated borrowers were misled by mortgage salespersons ("originators") – for example by use of teaser rates offering an initial period of lower amortization – and undertook repayment commitments which they

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suggests that perhaps a third of the total risk transferred was taken up in net terms by Asia, with Europe also accumulating a modest new amount of additional risk, and the US a net shedder of risk through these mechanisms). Further detailed analysis of this aspect is contained in Beltran et al. (2008), who judge that European banks were not disproportionately exposed to mortgage-backed securities relative to their holdings of other US obligations.

could not afford ("predatory lending"). This too we will not discuss further here in order to focus on solvency regulation.

What is noteworthy about the major losses surrounding the sub-prime debacle is the extent to which they have been associated with (i) the failure of mechanical risk-management tools and (ii) losses that were so far outside the projected range of possibilities that they imply modelling error.

Some have suggested that the structure of the models used for risk management was adequate but the distributional assumptions about shocks was too optimistic: tails not fat enough. In other words, just bad luck to be hit by a large exogenous shock.

The shortfall in mortgage servicing from this sub-prime lending should have been anticipated by the originators and by the arranger who acquired the stream of payments and structured them; it was not a random shock. [9] Some have rightly stressed the agency problems involved: in effect arguing that some originators and arrangers knew but did not care that they were selling on substandard products. In addition, though, the success of automated credit scoring systems in other contexts will have made it seem excusable to cut corners and not bother to exercise

[9] Although falling house prices are an important part of the story, It is important to note that the defaults on recent sub-prime mortgages in the US are higher than can be predicted from house price movements and borrower characteristics. Underwriting quality thus fell steadily from 2001; the deterioration was masked by the boom in house prices (Demyanyk and Van Hemert, 2008). A careful analysis of US default experience reveals that "homeownerships that begin with a subprime purchase mortgage end up in foreclosure almost 20 percent of the time, or more than 6 times as often as experiences that begin with prime purchase mortgages" (Gerardi et al., 2008).

independent judgment in underwriting. Of course, the reality is quite the reverse: if statistical risk models are to yield usable guidance, they must be fed reliable inputs.

In many cases, minor structural deficiencies in the models were systematically exploited by bankers, knowingly or unknowingly, to build an unstable and brittle cantilever-like structure supporting sizable expected returns at the risk of catastrophic failure.[10]

The most obvious example of such catastrophic failure is the astonishing decline in the market price of AAA-rated mortgage-backed securities, especially the so-called Mezzanine CDOs, which repackaged bundles of low-rated mortgage backed securities in such a way as to squeeze the maximum amount of AAA-rated tranches out of assumed lack of correlation between the underlying mortgages.

A key element of what seems to have happened here is that the rating agencies assumed correlations between the default rates of the underlying mortgage securities that were too low. [11] As such, it was relatively easy for ABS arrangers to construct

[10] Consider the applicability to the present context of the warning given by Weitzmann (2008) in the context of global warming: If we are uncertain about the parameters of a stochastic risk model, if the tails of the distribution of the true model are fat, and if the costs of outcomes in that tail are large, then neglect of this uncertainty can give dramatically wrong conclusions.

[11] The danger of precisely this error was highlighted by some specialists before the crisis broke. For example, Duffie (2008), in a June 2007 conference presentation wrote: "Even specialists in CDOs are currently ill equipped to measure the risks and fair valuation of tranches that are sensitive to default correlation….Currently, the weakest link in the risk measurement and pricing of CDOs is the modelling of default correlation."

AAA-rated (and hence low-yield) securities from high-yield mortgages that generated substantial surpluses to be distributed as fees (and income to the equity tranches). The more the lower-than-actual correlations could be exploited in security construction (as with multi-layered securitizations such as Mezzanine CDOs and CDO-squareds), the more this modelling error was likely to result in sizable rating errors on the senior tranches. [12,13] The global appetite for AAA-rated securities being high, this mechanism opened the door to a very large increase in tail risk, when losses occurred they would be more like falling off a cliff, than slipping down the a river bank.[14]

Here again agency problems arose. They related not only to internal remuneration incentives in the various firms involved, but also to the shared interest of arrangers

[12] Ironically it may have been the tranches priced as least risky that may have experienced the worst net yields: the ("toxic waste") equity tranches could have received juicy rewards in some cases perhaps for long enough to make good returns (Ashcraft and Scheurmann, 2008). Indeed, underestimating asset correlations in a securitized portfolio has the effect of *lowering* the likely losses on the equity tranche for any given average default rate (Belsham et al., 2005) Note, though, that some CDOs had additional protections for the senior tranches, such as default triggers giving the senior tranche investors the option to liquidate the collateral.

