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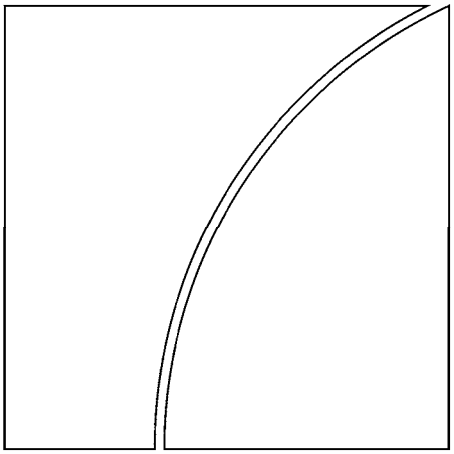

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No 60

Macroprudential regulation and policy

Proceedings of a joint conference organised by the
BIS and the Bank of Korea in Seoul on 17–18 January 2011

Monetary and Economic Department

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Papers in this volume were prepared for a conference organised by the BIS and the Bank of Korea in Seoul on 17-18 January 2011. The views expressed are those of the authors and do not necessarily reflect the views of the BIS or the institutions represented at the meeting. Individual papers (or excerpts thereof) may be reproduced or translated with the authorisation of the authors concerned.

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Foreword

The Bank for International Settlements (BIS) and the Bank of Korea (BoK) jointly organised a conference on macroprudential regulation and policy in Seoul, Korea, on 17–18 January 2011. The conference aimed to bring academics together with researchers at central banks and other public institutions to present and discuss ongoing theoretical and empirical work in the field. In response to their call for papers, the organisers received more than 75 submissions from central banks, public agencies, supranational organisations and academic institutions. From these, a selection committee from the BIS and the BoK chose 12 papers organised around the following four themes: (i) systemic risk; (ii) financial system procyclicality; (iii) macroeconomic impact studies and early warning indicators; and (iv) effective implementation of macroprudential policy.

In all, 35 participants took part, including central bank economists from Asia and the Pacific, Europe, Latin America and the United States, as well as academics from Europe, Korea and North America. Governor Choongsoo Kim of the BoK gave the welcome address, and Governor Stefan Ingves of Sveriges Riksbank and Professor Hyun Song Shin from Princeton University gave keynote speeches. The conference concluded with a policy panel focusing on macroprudential policy frameworks. This volume is a collection of the welcome address, keynote speeches, revised versions of all papers presented during the conference and the panel discussions.

Programme

Sunday 16 January

19:30	Welcome dinner hosted by Eli Remolona, Chief Representative, BIS Representative Office for Asia and the Pacific

Monday 17 January

09:00–09:20	Welcome address by Choongsoo Kim, Governor, Bank of Korea
09:20–10:00	Keynote speech by Hyun Song Shin, Professor, Princeton University ***"Macroprudential policies beyond Basel III"***
10:00–10:30	Group photo and coffee break
Session 1	***Systemic risk***
10:30–12:45	Chair: Dosoung Choi, Monetary Policy Committee Member, Bank of Korea
	Paper 1:
	"Systemic risk measures: the simpler the better?", **María Rodríguez Moreno** and Juan Ignacio Peña (Universidad Carlos III de Madrid)
	Discussant: Baeho Kim (Korea University)
	Paper 2:
	"Systemic risk contributions", Xin Huang (University of Oklahoma), **Hao Zhou** (Federal Reserve Board) and Haibin Zhu (BIS)
	Discussant: Prakash Kannan (International Monetary Fund)
	Paper 3:
	"Systemic capital requirements", **Lewis Webber** and Matthew Willison (Bank of England)
	Discussant: In-Ho Lee (Seoul National University)
12:45–13:45	Lunch
Session 2	***Procyclicality***
13:45–16:00	Chair: Ignazio Visco, Deputy Director General and member of the Governing Board, Bank of Italy
	Paper 4:
	"Monetary policy framework and financial procyclicality: international evidence", Kyungsoo Kim, Byoung-Ki Kim and **Hail Park** (Bank of Korea)
	Discussant: Dong He (Hong Kong Monetary Authority)

***Session 2** (cont)*

13:45–16:00

Paper 5:

"Boom-bust cycles and stabilisation policy – monetary and macroprudential rules: a loss function approach", Caterina Mendicino (Central Bank of Portugal) and **Maria Teresa Punzi** (Central Bank of Ecuador)

Discussant: Anella Munro (Reserve Bank of New Zealand)

Paper 6:

"Optimal macroprudential regulation in a Fisherian model of financial crises", Javier Bianchi and **Enrique G Mendoza** (University of Maryland)

Discussant: Dimitrios Tsomocos (University of Oxford Business School)

16:00–16:30 Coffee break

Session 3 ***Macroeconomic impact study and early warning indicators***

16:30–18:00 Chair: Christine Cumming, First Vice President, Federal Reserve Bank of New York

Paper 7:

"The long-term economic impact of higher capital levels", Jochen Schanz, David Aikman, Paul Collazos, **Marc Farag**, David Gregory and Sujit Kapadia (Bank of England)

Discussant: Ilhyock Shim (BIS)

Paper 8:

"Macrofinancial vulnerabilities and future financial stress: assessing systemic risks and predicting systemic events", Marco Lo Duca and **Tuomas Peltonen** (European Central Bank)

Discussant: Joshua Aizenman (University of California at Santa Cruz)

19:00–21:00 Conference dinner hosted by Choongsoo Kim, Governor, Bank of Korea

Tuesday 18 January

09:00–09:40 Keynote speech by Stefan Ingves, Governor, Sveriges Riksbank "Challenges for the design and conduct of macroprudential policy"

Session 4 ***Effective implementation of macroprudential policy***

09:40–11:30 Chair: Frank Packer, Head of Financial Stability and Markets in Asia and the Pacific, BIS

***Session 4** (cont)*

09:40–11:30	**Paper 9:** ***"Getting effective macroprudential policy on the road: eight propositions"***, Dietrich Domanski and Tim Ng (BIS) **Paper 10:** ***"Countercyclical tools: a comparative assessment"***, **Sang Chul Ryoo** and Cheol Hong (Bank of Korea) **Paper 11:** ***"Macroprudential policy and central bank communication"***, **Benjamin Born** (University of Bonn), Michael Ehrmann and Marcel Fratzscher (European Central Bank) **Paper 12:** ***"Thoughts on the proper design of macro stress tests"***, **Petr Jakubík** (European Central Bank) and **Gregory D Sutton** (BIS)
11:30–11:50	Coffee break
11:50–13:00	***Policy panel on the macroprudential policy framework*** Chair: Stefan Ingves, Governor, Sveriges Riksbank **Panelist 1:** Hoo-Kyu Rhu, Director General, Financial System Stability Department, Bank of Korea **Panelist 2:** Christine Cumming, First Vice President, Federal Reserve Bank of New York **Panelist 3:** Ignazio Visco, Deputy Director General and member of the Governing Board, Bank of Italy **Panelist 4:** David Longworth, Former Deputy Governor, Bank of Canada
13:00–13:10	***Wrap-up remark***
13:10–14:30	Lunch
14:30–19:00	Local tour

List of participants

Central banks

ECB	European Central Bank **Petr Jakubík** Economist Directorate General International
	Tuomas Peltonen Principal Financial Stability Expert Directorate General Financial Stability
Ecuador	Central Bank of Ecuador **Maria Teresa Punzi** Senior Economist Economics Department
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Italy	Bank of Italy **Ignazio Visco** Deputy Director General and member of the Governing Board
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United Kingdom	Bank of England **Marc Farag** Analyst Prudential Policy Division
	Lewis Webber Senior Economist Risk Assessment Division
United States	Federal Reserve Bank of New York **Christine Cumming** First Vice President
	Federal Reserve Board **Hao Zhou** Senior Economist Risk Analysis Section, Research Division

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	Seoul National University **In-Ho Lee** Professor Department of Economics

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	Frank Packer Head of Financial Stability and Markets Monetary and Economic Department
	Ilhyock Shim Senior Economist Monetary and Economic Department

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Policy Panel on the Macroprudential Policy Framework

Welcome address

Choongsoo Kim[1]

I bid a warm welcome today to all of you attending this conference, held jointly by the Bank of Korea and the BIS. Let me first single out for appreciation our keynote speakers, Governor Stefan Ingves of the Swedish Riksbank and Professor Hyun Song Shin of Princeton University. Their attendance as lecturers adds special lustre to our proceedings. I anticipate that, with their abundant experience and keen powers of discernment, these two experts will have great insights for us concerning the new policy tasks and changes in role of central banks since the global financial crisis. My thanks go out in addition to Eli Remolona, Chief Representative of the BIS Asia and Pacific Representative Office; Christine Cumming, First Vice President of the Federal Reserve Bank of New York; Ignazio Visco, Deputy Director General and Member of Governing Board of the Bank of Italy; David Longworth, Former Deputy Governor of the Bank of Canada, and to all of our other chairs, presenters and discussants, for your efforts to make this conference a success.

The global financial crisis has shown us the importance of shifting to a new paradigm in the macrofinancial stability framework as well as in the international financial order. In particular, a broad consensus in the international community has developed on the necessity of designing various tools, including macroprudential policies, to counter the heightened mood of anxiety we now see everywhere concerning systemic risk. This being the case, the theme of our conference, "Macroprudential regulation and policy", will be viewed with intense interest by the central banks and regulatory authorities that are responsible for financial stability. I am sure that the invaluable comments and policy proposals raised during this week's conference will be of great help to central banks and those in charge of government policy throughout the world.

Lessons of the global financial crisis

The global financial crisis that we are witnessing is the greatest shock to the world economy since the Great Depression of the 1930s, in terms of both intensity and duration. Even now the financial markets have not fully recovered to their pre-crisis level of activity. Nor can we rule out the possibility of the current recovery faltering, in view of the prolonged crisis aftershocks such as the continuing contagion from the European debt crisis. Various new expressions have consequently made their way into the mass media, including talk of a "two-speed global recovery", amid worries of widening of the gap in recovery between advanced economies and the newly emerging market economies, and of a so-called "three-way split", envisioning divergent patterns of economic growth in the United States, Europe and emerging markets including China.

When we look back at the history of economic crises, we find that, while they may have always been accompanied by massive financial and economic losses, they have also sparked reforms of existing systems. And so, as suggested by the expression "don't waste a crisis", if we can learn a lesson from it, a crisis can also be a valuable experience. We therefore need to work our way toward practical and concrete proposals to avoid a repetition

[1] Governor, Bank of Korea.

of this financial crisis based on the painful lessons we have learned. In this light, this week's conference will, I am sure, be a most timely and significant meeting of minds.

We can, I think, draw several vital policy lessons from the recent global financial crisis.

First and foremost, no matter how sound the economy of a country is in terms of macroeconomic fundamentals, its financial system is closely tied to the international financial markets. It may therefore be suddenly hit by the rapid worldwide spread of a shock from accumulated financial imbalances. In particular, the web of linkages between financial institutions acts to allocate risk efficiently when the going is good, but in times of turmoil it serves as a channel for risk transmission. It follows that the risk to the financial system overall is massively larger than the simple total of the risks of individual financial institutions. It is therefore extremely important to manage risk on the basis of the financial system as a whole, given the difficulty of securing macrofinancial stability solely through the microprudential regulation of individual financial institutions.

Second, while financial innovation does indeed promote efficiency, it can also act to foment financial imbalances. Furthermore, when the financial sector's growth outpaces that of the real sector, it may destabilise the macro economy. It is therefore hard to say for sure whether apparent financial development always plays a beneficial role in sustainable economic growth.

Third, price stability cannot by itself guarantee financial stability. Where the economy maintains low prices and rapid growth for a lengthy period of time, it is not unlikely that an accumulation of financial imbalances threatening financial system stability will be overlooked.

Last but not least, in a world economy of great mutual dependency between the financial and real sectors of the economy, to counter global financial crises we have no option but to turn to international cooperation. Fortunately, in the early stages of this last crisis, it proved possible to achieve successful international policy cooperation through the G20, the premium forum that leads the international debate on world economic stability. Under the aegis of the G20, moreover, the Financial Stability Board and the Basel Committee on Banking Supervision (BCBS) efficiently headed up international cooperation in the sphere of financial regulation.

Macroprudential policy tasks

In the wake of the global financial crisis, the dangers of systemic risk propagation must be recognised and the macroprudential soundness of the economy as a whole enhanced so as to counter them. Prior to the global financial crisis, financial systemic risk was insufficiently understood, and we cannot deny that the significance of such risk was underestimated. Similarly, in seeking to reduce the severe damage to the real economy arising from systemic risk, we need to move away from an emphasis on microprudential regulation to an approach that also incorporates a macroeconomic policy dimension.

Based on the aforementioned lessons from the global financial crisis, countries around the world are now involved in drawing up various plans for underpinning sustainable and balanced growth in a process centring on the G20. And, at the last G20 Summit in Seoul, substantial outcomes were achieved in the move towards the introduction of macroprudential policy-based financial regulation. That said, a large number of issues remain unresolved, as macroprudential regulation is still in its infancy.

Let me cite some examples. How should financial stability, which is the goal of macroprudential policy, be defined? And again, how can we reconcile macroprudential policy tools with our instruments of microprudential regulation? Further, how should we pursue financial stability jointly with monetary policy, which emphasises price stability, and what institutional arrangements must be put into place to facilitate macroprudential policy

cooperation with the supervisory authorities? On these and other issues, proposals based either on experience or on concrete theoretical grounds have yet to be presented.

Meanwhile, the correction of disequilibria in the global economy is an overall imperative, not just to eliminate the factors behind the current crisis but also to secure the future stability of the international financial order. We should therefore step up efforts to resolve the global imbalances in trade and capital movements that were among the root causes of the global financial crisis. Although the issue of these global imbalances has repeatedly loomed as a problem in the past, the international community has hardly started to undertake joint efforts to reduce them.

I hope that before long a consensus will be reached, under the aegis of the G20, on indicative guidelines for current account positions designed to resolve the global imbalances.

The existing framework of global financial regulation was largely designed with advanced countries and the banking sector in mind. And because of financial innovation and the like, the financial system has undergone great structural transformation with the rapid growth of the parallel "shadow banking system" encompassing investment banks, hedge funds and special purpose vehicles. In keeping with the reform of the financial environment, therefore, all major financial institutions in the markets, irrespective of their legal forms, should now be made subject to regulation. Furthermore, international consensus has also formed on the need for strengthening regulation of systemically important financial institutions (SIFIs). In practice, however, it has not been possible yet to draw up international standards for the selection of SIFIs, or for the method of their regulation. Within emerging market countries, similarly, the need for the regulation of SIFIs has now clearly emerged and very thorough discussion of this issue is called for.

In addition, concrete research is required to identify how the reorganisation of the international financial order will impact the financial structure and the financial and capital markets of emerging market economies. What effects the new capital and liquidity regulations decided on at the recent G20 Seoul summit will have on our the current interest rate-oriented monetary policy must also be determined. New factors restricting monetary policy may also be on the horizon. I am thinking here, for example, of the possibility of a conflict with interest rate policy arising from the liquidity control function of a countercyclical capital buffer, which is among the macroprudential policy instruments now being discussed.

Closing words

Historically, economic crises have led to crises in the field of economics itself. And economists and economic institutions by and large failed to predict the recent global financial crisis until it actually erupted, owing to their lack of understanding of speculation in the real estate market and of the behaviour and competition structures of banks. Nor can central banks escape this criticism. At the same time, however, the status of central banks has risen since the crisis, given their energetic participation as lenders of last resort in the process of overcoming it, in a manner very different from that seen during previous crises. However, there is also a heightened possibility now that the monetary policy credibility of central banks will be weakened, due to the conflict between their policy goals of financial system stability and price stability. In this context, as guardian of the financial system, the central bank is called upon by society to bear the responsibility for macroprudential regulation and policy, and to carry out the related tasks of analysis and examination.

As I have previously noted, the most vital and difficult mission now confronting us is the efficient management of systemic risk. And for this purpose I see it necessary to operate more advanced forms of regulatory surveillance and macrofinancial stability policy, to secure a more diverse range of policy instruments for ensuring soundness, and to further strengthen both international cooperation and market discipline. The recent debate in the G20 and the

BIS on developing and introducing macroprudential policy instruments has now also been reinvigorated. Notably, with regard to newly emerging market countries, which are relatively more exposed to excessive market risk and foreign currency liquidity risk than advanced countries, detailed evaluation is needed of the influence on their financial systems of proposed new micro- and macroprudential regulatory tools. And attention must also be given to choosing the right combination of regulations that can bring about the largest synergy effects.

As we have seen during the recent global financial crisis, the bankruptcy of huge financial conglomerates can potentially weaken the function of market competition – not only by heightening systemic risk but also due to too-big- or too-connected-to-fail expectations and the consequent possibility of government bailout. The macroprudential framework should thus be designed from a holistic perspective to prevent side effects arising from possible structural changes in the financial market and to shore up the function of the financial system in the long run.

I look forward to constructive and thorough discussions today and tomorrow on the meaning of macroprudential regulation and policy, on the tasks ahead, and on the role of the central bank in this regard. It will also be valuable if we can put our heads together to consider the impact of macroprudential policy on the real economy, and its relationship to other economic policies.

Drawing my remarks to a close, I should once again like to voice my deepest thanks to you all for setting aside some of your valuable time to be here. I know how busy the schedule is, but I do hope you will also have a chance, during your all too short stay here, to savour the beauty of Korea’s culture and natural environment.

Macroprudential policies beyond Basel III

Hyun Song Shin[1]

The centrepiece of the new capital and liquidity framework for banks known as Basel III is a strengthened common equity buffer of 7% together with newly introduced liquidity requirements and a leverage cap, to be phased in over an extended timetable running to 2019.

The elements that were most promising in living up to the macroprudential aims of regulatory reform – the countercyclical capital buffer and the capital surcharge for the systemically important financial institutions (SIFIs) – proved most controversial and have yet to be finalised.

Under its currently agreed form, Basel III is almost exclusively *micro*prudential in its focus, concerned with the solvency of individual banks, rather than being *macro*prudential, concerned with the resilience of the financial system as a whole.

The language of Basel III is revealing in this regard, with repeated references to greater "loss absorbency" of bank capital. However, achieving greater loss absorbency by itself is almost certainly inadequate in achieving a stable financial system, for two reasons:

- Loss absorbency does not address directly *excessive asset growth* during booms.
- Preoccupation with loss absorbency diverts attention from the *liabilities side* of banks' balance sheets and vulnerabilities from the reliance on unstable short-term funding and short-term foreign currency debt.

As argued below, increased systemic risk from interconnectedness of banks is a corollary of excessive asset growth. To be effective, a macroprudential policy framework must address excessive asset growth and fragility of bank liabilities.

We take each issue in turn.

Excessive asset growth in booms

During a lending boom, high bank profitability and low measured risks tend to bolster bank capital ratios. However, experience has shown repeatedly that rapid loan growth is achieved only at the cost of lowering lending standards. Take the example of Allied Irish Banks (AIB), which is currently very topical given the difficulties in Ireland, but there is no shortage of other examples from the recent global financial crisis.

[1] Hughes-Rogers Professor of Economics, Princeton University.

