FINANCIAL STABILITY AND BANK SOLVENCY

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Introduction

Financial stability has long been a cornerstone of public policy in general and central banking policy in particular. Indeed, it predates monetary stability as an objective of central banks in most countries, including in the United States and the United Kingdom. The past few years have, if anything, seen a deepening and a strengthening of the public policy focus on financial stability matters. There is no sign of a let-up. Indeed, one school of thought has it that, in an environment of monetary stability, such financial stability events could come thicker and faster in the future than they have in the past (Crockett, 2000).

Despite this increased public policy focus, many of the key tenets of a framework for financial stability remain relatively vague. How is financial stability best defined and measured? What are the causes and welfare consequences of different manifestations of instability? And what instruments are best placed to mitigate these costs? Answers to these questions have, to date, largely eluded policymakers and academics.

Unlike monetary stability, financial stability has no off-the-shelf definition. Myriad definitions have been proposed in the literature (see, for example,(Houben, Kakes and Schinasi, 2004)). A great many of these definitions view financial stability through the prism of financial crises. Indeed, some interpret financial instability even more narrowly, as a large-scale unanticipated collapse of the banking system which reduces the stock of money (for example, (Friedman and Schwartz, 1963)).

In this paper we take a somewhat broader definition. Financial stability can be thought to be, on the one hand, about enabling individuals to smooth consumption across time (for example, by saving and borrowing) or across states of nature (for example, through insurance contracts); and, on the other, about efficient financing of investment projects with saved resources. At root, it is about the saving-investment nexus (Haldane, 2004).

On this definition, financial *in*stability could be defined as any deviation from the optimal saving-investment plan of an economy deriving from imperfections in the financial sector. The advantage of this definition is that it is generic. It nests financial crises and specifically banking crises as a special case of financial instability; a drawing, if you like, from the tail of the financial instability distribution. Or put differently, a systemic banking crisis is a severe disturbance to the intermediated saving-investment nexus.

The relationship between systemic banking crises and financial stability more generally is clearly multi-dimensional. There are transmission channels working in both directions. Widespread banking insolvency may be sourced in general system-wide shocks to asset prices or real activity – a link from financial instability to banking crises; while systemic insolvency will itself typically have important implications for asset prices and real activity – a link from banking crises back to wider financial stability. We call this complex and interacting set of relationships the "solvency-stability" nexus; it is a sub-set of the saving-investment nexus.

This paper aims to explore this solvency-stability nexus, focussing in particular on the role of public policy in mitigating the welfare costs of financial instability. In Section 2 we consider some of the empirical evidence on links in the solvency-stability chain, most of it drawn from cross-country experience. Section 3 considers some of these same links using a calibrated, micro-founded model of the macro-economy. Section 4 provides a taxonomy of the various public policy instruments potentially available to the authorities to deal with instabilities; and it considers, in particular, different tools for resolving banking crises and the cross-country empirical evidence we have on the efficacy of those tools. Section 5 provides a general conceptual framework for assessing the welfare costs and benefits of different degrees of public sector intervention in resolving banking crises. Finally, Section 6 concludes with a forward-looking discussion of some of the open issues on the banking resolution front which have yet to be tackled comprehensively.

Empirical evidence on the solvency-stability nexus

The solvency-stability nexus embodies two distinct set of relationships, from stability to bank solvency and vice-versa. To date, these two relationships have tended to be considered separately, at least from an empirical perspective, using distinct methodological approaches. Both sets of approach have to tackle the difficult identification problem of isolating the effects of an (at least weakly) exogenous shock to either asset price/activity or to the banking sector.

Empirical work on the relationship from broader macroeconomic instability to banking stresses has evolved rapidly over recent years; it is described in some detail below. This work focuses on the effects of drawings from the tail of the distribution of macro outturns to banking profits and capital. In general, these "stress tests" have tended to unearth a high degree of robustness of banking sectors over recent years, at least in developed countries, other than Japan.

Empirical work on the relationship from banking stress to the economy, which is also described below, uses as its identification criterion drawings from a distribution of banking stress – that is to say, systemic banking crisis. In general, these "event studies" have tended to uncover a large output cost of banking crises– or at least large output losses are associated with these crises – in both developed and developing countries.

From financial instability to the banking system

Assessing the impact on banks of possible changes in the external environment is something that banks themselves carry out as part of their scenario planning. Increasingly, it is also being considered by supervisors as part of their regular supervisory processes. Recent policy initiatives have given an added impetus to such stress-testing exercises. For example, stress tests are now routinely carried out as part of the IMF's Financial Sector Assessment Programmes (FSAPs). These are health-checks on the financial sector, which the IMF carries out on member countries as part of its surveillance activities. Stress-testing will also be an important element of Pillar 2 of the new Basel Accord. For example, macro stress-testing should help give an indication of whether a recession will result in a shortfall in banks' risk-weighted capital. This is relevant to the debate on the procyclicality of the new Basel Accord (see, for example, (Kashyap and Stein, 2003)).

To quantify the impact of a deterioration in the macroeconomic/financial environment on banks' solvency, a number of issues need to be considered. Single factor sensitivity tests or macroeconomic scenarios need to be devised. The former assess the impact on banks of changing one particular factor, assuming the rest of the economic environment remains unchanged. These tests are used most frequently to assess the vulnerability of banks to market risk - for example, a step increase in interest rates, a change in the slope of the yield curve or an exchange rate depreciation.

Macroeconomic scenarios instead assess the impact on banks of a combination of changes in macroeconomic and financial variables. Scenarios are required that are low probability ("tail") events. In choosing these events, there is inevitably a trade off. Set the probability too high – and thus the size of shocks too low – and nothing would be learnt about how the banking system would fare in a period of stress. Set the probability too low and a complete collapse of the banking system will result, even though there would be almost no possibility of this event occurring.

Banks and financial authorities adopt a variety of approaches to devising scenarios. One approach is to develop a hypothetical adverse scenario, such as the impact of a large rise in world oil prices. Another approach is to take a historical scenario – such as the early 1990s recession in the UK – and apply it to banks' current portfolios. A third approach is to devise scenarios from a quantitative model. This approach has the advantage of being able to isolate the original shock and ensure that its impact on the rest of the economy is consistently traced through according to the parameters of the model.

The impact of such scenarios on the banking system as a whole can either be built-up from banks' individual portfolios (a "bottom-up" approach) or from the average balance sheet positions of the banking system as a whole ("a top down" approach). As part of the UK's FSAP, a hybrid approach was adopted. Specific macroeconomic scenarios were derived using an extension of the Bank of England's Medium-Term Macroeconometric Model.[1] The outputs from these scenarios were supplied to ten large UK banks as inputs to their own assessments (the "bottom-up" approach). These results were compared with the Bank's own analysis of the impact of the scenarios on UK banks using aggregate reduced-form relationships linking changes in macroeconomic variables to banks' aggregate loan loss provisions (a "top-down" approach).

One of the stylised facts from these types of stress tests, which have been carried out in a number of developed economies, is that a scenario usually needs to involve a large decline in output to cause a significant increase in banks' write-offs. This is consistent with historical patterns, as major fluctuations in write-offs and provisions in banking systems have tended to mirror the economic cycle. Another feature is that it is difficult to devise plausible scenarios that threaten the solvency of banking systems at the present time – or, indeed, even threaten individual large banks within the system. In the stress tests carried out as part of the UK FSAP, for example, the estimated potential losses in no case exceeded UK banks' annual profits or represented a large fraction of banks' capital.

Clearly, some caution needs to be attached to these estimates. There may be sharp discontinuities in economic behaviour and relationships in crisis periods both in how the initial shock affects the macro-economy and, in turn, how the macro-economy affects banks' balance sheets.