[13] On May 21, 2008 the Financial Times reported that Moody's uncovered a programming error in its model for valuing another form of credit derivative, namely CPDOs. Apparently the error resulted in some tranches being rated 4 notches above where they should have been. The high ratings puzzled some observers, but enabled the tranches to be sold at low yields.

[14] This feature is reflected for example in the very steep downgrades that occurred for some AAA rated ABS CDOs in 2007. The median downgrade among almost 200 such securities was 7 notches – a steeper downgrade than occurred in any comparably rated corporate bond for at least four decades (Joint Forum, 2008)

and the rating agencies in doing business even if it meant exaggeration of ratings. And this is not the first batch of rated securitizations to suffer default rates well in excess of what their initial ratings would have suggested.

Another illustration of the vulnerability of mechanical risk management tools comes from the experience of UBS, a bank which has experienced one of the largest loan-losses so far reported in the crisis. According to UBS's report to shareholders, one of the largest single sources of loss, accounting for more than a third of the bank's total losses, were assets described by the safe-sounding term "Amplified Super Seniors" in which the risk of loss was initially hedged through the purchase of protection from an insurer. Because of their AAA rating and the hedge, these assets were regarded as very safe and exempt from risk scrutiny, allowing them to be accumulated in large quantities by the relevant desks of the bank. The proportion hedged was, however, unfortunately limited to the first 2-4 per cent of loss.[15] Because the insurance was only first-loss, and the volume of assets large, the bank was much more highly vulnerable to model error or large shocks than its risk managers recognized.

Complacent over-reliance on mechanical risk-management rules that shut-off some high-risk high-return strategies can thus allow other more hidden, opportunities for leveraging risk. In the presence of moral hazard, this combination can even amplify overall risk.

[15] The bank states that "this level of hedging was based on statistical analyses of historical price movements that indicated that such protection was sufficient to protect UBS from any losses on the position" (UBS, 2008, p. 14). The level of hedging also seems to have been designed to meet internal risk-management rules (Hughes et al., 2008)

The danger that even simple risk-management rules could actually amplify risk has been discussed in the literature for at least thirty years (cf. Kahane, 1977; Honohan and Stiglitz, 2001, pp. 42-4). The circumstances under which this might happen are limited, but I suggest that the increased complexity and sophistication of the mechanical rules has meant that the remaining opportunities to game these rules result in much greater moral hazard. This, I believe, is what we have seen in the current crisis. Most of the big losses have resulted from some unit within a bank seeking to exploit a profit opportunity that requires very high volumes to be worthwhile and which exploits instrument design depending crucially on the accuracy of complex risk management models

Perhaps the bankers involved don't themselves realize the risks they are imposing on their institutions, perhaps they assume they have detected and are exploiting a market anomaly, or perhaps they don't care. In the last case, the ethical line may not be that great between the behaviour of such bankers and that of rogue traders (think of Société Générale's Jerome Kerviel; AIB's Rusnak and Baring's Leeson) who are said to have exceeded their authorized volume limits in the process of leveraging a small expected percentage gain. The huge scale of the bets unite them; the differences are legally distinguishable but operationally close (one breaches rules he thinks will not be enforced if he wins from the greater risk assumed; the others are bending rules to assume greater risk).

The implication for regulators is to rely much less exclusively on mechanical risk assessment models (which, however, provide an essential input), and instead take a

more traditional and holistic[16] view (which would include taking account of the possibility of model error and that it will be exploited). This implies building-in much higher margins of error in capital requirements – especially at times of rapid growth in balance sheets (as with the speed limits mentioned by Honohan and Stiglitz, 2001); close scrutiny (and risk-penalization) of gross positions for regulated or systemically important institutions, and much greater attention to personal incentive structures. Effective supervision requires a qualitative assessment of these institutions' overall risk management systems (not merely their mathematical risk models). Principles need to be elevated relative to mechanical rules which can and always will be gamed. The more precise the mechanical rules, the easier to game and the more dangerous the games can become.