Figure 1

Loan growth and provisions for AIB

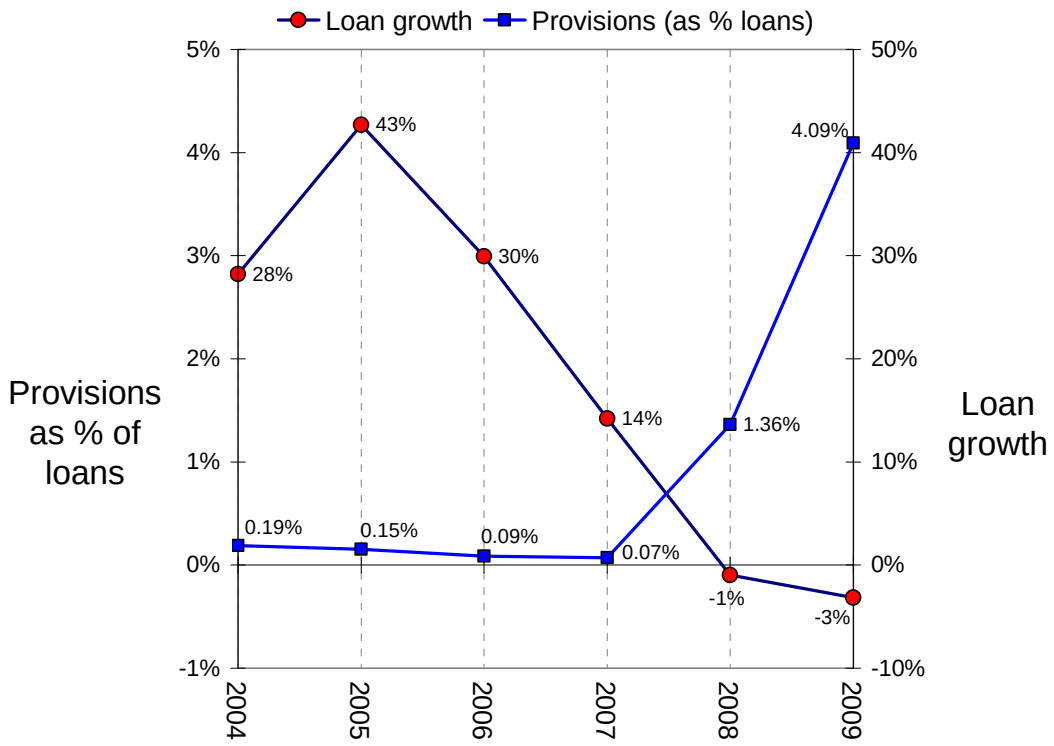


Figure 1 plots AIB's loan growth and loan loss provisions from 2004 to 2009. AIB's loan book increased by 43% in 2005 and by 30% in 2006, but loan growth came to a sudden halt with the global financial crisis. Provisions were low and falling throughout the lending boom. However, the underlying vulnerability of the loan book was exposed by the recession, and provisions have jumped above 4% of the total loan book.

Table 1

Capital ratios for AIB

	2004	2005	2006	2007	2008	2009
Tier 1 capital ratio (%)	7.9	7.2	8.2	7.5	7.4	7.2
Total capital ratio (%)	10.7	10.7	11.1	10.1	10.5	10.2

AIB's capital ratios were highest at the peak of the boom in 2006 and did not issue timely warnings, as seen in Table 1. The severity of the subsequent bust calls into question the philosophy of relying on capital ratios while neglecting asset growth itself.

Would additional measures, such as forward-looking provisioning, have prevented the collapse? Larger capital cushions would undoubtedly have mitigated the shock to the real economy, but the experience of Spain (which had such forward-looking provisioning) suggests that forward-looking provisioning may not be sufficient.

Membership of the euro zone prevented both Ireland and Spain from using an autonomous monetary policy to rein in domestic liquidity. However, the loss of autonomy over monetary policy is a more general theme that affects many more countries than just euro zone

members. Emerging economies with open capital markets face constraints on monetary policy from carry trade inflows. Faced with low interest rates in advanced economies, raising domestic interest rates may backfire by inducing greater carry trade inflows and looser domestic financial conditions. In Korea, market interest rates actually fell when the Bank of Korea started raising the policy rate in the summer of 2010.

When excessive asset growth is fuelled by loose domestic financial conditions, other tools may be necessary to lean against the build-up of vulnerabilities. Administrative measures on bank lending such as caps on loan-to-value (LTV) ratios and debt service-to-income (DTI) ratios may be important additional ingredients in the macroprudential policy framework. DTI rules serve as an anchor that ties loan growth to the wage level. The experience of Korea and other Asian economies suggests that DTI rules may be a useful complement to more traditional tools of banking supervision.

Keeping track of non-core liabilities

Excessive asset growth is mirrored on the liabilities side of the balance sheet by shifts in the composition of bank funding. The core funding available to the banking sector is retail deposits of household savers. However, retail deposits grow in line with the aggregate wealth of the household sector. In a lending boom when credit is growing very rapidly, the pool of retail deposits is not sufficient to fund the increase in bank credit. Other sources of funding are tapped to fund rapidly increasing bank lending. The state of the financial cycle is thus reflected in the composition of bank liabilities.

Figure 2

Composition of Northern Rock's Liabilities
(June 1998 - June 2007)

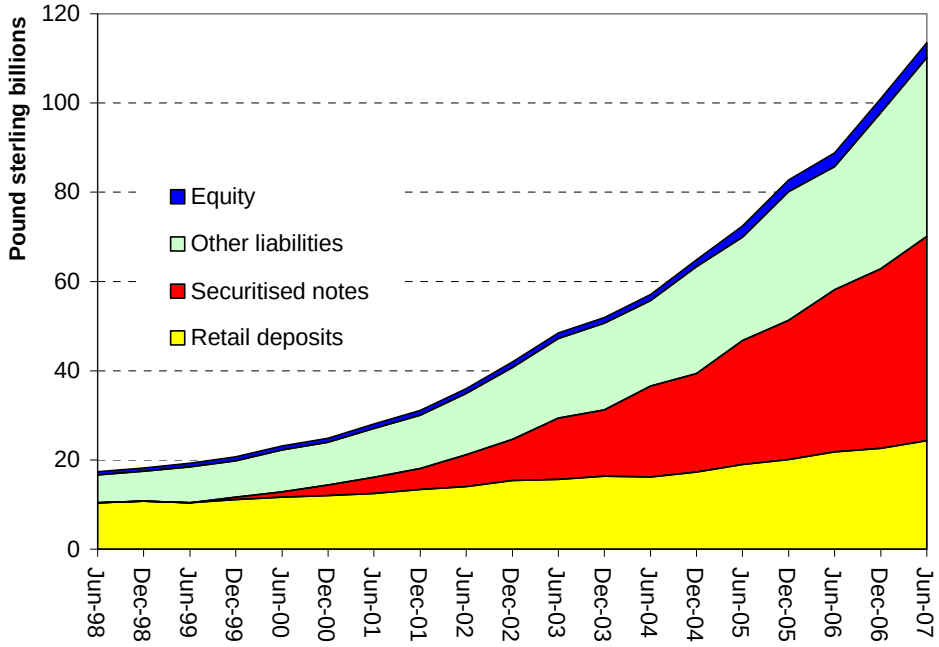


Figure 2 shows the composition of the liabilities of Northern Rock, the UK bank whose failure in 2007 heralded the global financial crisis. In the nine years from 1998 to 2007, Northern

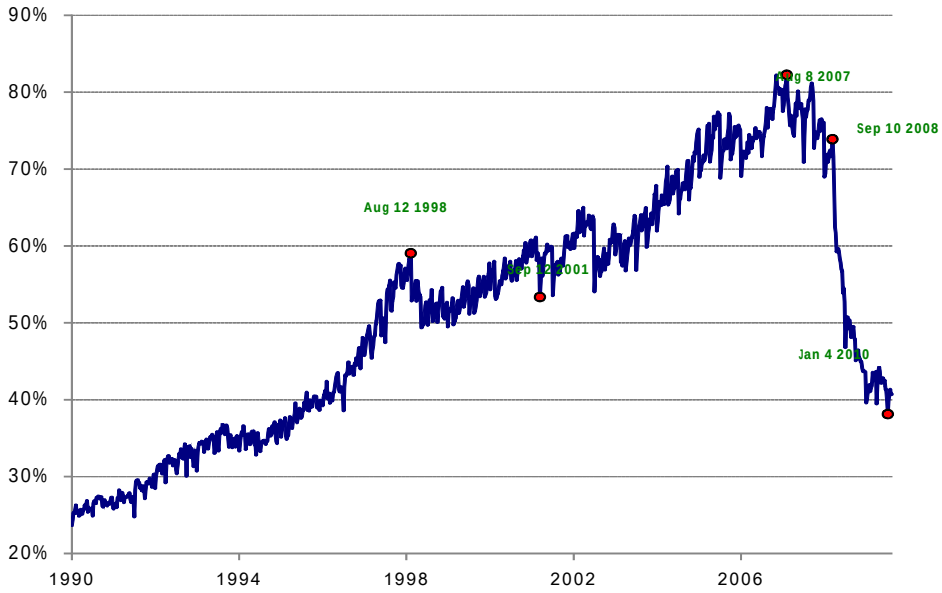
Rock's lending increased 6.5 times. This increase in lending far outstripped the funds raised through retail deposits (in yellow), with the rest of the funding gap supplied by wholesale funding (in red and light blue).

Northern Rock's case illustrates the general lesson that during a credit boom, the rapid increase in bank lending outstrips the core deposit funding available to a bank. As the boom progresses, the bank resorts to alternative, non-core liabilities to finance its lending. Therefore, the proportion of non-core liabilities of banks serves as a useful indicator of the stage of the financial cycle and the degree of vulnerability of the banking system to a downturn in the financial cycle.

The role of non-core liabilities in signalling the stage of the financial cycle can also be seen at the aggregate level. Figure 3 plots data from the United States and charts the stock of repurchase agreements (repos) of US primary dealers[2] plus the stock of financial commercial paper expressed as a proportion of the M2 money stock.

Figure 3

Repos and financial CP as proportion of M2



Source: US Federal Reserve.[3]

M2 consists of retail deposits and holdings in money market funds, and thus can be regarded as retail depositors' claims on the broader banking system. As recently as 1990, repos and financial CP were only a quarter the size of M2. However, the ratio rose rapidly and reached more than 80% by August 2007, only to collapse with the onset of the financial crisis.

In an open emerging economy, rapid increases in the non-core liabilities of the banking system show up as capital inflows through increased foreign exchange-denominated

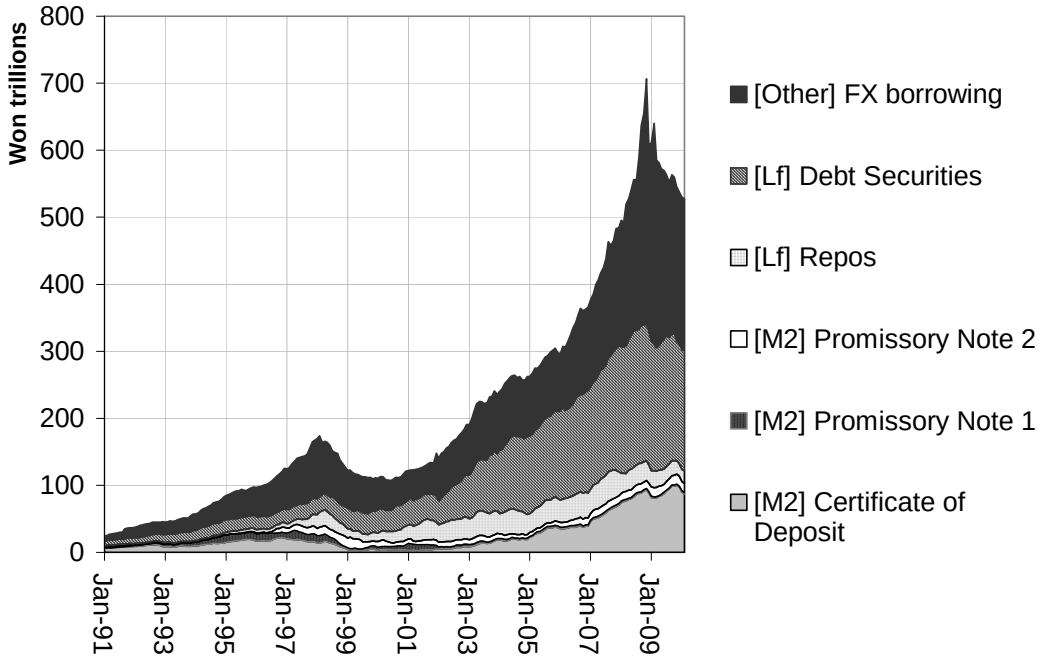
[2] US primary dealers are US banks and securities firms that have a daily trading relationship with the Federal Reserve, and which are permitted to bid at the auctions of US Treasury securities.

[3] See T Adrian and H Shin, "The changing nature of financial intermediation and the financial crisis of 2007–09", Federal Reserve Bank of New York Staff Report, no 239, April 2010, http://www.princeton.edu/~hsshin/www/ar2010.pdf

liabilities of the banking system. Figure 4 charts the non-core liabilities of the Korean banking sector with the FX liabilities shown in dark grey.

Figure 4

Non-core liabilities of Korean banking sector

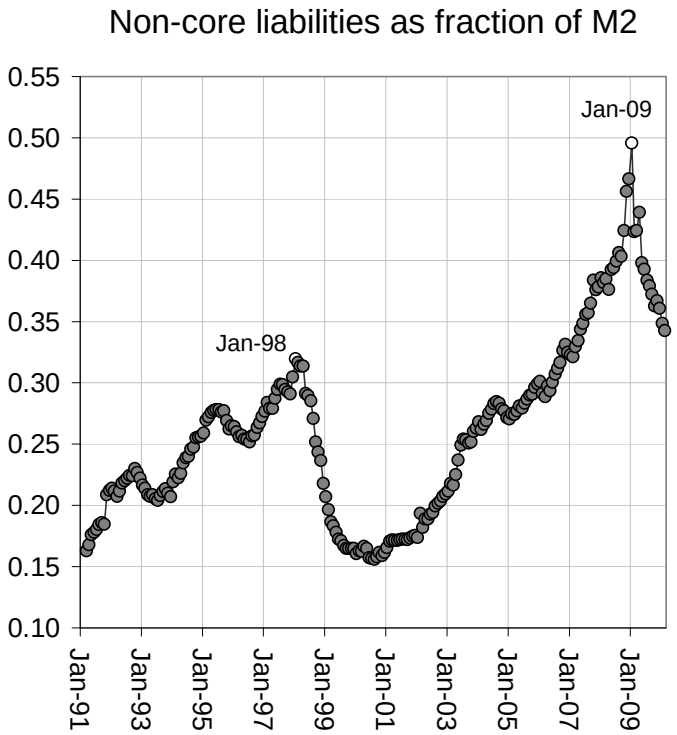


Source: H Shin and K Shin, "Procyclicality and monetary aggregates", paper for Bank of Korea 2010 conference, May 2010, http://www.princeton.edu/~hsshin/www/BOK2010.pdf

Note that the first peak in non-core liabilities coincides with the 1997 crisis. After a lull in the early 2000s, non-core liabilities increase rapidly in the run-up to the 2008 crisis. Figure 5 plots the non-core liabilities as a fraction of M2. We see that there has been substantial variation in non-core liabilities, ranging from around 15% of M2 to a peak of 50% in the Lehman crisis.

Figure 5

Non-core liabilities of Korean banking sector as a proportion of M2

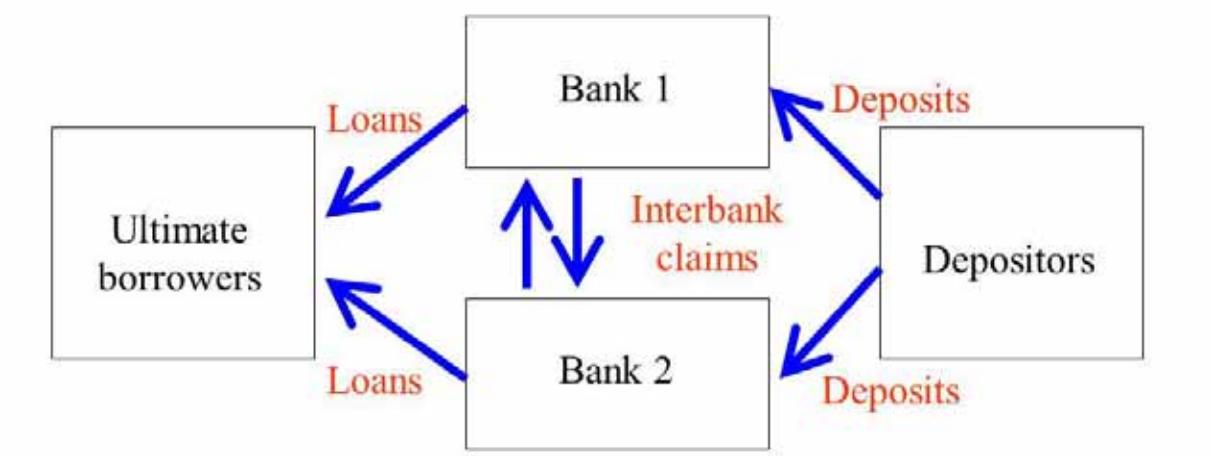


Interconnectedness and systemic risk

Excessive asset growth and greater reliance on non-core liabilities are closely related to systemic risk and interconnectedness between banks. In a boom when credit is growing rapidly, the growth of bank balance sheets outstrips available core funding, and asset growth is mirrored in the greater cross-exposure across banks. Consider a stylised banking system in Figure 6 with two banks – Bank 1 and Bank 2. Both banks draw on retail deposits to lend to ultimate borrowers. They also hold claims against each other.

Figure 6

Stylised financial system



Imagine a boom where the assets of both banks double in size, but the pool of retail deposits stays fixed. Then, the proportion of banking sector liabilities in the form of retail deposits must fall, and there must be increased cross-claims across banks. In this sense, the growth in bank assets and increased interconnectedness are two sides of the same coin.

The relationship between banking sector assets and increased cross-exposures across banks holds more generally as an accounting identity. Define the *core liabilities* of a bank as its liabilities to claimholders who are not financial intermediaries themselves. Retail deposits would be the best example of core liabilities. Covered bonds held by a pension fund would also count as a core liability. However, any liability of an intermediary held by another intermediary would be a *non-core liability*. Under this definition, we have the following accounting identity[4] for the total core liabilities of the banking sector:

$$\text{Total core liabilities} = \sum_{i=1}^{n} e_i z_i (\lambda_i - 1)$$

where e_i is the equity of bank i, λ_i is the leverage of bank i, z_i is the ratio of bank i's core liabilities to its total liabilities, and n is the number of banks in the banking system. Since total core liabilities (retail deposits) are slow-moving, a rapid increase in total bank assets (equity times leverage) must result in lower z_i values, implying a greater reliance on non-core funding.

In this way, there are close conceptual links between procyclicality, interconnectedness and the stock of non-core liabilities of the banking system. In a boom, we have the conjunction of three features:

- Total lending increases rapidly
- Non-core (including foreign currency) liabilities increase as a proportion of total liabilities
- Systemic risk increases through greater cross-holdings between intermediaries

In this respect, systemic risk is procyclical and excessive asset growth lies at the heart of the increase in bank interconnectedness. Therefore, addressing excessive asset growth in

[4] See H Shin, *Risk and liquidity*, Clarendon Lectures in Finance, Oxford University Press, 2010, Chapter 9.

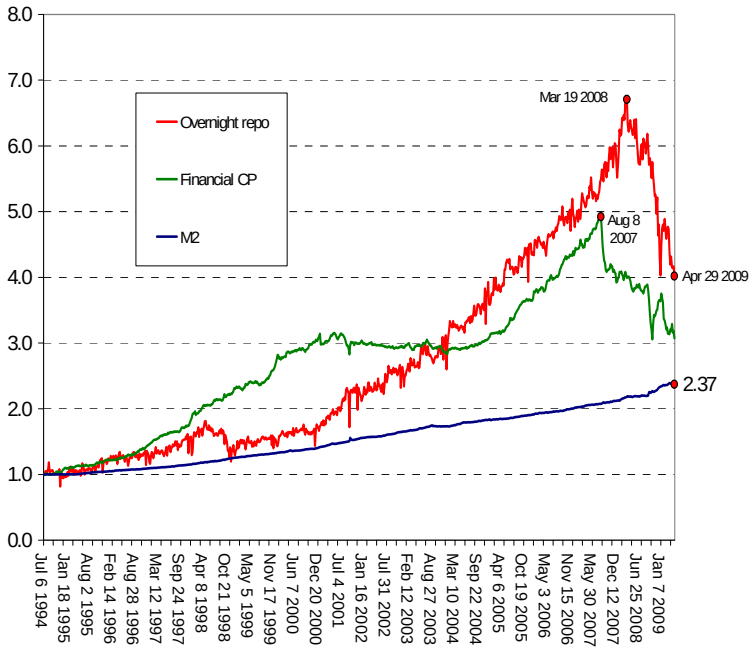
booms will go a long way toward mitigating systemic risks and the cross-exposure across banks.