These estimates are also sensitive to the assumed monetary policy response. For example, in the stress-tests carried out for the UK FSAP, the impact of a decline in aggregate demand was attenuated by the assumed loosening in monetary policy required to prevent price inflation falling below target. This policy response served to limit the adverse impact on the stability of the banking system. In addition, stress tests do not usually take into consideration the response of banks and their creditors, including other banks, to a balance sheet deterioration. For example, although individual bank actions might be designed to reduce potential losses, their collective responses might intensify economic stress – for example, through a credit crunch. If the shock were big enough to cause the failure of a large bank, this might have a direct impact on the capital, or even solvency, of other (counterparty) banks.[2] It might also be the case that banks hold capital as insurance against much more extreme events than are usually considered in these types of scenarios.[3]

From banking sector weakness to the macro-economy

Over the past quarter of a century, unlike the preceding twenty five years, there have been a number of episodes of systemic banking problems around the world. For example Caprio and Klingebiel (2003) document 117 episodes of systemic crises and 51 cases of borderline or non-systemic crises in developed and emerging market countries since the late 1970s. "Systemic" is defined as pertaining to cases where all or most of the capital in the banking system has been exhausted.

Most cross-country comparisons quantifying the adverse impact on the economy of banking crises measure the fiscal resolution cost to the government. These include the various types of expenditure involved in rehabilitating the banking system, including both bank recapitalisation and payments made to depositors (either implicitly or explicitly) through government-backed deposit insurance schemes. Estimates of these costs are shown in Table 1 below for 33 recent systemic banking crises. On average these costs are large – cumulatively, around 15% of annual GDP. They are higher in emerging-market economies, especially when accompanied by a currency crisis.[4] For example, the cumulative resolution cost of the Indonesian crisis which began in 1997 was around 50% of GDP, while the recent Turkish crisis has so far cost the authorities around 30% of GDP.

These fiscal costs of bank resolution may simply measure a transfer of income from current and future taxpayers to bank 'stakeholders', rather than measuring the cost to overall economic welfare.[5] Governments are presumably willing to incur these fiscal costs to *limit* broader welfare costs. Conversely, the government may incur only small fiscal costs yet the adverse economic effects of a banking crisis could be severe. For example, a banking crisis was an important feature of the Great Depression of 1929-33 and yet fiscal costs were negligible since there was little capital support for the failing banks and no deposit insurance.

One rough proxy for the broader welfare costs associated with banking crises is the loss of GDP during the crisis period compared with a measure of trend or potential output. On this measure, cross country estimates suggest that output losses during banking crises have been large – over 10% of GDP, see for example Bordo, Eichengreen, Klingebiel and Martinez-Peria (2001) and Hoggarth, Reis and Saporta (2002).

Such estimates are also reported in Table 1 below for a sample of 33 recent systemic crises. The measure "output losses 1" is the sum of deviations in GDP growth from the pre-crisis ten year trend, whereas measure "output losses 2" is the sum of output levels lost in the crisis period compared with the previous ten year trend.[6] The cumulative output loss during periods of systemic banking crises are also usually very large when a twin banking and currency crisis occurs. The latter may intensify banking system fragility if banks, or their customers, have large net foreign currency exposures.

Table 1:
Fiscal costs and output losses in thirty three systemic banking crises 1977-2002[(a)]

	Number of crises	Length of crisis (years), average	Non-performing loans (per cent of total loans)[(b)], average	Bank credit/ annual GDP (per cent)[(c)], average	GNP per head (US$ 000s , PPP basis) at the start of the crisis, average	Cumulative fiscal costs of banking resolution (per cent of GDP)[(d)], average	Output losses 1[(e)] (per cent of GDP), median	Output losses 2[(e)] (per cent of GDP), median
All countries	33	4.3	26.7	44.2	6.6	15.0	7.1	23.1
Banking crisis alone	10	4.6	23.7	44.9	7.3	7.8	2.4	15.7
Banking and currency crisis[(f)]	23	4.2	28.2	43.9	6.3	17.4	11.6	32.2

Sources: (Caprio and Klingebiel, 2003), (Hoelscher and Quintyn, 2003), (Hoggarth and Saporta, 2001), (Honohan and Klingebiel, 2003 (OECD, 2002) IMF, World Bank and Bank calculations.

(a) A systemic crisis is defined as when all, or nearly all, the capital in the banking system is eroded. The crises are Finland (1991–93), Japan (1992–), Norway (1988–92), South Korea (1997–2000), Spain (1977–85), Sweden (1991), Argentina (1980–82), Argentina (1995), Brazil (1994–96), Bulgaria (1996–97), Chile (1981–83), Colombia (1982–87), Côte d'Ivoire (1998–91), Czech Republic (1989–91), Ecuador (1996–2001), Ghana (1982–89), Hungary (1991–95), Indonesia (1997–), Malaysia (1997-2000), Mexico (1994–95), Paraguay (1995-99), Philippines (1981–87), Philippines (1998–2000), Poland (1992–95), Senegal (1988–91), Slovenia (1992–94), Sri Lanka (1989–93), Thailand (1983–87), Thailand (1997–2000), Turkey (1982–85), Turkey (2000–), Uruguay (1981–84), Venezuela (1994–95).
(b) Estimated at peak. Data available for 19 countries only. Comparisons should be treated with caution since measures are dependent on country specific definition of non-performing loans and often non-performing loans are under-recorded.
(c) At the beginning of the crisis. Credit to the private sector from deposit money banks (IFS code 22d) as a share of annual nominal GDP (IFS code 99b).
(d) Bank recapitalisation, government payouts to liability holders and public sector purchases of non-performing loans.
(e) Output losses1 is the cumulative deviation in the *growth* of output during the crisis period from its pre-crisis ten-year trend. Crisis ends when GDP growth returns to pre-crisis trend or if not occurred estimated up until 2002. Output losses2 is the cumulative deviation in the *level* of output during the crisis from its ten-year pre-crisis trend. Crisis end based on qualitative judgement of country experts, see Hoggarth and Saporta (2001). Data exclude Côte d'Ivoire. Because of data limitations, a three-year and six-year pre-crisis trend was used for Czech Republic and Slovenia respectively.
(f) A currency crisis is defined as a nominal depreciation in the domestic currency (against the US dollar) of 25% combined with a 10% increase in the rate of depreciation in any year of the banking crisis period.

These output measures give a useful benchmark for the magnitude of economy-wide losses associated with banking crises. But they do not explain the precise cause of the loss. One potential channel is through banks not fulfilling their intermediary function in the aftermath of a crisis. For example, in a sample of 36 developed and emerging-market banking crises, Demirgüç-Kunt, Detragiache and Gupta (2000) find that real bank credit fell markedly in the first three years after the crisis, despite some recovery in real output. This highlights the difficulty of getting banks to intermediate in the aftermath of a crisis, partly reflecting the persistence of low borrower creditworthiness and lack of good collateral.[7] Some banks may also have switched their portfolio

into more liquid and safer assets. In Indonesia, for example, at end-September 2003 (the latest data), and despite some recovery since the crisis, loans still accounted for only 30% of total banking system assets – less than the value of their government recapitalisation bonds (33%). Caution is needed in interpreting credit data during crises.[8] But overall, in the aftermath of the most recent systemic crises, bank lending remained depressed for several years afterwards, which is likely to have contributed to the fall in output.

Model-based evidence on the financial instability–bank insolvency nexus

The estimates in Section 2 were drawn largely from reduced-form or quasi reduced-form empirical models. In particular, banking behaviour was either suppressed or latent. The empirical estimates also considered separately the two relationships embedded within the solvency-stability nexus.