In practical terms, this perspective can be seen as consistent with some of the rhetoric of Basel 2, notably its Pillar 2 which emphasizes regulatory discretion. But it also casts doubt on the heavy reliance placed by much of the Basel discussions on the use of sophisticated but necessarily imperfect mathematical and statistical models of risk to define the required amounts of capital (under Pillar 1).

4. **Concluding remarks**

The structured finance crisis that has hit banking institutions on both sides of the Atlantic is working itself out against a background of macroeconomic imbalances and the reversal of overly-optimistic risk pricing. But the extensive banking losses are

[16] Lack of integration of risk management procedures was identified bin the follow-up to the Société Générale losses (Société Générale, 2008)

substantially attributable to failings within the banking sector itself. I have argued that some of the failures, both at the level of the banks and at the level of the regulators, results from over-reliance on mechanical risk-management models, such as have been given great emphasis in Basel 2. The power and sophistication of these models must not be allowed to displace the kind of discretionary and holistic risk-management culture that acknowledges the dangers of wilful or accidental model misspecification or mis-application. This broader perspective is already embodied in pillar 2 of Basel 2, and is a constant refrain of risk management manuals (cf. Institute of International Finance, 2008; Senior Supervisors' Group, 2008), but has in practice been displaced by an imperfect technology.

While they may have contributed to the crisis, the new risk-management techniques may also have provided the tools for early detection of problems in large banks, and allowed the losses to be stemmed before the bank's survival was endangered. In this context, it is significant that most of the banks that have actually been intervened by the public authorities had specialized heavily in mortgage finance or structured finance. Large diversified banks had additional revenue sources and held sizable capital to cover risks across their entire business.

Advances in technical risk-management may thus have protected the public finances this time around so far, in that large diversified banks have been able to deal with their structured-finance related problems before they got so deep as to require official intervention.

But the excessive double leverage – of capital and liquidity – adopted by overconfident risk managers produced a whiplash effect which has resulted now in a credit crunch. Limiting the further economic losses that could ensue should be a policy priority.

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Table 1: *Estimated fiscal costs of previous crises*

Costs (% of GDP)	CK estimates		Augmented estimates	
	All in database	Systemic only	All in database	Systemic Only
Mean	14.3	17.1	16.7	19.1
Median	10.0	13.2	13.2	15.5
Upper quartile	14.0	16.7	24.0	27.7
Lower quartile	3.0	5.0	5.0	10.0
No. of cases	56	45	93	78

Note: CK estimates are drawn from Caprio et al. (2005). Augmented estimates are based on the fitted regression line linking data on costs of different national crises from the CK estimate cases with non-performing loan ratios in those crises.

Table 2: *Reported credit losses by major banks 2007-8*

Bank		US$ bn	*Bank*		US$ bn
Citigroup	USA	55.1	Wells Fargo	USA	10.0
Merrill Lynch	USA	52.2	Credit Agricole	FRA	8.5
UBS	CHE	44.2	Barclays	GBR	7.6
HSBC	GBR	27.4	Canadian Imperial (CIBC)	CAN	7.0
Wachovia	USA	22.7	Fortis	BEL/NLD	6.9
Bank of America	USA	21.2	HBOS	GBR	6.7
Washington Mutual	USA	14.8	Bayerische Landesbank	DEU	6.7
Morgan Stanley	USA	14.4	Société Générale	FRA	6.4
IKB Deutsche Industrie	DEU	14.3	Mizuho Financial	JPN	6.0
JPMorgan Chase	USA	14.3	ING Groep	NLD	6.0
Royal Bank of Scotland	GBR	14.0			
Lehman Brothers	USA	13.8	Subtotal		400.2
Deutsche Bank	DEU	10.0			
Credit Suisse	CHE	10.0	Worldwide		510.8

Source: Bloomberg and Financial Times (Sep 11, 2008) http://www.ft.com/indepth/creditsqueeze