The growth in non-core liabilities is accompanied by the shortening of maturity of the liabilities. Figure 7 plots three series for the US: the size of the *overnight* repo stock, the total stock of financial commercial paper and M2, all normalised to equal 1 on 6 July 1994. In Figure 7 we see that M2 grows by a factor of 2.4, but overnight repos grow seven-fold before collapsing with the onset of the crisis in 2008.

Figure 7

Overnight repos and M2 (weekly data)

Normalised to 1 on 6 July 1994

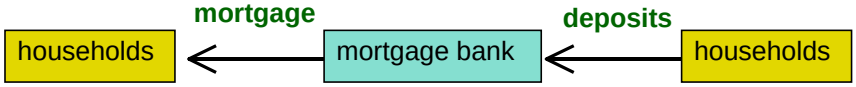


Source: Federal Reserve.

The prevalence of short-maturity liabilities is a consequence of longer intermediation chains and the need to maintain a lending spread for each link in the chain. Figure 8 depicts a traditional deposit-taking bank that collects deposits and holds mortgages. All banking liabilities are core liabilities in such a system.

Figure 8

Short intermediation chain

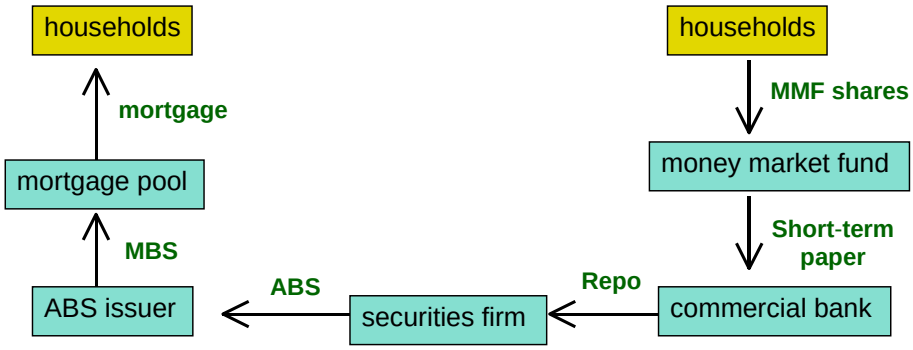


However, lengthening intermediation chains increase cross-exposures across intermediaries. In Figure 9, mortgage assets are held in a mortgage pool, but mortgage-backed securities (MBS) are owned by an asset-backed security (ABS) issuer who pools and tranches the MBS into another layer of claims, such as collateralised debt obligations (CDOs). Then, a

securities firm might hold CDOs, financing them by pledging them as collateral to a commercial bank through repurchase agreements (repos). The commercial bank in turn funds its lending to the securities firm by issuing short term liabilities such as financial commercial paper. Money market mutual funds complete the circle, and household savers own shares to these funds.

Figure 9

Long intermediation chain



The illustration in Figure 9 is a simple example of potentially much more complex and intertwined relationships. At each stage of the intermediation chain, the funding interest rate must be lower than the asset interest rate. As the intermediation chain becomes longer, more short-term funding must be used to support the chain, as short-term funding tends to be the cheapest. In this way, the prevalence of short-term debt is a natural consequence of the increased weight of non-core liabilities in the intermediary sector.

What is noticeable from the institutions involved in Figure 9 is that they were precisely those institutions that were at the sharp end of the recent financial crisis. Subprime mortgages cropped up in this chain, and the failure of Bear Stearns and Lehman Brothers owed much to problems in the smooth functioning of this chain.

Securitisation is a way for intermediaries to tap non-deposit funding by creating securities that can be pledged as collateral. The demand for collateral assets is therefore a demand for leverage. In this respect, subprime lending in the United States can be seen as a reflection of the wider principle that the growth of non-core funding is a sign of excessive asset growth in a lending boom.

Macroprudential policy frameworks

A macroprudential policy framework should encompass a system of early warning indicators that signal increased vulnerabilities to financial stability and a set of associated policy tools that can address the increased vulnerabilities at an early stage.

1. Macroprudential indicators. Excessive asset growth is at the core of increased financial sector vulnerabilities. The challenge is knowing when asset growth is "excessive". Simple rules of thumb such as the ratio of total credit to GDP may be useful, but more promising are measures derived from the liabilities side of banking sector balance sheets. The ratio of non-core to core liabilities of the banking sector may be especially useful in gauging the stage of the financial cycle. Monetary aggregates and other liability measures of the banking sector may be usefully developed to track potential vulnerabilities. Whereas the traditional role of monetary aggregates has been through their effect on inflation, the

macroprudential role of monetary aggregates has to do with the behavioural and stability properties of such aggregates. The legal form of the claim may not coincide with the behavioural properties of the claim. For instance, household deposits will have empirical traits that differ from interbank deposits, even though the legal form of the claims is identical.

Measures of cross-exposures across intermediaries (such as CoVaR) may be useful complementary indicators, bearing in mind that cross-exposures themselves are procyclical, and track non-core liabilities.

2. Macroprudential tools. Macroprudential policy tools to mitigate vulnerabilities should ideally be designed to fit closely with the early warning indicators and the conceptual underpinnings for the relevant economic externalities. Examples of macroprudential policy tools include:

- ***LTV and DTI caps***. When monetary policy is constrained, administrative rules that limit bank lending such as caps on loan-to-value ratios and debt service to income ratios may be a useful complement to traditional tools in banking supervision.
- ***Leverage caps***. Caps on bank leverage may be used as a way to limit asset growth by tying total assets to bank equity.[5] The rationale for a leverage cap rests on the role of bank capital as a constraint on new lending rather than the Basel approach of bank capital as a buffer against loss. Korea's leverage cap on bank FX derivative positions introduced in June 2010 is aimed at limiting the practice of banks hedging forward dollar positions with carry trade positions in Korean won funded with short-term US dollar debt. The leverage cap has moderated carry trade capital inflows into Korea, but the primary rationale of the leverage cap is as a macroprudential measure aimed at financial stability rather than as a capital control tool.
- ***Levy on non-core liabilities.*** The stock of non-core liabilities reflects the stage of the financial cycle and the extent of the under-pricing of risk in the financial system. A levy or tax on the non-core liabilities can serve to mitigate pricing distortions that lead to excessive asset growth. The Financial Stability Contribution recommended by the IMF in its report on the bank levy[6] to the G20 leaders is an example of such a corrective tax.

The levy on non-core liabilities has many desirable features. First, the base of the levy itself varies over the financial cycle. The levy bites hardest during the boom when non-core liabilities are large, so that the levy has the properties of an automatic stabiliser even if the tax rate itself remains constant over time. Given the well-known political economy challenges to the exercise of discretion by regulators, the automatic stabiliser feature of the levy has important advantages.

Second, the levy on non-core liabilities addresses the financial vulnerability while leaving unaffected the essential functioning of the financial system in channelling core funding from savers to borrowers. By targeting non-core liabilities only, the levy addresses externalities associated with excessive asset growth and systemic risk arising from interconnectedness of banks.

Third, the targeting of non-core liabilities addresses the vulnerability of open emerging economies to sudden reversals in capital flows due to deleveraging by banks. Indeed, for emerging economies, the levy on non-core liabilities could be aimed more narrowly at the

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[5] S Morris and H Shin, "Financial regulation in a system context", Brookings Papers on Economic Activity, 2008, http://www.princeton.edu/~hsshin/www/BPEA2008.pdf.

[6] "A fair and substantial contribution by the financial sector", Report by the IMF to the G20, June 2010, http://www.imf.org/external/np/g20/pdf/062710b.pdf.

foreign currency denominated liabilities only. A levy on the FX liabilities of the banking sector will have an impact on foreign currency flows, but such a policy is a macroprudential tool aimed at financial stability, rather than a tool for capital controls or a tool to manage exchange rates.

The revenue raised by the levy is a secondary issue. The main purpose of the levy is to align incentives. A good analogy is with the congestion charge used to control car traffic into central London. Under this charge, car drivers pay a daily fee of £8 to drive into central London. The main purpose of the charge is to discourage drivers from bringing their cars into central London, thereby alleviating the externalities associated with traffic congestion. In the same way, the non-core liabilities bank levy should be seen primarily as a tool for aligning the incentives of banks more closely with the social optimum. The revenue raised by the levy would also be of benefit (perhaps for a market stabilisation fund) but the revenue is a secondary issue.

Challenges for the design and conduct of macroprudential policy

Stefan Ingves[1]

The last three years have been a challenging time for central bankers and policymakers. And yet significant challenges lie ahead. The crisis exposed gaps in the existing regulatory frameworks and raised questions about previously accepted beliefs and practices. We are still trying to understand the key lessons from the crisis so we can determine the reforms to the financial system, regulatory structures and policy instruments that are needed to enhance financial stability. But it is clear that a major element of these reforms will be the development and implementation of effective macroprudential frameworks empowering some form of agency to identify system-wide risks to financial stability, and providing the instruments to prevent and mitigate those risks.

Of course, while the reforms are being developed and implemented, we must rely on the existing framework and instruments to support the fragile recovery of the real economy and financial system.

Sweden's economy is recovering but vulnerabilities remain

Strong Swedish recovery from the crisis

As in many countries, GDP fell sharply in Sweden as a consequence of the financial crisis. But Sweden is now experiencing a relatively strong economic recovery (see Figure 1) and the Swedish banking sector appears resilient.

Swedish banks' access to market funding, which was disrupted after the failure of Lehman Brothers, has recovered sufficiently to enable the Riksbank to withdraw the extraordinary lending it provided during the crisis.[2] In addition, the four largest Swedish banks, which have a combined market share of about 75%, are well capitalised. Indeed, the Riksbank estimates that, by the end of 2011, they will already have sufficient resources to meet the forthcoming Basel III capital requirements, including the capital conservation buffer and a full-scale countercyclical capital buffer, without undertaking any exceptional capital-raising exercises (see Figure 2).[3]

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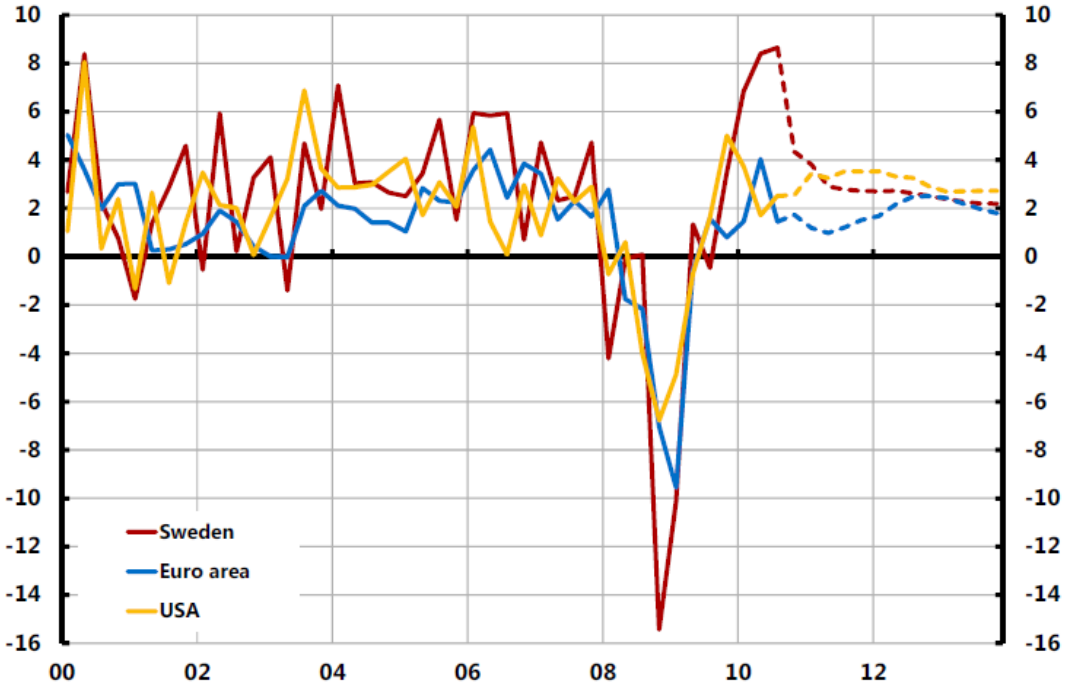
[1] Governor, Sveriges Riksbank.

[2] During the crisis, the Riksbank provided extra liquidity to the Swedish banking sector through a number of long-term loans in SEK and USD.

[3] However, we expect that some banks will need to raise their liquidity buffers to meet the new Basel III liquidity rules.

Figure 1

Development of GDP in selected countries and regions

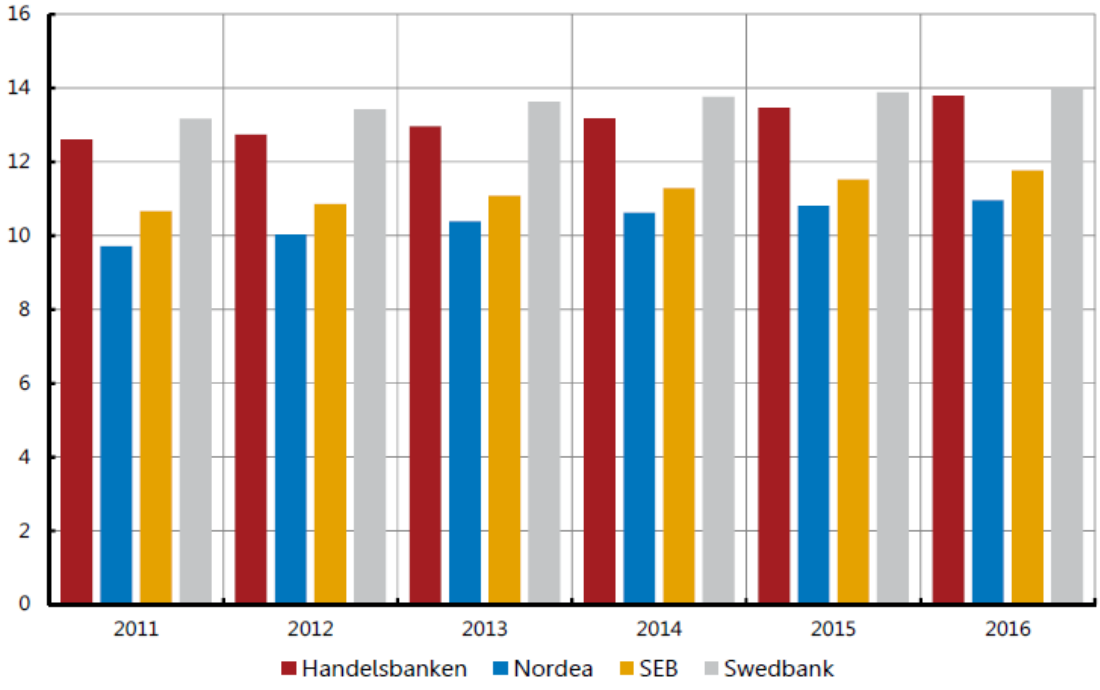


Quarterly changes in per cent, annual rate, seasonally adjusted data.

Sources: Bureau of Economic Analysis, Eurostat, Statistics Sweden and the Riksbank (Monetary Policy Update, 15 December 2010).

Figure 2

Estimated common equity Tier 1 capital ratios for the four largest Swedish banks



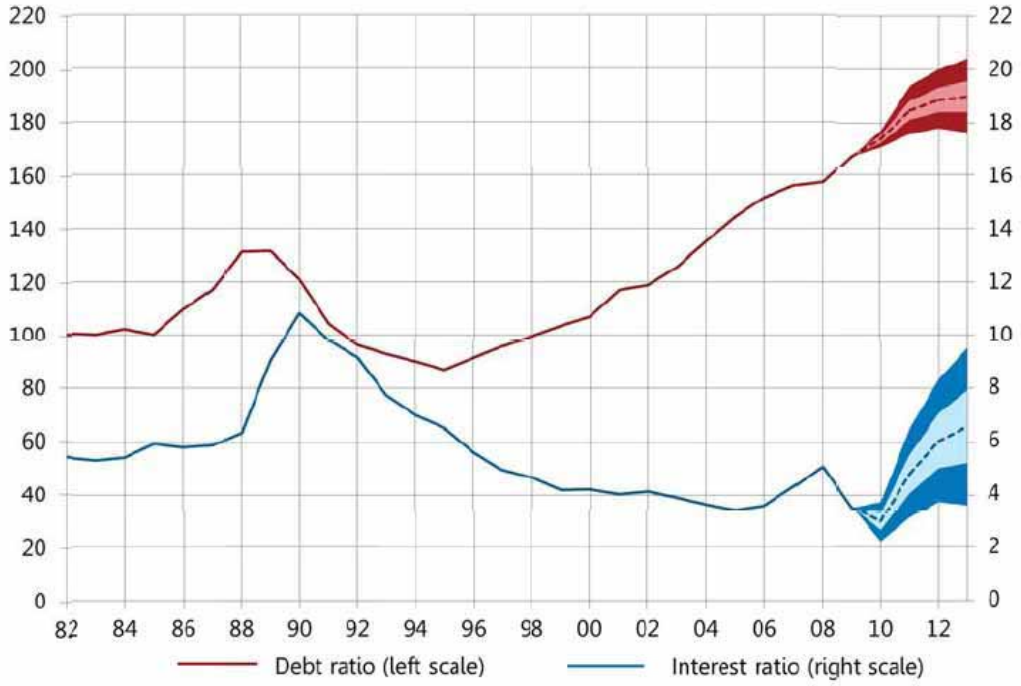
Sources: Bank reports and Riksbank calculations (The Riksbank's Financial Stability Report 2010:2).

But potential vulnerabilities are building up in Sweden

Despite these positive developments, there are still vulnerabilities in the Swedish financial system. Recent surveys suggest that Swedish households remain capable of servicing their debts.[4] At the same time, household credit losses in Sweden are traditionally low: even in 1992, at the peak of the Swedish banking crisis, credit losses from households only made up 6% of total credit losses.[5] But household indebtedness has continued to grow faster than income (see Figure 3), loan-to-value ratios have increased, and a large proportion of mortgages are variable-rate loans. These vulnerabilities could impair the financial system by increasing loan losses if the current economic recovery were to stall, or by impairing Swedish banks' ability to finance mortgages if investors' confidence in Swedish covered bonds were to fall.

Figure 3

Swedish household debt and post-tax interest expenditure



Per cent of disposable income.

Sources: Statistics Sweden and the Riksbank (The Riksbank's Financial Stability Report 2010:2).

It is too early to establish whether recent repo rate increases and the introduction of a maximum permitted loan-to-value ratio of 85% for residential mortgages by Finansinspektionen (the Swedish Financial Supervisory Authority) have had a discernable effect on credit growth. In any case, house prices are continuing to grow (see Figure 4). The Riksbank does not consider the present level of house prices and household debt to be an

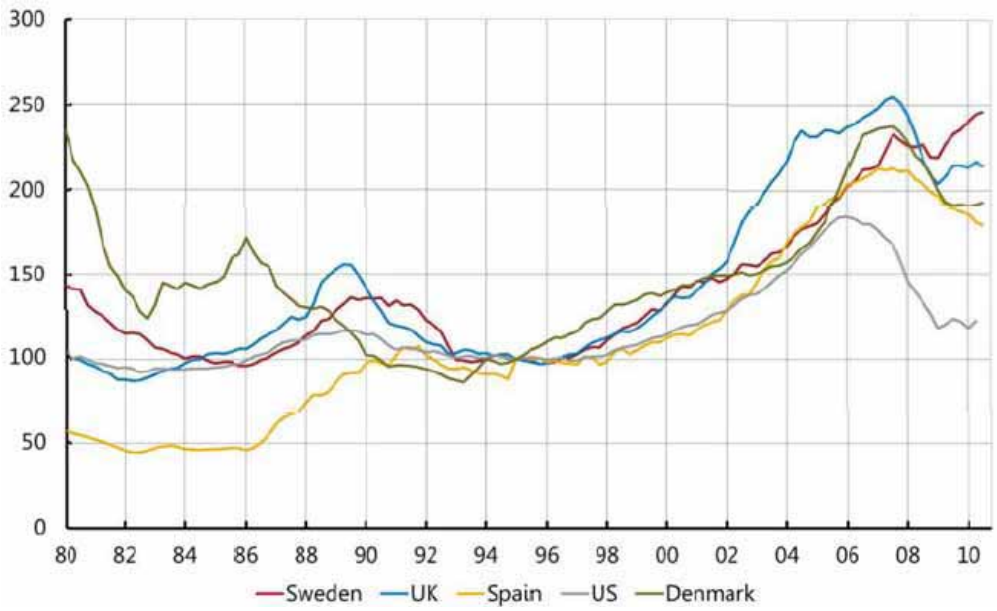
[4] See Finansinspektionen, "The Swedish mortgage market and bank lending", February 2010, and Sveriges Riksbank, "Financial Stability Report 2009:2".