In this section, we describe an approach which is founded on micro-economic behaviour by all agents, including banks. This means that bank behaviour is endogenous, with banks making profit-maximising choices including about future expected returns on the loans they extend. This approach also allows us to study the two sets of relationship between solvency and stability in an integrated framework rather than separately. As such, this model-based approach is some ways better placed to assess welfare-theoretic and public policy questions. At the same time, quantitative calibrations of this model throw up their own puzzles and peculiarities.

The model by Chen

Banking sector intermediation exists to mitigate informational asymmetry problems – financial frictions – between borrowers and lenders (Freixas and Rochet, 1997). So to model the economic impact of bank behaviour we need, at a minimum, a dynamic model of the economy with embedded financial frictions. Ideally, the model would embed a banking sector with multiple, heterorogenous banks connected to each other through an inter-bank market – thus enabling an analysis of contagion through direct inter-bank links – and would allow for both borrower and bank default and insolvency.

Unfortunately, the literature on dynamic general equilibrium models with micro-founded financial intermediation is still nascent. One important exception is (Chen, 2001) which embeds a representative financial intermediary in a standard model of the macro-economy.[9] The model has been recently modified and applied by (Aikman and Vlieghe, 2004). Haldane, Hall, Saporta and Tanaka (2004) have also used the model to evaluate the welfare implications of financial frictions.

At the heart of Chen's model is a double moral hazard problem in the spirit of Holmstrom and Tirole (1997) – an information asymmetry between entrepreneurs and banks on the one hand, and between banks and depositors, on the other. Entrepreneurs gain private benefits from embarking on bad projects (eg, they might initiate a corporate takeover that is unprofitable but gives them the pleasure of expanding their "empire" – see Jensen, 1986). Banks deter such behaviour through monitoring. But monitoring is costly for banks, and depositors cannot verify whether banks are doing this job correctly when using their deposits to fund good projects. So both entrepreneurs and

banks are potentially subject to a moral hazard problem – entrepreneurial incentives to undertake bad projects and banks' incentives to "shirk" from monitoring.

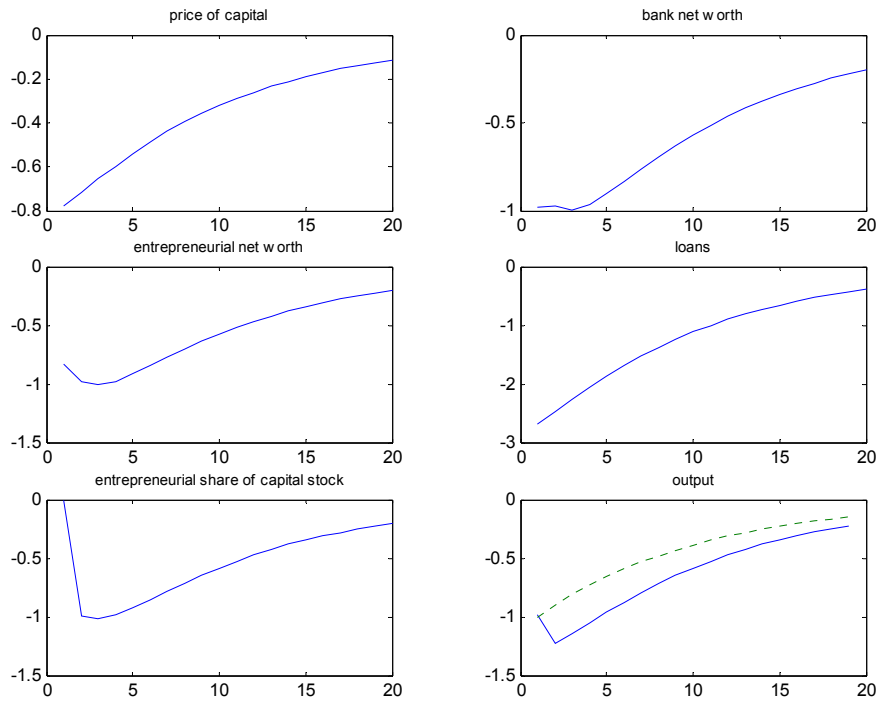
Aggregate output is maximised if households lend all of their money to entrepreneurs via the financial intermediaries. But given asymmetric information, households are willing to deposit their money in a bank only when they can be sure that the bank has adequate incentives to monitor the entrepreneurs. These frictions mean that not all of the economy's capital is channelled to the productive sector. Entrepreneurs face a credit constraint. Equilibrium output depends on the magnitude of this credit constraint, which, in turn, depends on the size of the frictions. For example, when monitoring is very costly, banks have little incentive to monitor their borrowers, so households are unwilling to hold bank deposits. This reduces bank lending to entrepreneurs, thereby lowering steady state output.[10]

From macro shocks to output loss via the financial sector

The framework by Chen allows us to investigate how shocks to the macro-economy can be magnified by the financial sector. This is ultimately the aim of the "stress-test" approach outlined in the previous section. But unlike the stress-tests, a model-based approach allows us to explore the full nexus between macro-shock-banking-sector-health-output-loss.

Chart 1 (reproduced from (Aikman and Vlieghe, 2004)) shows how the key variables in the model respond to a persistent negative shock to productivity. The productivity shock lowers output, bank capital and *ex post* entrepreneurial returns immediately. In the absence of frictions that generate credit constraints, the Modigliani Miller (1958) theorem holds and the effect on output stops there (the dashed line in the bottom right panel of Chart 1). Banks are entirely passive in this scenario and have no impact on output dynamics.

Chart 1: Response to Productivity Shock



Note: Responses to a 1 percent fall in the level of productivity, with an autocorrelation of 0.9 (i.e. 90 percent of the shock persists into the next period and so on). Units along the vertical axis are percentage deviations from the initial level of each variable. The solid line in the bottom right panel represents the response of aggregate output when credit constraints are binding; the dashed line represents the output response when credit constraints are non-binding. The time scale along the horizontal axis represents quarters. And the shock occurs after one quarter.

But in the presence of frictions, this is no longer the case (compare the dashed line with the solid line in the bottom right panel of Chart 1). Financial effects – working through two channels – magnify the effect on output of the initial productivity shock significantly. The first channel is often referred to as the "bank capital channel"; it works as follows. The first-round effect of the productivity shock on bank capital and entrepreneurial returns means that bank owners have less of their own money at stake (ie, less equity capital on the liability side of banks' balance sheets) and face fewer profitable opportunities (ie, lower expected returns on the asset side of their balance sheets). Both effects increase the riskiness of banks in the eyes of depositors. Fewer deposits and less capital imply a contraction in the supply of bank loans which in turn has a second-round negative effect on output.