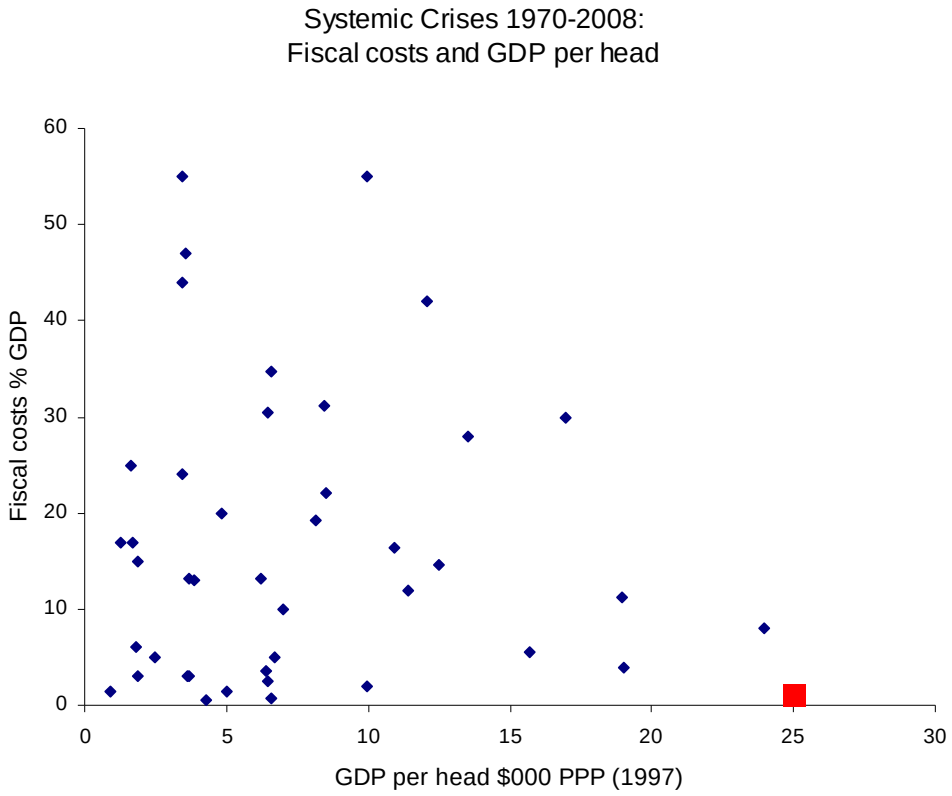

Figure 1: *Historic crises: fiscal costs and GDP per head*.
(The square marker indicates 2007-8 based on officially recognized solvency interventions to date
Source: see Box and text)
Crisis database cost

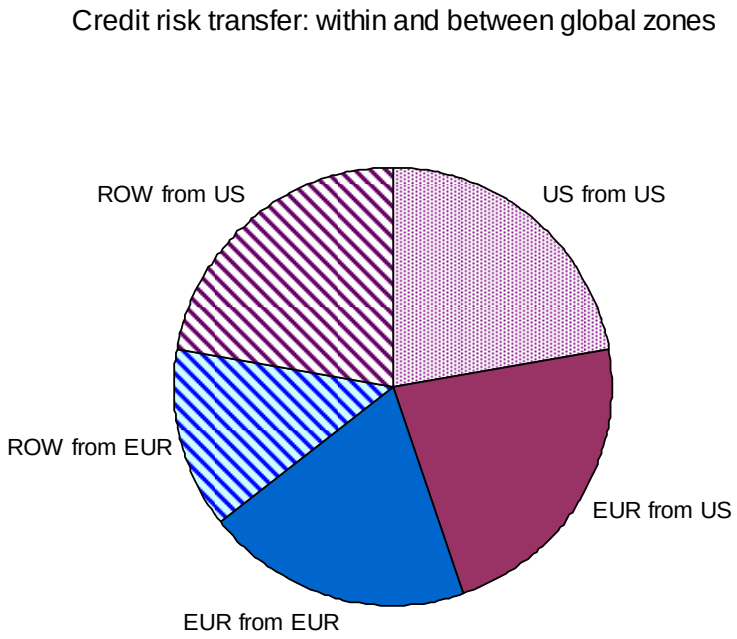

Figure 2: *Estimated proportionate pattern of credit risk transfer*
(The pie represents all credit risk transferred globally from the US and Europe. Each slice represents intra or inter-regional transfers. Thus 'EUR from EUR' represents the credit risk transferred from one European institution to another; 'ROW from US' represents credit risk emanating from the US and assumed by an institution in the Rest of the World. Source: based on Joint Forum, 2008)
Crisis database cost

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