[5] Finansinspektionen, "Utvecklingen på bolånemarknaden 2008", 2009:7. (Only available in Swedish.)

immediate threat to financial stability, but their current growth rates are unsustainable, so future problems cannot be ruled out.

Figure 4

Real residential property prices in Sweden and other countries



Index 1995 Q1 = 100.

Sources: Reuters Ecowin and Statistics Sweden (The Riksbank's Financial Stability Report 2010:2).

If the current growth rates of house prices and household debt are considered to be a potential threat to future financial stability, it may be necessary to act soon, because it will take time for any measures to take effect. So the Riksbank is investigating instruments (existing or potential) to prevent or mitigate this threat by smoothing the house price cycle, controlling household indebtedness or improving the resilience of banks. A range of prohibitive instruments could be used to restrict the choices of households and financial institutions. These could include, for example, the introduction of a binding maximum loan-to-value ratio on household borrowing[6] or a maximum debt-to-income ratio, or the requirement for mortgage interest payments to be fixed for a certain time period. There is also a range of taxation instruments that could act on the price of the activities of households and financial institutions. Such could include changes to financial institutions' capital requirements or changes to the reserve requirements (SEK or foreign currency) that financial institutions are required to hold at the central bank. The choice between prohibition and taxation is not new to public choice economics.

And vulnerabilities are building up internationally

The build-up of problems is even more apparent on the international scene; in particular it is reflected in the recent difficulty eurozone countries with weak public finances have had in

[6] The current maximum loan-to-value ratio constrains the amount a household can borrow in a mortgage contract but places no limit on other forms of lending to that household. A binding maximum loan-to-value ratio on household borrowing could place a firmer limit on households' total borrowing.

issuing government bonds.[7] Investors are increasingly looking at sovereign risk in the same way as the Riksbank is viewing Swedish household debt. For example, the picture that debt-to-GDP ratios give for countries' ability to repay debt is similar to the one that the debt-to-income ratio shows for households. There are fairly well developed and commonly used techniques to estimate probabilities of default (PD) and loss-given-default (LGD) on banks' loan portfolios, which are useful for the conduct of microprudential policy. These techniques are also useful for macroprudential policy, and should be used more extensively, as they can be used to estimate PDs and LGDs at an aggregated level for entire sectors (eg banks, households, corporates). I would expect that these same techniques could be used to assess sovereign debt but, to my knowledge, I believe this is not done.

An analogy can also be drawn between the macroprudential tools the Riksbank is considering for household debt and the Stability and Growth Pact for countries in the euro zone. The Stability and Growth Pact is designed to facilitate the stability of the Economic and Monetary Union (EMU) by placing upper limits on member countries' national debt (60% of GDP) and annual deficit (3% of GDP). These are somewhat similar to maximum loan-to-value ratios and debt-to-income ratios for households. The Stability and Growth Pact was reformed in 2005, making it more enforceable by relaxing the rules to reflect the difficulty of adhering to limits throughout the economic cycle as the burden on public debt increases during a recession due to automatic stabilisers (such as increased social security payments). A number of measures were introduced in the euro zone during the crisis to protect the EMU, such as the creation of the European Financial Stability Facility. The debate about longer-term reforms is currently ongoing.

Calibrating these rules and national macroprudential instruments, such as a maximum household debt-to-income ratio, is difficult because we lack a complete understanding of how risks to the financial system develop and how macroprudential instruments act on those risks. As a result, decisions cannot be fully guided by theory; instead, policymakers are required to make genuine policy judgments. This may be more difficult to achieve for international tools that require agreement between multiple national policymakers.

Macroprudential policy needs to be operational soon

It is therefore clear that vulnerabilities are emerging as countries recover from the crisis and it is important that national authorities are soon able to implement macroprudential policies to address those risks. Leading the development of formalised macroprudential policy arrangements are the European Systemic Risk Board, which will hold its inaugural meeting in just two days, and the Financial Stability Oversight Council in the United States, which held its first meeting in October 2010. But many other countries are thinking seriously about how to implement and conduct macroprudential policy in their jurisdictions.

[7] One of the reasons that the Swedish economy is currently experiencing relatively strong economic growth is that Sweden's public finances were comparatively strong going into the crisis. Therefore, Sweden has managed to avoid the fiscal consolidation currently seen in many other EU countries. One reason for Sweden's robust public finances is that it had to implement a programme of fiscal consolidation in the mid-1990s, following the Swedish banking crisis. Therefore, Sweden had already learnt the importance of maintaining sustainable deficits and debt levels, and had already imposed many of the public reforms required to deal with structural problems that can inhibit economic recovery.

Governance arrangements for macroprudential policy

A vital aspect of the macroprudential policy framework will be the design of the governance arrangements. They will determine how the different elements of the framework are brought together and will influence how macroprudential policy interacts with other policy areas.

Governance arrangements should be effective in three broad areas: they must ensure that the macroprudential decision-maker (the "macroprudential agency") has (i) a clear mandate; (ii) access to the necessary information and the analytical capability to set policy; and (iii) control over a sufficient set of tools to achieve its mandate.

The need for a clear mandate

Effective governance arrangements must ensure that the macroprudential agency has a clear mandate. That is, the objectives of macroprudential policy, the tools available to the macroprudential agency and the interaction of macroprudential policy and other public policies must be clearly set out. This is necessary to ensure that (a) there is no ambiguity about the macroprudential agency's role; (b) expectations for the agency are in line with what it can achieve; (c) the macroprudential agency can be held accountable for its actions (or lack of action); and (d) any overlaps between policy areas or agencies can be better handled.

It may be desirable to set out the macroprudential mandate (and objectives) explicitly because this could make it easier for the macroprudential agency to defend unpopular but necessary interventions. It would also allow policy objectives to be ranked, which would help manage policy trade-offs. However, when setting explicit mandates or objectives in law, care must to be taken to avoid inadvertently constraining policy actions. This is a potential problem because we do not fully understand the variables that influence financial stability. Indeed, we currently lack a precise but comprehensive definition of financial stability.

In addition to giving the macroprudential agency a clear mandate, there should be a transparent decision-making process that avoids political and interest group pressure. This is necessary to ensure that the macroprudential agency is free to make interventions that impose short-term costs on financial institutions or the public in order to achieve long-term benefits through financial stability.[8] While the macroprudential agency must be independent, it must also be accountable for its actions (or lack of action). A clear mandate will help achieve accountability and make it easier to assess how far the macroprudential agency is achieving its objectives.

Information and analytical capability

Effective governance arrangements must also ensure that the macroprudential agency has access to the information and analytical capability needed to quickly identify system-wide risks and to determine when and how instruments should be used in response to these risks.

Information on exposures between institutions and on exposures commonly held by institutions is likely to be crucial for macroprudential supervision. Much of this information will need to be obtained from individual institutions and may overlap with the type of information

[8] This argument is developed by Martin Cihák in a speech entitled "Price stability, financial stability and central bank independence", 38th Economics Conference of the Oesterreichische Nationalbank, 2010. A number of case studies illustrating how inadequate independence arrangements for financial sector regulators and supervisors have contributed to the emergence and scale of financial crises are presented by Marc Quinton and Michael Taylor in "Regulatory and supervisory independence and financial stability", *IMF Working Paper*, WP/0246, 2002.

collected for microprudential purposes. The collection and sharing of this information may be easier if the microprudential and macroprudential agencies are located together. An alternative approach would be to give a separate microprudential agency responsibility for collecting the information necessary for the conduct of microprudential and macroprudential policy. Memorandums of understandings or information-sharing protocols would then be used to ensure the free sharing of information between agencies.

The analytical skills and tools required for macroprudential policy are likely to draw on those used for macroeconomic analysis and, to a lesser degree, microprudential analysis. But the macroprudential agency will need to build new analytical techniques. Before the crisis, many central banks had already begun to develop the type of system analysis that will be required for macroprudential supervision (for example, in the assessment of interdependencies and systemic risks included in financial stability reports) – but the analytical techniques remain in their infancy.

Control over a sufficient set of tools

As well as the information and knowledge necessary for effective analysis, the macroprudential agency must have access to suitable instruments in order to achieve its mandate. Otherwise there will be unreasonable expectations of what the macroprudential agency can achieve, as it may be unable to address the system-wide risks that it identifies.

The macroprudential mandate is likely to be broad in scope, as system-wide risks can arise in a wide range of ways and from a wide range of sources. Consequently, the range of macroprudential instruments must be equally broad in scope. Discussions of macroprudential instruments usually emphasise the need for instruments that operate in two dimensions: the time or cyclical dimension, in which instruments are designed to counteract financial multipliers/accelerators that amplify cycles; and the cross-sectional dimension, in which instruments are required to isolate or dampen the transmission of problems across the financial system.

While it is important that the macroprudential agency has control over instruments to prevent and mitigate system-wide risks, it is not essential for the agency to implement these instruments itself. The macroprudential toolkit is likely to include instruments used for other policy objectives and not implemented by the macroprudential agency (for example, capital requirements and insurance premiums).

Overlap between policy areas

The overlap between different policy areas is one of the major challenges to the design of effective governance arrangements. Responsibility for using instruments that can be used for multiple policy objectives is more complicated and policy-setting is more difficult as policymakers must consider the unintended impact of their instruments on other policy objectives and the unintended impact of other policymakers' instruments on their own policy objective. The use of an instrument for one objective may conflict with or amplify the effect of instruments used to achieve a different policy objective. This is best illustrated by considering the relationship between macroprudential policy and monetary policy.

Monetary policy instruments can affect financial stability

Monetary policy instruments can have an effect on financial stability. Recently, it has been proposed that monetary policy can affect the build-up of risk in the financial system through the "risk-taking channel", an independent and previously unrecognised part of the transmission mechanism.[9] There are a number of ways in which (loose) monetary policy is said to encourage risk-taking. Low interest rates can encourage investors to select higher-yielding, riskier assets over low-yielding, safe assets in a "search for yield". Investors (such as pension funds) may make this substitution in the hope of attaining returns that match their commitments.

Alternatively, investors may be encouraged to take greater risks if they perceive that monetary policy is being used asymmetrically – that is, that the policy rate is reduced aggressively in the event of a sharp fall in asset prices but the policy rate is not used to address sharp increases in asset prices.

Another, more indirect channel, is formed by a feedback loop that amplifies asset price increases and causes banks to increase their holdings of risky assets. It is argued that financial institutions target leverage ratios that are constant (commercial banks) or procyclical (investment banks). Therefore, an increase in the value of financial assets causes financial institutions to increase their balance sheets to maintain their target leverage ratios, which puts further upward pressure on asset prices. This also causes an increase in the level of risk in the financial system because the availability of safe investments is limited, so banks must move up the risk spectrum towards risky borrowers when they increase their balance sheets.

Macroprudential policy instruments can affect price stability

Macroprudential policy instruments can also have an effect on price stability. This can be illustrated using a highly stylised view of the monetary policy transmission mechanism:

$$i_t^{lending} = i_t + \delta_t \,.$$

This equation describes how banks' lending rates are a function of the central bank's policy rate plus an interest rate margin or spread. The interest rate margin (δ_t) is a function of the compensation taken by banks for factors such as administrative costs, capital costs, risk premiums and the banks' profit margins. The failure of macroprudential policy can affect the transmission mechanism of monetary policy by affecting the interest rate margin. For example, during a crisis, the relationship between the policy rate and market rates may diverge as market rates are increasingly governed by uncertainty over credit risk.

But macroprudential policy can also affect the transmission mechanism outside a crisis. This is because the bank lending rate is also a function of financial regulations (placed on banks to enhance financial stability and consumer protection), as these tend to increase banks' costs which, to a certain extent, are passed on to customers in the form of an increased interest rate margin. This concept can be illustrated in the stylised equation for the lending rate by adding a variable (z_t) which designates regulations affecting the interest rate margin:

$$i_t^{lending} = i_t + \delta_t(z_t) \,.$$

[9] The concept of a risk-taking channel was introduced by Claudio Borio and Haibin Zhu in "Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism?", *BIS Working Paper*, no 268, 2008.

This equation is, of course, a simplification, but it is useful for illustrative purposes. It shows how some static macroprudential instruments, such as increased capital or reserve requirements, will affect the interest rate margin in a "one-off shift" when they are introduced, which will affect the transmission mechanism during the period of adjustment. However, there are also likely to be dynamic macroprudential instruments, such as time-varying countercyclical capital buffers, aimed at ensuring that macroprudential policy can influence the availability and pricing of credit throughout the cycle. These time-varying instruments will affect the transmission mechanism on an ongoing basis as they change over time.

But the instruments are not perfect substitutes

While the effects of monetary and macroprudential instruments may overlap, they are not perfect substitutes.[10] As stated earlier, the macroprudential policy toolkit is likely to include a diverse range of instruments that operate in different ways on different elements of the financial system. And the effect of these instruments on policy objectives other than macroprudential policy will also vary. For example, cross-sectional instruments are less likely to conflict with monetary policy than with the cyclical dimension of macroprudential policy. And instruments aimed at a narrow range of financial institutions or agents will be easier to focus on financial behaviour rather than on macroeconomic factors.

In general, it is desirable to use instruments with a narrower focus to address specific problems, as they can be better tailored to the problem and will have fewer unintended consequences on the real economy and on other policy objectives. However, there will be times when instruments with a broader scope will be desirable – for example, when there is a danger that developments in the financial system will enable agents to circumvent more narrowly focused instruments.

The ability to circumvent instruments forms one of the challenges for macroprudential policy. The effectiveness of macroprudential policy could be strained when the build-up of risks (for example, an asset price bubble) in the financial system justifies significant policy intervention to contain the risks but the prevailing macroeconomic conditions do not justify a similarly aggressive monetary policy. While the macroprudential agency may tighten policy substantially to increase market interest rates (to dampen the asset price bubble), doing so will increase the incentive to circumvent the intervention (for example by borrowing from institutions outside the scope of macroprudential policy, such as foreign lenders). This implies that the effectiveness of time-varying macroprudential instruments will vary depending on the arbitrage opportunities available to borrowers and lenders in the economy.

Macroprudential and monetary policy instruments must be coordinated

The interaction between macroprudential policy and monetary policy instruments means that it will be necessary to coordinate their use. This is for three reasons. Firstly, there is a danger of the instruments conflicting if they are implemented in an uncoordinated manner by authorities with different objectives. This has been shown to lead to a "push-me, pull-you" problem in which monetary policy and macroprudential policy instruments are used more aggressively, in opposing directions, leading to a worse outcome than if the instruments had been coordinated.[11]

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[10] A paper by C Bean, M Paustian, A Penalver and T Taylor, "Monetary policy after the fall", read at the Federal Reserve Bank of Kansas City Annual Conference, August 2010, shows that monetary policy instruments and macroprudential instruments (a lump-sum levy/subsidy on the banking sector) are not perfect substitutes in a sticky-price New Keynesian macroeconomic model with a banking sector.

[11] C Bean *et al*, ibid.

Secondly, in most cases, monetary policy and macroprudential policy instruments should reinforce, not conflict with, each other. But it will still be necessary to monitor and understand the overlap between the instruments to ensure optimal policy.

Thirdly, in some extreme situations, the use of instruments usually prescribed for monetary or macroprudential policy will be insufficient to meet their respective policy objectives. In such situations, monetary and macroprudential policy instruments will be required to work in tandem to meet the policy objectives. Close coordination will be needed to guide use of the tools in these circumstances, as the distinction between the objectives of the instruments will be blurred.

The overlap between macroprudential and monetary policy is one rationale for giving the central bank a prominent role in the setting of macroprudential policy. In addition, many central banks already have some of the analytical skills that will be needed for conducting the policy. However, greater analytical capacity will need to be built up.

Analytical tools must be developed to guide policy

While we know that there is an overlap between macroprudential policy and monetary policy, we lack models that describe the relationship in much detail. It is a difficult task for a number of reasons: (a) in the models currently used by central banks, financial sectors are poorly modelled, so it is difficult to introduce financial instabilities; (b) developments in financial markets are sometimes driven by psychology, which is difficult to replicate in models with rational agents; (c) the risk of a crisis cannot be modelled in the usual way, as it is more like an extra channel in the transmission mechanism; and (d) policymakers want models that can give them guidance on when to act, which is extremely challenging.

One approach that I find promising was recently outlined in a presentation by Michael Woodford.[12] He described a version of a new Keynesian model with two possible states for credit spreads: normal and elevated (that is during a crisis). He argued that it is the degree of leverage in the financial system, rather than the level of asset prices, that poses a risk to financial stability. In a standard New Keynesian model, the optimal policy commitment will be to hold the output gap-adjusted price level (the "optimal target criterion") constant. However, Woodford showed that when the likelihood of a crisis increases when leverage increases, the optimal target criterion is altered to include a factor relating to the marginal increase in the expected loss from a crisis per unit increase in the level of leverage. Therefore, the central bank should balance its inflation and output stabilisation objectives against its concerns about financial instability. An attractive feature of this model is that it shows that, in most cases, the central bank will set the optimal policy rate in the usual manner (that is, it can disregard the factor relating to the marginal risk of a crisis in the optimal target criterion) but, if required, the central bank can affect the probability of a crisis by keeping the policy rate higher.

An alternative approach is to describe the connection between the Taylor rule for monetary policy and a form of Taylor rule that describes how regulations vary based on an assessment of, for example, credit growth.[13] The different rules are connected through the stylised view of the monetary policy transmission mechanism presented earlier:

$$i_t^{lending} = i_t + \delta_t(z_t)\,.$$

[12] M Woodford, "Inflation targeting and financial stability", Czech National Bank seminar, September 2010.

[13] S Ingves, "Monetary policy and financial stability – some future challenges", Swedish Economics Association, May 2010.