There is also a second channel at work too – the so called "entrepreneurial-net-worth channel". With less net worth and lower expected returns, banks view entrepreneurs as having less at stake in ensuring good project outcomes. They therefore cut back lending even further. As a result, entrepreneurs are able to buy less capital for use in the following period, which lowers expected

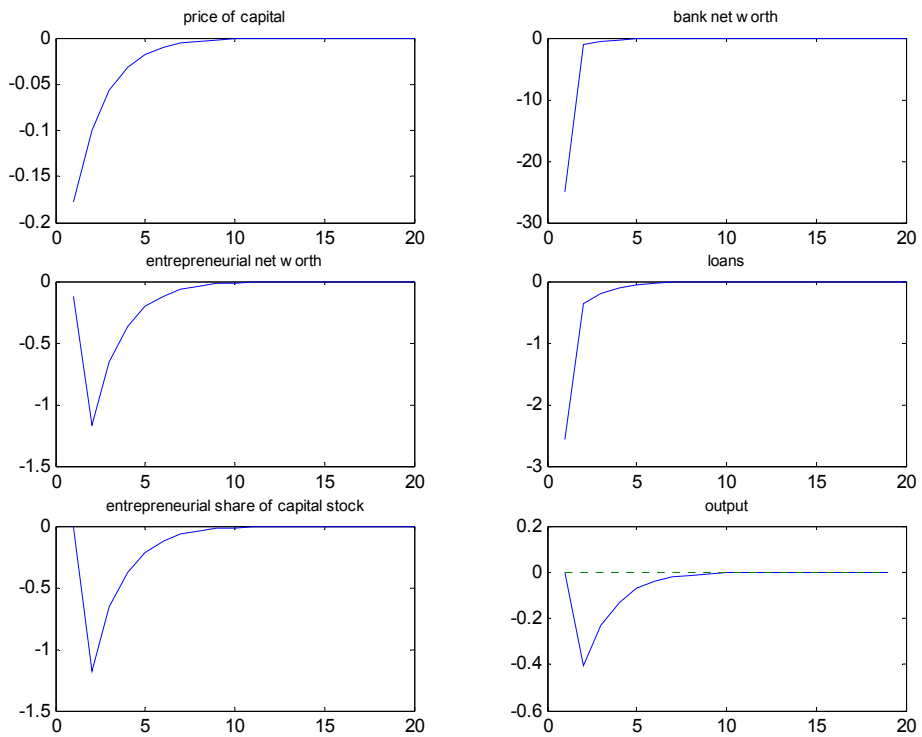
future returns from capital. This depresses entrepreneurial net worth further, amplifying further the impact of the macro-shock.

From banking sector problems to output

The model by Chen also allows us to explore the other aspect of the solvency-stability nexus. In particular, we can trace the behavioural response of the economy to a large exogenous shock to bank capital and measure accurately its impact on output – the equivalent of a systemic banking crisis. Chart 2 (also reproduced from Aikman and Vlieghe) shows the effect of such a shock on key variables in the model.

As with the productivity shock, the effect on output is magnified relative to the frictionless economy (comparing the dashed with the solid line in the bottom right panel of Chart 2). But the quantitative effect on output is more modest and less persistent (compare the scale of the vertical axes in the bottom right panels of Charts 1 and 2). Aikman and Vlieghe provide an illuminating discussion of why this is the case. In a nutshell, the difference is due to the fact that exogenous shocks to bank capital have no first-round effect on the expected profitability of banks. Indeed, after the shock has hit the economy, depositors expect banks to earn a higher return on capital than before, which in turn is perceived to help improve bankers' incentives to monitor entrepreneurs. As a result, the impact on bank loan supply following the shock to net worth is less persistent than is the case with a productivity shock (compare the middle right panels in Charts 1 and 2).

Chart 2: Response to a shock to bank capital



Note: The figures show the percentage deviations from long run equilibrium for each variable following a once-and-for-all shock that reduces bank capital by 25 percent (i.e. were loans to remain constant, the capital-to-asset ratio of the banking sector would fall from 8 percent – the assumed long run value – to 6 percent). The solid line in the bottom right panel represents the response of aggregate output when credit constraints are binding; the dashed line represents the output response when credit constraints are non-binding. The time scale along the horizontal axis represents quarters. And the shock occurs in quarter one.

Discussion

The identification problems that plague the reduced-form and quasi-reduced form approaches described in Section 2 are reduced with a model-based approach. Applications of the model by Chen illustrate this. The "bank capital channel" can be clearly identified and its impact – which, in turn, depends on the source of the shock – can be accurately quantified.

Although illuminating, the model-based results do, however, throw up some puzzles, especially when compared with the reduced-form results. In particular, the model-based approach appears to suggest that the adverse impact of a direct shock to the banking sector is more modest than if the initial shock emanated from the real economy. The literature that has adopted the reduced-form has reached the opposite conclusion.

The comparison between the two approaches should not be taken literally for (at least) three reasons. First, the reduced-form approach cannot distinguish the source of the shock – that is, whether the shock to bank capital is direct (for example, due to losses on credit exposures with foreigners) or emanates from a shock elsewhere in the real economy. Second, the reduced-form estimates on the output costs of banking crises study "tail" outcomes – banking crises. Although Aikman and Vlieghe calibrate the shock to bank capital to be large – a once-and-for-all shock that reduces capital by 25% – it is unlikely that this is strictly comparable to the events analysed in the reduced-form banking crises literature. Table 1 suggests that, on average, non-performing loans as a percentage of total loans during banking crises are around 25%. Given that typical net worth to loan ratios for banks in the UK are around one tenth, this suggests that observed shocks to bank assets during banking crises might be significantly larger than the shock simulated above. Third, in the model by Chen the default rate of entrepreneurs who borrow from banks is set exogenously. There is no mechanism through which a reduction in the supply of loans – a credit crunch – can influence lender default rates which, in turn, can further reduce loan supply.

Despite these caveats, it would be worthwhile continuing to fine-tune model-based estimates of the solvency-stability nexus, to disentangle the true scale of the interactions between the banking sector and the real economy. Debate still rages on the scale of these interconnections and micro-founded models provide a better basis for seeking an eventual quantitative consensus.

Financial Stability Instruments

A Taxonomy of Instruments

Sections 2 and 3 helped establish that the stability-solvency nexus is behaviourally complex and that spillovers between the two may be quantitatively non-trivial. That takes us very naturally to the question of what role public policy might play in mitigating these spillovers and their attendant welfare costs.

When thinking about the instruments of financial stability policy, it is useful to consider a three-way classification (Large, 2004): surveillance; infrastructure; and crisis management. These tools serve potentially different roles at different points along the financial stability transmission process. Some tools are also better equipped for dealing with different of the links embedded within the solvency-stability relationship.

Consider first, for example, the link from broader financial instabilities, or macro shocks, to banking crises. The two tools best equipped to deal with those spillovers are surveillance and infrastructure. Surveillance serves as a form of long-range radar on incipient instabilities. Its role is to spot shocks before they occur - or at least before their deleterious effects begin to take hold. Detection of, and transparency about, those shocks may itself help engineer an orderly, pre-emptive response by private market participants (see (Gai and Shin, 2003)). This, in turn, should lower the probability of fully-blown banking crisis. In essence, that is the rationale behind central banks publishing *Financial Stability Reports*.[11] At the same time, transparency about risks may be a double-edged sword, as the revelation of bad news could itself risk triggering a banking crisis. For

that reason, effective surveillance is probably necessary, but is unlikely to be sufficient, to minimise the adverse spillover effects of macro instability to banking crises.

The second instrument, financial infrastructure, comprises a rather different set of tools. These do not forestall shocks, but rather prevent them generating systemic failure if and when a shock occurs. For example, target ratios for capital or for liquid assets across banks can help cushion the effects of shocks, thereby helping avert system-wide banking crises. International initiatives by the Basel Committee on Banking Supervision, both on liquidity provision and on target capital ratios, are intended to meet this need.

The third tool in the box is crisis management. The usefulness of this tool is greatest when dealing with the second link in the solvency-stability chain – from bank insolvency to broader financial and macro stability. Effective banking resolution can help minimise disruption to asset prices and real and financial activity. But what approach is best suited to minimising such disruption? And in what circumstances?