The policy rate (i_t) is determined by the well-known Taylor rule for monetary policy. The interest rate margin (δ_t) is influenced by regulation (z_t), which is itself determined by non-time-varying regulations ($\bar{z}$), the credit gap (measured as actual credit volume in relation to a level deemed sustainable over the long-term ($l_t - \bar{l}_t$)), and the output gap (measured as the actual level of output in relation to a level deemed sustainable over the long-run, ($y_t - \bar{y}_t$)):

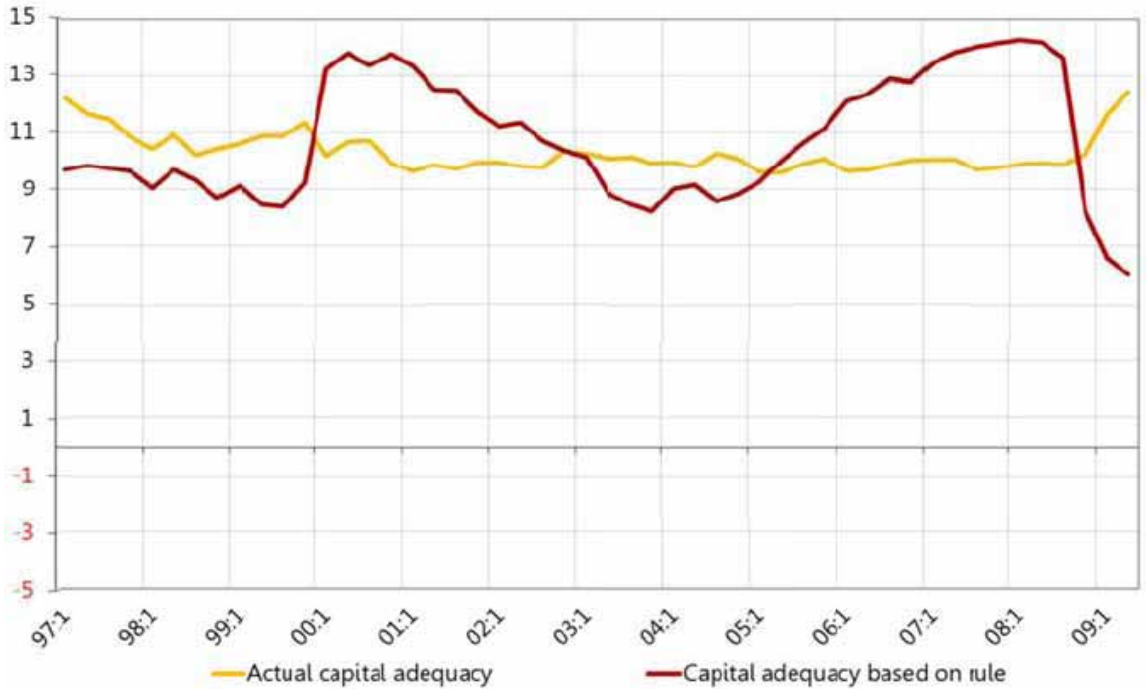
$$z_t = z\left(\bar{z}, l_t - \bar{l}_t, y_t - \bar{y}_t, \cdots\right).$$

Together, the Taylor rule for monetary policy and the rule for regulation form, through the bank lending interest rate equation, a system that describes the relationship between monetary policy and macroprudential policy. I should emphasise that this is merely an illustration of a quite loose concept, rather than a description of a concrete proposal or model. But it helpfully illustrates the type of work that must be carried out before any theory or model can be applied in practice.

The Riksbank has used a simple version of this rule to illustrate the effect that countercyclical capital buffers could have had in Sweden between Q1 1997 and Q2 2009 (see Figure 5). Under this rule, capital adequacy for the four main banks in Sweden is a function of the banks' long-run capital adequacy ratio, the credit gap and the output gap.

Figure 5

Countercyclical capital buffer using capital adequacy rule



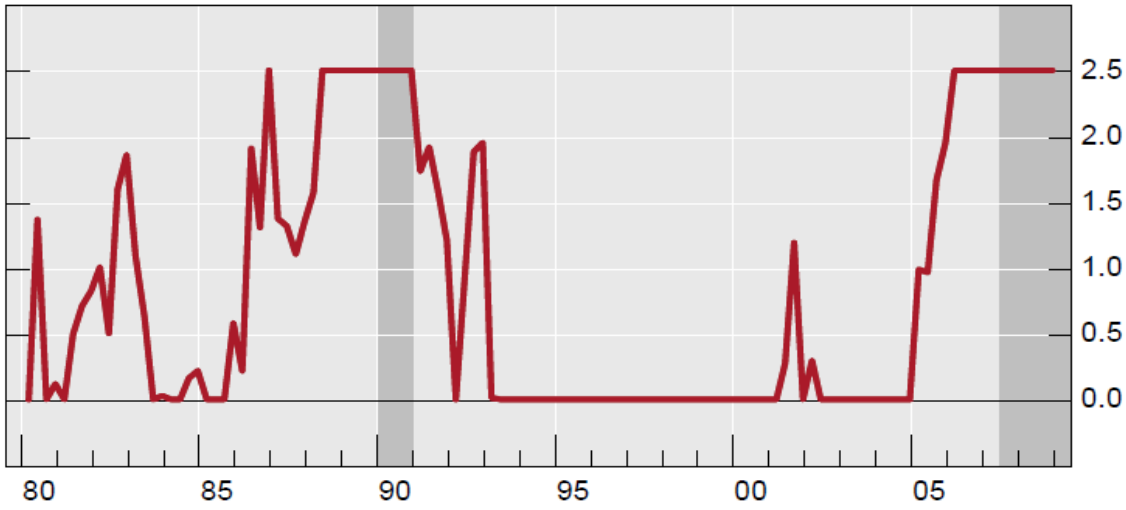
Source: Riksbank.

Again, this exercise is purely illustrative, but the results are encouraging, as the rule would have raised the banks' capital in the run-up to the recent crisis and lowered it after the crisis hit. And the results broadly match those from a similar exercise conducted by Claudio Borio,

in which a measure of the credit-to-GDP was used to guide the size of countercyclical capital buffers in Sweden since 1980 (Figure 6).[14]

Figure 6

Countercyclical buffers in Sweden using credit-to-GDP gap rule



Vertical shaded areas indicate the starting years of system-wide banking crises. The countercyclical buffer is 0 when the value of the credit/GDP gap is below 2, and 2.5 when it is above 10%; for gaps between 2 and 10% the buffer is calculated as 2.5/8 times the value of the credit/GDP gap exceeding 2%.

Source: BIS calculations.

However, much more work is required, for example to allow the approach to include other regulations, to determine how best to calculate the sustainable level of credit in the long run, and to overcome the econometric problems when estimating the rule.[15] And it is a long way short of being something that can guide the practical use of macroprudential policies.

Summary

In this speech, I have broadly illustrated some of the thoughts and reflections that macroprudential (and other) policymakers will need to consider going forward. There are many challenging issues: some of them are new (and particular to macroprudential policy) but many of them are not, such as the need to manage the overlap between policy areas. However, we can already see system-wide risks again building in financial systems, in Sweden and internationally – so it is important that we now face these challenges head on.

[14] C Borio, "Credit in monetary and (macro-)prudential policy", Sveriges Riksbank workshop on housing markets, monetary policy and financial stability, November 2010.

[15] The Riksbank faced several econometric problems when attempting to estimate the capital adequacy rule shown in Figure 4. For example, we used a short time series and faced an endogeneity problem (because bank lending is included on the left and right hand side of the rule). Therefore, in this exercise, we have simply selected coefficients that achieve what we believe to be an appropriate level of sensitivity between capital adequacy regulation and the output gap and the bank lending gap.

The first challenge will be designing effective macroprudential frameworks to ensure that the appropriate agencies are given the appropriate mandates, sufficient capability, and policy instruments to deal with threats to financial stability. Governance arrangements will play an important role. They will help to clearly define the role of macroprudential policy, to ensure that it can be used effectively, and to manage the interaction with other policy areas. While there are likely to be numerous solutions for the design of effective governance arrangements, the issues and key concerns are fairly well defined and understood.

Unfortunately, as I have discussed, it is clear that we do not have the same understanding of the more technical aspects of how macroprudential instruments should be used and of how they interact with other policy areas. I have highlighted a couple of high-level approaches to modelling the interaction of macroprudential policy and monetary policy, but these are not yet sufficiently developed to produce anything that is practically applicable. So there are likely to be a number of open questions and uncertainties when macroprudential policy becomes active. Fortunately that is nothing new for policymakers.

That said, this is an exciting and, I believe, potentially very fruitful area for research in the future. And it is encouraging to see prominent researchers becoming increasingly interested in issues related to financial stability. I am therefore hopeful that there will be mutually beneficial cooperation between academics and policymakers in the future.

Systemic risk measures: the simpler the better?

María Rodríguez-Moreno and Juan Ignacio Peña[1]

Introduction

The financial system plays a fundamental role in the global economy as the middleman between agents who need to borrow and agents who are willing to lend or invest. As a consequence, it is naturally linked to all economic sectors and, therefore, if the financial system does not work properly, its problems have a strong impact on the real economy. We can see this in the deteriorating fundamental macro variables of the United States and Europe, including GDP growth rate, unemployment rates and government deficits.

Many of these problems come from events related to systemic risk, extending from the banking sector to the real economy. Thus, it is important to understand the available measures of systemic risk and their relationships with one another in order to show later an indicator of their relative usefulness. This article aims to shed some light on these pressing issues by means of an empirical analysis of the most widely used and best known measures of systemic risk employed by investors and regulators worldwide.

In this paper, we concentrate on what are widely acknowledged to be the most important systemic actors: the biggest banks in the two biggest economic areas (Western Europe and the United States).[2] Using daily data, we construct and compare a comprehensive set of measures for these major actors. Specifically, we compute six different sets of systemic risk measures for a sample of the 20 biggest European and 13 biggest US banks from January 2004 to November 2009.[3] The six measures are based on (i) principal components of the bank's credit default swaps (CDS); (ii) interbank interest rates; (iii) structural credit risk models (Merton (1973)); (iv) collateralised debt obligation (CDO) indices and their tranches; (v) multivariate densities computed from CDS spreads; and (vi) co-risk measures. Unlike previous studies, we do not focus on just one market (stock market) to compute our measures, but use data from several markets: stock, credit and derivatives markets. Then, we run a "horse race" to evaluate the usefulness of these measures on the basis of three different criteria: (i) Granger Causality tests; (ii) Gonzalo and Granger metric; and (iii) McFadden R-squared. Finally, we run some additional checks to verify the robustness of the "horse race" results.

Our results imply that the best-performing measures of systemic risk are based on simple indicators obtained from credit derivatives and interbank rates. Measures based on complex models or convoluted statistical procedures do not perform particularly well in our sample. It seems that "model risk" is an issue when developing appropriate measures of systemic risk. Therefore, the implication for investors and regulators looking for reliable systemic risk indicators is to stick to simple, robust indicators based on credit derivatives and on interest rates data from the market.

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[1] Department of Business Administration, Universidad Carlos III de Madrid.

[2] Billio et al (2010) find that banks may be more central to systemic risk than non-bank financial institutions that engage in banking functions.

[3] In a recent study, the International Monetary Fund (2009) posits that smaller institutions may also contribute to systemic risk if they are closely interconnected. However, systemic risk should be most readily observed in the largest banks.

Systemic risk measures

In this section, we briefly summarise the systemic risk measures proposed in the literature, which are based on market information.

- Principal Component Analysis (PCA): CDS are credit derivatives that provide insurance against the risk of default of a certain company and, hence, their spreads measure the risk that is faced by bondholders of the reference entity. We perform a PCA on a pool of CDS spreads and consider the first principal component as a systemic risk measure because it is the common factor that is driving the CDS spreads, and the nature of such spreads should be reflecting the common risk of default.
- LIBOR spreads: this group of measures involves the use of LIBOR[4] as the reference interest rate relative to either the Overnight Interest Swap (OIS) or treasury bills (TBILLs). These two proxies of systemic risk are similar, but important conceptual differences exist between them. The LIBOR-OIS spread reflects liquidity and default risk over the following months while the LIBOR-TBILL spread captures not only liquidity and default risk but also the additional fact that, during periods of turmoil, investors lend against treasury bills (the best form of collateral), measuring the "flight to quality" effect.
- Structural model: the third group of measures is based on the framework of Merton's model (1973). The basic reference is Lehar (2005), although other authors use similar approaches. Lehar (2005) proposes a systemic risk measure based on the probability of default of a given proportion of banks in a given financial system. The probability of default is linked to the relationship between the banks' asset value and their liabilities. In summary, the procedure for estimating this variable consists of recovering the bank's asset portfolio and correlations through Merton's model and an Exponential Weighted Moving Average (EWMA) model, respectively. Then a simulation is carried out to infer the banks' future asset portfolio and compare it with their liabilities according to different criteria, in order to construct two systemic risk indexes: SIV and SIN, which refer to a systemic risk index based on the expected value of bank's asset portfolio and a systemic risk index based on the expected number of defaulted banks, respectively.
- CDO indexes and tranches: some authors used CDOs to estimate systemic risk measures. We base this group of measures on Bhansali, Gingrich and Longstaff's (2008) paper. They extract the idiosyncratic, sector-wide and economy-wide, or systemic risk components from US (CDX) and European (iTraxx) prices of indexed credit derivatives by means of a linearised three-jump model. In summary, they calibrate the model to both the CDO indexes and their tranches. They then break down the CDO indexes into three different spreads.
- Multivariate Density: Another set of measures assesses systemic risk by recovering the multivariate density of an analysed portfolio. Within this line, we follow Segoviano and Goodhart (2009), who propose a set of banking stability measures based on distress dependence, which is estimated by the Banking System Multivariate Density (BSMD). BSMD is the key element for measuring banking stability and is estimated by means of Consistent Information Multivariate Density Optimizing (CIMDO) methodology (see Segoviano (2006)). Once the BSMD is recovered, the authors propose two measures for common distress in the banking

[4] We use the LIBOR for the main currencies under study (ie USD LIBOR and EURIBOR).

system: the joint probability of distress (JPoD), which represents the probability of all banks in the portfolio becoming distressed, and the Banking Stability Index (BSI), which represents the expected number of institutions to become distressed, conditional on the fact that at least one institution has become distressed. However, the estimation of the BSMD becomes harder as we increase the number of banks under analysis. To overcome this problem, we analyse this measure using "reduced portfolios" according to three criteria: (i) level of CDS spread; (ii) level of liabilities; and (iii) level of the liabilities over market value ratio. That is, for each period of time, we choose three banks which are at the top of each classification and estimate the corresponding BSMD.

- "Co-risk management" tools: the last set of systemic risk measures are based on the traditional risk management tools such as value-at-risk (*VaR*) and expected shortfall (*ES*). Adrian and Brunnermeier (2009) propose estimating institution *i*'s co-value-at-risk ($CoVaR_i$) as the whole system's (ie, portfolio's) VaR_s conditioned on institution *i* being in distress (ie being at its unconditional VaR_i level). On the basis of *CoVaR*, they calculate the marginal contribution of institution *i* to the overall systemic risk as the difference between *CoVaR* and the unconditional whole system's *VaR*, which is denoted as Delta Co-Value-at-Risk ($\Delta CoVarR_i$). Therefore, $\Delta CoVarR_i$ allows us to determine how much an institution adds to overall systemic risk. Then, we add the $\Delta CoVarR_i$ of each institution using two different criteria, equally weighted, and weighted by market capitalisation. Additionally, we apply the "co-risk" methodology to the *ES* through the quantile regression.

Horse race

In this section, we choose the most informative variables within each group, by regressing the measures against the influential events that have marked the main episodes of the crisis. Then we rank the systemic risk measures according to their performance in the Granger causality test, the Gonzalo and Granger metric and the McFadden R-squared.

To choose the most informative variables about systemic risk, we use the Influential Events Variable (IEV). This is a dummy variable which equals 1 on a date when there is important systemic news during the financial crisis and is equal to 0 otherwise. This variable covers a wide variety of events such as: bankruptcies (financial and non-financial firms), substantial firms' losses, stock market downturns, takeovers among financial institutions, and nationalisations or bail-outs among others. Then, we run logistic regressions, using each systemic risk measure as an explanatory variable, and choose the systemic risk measures with the highest average McFadden R-squared. Table 1 summarises the selected systemic risk measures for those groups in which there is more than one proposed measure.

In order to rank the selected variables across groups within each economic area, we employ three criteria: (i) Granger causality test; (ii) Gonzalo and Granger metric; and (iii) McFadden R-squared. The first criterion gives information on the very important issue of which market provides the leading indicator. Having reliable early indicators is of crucial importance for market agents and especially for regulators.[5] The second and third criteria relate, from

[5] As documented in Sorkin (2010), on 5 June 2007, none other than the Fed chairman Ben Bernanke said, "At this point the troubles in the subprime sector seem unlikely to seriously spill over to the broader economy or the financial system." To be fair, not only regulators appear strikingly short-sighted, but academics as well deserve a mention. For instance, in a paper on measures of systemic risk published in the *Journal of Financial Economics* (available online, edition 3 July 2007), Bartram, Brown and Hund (2007) said that "the distress of central bankers, regulators and politicians about the events (systemic risk) we study could be overstated and

different perspectives, to each measure with an unobservable component, that is, the underlying *systemic risk trend* in the economy. In the Gonzalo and Granger metric, we compare, by pairs of measures, the contribution of each measure to the unobserved component, while by means of the McFadden R-squared, we measure the relationship between each measure and the IEV which is a proxy for the main systemic events of the current crisis.

(i) Granger causality test: the first classification is based on the Granger causality test (Granger (1969)). This test intuitively examines whether past changes in one variable, X_t, help to explain contemporary changes in another variable, Y_t. If not, we conclude that X_t does not Grange-cause Y_t. We carry out the Granger causality test by pairs of measures within each economic area. To rank the measures, we give a score of +1 to measure X if X Granger causes another measure, Y, and we give a score of –1 to measure X if X is caused in the Granger sense by Y. The best measure receives the highest positive score and the worst measure the highest negative score.[6]

(ii) Gonzalo and Granger metric: the second classification is based on the Gonzalo and Granger (1995) (GG) metric. This analysis allows us to determine, by pairs of measures, the relative contribution of each measure to the unobserved factor that is the driving force in the cointegration relationship. In our framework we define that unobserved factor as the *systemic risk common trend* in the economy. To rank the estimated measures we make use of the fact that the GG metric is bounded between 0 and 1. We assign a score of +1 to measure X if X contributes more to the systemic risk common trend factor (ie its GG metric is larger than 0.5) than the measure Y, which is assigned –1, and we assign a score of –1 to measure X and a score of +1 to measure Y otherwise.

(iii) McFadden R-squared: previously, we made use of the logistic and multinomial regressions against the Influential Event Variable (IEV) to rule out those variables which provide less information about the systemic events within each group of measures. In this case, we rank the systemic risk measures by pairs, assigning a score of +1 to the measure with the highest R-squared and –1 to the one with the lowest R-squared.

Table 2 summarises the ranking scores according to the specified criterion. For the European market, the best indicator is the LIBOR-OIS spread followed by the first principal component of the single-name CDS whereas the least reliable indicator is the $\Delta CoES_i$. For the US market, the best indicator is the first principal component of the single-name CDS followed by the LIBOR-TBILL spread, whereas the least reliable indicator is the $\Delta CoVarR_i$.

Additionally, we conduct robustness tests to show the consistency of the results. It can be argued that assigning the same weight to all the events, irrespective of their potential severity and impact on the financial system, may bias the results. To deal with this possible problem, we employ an alternative definition of the dependent variable: instead of using only two values (ie 1 or 0), we decompose the IEV variable into four different levels, in accordance with the event's severity. The multinomial Logit regression outcomes are not materially

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that current policy responses to financial crises could be adequate to handle major macroeconomic events." Spot on.

[6] This ranking procedure is related to the well-known Condorcet voting method. The Marquis de Condorcet, a prominent reformer who became a secretary of the revolutionary French National Assembly in 1791, suggested dividing elections into a series of one-on-one contests, so that every candidate is directly compared with every other. If there is a candidate who wins every such match, it is clear who should be the overall winner of the tournament. However to avoid some of the problems of the Condorcet approach we also allow for negative as well as positive scores.

different from the ones obtained using a standard Logit regression. On the other hand, it can also be argued that the Granger causality test is designed to handle pairs of variables, and could produce misleading results when the true relationship involves three or more variables. To deal with this criticism, we run a VAR equation in which we consider the six selected systemic risk measures by economic area and establish a ranking score according to the significant coefficients. Those scores are broadly in agreement with the Granger causality test in both portfolios.

Conclusion

In this paper, we compute six different sets of systemic risk measures for a sample of European and US banks from January 2004 to November 2009. The six measures are based on (i) principal components of the banks' credit default swaps; (ii) interbank interest rates; (iii) structural credit risk models; (iv) collateralised debt obligation indexes and their tranches; (v) multivariate densities computed from CDS spreads; and (vi) co-risk (CoVaR) measures. We then compare them using three different criteria: (i) Granger causality tests; (ii) the Gonzalo and Granger metric; and (iii) their relation to an index of systemic events. We find that for the European market, the best indicator is the LIBOR-OIS spread followed by the principal component of the single-name CDS, whereas the least reliable indicator is the equally weighted Delta Co-Expected Shortfall. For the US market, the best indicator is the first principal component of the single-name CDS followed by the LIBOR-TBILL spread, whereas the least reliable indicator is the equally weighted Delta-Co-Value-at-Risk.

Therefore, our results imply that the best-performing measures of systemic risk are based on simple indicators obtained from credit derivatives and interbank rates. On the other hand, indicators relying on complex statistical procedures or questionable assumptions do not perform particularly well in our sample. The implications for investors and regulators are straightforward: look for simple, robust indicators based directly on liquid market prices of credit-sensitive instruments; beware of overcomplicated modelling based on dubious assumptions; and avoid inferences from the prices of financial products traded in thin markets.

Table 1

Selected measures by group

	LIBOR spreads	Structural models	Multivariate densities	"Co-Risk" tools
European Portfolio	LIBOR-OIS	SIN	BSI Reduced Portfolio Liabilities/MV	*ΔCoES* Equally Weighted
US Portfolio	LIBOR-TBILL	SIV	BSI Reduced Portfolio Liabilities/MV	ΔCoVaR Equally Weighted

This table contains the selected measures by group based on the average McFadden R-squared.

Table 2

Horse Race

Panel A: European Portfolio

	Granger causality test	GG metric	McFadden R-squared	Final score
LIBOR-OIS	0	3	5	8
PCA	3	3	1	7
CDO	0	2	–3	–1
BSI	–1	–3	3	–1
SIN	–1	0	–5	–6
ΔCoES	–1	–5	–1	–7

Panel B: US Portfolio

	Granger causality yest	GG metric	McFadden R-squared	Final score
PCA	3	4	–3	4
LIBOR-TBILL	1	–3	5	3
CDO	0	–1	3	2
SIV	2	4	–5	1
BSI	–3	1	–1	–3
ΔCoVaR	–3	–5	1	–7

This table reports the ranking scores of the systemic risk measures among three classifications: Granger causality test, Gonzalo and Granger metric and McFadden R-squared. We also report the final score, which is the sum of scores among classifications. Panel A refers to the European portfolio and Panel B to the US portfolio.

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Systemic risk contributions[1]

Xin Huang, Hao Zhou and Haibin Zhu[2]

1. Introduction

The recent global financial crisis has led to a re-examination and reform of the international regulatory framework, and most remarkably to the introduction of macroprudential regulation. Against this background, this paper proposes a consistent framework for measuring systemic risk and decomposing it into contributions from individual banks. Our systemic risk measure can be interpreted economically as an insurance premium that covers distressed losses in a banking system, which is the concept of a risk-neutral market price, assuming that such an insurance market exists and functions properly. Within the same framework, the systemic importance of each bank (or a group of banks) can be properly defined as its marginal contribution to the hypothetical distress insurance premium (DIP) of the whole banking system. This approach allows us to study the time variation and cross section of the systemic risk contributions of large and complex US financial institutions (LCFIs). Our metric can be applied using only publicly available information for large banking organisations.

We applied this approach to the 19 bank holding companies (BHCs) covered by the US Supervisory Capital Assessment Program (SCAP) – commonly known as the macro stress test – during the period from January 2004 to December 2009. However, unlike the SCAP, our analysis did not rely on any confidential, supervisory, or proprietary information or data. Our findings suggest that the systemic risk indicator stood at its peak of around $1.1 trillion in March 2009 and has since fallen to about $300 billion – the level reached in January 2008. A bank's contribution to the systemic risk indicator appears to be linearly related to its default probability but highly nonlinear with respect to institution size and its asset correlation with the rest of the banking system.

More importantly, we can rank the systemic importance of LCFIs in the US banking sector. Based on our measure since the summer of 2007, Citigroup has remained the largest contributor to systemic risk, the contributions of Bank of America and Wells Fargo have risen, and that of JPMorgan Chase has declined. The relative contributions to systemic risk from both consumer banks and regional banks seem to have increased somewhat since 2009, possibly because of the deteriorating situation in the commercial real estate and consumer credit sectors, which typically lag the business cycle. Overall, our analysis suggests that size is the dominant factor in determining banks' systemic risk contributions, but size does not change significantly over time, at least within a reporting quarter. The obvious time variations in the marginal contributions are driven mostly by the risk-neutral default probability and equity return correlations. In essence, the systemic importance of each institution is jointly determined by the size, default probability and asset correlation of all institutions in the portfolio.

Finally, our measure of the systemic importance of financial institutions noticeably resembles the SCAP result. Based on the data through 31 December 2008, the 19 banks' contributions to the systemic risk indicator are mostly in line with the SCAP estimate of losses under an

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[1] The note is an abridged version of "Systemic risk contributions", *Finance and Economics Discussions Series*, Federal Reserve Board, 2011–08, 2011.

[2] Xin Huang is with the University of Oklahoma, Hao Zhou is with the Federal Reserve Board, and Haibin Zhu was with the BIS when the paper was presented at the conference. He is now at JPMorgan.

adverse economic scenario as released on 9 May 2009, with an R-square of 0.62. Not surprisingly, the two results are not identical, because the SCAP estimate is based on statistical expected losses but our systemic risk measure also contains a risk premium component. In particular, Goldman Sachs, Citigroup and JPMorgan Chase would be viewed as contributing more to systemic risk by our method (from a risk premium perspective) than by the SCAP results, while Bank of America and Wells Fargo would be viewed as more risky by the SCAP results (from an expected loss perspective) than by our method.

2. Methodology

2.1 Constructing the systemic risk indicator

The systemic risk indicator, a hypothetical insurance premium against catastrophic losses in a banking system, was constructed from real-time publicly available financial market data. The two key default risk factors, the probability of default (PD) of individual banks and the asset return correlations among banks, were estimated from CDS spreads and equity price co-movements, respectively.

The PD measure used in this approach was derived from single-name CDS spreads. A CDS contract offers protection against default losses of an underlying entity; in return, the protection buyer agrees to make constant periodic premium payments. The CDS market has grown rapidly in recent years, and the CDS spread is considered superior to the bond spread or the loan spread as a measure of credit risk. Under the simplifying assumptions of a flat term structure of the risk-free rate and a flat default intensity term structure, the one-year risk-neutral PDs of individual banks can be derived from CDS spreads in a straightforward manner (Huang, Zhou and Zhu (2009)).

Systemic risk in a financial sector is in essence a joint default event of multiple large institutions, which is captured by the correlations of observable equity returns. At a more fundamental level, such a correlation structure is driven by the common movements in underlying firms' asset values. The common movements can be due to the business cycle, interbank business linkages or shift in market sentiment that affects the valuation of bank assets simultaneously. We measured the asset return correlation by the equity return correlation, as the equity market is the most liquid financial market and can incorporate new information on an institution's default risk in a timely way. The standard approach is to use the so-called historical correlation, which is based on the past year of daily return data.

Based on the inputs of the key credit risk parameters – PDs, LGDs, correlations and liability weights – the systemic risk indicator can be calculated by simulation (Huang, Zhou and Zhu (2009)). In short, to compute the indicator, we first construct a hypothetical debt portfolio that consists of the total liabilities (deposits, debts, and others) of all banks. The indicator of systemic risk, effectively weighted by the liability size of each bank, is defined as the insurance premium that protects against the distressed losses of this portfolio. Technically, it is calculated as the risk-neutral expectation of portfolio credit losses that equal or exceed a minimum share of the sector's total liabilities (10% in our case).

2.2 Identifying systemically important banks

For the purpose of macroprudential regulation, it is important not only to monitor the *level* of systemic risk for the banking sector but also to understand the *sources* of risk in the financial system, ie to measure the marginal contributions of each institution. This information is especially useful considering the reform effort of the financial regulations across the globe, with the main objective of charging additional capital for systemically important banks and supporting a resolution regime for these banks.

Following the standard measures of risk, including VaR, ES and the DIP used in this study, the total risk can be usefully decomposed into a sum of marginal risk contributions (Huang, Zhou and Zhu (2010)). Each marginal risk contribution is the expected loss from that subportfolio, conditional on a large loss for the full portfolio. The additivity property of the decomposition results – ie the fact that the systemic risk of a portfolio equals the marginal contribution from each subportfolio – is extremely important from an operational perspective. Whereas the macroprudential approach focuses on the risk of the financial system as a whole, in the end regulatory and policy measures are introduced at the level of individual banks. Our approach, therefore, allows a systemic risk regulator to easily link the regulatory capital assessment with risk contributions from each institution.

The most closely related approach is the CoVaR method proposed by Adrian and Brunnermeier (2009). CoVaR looks at the VaR of the whole portfolio conditional on the VaR of an individual institution. In other words, the focus of CoVaR is to examine the spillover or correlation effect from one bank's failure to the whole system, but CoVaR underplays the importance of institutional size by design. By comparison, our definition of DIP is along the same line, but DIP focuses on the loss of a particular bank (or bank group) conditional on the system being in distress. Nevertheless, a major disadvantage of CoVaR is that it can be used only to identify systemically important institutions but cannot appropriately aggregate the systemic risk contributions of individual institutions.

Another alternative is the MES proposed by Acharya, Pedersen, Philippon and Richardson (2010). MES looks at the expected loss of each bank conditional on the whole portfolio of banks performing poorly. Again, in comparison, MES is similar to our DIP measure in that both focus on each bank's potential loss conditional on the system being in distress exceeding a threshold level, and both are coherent risk measures. They differ slightly in the sense that the extreme condition is defined by the percentile distribution in the MES setting but by a given threshold loss of the underlying portfolio in the case of DIP. Also, the probabilities in the tail event underpinning MES are normalised to sum to 1; these probabilities are not normalised for DIP. The more important difference is that MES is calculated based on equity return data, while our DIP measure is based mainly on the CDS data. Compared with equity return data, CDS data are better and purer sources of default risk information.

3. Empirical application

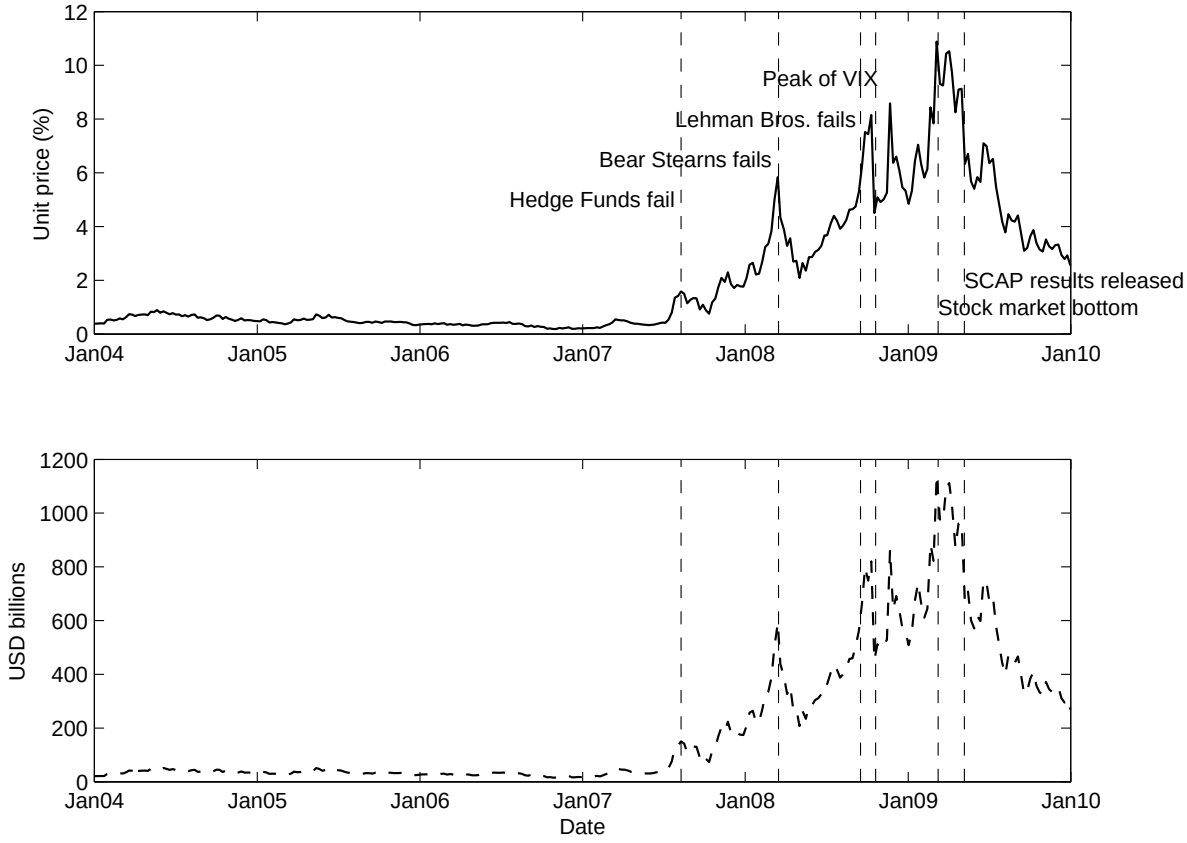
We applied the methodology described in Section 2 and examined the systemic risk in the US banking system consisting of the 19 banks covered by the SCAP, commonly known as the macro stress test. Using these banks as an example, we first reported the systemic risk indicator for these institutions as a group and then analysed the systemic importance of individual banks.

Figure 1 reports the time variation of the DIP. The systemic risk indicator for the US banking system was very low at the beginning of the financial and credit crises. For a long period before the collapse of two Bear Stearns hedge funds in early August 2007, the DIP for the list of 19 SCAP banks was merely one-half of 1 percentage point (or less than $5 billion). The indicator then moved up significantly, reaching the first peak when US bank regulators arranged for Bear Stearns to be acquired by JPMorgan Chase on 16 March 2008. The situation then improved significantly in April and May 2008 owing to strong intervention by major central banks. Things changed dramatically in September 2008 with the failure of Lehman Brothers. Market panic and increasing risk aversion pushed up the price of insurance against distress in the banking sector. The DIP shot up and hovered in the range of $500 billion to $900 billion. One week before the stock market reached the bottom, the systemic risk indicator peaked at around $1.1 trillion. Since the release of the SCAP result in

early May 2009, the DIP has come down quickly and has returned to the pre-Lehman level of $300–400 billion.

Figure 1

Systemic risk indicator of the 19 US SCAP banks



Notes: The figure plots the systemic risk indicator for the SCAP banks, defined as the price for insuring against financial distresses (at least 10% of total liabilities in the banking system are in default). The price is shown as the cost per unit of exposure to these liabilities in the upper panel and is shown in dollar terms in the lower panel.

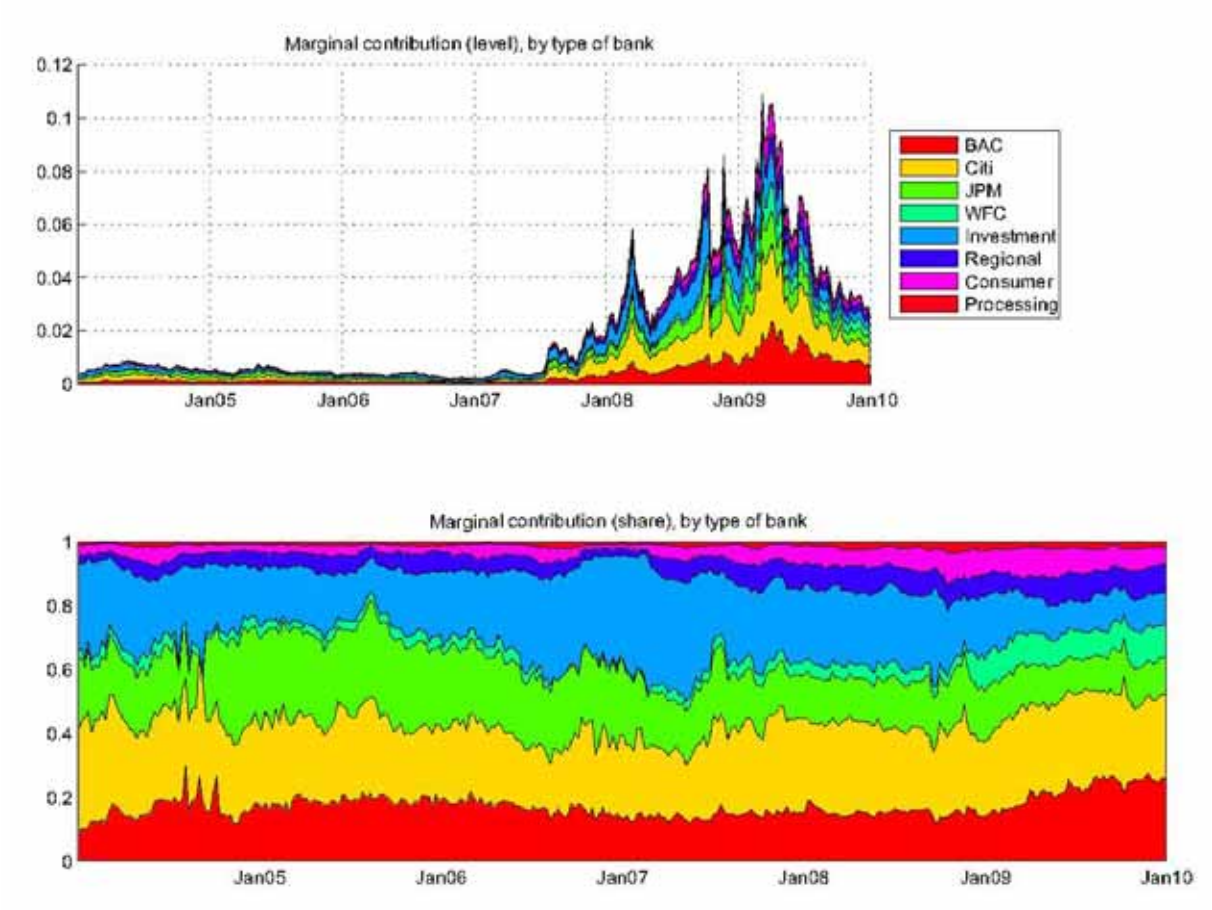
Using the methodology described in Section 2, we calculated the marginal contributions of each group of banks to the systemic risk indicator, both in level terms and in percentage terms. Figure 2 shows that, based on our measure after the summer of 2007, Bank of America and Wells Fargo increased their systemic risk contributions, Citigroup remained the largest contributor, and JPMorgan Chase reduced its marginal contribution. Recall that Wells Fargo acquired Wachovia, and Bank of America acquired Merrill Lynch, during the height of the financial crisis. Figure 2 also reports the systemic risk contributions of other banks, which are grouped into four categories.[3] The relative contributions to the systemic risk indicator from both consumer banks and regional banks seem to have increased somewhat since

[3] The four categories are as follows: (1) investment banks (Goldman Sachs and Morgan Stanley); (2) consumer banks (GMAC and American Express); (3) regional banks (US Bancorp, Capital One, PNC Financial, SunTrust, BB&T, Regions Financial, Fifth Third and KeyCorp); and (4) processing banks (Bank of New York Mellon, State Street and Northern Trust). Bank of America, Citigroup, JPMorgan Chase and Wells Fargo are listed as individual large complex financial institutions.

2009, possibly because of the worsening situations in the commercial real estate and consumer credit sectors, which typically lag the business cycle.