Methods of resolving a banking crisis

There is a range of options for resolving insolvent banks. At one extreme, a bank can be kept open through an injection of capital. At the other, a bank can be closed, its assets sold and depositors and possibly other creditors paid off. Between these extremes, a bank's licence may be removed but with the bank sold off to another bank, in full or part, to preserve the bank's activities. The extent of involvement by the authorities may also vary. It may be limited to encouraging or organising private sector support, or extended to official financial support, in the limit through government takeover.

When a bank is financially distressed, it is widely accepted that there should be a preference for private sector solutions. These are likely to place existing capital holders in a first-loss position and impose no direct costs on the taxpayer. If an unassisted private sector solution cannot be found, a decision next needs to be made about whether to liquidate the bank or provide some form of government assistance. In exceptional circumstances, if there is a systemic threat, governments might consider a takeover or guarantee of the failed bank.

Plainly, the choice of policy options in a banking crisis is sensitive to the type and size of shock affecting the financial system, in particular whether failures are thought likely to have systemic effects. If the situation is non-systemic, the focus of the resolution is likely to be on the individual failed bank's balance sheet. For example, the failed bank could be merged with a healthy bank or liquidated.

In a systemic situation, however, the immediate aim of the authorities is usually to restore stability of the system as a whole. Guarantees are likely to be necessary to liability-holders of the failed bank(s), and perhaps to the financial system as a whole, to avoid or reduce depositor panic. In these circumstances, the aim is first to stabilise the liabilities of the banking system and thereafter to consider restructuring the assets of the failing banks.

It is possible to put these informal ideas about banking resolution into a structured framework. In essence, systemic crises can be analysed along two dimensions: (i) the breadth of the shock that hits the financial system (for example, is the impact of the initial shock confined to one or two banks or does it affect many banks?); and (ii) the extent to which the initial bank failure(s) then affects the rest of the financial system. Such contagion or spillover effects could reduce the value of other banks' assets through direct exposures to the failed bank, or indirectly, by depressing the price of marketable assets held by other banks. In addition, on the liability side, an initial bank failure could trigger a withdrawal of deposits from other banks thought to face problems similar to the failed bank. A stylised representation of this framework is shown in Diagram 1.

Diagram 1:
Types of shocks to the financial system

TRANSMISSION OF SHOCK ↓ / SHOCK →	Idiosyncratic	Common
No widespread contagion	(Small-medium bank) A Barings BCCI	(Sectoral or regional banks) B S&L (US)
Potential widespread contagion	Continental Illinois C (Isolated LCFI failure)	Small banks (UK) (system-wide crisis) D Nordic countries (early 90s) Japan (90s) East Asia (late 90s)

Quadrant A comprises of an idiosyncratic shock to one bank where the contagion effects for the system are thought to be small, such as the failure of a small or medium-sized bank because of management failure or fraud (eg Barings). Quadrant B shows situations where there are common shocks hitting a number of banks, but where the spillover effects are likely to be small. This would apply when a group of banks have limited interlinkages with the rest of the financial system, such as a specific shock to a region (eg New England in the early 1990s) or sector (eg the US savings and loans crisis in the 1980s). Quadrant C shows situations where the shock is specific but the linkages are thought to be strong. This might involve a large complex financial institution (LCFI). Quadrant D depicts a situation where several banks suffer a common shock that could affect the whole system (eg the Nordic countries in the early 1990s or Japan through the 1990s).

If an idiosyncratic shock causes the failure of a small or medium-sized bank – quadrant A – the policy response itself, or the bank's reaction to the policy action, should have a minimal direct short-term impact on the rest of the financial system. Its borrowers, for example, should be able to switch to other lenders. Other similar banks thought to be weak could lose deposits, but there is likely to be a flight to quality within the financial system rather than a reduction in the aggregate deposits of the system.

The pictures changes if one very large bank fails (quadrant C), or a number of banks fail at the same time (quadrant D). If the LCFI failure is due to a specific factor, such as fraud, the systemic threat will depend on the size and type of direct linkages that the failed bank has with the rest of the financial system. But a more general shock could threaten unconnected banks. In case C – the failure of one large bank – the focus is to maintain the activities of the problem bank or, failing this, to unwind it in an orderly fashion, so as to limit the impact on other financial institutions and markets.[12]

In case D – a system-wide crisis – the key immediate aim of the authorities is usually to stabilise the financial system as a whole (at minimum fiscal and moral hazard cost) and only then to focus on restructuring the failed banks. Most recent systemic crises have typically been caused by an adverse macroeconomic shock weakening the whole financial system, rather than resulting from the impact of contagion following the failure of just one individual bank (see (Borio, 2003)).

This restricts the policy options. In a systemic crisis, no well-capitalised domestic private banks may be available to buy the failed banks, leaving takeovers by foreign banks or the government as the only option. In recent systemic crises, some countries have relaxed rules on foreign entry to allow takeovers by foreign banks – such as in Finland and Mexico – while others have relied more on government ownership. For example, following the banking crisis in Norway, and more recently in South Korea, the government became owner of more than half of the banking system.

It may also be more difficult to penalise stakeholders in a system-wide crisis. In principle, existing shareholders' capital can, and should, be written down during system-wide crises. But evaluating the underlying value of impaired assets may be harder than during normal market conditions. Estimates of cashflow, interest rates and underlying business conditions will be uncertain, as will the value of collateral. This may lead to an understatement of losses, thus imposing costs on taxpayers rather than on existing shareholders. Such understatements occurred recently in Mexico and Indonesia.

In most systemic banking crises during the 1990s, central banks provided liquidity support to problem banks, to offset withdrawals by depositors and other creditors. Central banks have often made losses on this lending to banks that turned out to be insolvent. Blanket guarantees to depositors and other creditors have also often been provided, albeit sometimes temporarily. Confidence in the banking system has in most cases revived quickly. But in highly dollarised banking systems, LOLR has been limited by the level of international reserves and offering guarantees to holders of foreign currency deposits may not in these circumstances be credible. More generally, the credibility of a blanket guarantee may be undermined if the government has a

large debt burden.[13] In the recent Argentinian crisis (2001-2002), for example, a blanket guarantee to liability holders was not given. Such guarantees would not have been credible given that the source of the crisis was the unsustainability of the fiscal position. Instead, to prevent bank runs, a temporary deposit freeze was imposed.

To what extent does empirical evidence bear out these conclusions when dealing with systemic crises? Table 2 shows the relationship between (open-ended) liquidity support and government guarantees and the output losses incurred during 33 recent systemic banking crises. Open-ended liquidity support is defined as support provided for more than twelve months which is greater than the aggregate capital of the financial system; while blanket guarantees are either explicit ones or where state banks account for more than 75% of the banking system's assets (Honohan and Klingebiel, 2003).

After controlling for the importance of bank intermediation in the economy (measured by bank credit/GDP), open-ended liquidity support is associated with *larger* declines in output during a banking crisis.[14] This still appears true after allowing for other factors that may affect output losses, such as whether a currency crisis also occurs (Table 2, equation 1). But there is no evidence, either positive or negative, of an association between deposit guarantees and the output losses of crises (Table 2, equation 2). Provision of open-ended liquidity support may testify to some countries' reluctance to allow banks to fail (see (Bordo *et al,* 2001)). Support was in some cases given to insolvent banks, not just those that were fundamentally sound but illiquid. This may have increased moral hazard, enabled some banks to gamble for resurrection and facilitated continuing financing for loss-making borrowers. The upshot may have been a more protracted period of output loss. But these conclusions are necessary tentative and the results event-specific. And there may be other channels at work. In the next section, we sketch a general framework which might be used to help assess the optimum size and shape of government interaction in a banking crisis.