Figure 2

Marginal contributions to systemic risk by each group of banks

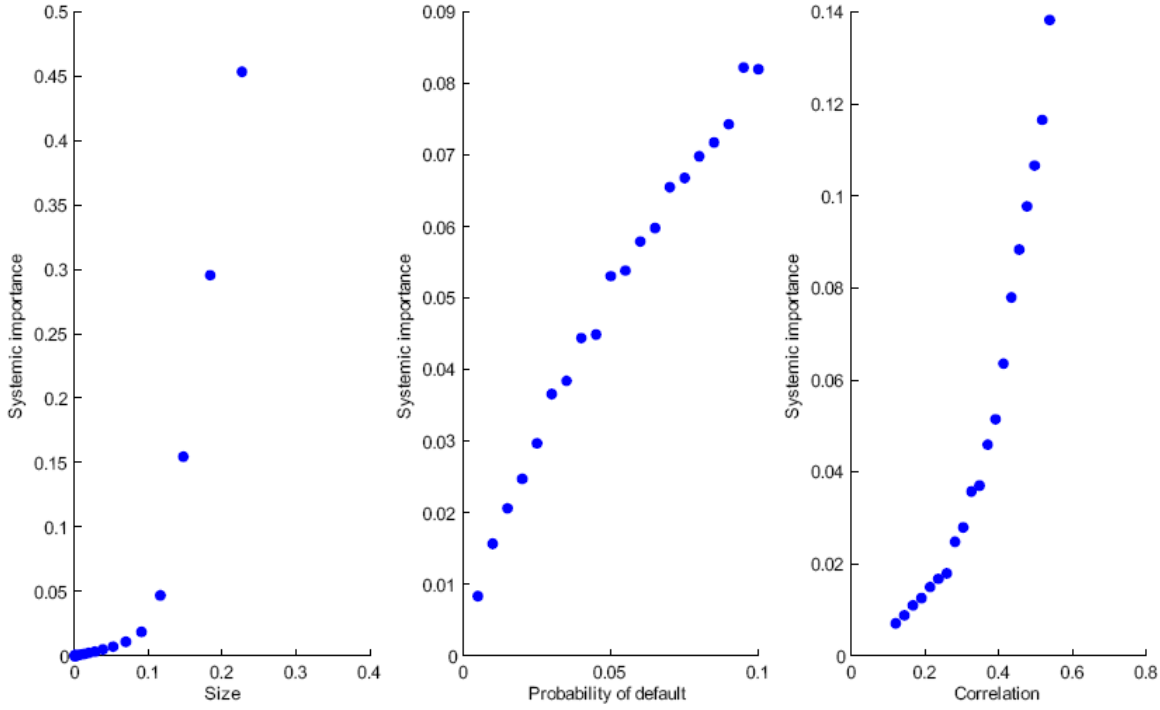


Notes: The figure shows the marginal contribution of each bank or banking group to the systemic risk indicator, the distress insurance premium in unit cost term. The contribution is shown in level terms in the upper panel and as a percentage of the total risk in the lower panel.

The above findings support the case for distinguishing between microprudential and macroprudential perspectives of banking regulation: the failure of individual banks does not necessarily contribute to the increase in systemic risk. Size, correlation and the interactions between the determinants play important roles. The nonlinear effect is more visible in a hypothetical calibration exercise examining the relationship between our measure of systemic risk contributions and an institution's size (total liability), (risk-neutral) default probability, and (average) historical correlation (Figure 3). The relationship looks roughly linear for default probability but highly nonlinear with respect to size and, to a lesser degree, correlation. In fact, when the bank size is below 10% of the total portfolio, the slope of the systemic importance with respect to size is very flat; but when the size is beyond 10%, the contribution to systemic risk shoots up almost vertically. An intuitive reason is that, when a bank is too big, its failure is considered a systemic failure by definition. This consideration may indicate a desirable maximum size of the large complex financial institutions, which, by limiting the systemic risk, could provide a societal benefit. The relationship between systemic importance and correlation shows a similar nonlinear pattern but is less dramatic. In other words, systemic importance is a joint effect of an institution's size, leverage, and concentration and is highly nonlinear.

Figure 3

Relationship between systemic risk contribution and bank size, PD and correlation



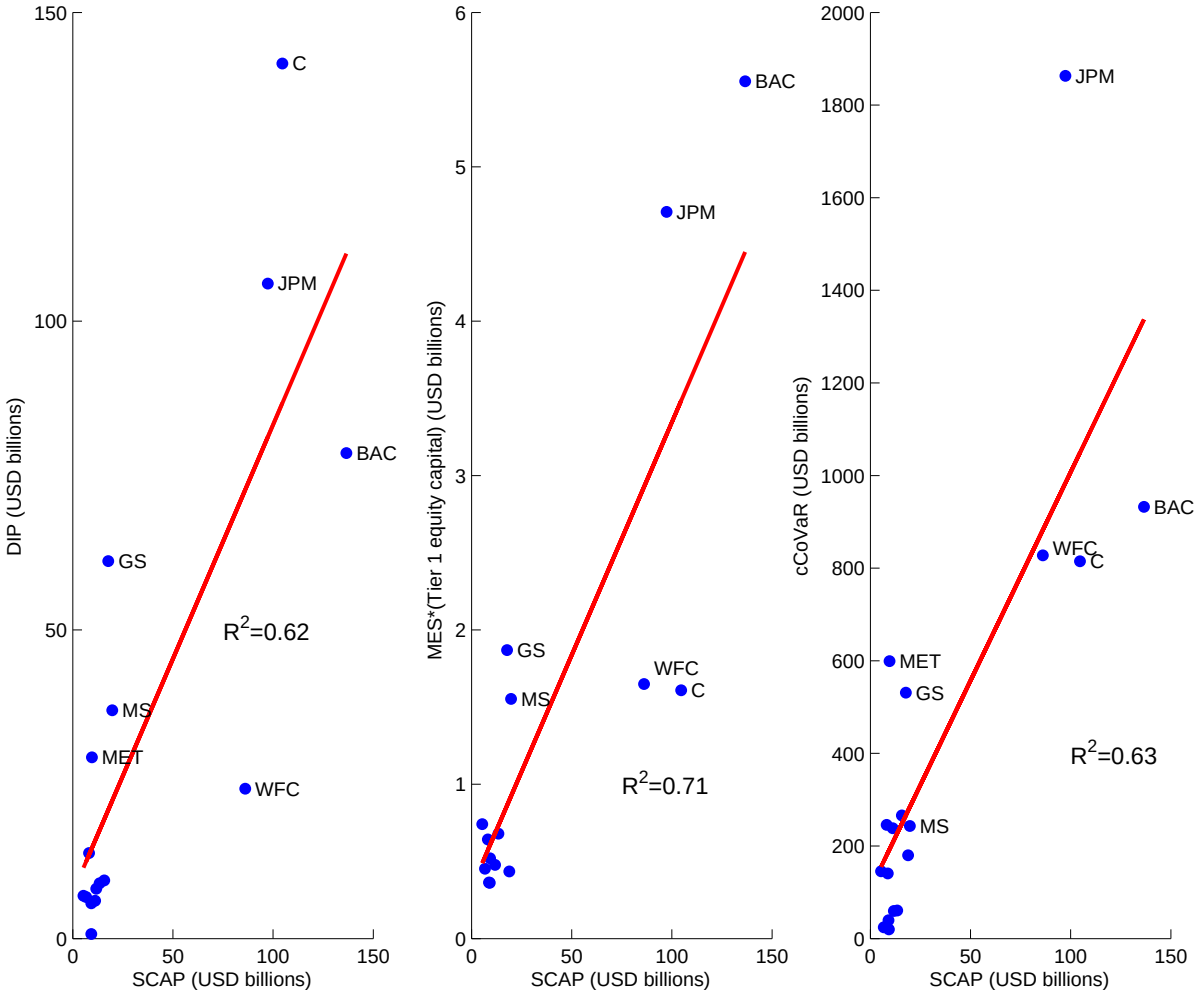
Notes: This figure plots a hypothetical calibration exercise based on a group of 20 banks, with average LGD of 0.55 and distress threshold 10%. For the impact of size (left panel), PD is 0.02 and correlation is 20%; for the impact of PD (middle panel), PD changes from 0.005 to 0.1; for the impact of correlation (right panel), the loading coefficient in a one-factor model ranges between 0.2 and 0.96.

We can further compare different measures of systemic importance with the SCAP estimate of losses under an adverse economic scenario as released in May 2009 by the Federal Reserve (2009). The left-hand panel of Figure 4 suggests that, based on the data through 31 December 2008, the 19 banks' contributions to our DIP systemic risk indicator are largely in line with the SCAP estimate of losses, with an R-square of 0.62. Note that the SCAP estimate is based on statistical expected losses but our systemic risk measure also contains a risk premium component. As a result, the exact ranking of systemic importance can be different. For instance, Goldman Sachs, Citigroup and JPMorgan Chase would be viewed as contributing much more to systemic risk by our method from a market risk premium perspective than by the SCAP results, while Bank of America and Wells Fargo would be viewed as more risky by the SCAP from an expected default loss perspective than by our method.

The middle panel shows that MES weighted by Tier 1 capital has a higher correlation with SCAP expected losses, with an R-square of 0.71. Relative to SCAP, MES considers Bank of America, JPMorgan Chase and Goldman Sachs more risky and Wells Fargo and Citigroup less risky. The right panel shows that CoVaR in dollar terms has a similar correlation with the SCAP results, with an R-square of 0.63. Compared with SCAP, CoVaR ranks JPMorgan Chase, MetLife, and Goldman Sachs as more risky but Citigroup and Bank of America as less risky.

Figure 4

Comparing systemic risk measures: DIP, MES and CoVaR versus SCAP results



Notes: This figure compares three systemic risk measures: distressed insurance premium (DIP), marginal expected shortfall (MES) weighted by bank's Tier-1 capital, and conditional value-at-risk (CoVaR) in dollar terms. These measures are compared to the SCAP stress test result on the 19 largest US BHCs for the fourth quarter of 2008.

4. Policy implications

In this paper, we advocate a methodology to measure the systemic importance of individual banks and their marginal contributions to a distressed insurance premium that relies only on publicly available information. We applied this methodology to the 19 banks covered by the SCAP, or stress test programme. Our results have several important policy implications.

First, our analysis provides useful inputs for the ongoing discussion of the imposition of capital surcharges on systemically important financial institutions (SIFIs). The 2007–09 global financial crisis has led the international community of supervisors and regulators to reform the regulatory framework to ensure that a crisis on this scale never again happens. As an important part of the global initiatives, there is a general consensus that SIFIs need to set aside an additional capital buffer. In practice, the Swiss regulator has announced a plan to impose total capital requirements of as high as 19% on the two largest Swiss banks, of which systemic surcharges account for 6 percentage points. Similarly, the Chinese regulator has

imposed a minimum capital adequacy ratio of 11.5% for large banks, in contrast to one of 10% for small and medium-sized banks.

However, much remains to be decided regarding the definition of SIFIs and the calculation of capital surcharge for SIFIs. In this paper, we show that the systemic importance of financial institutions depends on their size, correlation and PD, which is highly consistent with views widely shared among regulators and supervisors. More importantly, the additivity property of our systemic risk contributions, as discussed in Section 2.2, makes it feasible to directly map our measures onto capital surcharges. Preliminary analysis shows a high correlation between our systemic importance measures and the US government's capital infusion into the banking system in 2008–09. Further analysis is necessary to make the mapping of our systemic risk contributions onto capital surcharges more rigorous.

Second, although the proposed DIP measure is risk-neutral, the framework can be easily extended by replacing key inputs with the regulator's confidential information or other input variables for the purpose of policy analysis. For instance, one can replace the risk-neutral PDs in our framework with objective measures of PDs and calculate the DIP on an incurred-cost basis. This objective measure, by filtering out the risk premium components, can provide useful complementary information for supervisors.

Third, our systemic risk indicator is designed as a real-time signal of the systemic risk in a banking system, and cannot be interpreted directly as an early warning indicator. Indeed, the DIP measure was low in 2007 and went up rapidly as the crisis deepened. Thus users should be careful in interpreting the results. However, there are ways to incorporate our measure into an early warning system, for example, in the stress-testing exercise as illustrated in Huang, Zhou and Zhu (2009).

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Systemic capital requirements[1]

Lewis Webber and Matthew Willison[2]

Introduction

Banking regulation has historically focused on making a detailed assessment of risk at the level of individual banks' balance sheets. But, in an interconnected system, banks that appear sufficiently healthy when viewed individually may collectively present a material threat to the solvency of the system as a whole. First, there may be similarities between banks' asset exposures that generate a tendency for banks' solvency positions to deteriorate and improve together. This can leave the system vulnerable to common shocks to the macroeconomy or to capital markets. Second, losses at an individual bank that are sufficient to cause it to default may trigger contagious failures of other banks in the system if they have extended it loans. Such contagious failures could, in turn, trigger further rounds – or cascades – of contagious defaults in the banking system. System-wide losses could then far exceed the size of the initial shock.

Vulnerabilities of the system as a whole that cannot be identified by focusing narrowly on the health of individual banks suggest that a change in the way that risks to the banking system are assessed and prudential requirements for banks are calibrated could be beneficial. This paper describes a system-wide risk management approach to deriving capital requirements for banks that reflect the impact their failure would have on the wider banking system and the likelihood of contagious losses occurring.

At the centre of the approach is the policymaker's optimisation problem. The policymaker is assumed to be interested in ensuring that the probability of banking system insolvency over a given time horizon is less than a chosen target level. This reflects the policymaker's systemic risk tolerance. The target could, of course, be achieved in all states of the world by setting very high systemic capital requirements. But the policymaker may also want to limit the potential inefficiency costs associated with regulatory capital requirements. In particular, if equity capital is more expensive than debt because of market frictions, higher capital requirements could, for example, increase the cost of bank lending to non-bank borrowers in the wider economy. The possible trade-off between financial stability and financial efficiency motivates a constrained optimisation problem, where a policymaker seeks to identify capital requirements for individual banks that keep to a minimum the total level of capital in the banking system overall, subject to meeting their chosen systemic risk target. The solution of the constrained optimisation problem is a unique level of capital in the banking system and its distribution across banks.

In this paper, the constrained optimisation problem faced by the systemic policymaker is combined with a structural model of the banking system to determine risk-based systemic capital requirements for individual banks. The evolution of banks' balance sheets and the manner in which interbank (or "network") exposures between firms are cleared follow Elsinger et al (2006), in the spirit of Merton (1974). This captures two drivers of systemic risk: (i) the correlations between banks' assets that may lead to multiple banks becoming

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[1] This paper is an abridged version of L Webber and M Willison, "Systemic capital requirements", *Bank of England Working Paper 436*, 2011.

[2] Bank of England.

fundamentally insolvent simultaneously; and (ii) the potential for contagious failures to occur, as losses from fundamentally insolvent banks are transmitted and amplified in the wider system via defaults on interbank obligations.

The paper assumes a very specific form of an objective function that a systemic policymaker could adopt, centred solely on resilience. A broader modelling framework and objective function might also include measures of cyclical imbalances in the economy including, for example, deviations of bank credit availability from a measure of equilibrium. These considerations are beyond the scope of this paper. Moreover, the modelling choices in the paper reflect a trade-off between realism (complexity) and pragmatism (simplicity) in the description of credit risks facing an interconnected banking system. As such, the primary focus of the paper is to obtain general insights into the properties of risk-based systemic capital requirements, rather than to calibrate precise nominal amounts that may be required to achieve particular risk targets in practice.

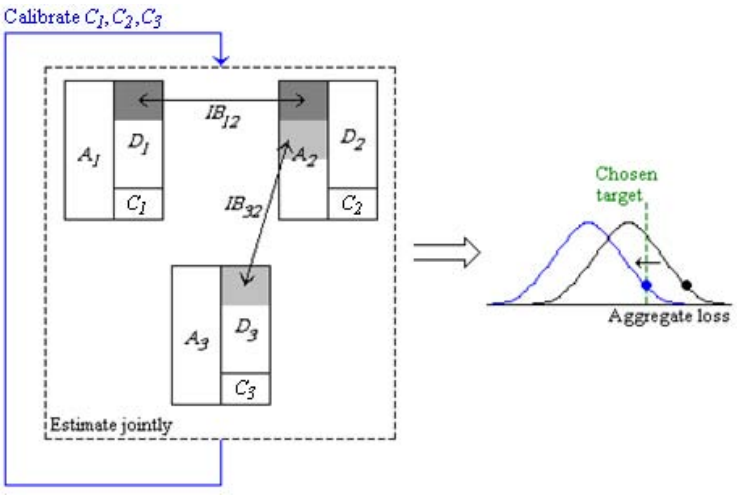
The paper is structured as follows. First we outline the details of the model and the policymaker's optimisation problem. We then set out the calibration of the model and the iterative process used by the policymaker to determine banks' systemic capital requirements – namely, the minimum configuration of capital across banks consistent with a particular measure and target for system-wide credit risk. Finally we present illustrative results for systemic capital requirements and comparative static exercises.

Modelling systemic solvency risk

This paper uses the Merton-style structural credit risk model described by Elsinger et al (2006) to quantify risks to the solvency of an interconnected banking system. The model can be thought of as a panel of correlated Merton (1974) balance sheet models, jointly estimated using observed bank equity returns, and combined with a network of interbank exposures that is cleared using the algorithm described by Eisenberg and Noe (2001). Figure 1 illustrates the broad setup of the model used to quantify systemic risk in this paper (inside the hatched border) and the type of comparative static exercises and numerical optimisations that can be performed using the model (blue). The asset value dynamics of the combined balance sheet model can be used to produce the distribution of asset shortfalls below promised debt liabilities for the system as a whole – which are hereafter called *system losses*.

Figure 1

A general balance sheet model for quantifying systemic credit risk(a)



(a) *A*, *D* and *C* refer to assets, debt and capital, respectively.

Each bank $\{i\}_{i=1,2,\ldots,n}$ holds assets outside of the banking system of A_i^0 and is assumed to have a single issue of zero-coupon debt outstanding to non-banks with a face value of D_i^0 that falls due for repayment at time $\tau_i = \tau$. In addition, each bank $\{i\}_{i=1,2,\ldots,n}$ may have an aggregate interbank asset against the other banks in the system of A_i^I and an aggregate interbank liability of D_i^I. These inter-bank exposures are captured in an inter-bank matrix M. Like debt to non-banks, interbank debt is also assumed to have a maturity $\tau_i = \tau$. Banks are also partly financed by equity: bank *i* has a capital ratio $c_i = \frac{C_i}{A_i}$, where C_i is the nominal value of capital issued by a bank. Total system assets are given by $A \equiv \sum_i A_i = \sum_i \left(A_i^0 + A_i^I\right)$ and the total face value of debt liabilities is $D \equiv \sum_i D_i = \sum_i \left(D_i^0 + D_i^I\right)$.

Each bank's assets A_i evolve according to a geometric Brownian motion with *ex ante* fixed coefficients $\{\mu_i, \sigma_i\}$:

$$\frac{dA_i}{A_i} = \mu_i dt + \sigma_i dW_i^P \text{ for } i = 1,2,\ldots,n \quad (1)$$

and where shocks may be correlated across banks, $dW_i^P dW_j^P = \rho_{ij} dt \neq 0$.