Table 2:
Impact of liquidity support and government guarantees on output losses

1. YLOSSES1[(a)]

	A. Liquidity support (LOLR)		B. Blanket guarantee (GUAR)	
	(1)		(2)	
LOLR[(b)]	4.5	(1.2)		
GUAR[(c)]			0.7	(0.2)
CRGDP[(d)]	0.34	(5.6)	0.35	(5.6)
CUR[(e)]	9.4	(2.3)	10.5	(2.6)
R^{-2}	0.56		0.54	
DW	2.0		1.9	
Number of observations	32		32	

2. YLOSSES2 [(f)]

	A. Liquidity support (LOLR)		B. Blanket guarantee (GUAR)	
	(1)		(2)	
LOLR[(b)]	28.2	(1.9)		
GUAR[(c)]			-12.4	(0.8)
CRGDP[(d)]	0.99	(4.3)	1.1	(4.5)
R^{-2}	0.42		0.36	
DW	2.7		2.4	
Number of observations	32		32	

Sources: (Honohan and Klingebiel, 2003), IMF and Bank calculations.
Note:
t-statistics in parentheses.
(a) YLOSSES1: Cumulative deviation in the *growth* of output during the crisis period from its ten-year pre-crisis trend.
(b) LOLR: one where liquidity support provided for more than twelve months that is greater than the aggregate capital of the banking system, 0 otherwise.
(c) GUAR: one where explicit government guarantee or implicit one (where state banks account for 75% or more of banking system assets), 0 otherwise.
(d) CRGDP: Bank credit to the private sector/annual GDP (%) at the outset of the crisis.
(e) CUR: one where currency crisis, 0 otherwise. Currency crisis is a nominal depreciation (against the US dollar) of 25% combined with a 10% increase in the rate of depreciation in any year of the banking crisis period.
(f) YLOSSES2: Cumulative deviation in the *level* of output during the crisis period from its ten year pre-crisis trend.

A Framework for Assessing Public Intervention in Bank Resolution

There are few issues more controversial than whether policy makers should shoulder the losses of failing financial institutions in full, in part or not at all. The debate is highlighted by two important recent papers: Gorton and Huang (2004) show that there are circumstances in which *full* coverage is appropriate, while Allen and Gale (2004), in a not dissimilar framework, argue that financial crises may be naturally-occurring, contingent phenomena in a constrained-efficient equilibrium that need *not* call for any response by the authorities at all. The aim of this section is to provide a simple framework within which the *optimal* degree of coverage can be determined.

There are several arguments both in favour and against public guarantees upon, or insurance of, claims on banks. Of those in favour, four stand out:

- Depositors are risk-averse, and often quite unaware of troubles facing banks. They would suffer a direct loss of welfare unless covered;
- Individuals who lose deposits in failing banks may be unable to borrow or liquidate other assets, forcing them to cut consumption sharply;
- The absence of cover could deprive the economy of some of the benefits of financial intermediation;
- Depositors in other, probably solvent banks, may take fright, precipitating a systemic crisis.

In most countries the public authorities provide deposit insurance suggesting these arguments have force. At the same time these objectives could be met in different ways. For example, the first argument might be met in part by making losses on deposits in failed banks tax deductible, though that would only provide partial insurance. The second problem might be solved by offering bank crisis victims *loans,* not grants, but this might fail to meet the first argument. The third argument rests on the idea that as bank deposits come to appear safer, more ex-ante profitable investment opportunities will be exploited through additional bank lending. It is unclear that deposit insurance is the ideal vehicle for remedying such a problem if it exists. The fourth argument carries perhaps the greatest weight. A big run on banks wrongly thought insolvent could turn into a set of self-fulfilling expectations.

There are two main counter-arguments to the provision of government guarantee of deposits:

- Moral hazard which affects both banks and their depositors;
- The fiscal and wider macro costs of generous guarantees may be large.

The first argument stresses that guarantees are equivalent to the public sector issuing a put option on banks' assets. If monitoring efforts are unobservable and privately costly, and taking up this put option is treated as free at the margin, those running banks may affect behaviour, in such a way that banking crises become graver and more likely. Depositors will also be tempted to take less care about where they lodge their funds, with safer banks cross-subsidizing weaker ones as a result. So if today's crisis is resolved with unexpected leniency, relevant parties may alter their actions and make it likelier that the crisis is repeated

While this moral hazard argument has received considerable attention, the second, about its wider macroeconomic and fiscal consequences, has not. It seems perhaps to have been accepted that the conferment of public guarantees, or bailouts for insolvent deposit insurers, involves only modest amounts of additional government debt, or may be that, for Ricardian equivalence reasons perhaps, the consequences of any additional public borrowing can be ignored.

But as discussed in Section 2, the additional public sector borrowing that accompanies severe financial crises is far from trivial. The direct fiscal costs of recent crisis resolution in Indonesia, Mexico and Thailand, for example, are of the order of 20% or more of annual GDP. Amortizing new debt on this scale at a real rate of interest of 5% over, say, twenty years (which is equivalent to assuming the annual recurrence probability of a similar crisis is 5%), implies a need to raise an additional 1.5% of GDP or so each year in tax revenues, if governments cannot or do not reduce their other outlays.

If the country in question taxes all income, including profits, at a flat rate, with no deduction for investment, its output and capital stock depend negatively upon that tax rate.[15] The rate of tax will have to rise to service the additional debt, assuming that the country is taxing below the point of maximum yield. If a crisis is unexpected and/or resolved at an unexpectedly large fiscal cost, long run output will probably have to fall. And the drop is larger if the way a current crisis is resolved makes agents expect an increased frequency and gravity of future crises. This might account for the stylised facts presented earlier whereby output stays depressed for several years after a banking crisis, the more so when accompanied by state guarantees.

The steady state link between tax receipts (R) and the income tax rate, s, would then be a Laffer curve, first rising with s, and then, after a maximum, say at s^*, sloping down.[16] And with s at either of its extreme values, 0 or 1, R vanishes.[17] If the production function is Cobb Douglas, $s^* = 1-\gamma$, where γ is the competitive profit share. This creates a long run link between output per head, $f(k)$, and s.[18]

The third link between R and the degree to which financial crisis losses are absorbed by the state. Let the authorities bear the fraction ξ of such losses $(1 \geq \xi \geq 0)$, and let the probability of a crisis in any year be $[N\chi(\xi)]^{-1}$, with $\chi' < 0$: greater generosity increases the incidence of crisis, given moral hazard effects. Moral hazard may also affect the gravity of losses, z, in a financial crisis too, so $z = z(\xi)$.

We need to distinguish between a *primary* crisis of z, and a *systemic* crisis. Denote a crisis by $z(1+p(1-\xi))$, where $p \geq 0$ is a parameter capturing "systemicity". Let the primary crisis of total size z affect a fraction τ of the population and assume a systemic crisis affects everyone else. The extra fiscal revenue needed annually to meet crisis resolution costs is $\Delta R = \xi h(\xi) z(\xi)(1+p(1-\xi))$, where $h(\xi) = \beta\{1-(1+\beta)^{-N\chi(\xi)}\}^{-1}$ is the cost of amortizing an additional \$1 over $N\chi(\xi)$ years at a net-of-tax rate of β. So, $R = R(\xi)$, with R' typically (if not invariably) positive. Greater official

liberality in covering financial crisis losses goes hand-in-hand with a higher tax rate, a higher pre-tax interest rate, and lower capital and output.

This gives the case against generous official coverage of crisis losses. Crises are bigger and more frequent (though less systemic), and output per head is typically squeezed by the need to increase the rate of income tax. What about the advantages? Generosity helps to sustain crisis victims' consumption when the crisis hits. With no coverage, crisis victims would lower their consumption sharply, if only briefly. The more risk-averse they are, the greater the social gain from cushioning them from some of the loss they would otherwise face. On top of this, more official generosity implies a reduced chance of a run on other banks.

What each of the primary crisis victims will lose in such an event is $(1-\xi)z(\xi)/\tau$; each of the others loses $(1-\xi)^2 pz(\xi)/(1-\tau)$. If the social welfare function is Benthamite (average utility) and writing their respective crisis consumption levels as c_V and c_N, and the coefficient of relative risk aversion, assumed constant, as α, the *marginal benefit of loss coverage* in any year in which a crisis occurs will be:

$$MB = [c_V^{-\alpha}(z(\xi)-(1-\xi)z'(\xi)) + c_N^{-\alpha} p(1-\xi)(2z(\xi)-(1-\xi)z'(\xi))]\,[N\chi(\xi)]^{-1} \qquad (1)$$

Here the frequency of crises is $[N\chi(\xi)]^{-1}$, so the expression for marginal benefit should be multiplied by that.

Meanwhile, the *marginal cost of loss coverage* consists of two elements: (i) the loss in steady-state consumption due to the rise in (distortionary) taxation needed to service and amortize the extra debt, and (ii) the loss in welfare from the increased frequency of crises. This can be expressed as:

$$MC = [\frac{z(\xi)(1+p(1-\xi))c^{-\alpha}}{N\chi(\xi)}]\{\frac{h}{Y}(1+\frac{\xi z'(\xi)}{z(\xi)}-\frac{p\xi}{1+p(1-\xi)}-\xi Nh\chi'(\xi))Z-\frac{\chi'(\xi)(1-\xi)}{\chi(\xi)})\} \qquad (2)$$

where $Y \equiv \frac{(1-s)(1-\gamma)}{\gamma} - s$ and $Z \equiv N\chi(\xi) + [(\frac{c}{c_N})^{\alpha} - 1] + \tau[(\frac{c}{c_V})^{\alpha} - (\frac{c}{c_N})^{\alpha}] > 0$. Y must be positive if s is to the left of the Laffer curve maximum.

If the public authorities are concerned to maximize a representative agent's expected steady state utility, the maximand will be

$$W = [N\chi(\xi)(1-\alpha)]^{-1}\{(N\chi(\xi)(c^{1-\alpha}-1) + (c_N^{1-\alpha} - c^{1-\alpha}) + \tau(c_V^{1-\alpha} - c_N^{1-\alpha})\} \qquad (3)$$

and steady state consumption (in non-crisis years), c, equals q minus government spending, G, which we take as constant. With q Cobb Douglas ($q = k^{\gamma}$, $1 > \gamma > 0$), capital's marginal product, $\gamma k^{\gamma-1}$, equals the long run rate of interest grossed up for tax, $\beta/(1-s)$. So the marginal effect of s upon c is $-\gamma q/(1-\gamma)(1-s)$. A balanced budget for the government implies $sq = \beta D_0 + \Lambda + G$,

where D_0 is recurrent debt independent of crisis amortization costs, and Λ equals these costs. Λ will equal $\xi z(\xi)h(1+p(1-\xi))$. So maximizing (3), subject to the constraint Min$[\xi, 1-\xi] \geq 0$, normally entails equating marginal benefit and marginal cost, (1) and (2). This will describe an interior solution ($1 > \xi > 0$) if the welfare curve, *W*, is humped in this range, as a function of ξ. If *W* is always increasing, full coverage (ξ=1) is best; if always decreasing, optimal coverage should be zero.[19]

If there is a single interior optimum, ξ^* what influences its size? We may infer:

(i) a rise in the knock-on effect parameter – making the crisis more systemic – will raise optimal coverage of government guarantees;
(ii) exogenous increases in the coefficient of relative risk aversion, α , or the size or probability of the crisis *z* and N, or downward-flexibility of *G* during or immediately after the crisis also increases the optimal coverage ratio;
(iii) an exogenous rise in the income tax rate, *s*, will reduce optimal coverage;
(iv) optimal coverage falls if moral hazard effects strengthen (raising z' or making χ' more negative), and also if crisis victims are able to sustain consumption at times of shock by borrowing on their own.

These results describe time-consistent, optimum policy in a recursive, certainty-equivalent setting. The authorities might be tempted to act time-inconsistently. What would that imply? If preoccupied with dealing with a crisis here and now, they may not pay much attention to longer-run effects. In particular, they may discount the terms in z' and χ'. This will raise perceptions of marginal benefit and lower those of marginal cost. They be more generous in covering the crisis. The short-run discretionary optimum value of ξ will be larger than the ξ^* that equates (1) and (2); it might jump to its maximum of unity. That might also happen if policy makers discounted the future faster than the private sector.

An unexpectedly severe crisis may provoke quite different reactions from a "standard" one. Victims' marginal utilities of consumption will be huge when the crisis hits. The risk of recurrence of a crisis on this scale may be judged remote, so that the current, abnormally high value of ξ may not just be warranted, but also leave future expectations of lower ξ unaffected and thus do little, if any, damage through moral hazard effects. Bu the consequences will involve an unanticipated and enduring rise in income tax rates. That will depress capital and output, over time. If labour were endogenous (we have simplified our model, by assuming it is not), and if $\alpha > \gamma$ (a highly plausible assumption), agents will react by supplying less labour right away, and though this effect is not permanent, it will undoubtedly depress the time path of output in the immediate aftermath of the crisis and beyond.

Many other refinements could be made to the model, to incorporate monetary variables explicitly, to open the economy, to depart from certainty equivalence, to micro-found the $z(\xi)$, $\chi(\xi)$ and $p(\xi)$ functions, and to explore the dynamics. Even in its simple form sketched above,

nonetheless, the framework serves as a way of organizing thoughts about the intricate, important and controversial issue of how much state coverage of banking system losses is appropriate in crises. In principle, it might be possible to calibrate the model, say the $z(\xi)$, $\chi(\xi)$ and $p(\xi)$ functions, to conduct comparative static experiments. If nothing else, the model makes clear that there is no one-size-fits-all answer to the question of optimal public intervention in a banking crisis. Different solutions befit different situations. The framework presented here outlines the key factors that might determine this public policy choice.

Open Issues in Bank Resolution

We conclude with some thoughts on two issues on the banking resolution front where there remains uncertainty or ambiguity, not all of which is probably constructive. These issues could form part of a forward-looking agenda for policymakers.

Judging "Systemic"

Academics and policymakers are largely agreed that systemic importance is a key criterion when judging how best to respond to crises. What they have been unable to agree upon, however, is a coherent quantitative definition of "systemic". In some ways it is striking that so little progress has been made on this question. It would be the equivalent of monetary policymakers acting without a coherent yardstick for the prices of goods. On the other hand, the conceptual and measurement problems associated with measuring systemic risk are much more acute than for consumer prices.

There are several aspects of systemic risk that might bear further consideration. First, how far is it possible to judge systemic importance *ex-ante*? If systemic risk is a public bad, regulation can be used as an *ad valorem* tax on systemic risk to minimise provision of that bad. But to set such a tax schedule would require ex-ante quantitative measures of systemic risk. Because systemic risk is rooted in externalities across institutions or markets, it cannot be measured by balance sheet size alone. Simulation, sensitivity analysis or stress-testing would be necessary, all of which are relatively embryonic in a banking context.

Given this unresolved measurement problem, it is perhaps not surprising that there has been no attempt in practice to quantify regulation on the basis of systemic risk. Rather, current practice is to key regulation – for example, capital and liquidity ratios – off idiosyncratic risk. While measurable, this risk does not necessarily equate with a market failure or externality, unlike systemic risk.

Second, how far is it possible to judge systemic importance *ex-post*? After a crisis has struck, it is perhaps situations, rather than institutions per se, that are systemic. The reason is that time – or rather the lack of it – blurs the distinction between liquidity and solvency in real crises. When time is short, the two may effectively be one and the same. Policy authorities may often be willing to take actions when time is short which they would not countenance if given a longer window for action. For example, they might extend liquidity when there are genuine concerns about solvency, but there is not the time to assess this properly nor to wind-down the firm in an orderly fashion. This means that, even if ex-ante criteria for systemic importance were defined, these may need to be

overridden in crisis circumstances if the time interval is short. Ex-post measures of systemic importance are inevitably event and time-specific and as such are unlikely to be amenable to simple quantification. [20]

Third, is systemic importance better measured using monetary or welfare units? The two need not and often will not deliver the same outcome. LTCM was systemic by dint of the sheer size of its positions, even though end-investors in LTCM were both small in number and rich enough to bear the consequences without a significant loss of welfare. The savings and loans institutions were systemic less because of their size and more because of the adverse welfare implications of their failure for thousands of end-savers and borrowers. [21] Where regulators draw that line is a difficult judgement.

All three of these issues present real choices and challenges to policy makers. There is an urgent need for further conceptual and quantitative research to better enable policy makers to make these choices.

Dealing with Large Complex Financial Institutions (LCFIs)

Recent years have seen the emergence of a new type of financial entity – the LCFI. The challenges these new entities pose are partly the consequence of them being "large", but are most acute as a result of their "complexity". The scale of LCFI operations inevitably raise traditional concerns about "too big to fail". In equal measure, however, they have raised fears about "too big to save". In other words, we may be about to enter an era where financial crises, while less frequent than in the past, are also on a larger scale when they do arrive – an era of "super-systemic" crises (see (Haldane, 2005)).

The complexity of LCFIs derives from their crossing traditional boundaries, both functional (commercial banking, investment banking, insurance, fund management etc) and geographic. Though the former is the development most often focussed on the latter poses at least as many headaches from a regulatory perspective. Cross-border financial institutions have traditionally been regulated on a "home country" basis – that is to say, lead regulation is undertaken by the authorities where the institution is legally incorporated. This approach has some logic from a financial stability perspective, as it would be the home legal jurisdiction that would dictate the terms and conditions of any winding-up of that entity.

That logic begins to fray, however, when we consider stressed situations short of genuine insolvency. Who provides the liquidity and/or the capital to mitigate problems in those situations? The home country may in some cases have neither the resources (for example, in the case of a liquidity problem in a foreign jurisdiction) nor the incentives (for example, in the case of a solvency problem in a foreign jurisdiction) to act optimally. Put at its most general, LCFIs potentially give rise to situations where there is a disjunction between those charged with limiting systemic risk (the home country) and those bearing that risk (the host). And that, in turn, calls into serious question the home-host model of international supervisory co-operation.

In a world of LCFIs, further thought needs to be given to how, and by when, liquidity and capital might be provided to a distressed entity in the context of banking resolution. By definition, this is likely to require some international agreement among policy authorities, both home and host. This will not happen quickly. But if super-systemic crises indeed become a reality, the pressure for such an agreement will tend to increase rather than diminish with time.

[1] The initial shocks assumed in each scenario were a 35% decline in world and UK equity prices; a 12% decline in UK house and commercial property prices; a 1.5 percentage point unanticipated increase in UK average earnings; and a 15% unanticipated depreciation in the trade-weighted sterling exchange rate. For more details, see Hoggarth and Whitley (2003).
[2] See Elsinger, Lehar and Summer (2003) and Wells (2002).
[3] The UK shocks were calibrated to be in the order of a 1 in 200 event (ie 99.5% confidence) whereas our discussions with major UK banks suggest they hold capital to withstand 99.98% (3999/4000) events.
[4] A currency crisis is defined here, as in Frankel and Rose (1996), as a nominal depreciation in the domestic currency (against the US dollar) of 25% combined with a 10% increase in the rate of depreciation in any year of the banking crisis period. The latter condition is designed to exclude from currency crises high inflation countries with large *trend* rates of depreciation.
[5] However, raising (non-lump sum) taxes may have a large distortionary impact on economic welfare.
[6] For a discussion of the issues in measuring the output costs of banking crises see Hoggarth and Saporta (2001).
[7] There is a difficult identification problem of knowing the extent to which the decline in the amount of credit and its share of total assets reflects either (i) a desire for banks to reduce lending, (ii) a constraint, such as insufficient capital, on the ability of banks to lend, or (iii) a fall in loan demand by banks' customers.
[8] One problem in interpretation is that credit data include write-offs of bad loans.
[9] Although, unsurprisingly given the state of technology, the model falls short of the 'ideal' model described above.
[10] Haldane *et al (*2004) show that the impact on output of even moderate monitoring costs (as a percentage of output) can be very significant.
[11] Including the UK (since 1996), Sweden (1997), Hungary (2000), Norway (2000), Austria (2001), Spain (2001), Belgium (2002), Denmark (2002), France (2002), Canada (2003), Finland (2003), and Australia (2004), together with the International Monetary Fund and the Bank for International Settlements.
[12] In the United States, for example, the FDIC would probably set up a bridge bank immediately following the failure of a (deposit-taking) LCFI (Bovenzi ,2002).
[13] See Hoelscher and Quintyn (2003) for a discussion of resolution policies in economies with highly dollarised banking systems and large government debt burdens.
[14] Output losses are measured on the basis of the two methods discussed earlier.
[15] So we assume that this country, like most, does not follow the advice of Lucas (1990) or Kaldor (1956) to exempt profits or deduct net investment from the tax base.
[16] For sufficiently low *s, R* is increasing in *s*, but beyond *s**, the curve starts to slope down.
[17] The assumptions behind this Laffer curve include: a given discount rate for utility, β, in continuous time; exogenous population, technology and labour supply, with infinitely lived and homogeneous individuals; perfect competition, with output per head an increasing, concave function of capital per head, k ; a steady state with stationary consumption; and all income taxed at the rate *s*.
[18] Perfect competition and stationarity, meanwhile, will imply $f'(k) = \beta/(1-s)$, so that $q \equiv f(k) = f(f'^{-1}(\beta/(1-s)))$. Under Inada conditions, *f(k)* vanishes at *s*=1, and this explains why *R*=0 (=*sf(k)*) here too. As *s* falls below this, output rises, and the relation is concave if capital's share of income is less than one half.
[19] If *W* is M shaped, the optimal coverage is given at the higher hump, and a W-shaped welfare curve could indicate full, interior or zero coverage, depending on which gave highest welfare. These strange cases are in fact quite conceivable, because we cannot be quite sure that the marginal benefit curve slopes down, nor that the marginal cost curve slopes up, throughout their lengths. The *MC* curve can misbehave because of the influence of the systemicity parameter, *p*. Intuitively, greater coverage could be cheaper than less if this lowers the knock-on effects the financial crisis has on other banks enough. So the second order condition for an interior optimum, that *MC* cuts *MB* from below, is important. Furthermore, if either $\chi(\xi)$ or $z(\xi)$ were undifferentiable, the *W* curve would display discontinuity.
[20] Better disclosure, accounting and auditing standards, however, can help mitigate, to a degree, the difficulty in making these *ex post* judgements.
[21] A similar argument can be made when comparing the systemic importance of a banking crisis affecting a low income country vis-à-vis that of higher income country

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