Based on these correlated asset dynamics, the solvency positions of banks $\{i\}_{i=1,2,\ldots,n}$ are checked at date $\tau_i = \tau$. There are two types of default in the model, labelled "fundamental" and "contagious". If, after simulating forward the above diffusion process, the assets of any given bank, X, are below its (fixed) debt liabilities at time $\tau_X = \tau$, bank X is declared fundamentally insolvent. In this case, its loss-given-default is endogenously given by the difference between the level of assets at the point at which solvency is assessed and the face value of its debt falling due. But losses for the system do not end here. The fundamental default of bank X triggers losses for other banks in the network that have extended it interbank loans. In some cases, clearing of the interbank network M may result in a second bank, Y, defaulting – even though it may be above the solvency threshold if it had not made this loss on its interbank exposure to bank X. This represents a contagious failure for bank Y. In this case, the assets of bank Y are marked down from the level reached under the diffusion process in equation **(1)** by an exogenously-chosen contagious bankruptcy cost of 10% (based on James (1991)). The interbank positions of other banks in the network are then re-evaluated. This process is repeated until there are no further rounds of contagious default in the banking network. It presents a mechanism by which losses initially borne by one bank can be transmitted and amplified through an interconnected banking system. Denoting the value of each banks' assets after network clearing by $\tilde{A}_i$, total losses in the banking system at debt maturity $\tau_i = \tau$ are thus given by:

$$L = \sum_i \left(D_i - \tilde{A}_i(\tau)\right) \quad (2)$$

Policymaker's optimisation problem

If capital is more expensive than debt, the efficiency of the banking system is a decreasing function of the total capital held across banks. Capital could be more expensive than debt for

various reasons, including because of principal agent problems between managers and shareholders (Jensen (1986); Jensen and Meckling (1976)) or because of information asymmetries between insiders and external investors (Myers and Majluf (1984)). A policymaker interested in mitigating systemic risk, however defined, while limiting inefficiency in the banking system might therefore seek to achieve a chosen systemic risk objective for the lowest compatible level of capital in aggregate. In this paper, the systemic risk objective is defined in terms of a target for the location of the z^{th} percentile of the distribution of system losses relative to promised debt liabilities. The constrained optimisation problem is:

$$\min_{\{C_i\}_{i=1,2,\ldots,n}} \left(\sum_i C_i \right) s.t. VaR_z^{system}\left(\{C_i\}_{i=1,2,\ldots,n}\right) = 0 \quad (3)$$

The constraint in equation (3), $VaR_z^{system}\left(\{C_i\}_{i=1,2,\ldots,n}\right) = 0$, can also be expressed as $\Pr\left(\sum_i \left(A_i(C_i)\right) < \sum_i \left(D_i\right) \right) = 1 - z$. In other words, the policymaker tries to keep inefficiency (total capital) to a minimum subject to the banking system remaining solvent with a chosen target probability (the probability of system assets being below system liabilities being equal to $1-z$).[3] The parameter z reflects the trade-off between the systemic risk and efficiency objectives. For example, a high value of z might be suitable if there is a relatively shallow trade-off between systemic risk and economic efficiency, ie in the case that equity capital is not materially more expensive than debt.[4]

Solving the policymaker's optimisation problem is complicated by the fact that the optimal level of capital in the banking system in aggregate and the optimal distribution of capital across banks are not separable. For example, consider a system of two banks. Each has the same fundamental uncertainty about asset value returns going forward, but bank *X* starts with a much larger cushion of capital than bank *Y*. In this case, an extra £1 of capital given to bank *X* has a smaller impact on its asset shortfall distribution than if it were given to bank *Y*. If, in addition, bank *X* (idiosyncratically safe) has a large interbank asset against bank *Y* (idiosyncratically risky), giving an extra £1 to bank *Y* materially reduces the contingent-default risk of bank *X* – and, consequently, for the two-bank system in aggregate. Increasing the aggregate level of capital by £1 therefore has little impact on systemic risk *unless* it is given to bank *Y.*

To solve the policymaker's optimisation problem we use the following iterative procedure:

1. Determine the total level of system capital, holding fixed the relative shares of total capital for each bank, which achieves the chosen systemic risk constraint. This is done by taking each bank's observed capital levels and increasing (decreasing) total system capital, $\sum_i C_i$, if $VaR_z^{system}\left(\{C_i\}_{i=1,2,\ldots,n}\right) = 0$.

2. Adjust the share of total capital held by each bank, $\{C_i\}_{i=1,2,\ldots,n} \rightarrow \{\tilde{C}_i\}_{i=1,2,\ldots,n}$, such that $VaR_z^{system}\left(\{\tilde{C}_i\}_{i=1,2,\ldots,n}\right) < 0$. If this is possible, the allocation $\{\tilde{C}_i\}_{i=1,2,\ldots,n}$ must be

[3] The assumption that the policymaker sets banks' capital requirements to limit the probability of system insolvency is conservative. Other assumptions could be made. For example, the policymaker could seek to limit the probability that the shortfall of assets below debt liabilities for the system does not exceed a particular (non-zero) value, to reflect the investment capital that may be available from investors prior to systemic default.

[4] The extent to which equity capital is relatively more expensive than debt for banks remains an open question. For example, see Admati, DeMarzo, Hellwig and Pfleiderer (2010).

superior to $\{C_i\}_{i=1,2,...,n}$ because systemic risk is lowered for the same level of efficiency since $\sum_i \tilde{C}_i = \sum_i C_i$. The reallocation of capital across banks is done using simulated annealing to try to ensure that the global solution of the policymaker's constrained optimisation problem is obtained (see Cerny (1985)).

3. Reduce the level of system capital by a small amount ε, allocated pro-rata across banks, and perform the optimisation in step 2 again.

4. Repeat steps 2–3 until it is no longer possible to further reduce system capital and simultaneously achieve the policymaker's chosen tolerable level of systemic risk. This yields the minimum level of aggregate capital that can be allocated across banks and simultaneously meet the chosen systemic risk constraint.

Model calibration

The model is calibrated using UK data for the period 2004 H1 to 2009 H1. Banks' balance sheets are based on information from five major UK banks' published accounts. "Debt" is interpreted as total liabilities excluding large exposures to the other four banks, minus shareholders' funds excluding minority interests.[5] "Large exposures" are defined as those exposures that exceed 10% of eligible capital,[6] which UK banks must report to their supervisors. The interbank network is calibrated to these large exposures.[7] When banks fail because of losses on interbank exposures (contagious default) rather than in response to the value of their non-bank assets (fundamental default), this paper assumes that assets are marked down by 10% from the level reached endogenously through the diffusion process in equation **(1)**. It is assumed that banks have a weighted-average debt liability of one year, at which point their solvency is assessed. Banks' observed equity prices are used to estimate the contemporaneous expected return on banks' assets and the variance-covariance structure between banks' asset returns.

Results

Figure 2 shows the surcharges that would need to be added to banks' capital ratios to solve the policymaker's optimisation problem in the illustrative case z = 0.05. They differ across banks because losses incurred by the rest of the system differ according to which bank(s) fails and because the probabilities of such losses crystallising vary. By design of the policymaker's optimisation problem, the corresponding distributions of system losses under the optimised configurations of bank capital shift to the level (see Figure 3 for the case for 2009 H1).

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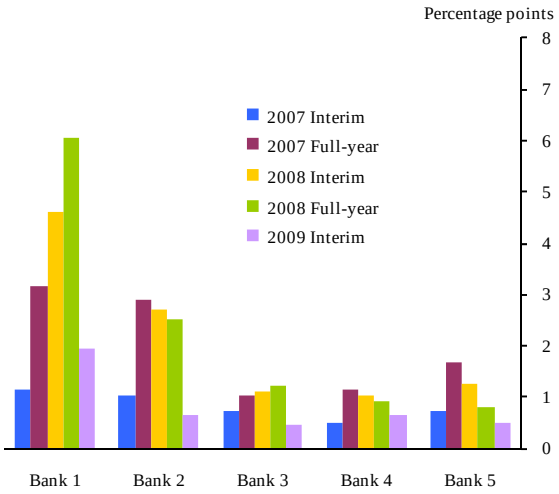
5 This is approximately equivalent to assuming that all Tier 1 capital is sufficiently loss-absorbing.

6 Defined as Tier 1 plus Tier 2 capital.

7 This relaxes the maximum entropy approach adopted in Elsinger et al (2006).

Figure 2

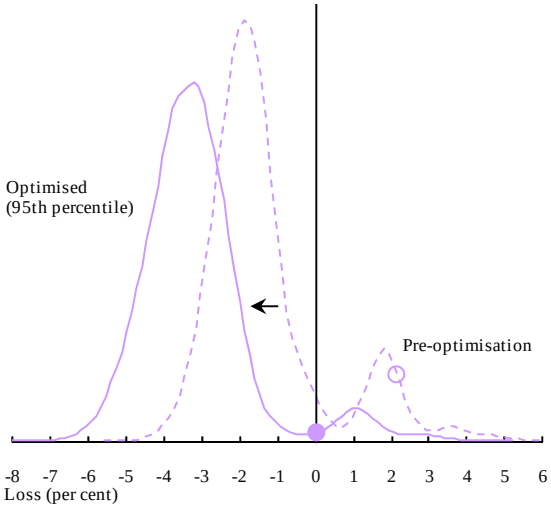
Systemic capital surcharges[(a)]



(a) Change in the ratio of capital to assets for each bank in the network following the optimisation in equation (3).

Figure 3

System loss distributions pre- and post-optimisation (2009 H1)[(a)(b)(c)]



(a) Accounting for asset correlation and explicit interbank exposures between firms, assuming contagious default carries a deadweight cost of 10% of assets.

(b) Following the optimisation in equation (3). Circles show location of 95th percentile.

(c) Loss expressed as a fraction of system-wide debt liabilities.

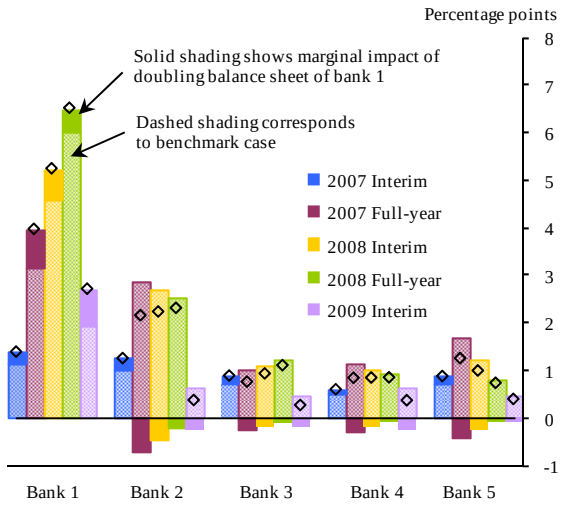
Changing the characteristics of banks in ways that affect the impact of a bank failure on system losses changes the values of the capital surcharges. Figure 4 shows what happens if the size of one bank (bank 1) is increased. Systemic capital surcharges for bank 1 are higher than in the benchmark case to offset the larger impact its failure has on the rest of the system through the interbank network. This is actually sufficient, in a number of instances, to reduce systemic capital surcharges for the other banks in the network because there are fewer scenarios under which they experience interbank losses large enough to cause them to contagiously fail, which would otherwise further transmit and amplify losses. Figure 5 shows the marginal impact on systemic capital surcharges of doubling direct balance sheet exposures between banks. These results illustrate a robust-yet-fragile property of financial networks: the system as a whole can in some circumstances be made substantially more robust for a relatively small increase in aggregate capital, notwithstanding differences in capital surcharges across banks.

Conclusions

The financial crisis has led to calls for banks' capital requirements to be set, in part, to reflect the impact that their failure would have on the rest of the financial system. This paper has presented a potential system-wide risk management approach to informing the calibration of such systemic capital requirements. Using a calibrated model of a stylised banking system, the results in this paper illustrate that banks' systemic capital requirements are increasing in balance sheet size and in the value of their interbank obligations, other things being equal.

Figure 4

Systemic capital surcharges when one bank doubles in size[(a)(b)]

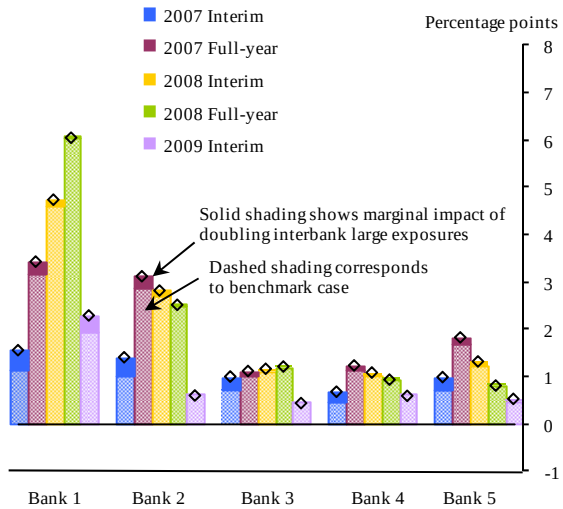


(a) Change in the ratio of capital to assets for each bank in the network following the optimisation in equation **(3)**.

(b) Diamonds show total change in capital requirement.

Figure 5

Systemic capital surcharges when interconnections double in size[(a)(b)]



(a) Change in the ratio of capital to assets for each bank in the network following the optimisation in equation **(3)**.

(b) Diamonds show total change in capital requirement.

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Monetary policy framework and financial procyclicality: international evidence

Kyungsoo Kim, Byoung-Ki Kim and Hail Park[1]

Introduction

The recent global financial crisis has highlighted the importance of financial procyclicality and its role in increasing systemic risk. The Financial Stability Forum (2009, p 8) defined financial procyclicality as "the dynamic interactions (positive feedback mechanisms) between the financial and the real sectors of the economy". Financial procyclicality, according to this definition, does not refer only to the fluctuations of financial variables around a trend. Rather, as noted by Landau (2009), it encompasses all of the following three components: fluctuations around the trend, changes in the trend itself, and possible cumulative deviations from the equilibrium value. To better understand financial procyclicality, therefore, we need to investigate the positive feedback mechanism destabilising the financial system.

There is a growing literature on this subject and, as we understand, two suspects for causing the global financial crisis have come to the fore: central banks' loose monetary policy and financial intermediaries' behaviour. These two suspects are likely to be interdependent,[2] which is in fact the exact topic that Adrian and Shin (2008) dealt with. Bean et al (2010) and Dokko et al (2009) also acknowledged this possibility. Indeed, monetary policy is transmitted to the real economy due to the existence of links between monetary policy and financial intermediaries' behaviour. Furthermore, the interdependence between the two suspects in the current interest rate-oriented monetary policy framework has become unimaginably tighter.[3] Financial intermediaries can always tap the central bank under the interest rate-oriented monetary policy framework, because the central bank's high-powered money is injected into the financial system on an on-demand basis to keep short-term market rates closely aligned with the policy rate. Interbank transactions involving maturity transformation pave a silky way for this overnight funding to be extended into long-term loans to the ultimate borrowers. This process can cause excessive leverage by financial intermediaries, and can thus increase financial procyclicality.

This paper seeks international evidence, by examining country-level panel data from 14 countries with an inflation targeting framework and a floating exchange rate, that interbank transactions under an interest rate-oriented monetary policy framework can foster or accelerate financial procyclicality.

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[2] There is a huge literature on the monetary policy transmission channels that explicitly incorporates financial intermediaries' behaviour. See Bernanke and Gertler (1995) and Borio and Zhu (2008).

[3] This does not necessarily imply that the central bank can more easily control financial intermediaries' behaviour under the current monetary policy framework. Kim et al (2010) report that the two suspects' interdependence is evident during boom and bust periods while being insignificant during normal periods.

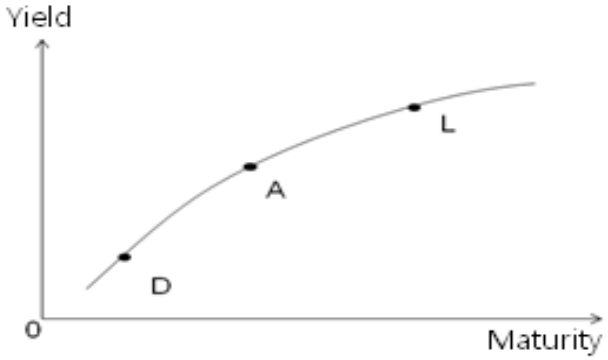
Interbank transactions, monetary policy framework and monetary policy[4]

This paper seeks international evidence, by examining country-level panel data from 14 countries with an inflation targeting framework and a floating exchange rate, that interbank transactions under an interest rate-oriented monetary policy framework can foster or accelerate financial procyclicality (FP hereafter).

Consider an upward-sloping yield curve, as shown in Figure 1. Bank 1 takes a deposit at D and makes a loan at L. It can then enjoy profits from the vertical difference between points L and D multiplied by the volume of the loan (or deposit), at the risk of maturity mismatch by the horizontal difference between points L and D multiplied by the volume of the loan. In this way maturity is transformed, and the maturity transformation (MT hereafter) is the essence of the banking activity.

Figure 1

Interbank transactions involving MT



Suppose that Bank 2 comes in and issues an interbank liability to Bank 1. Instead of making a loan, Bank 1 lends to Bank 2 at A and Bank 2 in turn supplies the loan at L. Through this interbank liability, MT is exploited: Bank 1 shares the profit with Bank 2 with the benefit of less exposure to the risk of maturity mismatch. In fact, one can imagine that other banks also issue interbank liabilities and share profits through exploiting MT.

Through the creation of interbank liabilities, however, systemic risk emerges. If for some reason Bank 2 becomes insolvent, then it may ignite a chain effect on Bank 1. In fact, when MT is exploited by many banks, the entire banking system may be exposed to potential systemic risk. Therefore, even though MT can reduce the risk of maturity mismatch at the individual firm level, the aggregate risk or systemic risk will rise.

Interbank liabilities, however, do not automatically increase bank loans to the ultimate borrowers. As can be seen in Figure 1, MT, no matter how massive it is, only splits profit and risk between the banks engaged in such activities. But experience says interbank liabilities do in fact increase lending to the ultimate borrowers, the liquidity for which must come from somewhere else.[5]

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[4] This part draws heavily on Kim et al (2010). Be advised, however, that Kim et al adopted a more formal approach.

[5] Shin (2009) noted that lending to the ultimate borrowers must be funded either from the equity of financial intermediaries or by borrowing from creditors outside the intermediary sector.

This paper explores the possibility that an interest rate-oriented monetary policy framework fosters or accelerates FP. Under the current interest rate-oriented monetary policy framework, financial intermediaries can always tap the central bank provided they are willing to pay the policy rate. This is because the central bank's high-powered money is injected on an on-demand basis into the financial system to keep the short-term market interest rates closely aligned with the policy rate. Loose monetary policy in this environment can induce massive interbank transactions involving MT financed by the additional supply of high-powered money, which translates into a huge increase in loans to the ultimate borrowers, and in turn raises financial stability issues.[6]

Data and empirical analysis

Our country-level data set covers 14 countries for the years 2002–09: the United Kingdom, Sweden, Iceland, Australia, New Zealand, South Africa, Brazil, Chile, Colombia, Mexico, Peru, Indonesia, Korea and Thailand. These countries are selected from among those adopting inflation targeting and floating exchange rate arrangements. Core assets are defined as the loans of the banks; thus, we use claims on the private sector in deposit money banks. Non-core liabilities[7] consist of bonds, liabilities to other banking institutions, foreign liabilities etc. The monthly series of core assets, non-core liabilities, monetary base, and broad money (M2 hereafter) are taken from the IFS (International Financial Statistics) data set. The series of the short-term and long-term interest rates are obtained from the IFS and Bloomberg. The growth rates of core assets, non-core liabilities, monetary base and M2 are employed in the empirical analysis. All growth rates are year-on-year rates, calculated as the differences in logarithms of the variables at times t and t-12; accordingly, the sample period for the estimation is between 2003 and 2009.

We investigate the effects of non-core liability growth on core asset growth, monetary base growth and M2 growth, using the dynamic panel method. In order to examine these relationships, the following regression models are considered:

$$CA_{it} = \beta_1 CA_{it-1} + \beta_2 NCL_{it} + \beta_3 Z_{it} + f_i + \varepsilon_{it}, \quad (1)$$

$$M\_BASE_{it} = \beta_4 M\_BASE_{it-1} + \beta_5 NCL_{it} + \beta_6 Z_{it} + f_i + \varepsilon_{it}, \quad (2)$$

$$M2_{it} = \beta_7 M2_{it-1} + \beta_8 NCL_{it} + \beta_9 Z_{it} + f_i + \varepsilon_{it}, \quad (3)$$

where CA_{it} is the core asset growth rate of individual country i in the year t, NCL_{it} the non-core liability growth rate, M_BASE_{it} the monetary base growth rate and $M2_{it}$ the M2 growth rate, Z_{it} denotes the control variables, and f_i is an individual fixed effect.

The short-term interest rate and the term spread between long-term and short-term interest rates are regarded as the control variables in Equation (1), while only the short-term interest rate is employed as a control variable in Equations (2) and (3). We use dynamic panel

[6] Adrian and Shin (2008) pointed out that loose monetary policy might encourage risk appetite so that financial intermediaries would want to borrow short and bear illiquid balance sheets. Giavazzi and Giovannini (2010) also claimed that inappropriate monetary policy in the form of a low policy rate as a result of overlooking the risk of a financial crisis could induce excessive MT and increase the probability of such a crisis. This, they emphasised, could push the economy into a low-interest-rate trap, since the crisis would require low interest rates to keep the financial intermediaries alive.

[7] We use non-core liabilities as a close proxy for interbank liabilities, and core assets for loans to the ultimate borrowers. Shin and Shin (2010) distinguished between core and non-core liabilities of the banking sector. Core liabilities are held by the ultimate domestic creditors, such as the domestic household sector, while non-core liabilities are held by other financial intermediaries or foreign creditors.

analysis because the dependent variables are substantially affected by their own lagged values. More precisely, we use the difference GMM method employing the lagged dependent variables as instrumental variables, as proposed by Arellano and Bond (1991).

Effect of non-core liabilities on core assets

We report the estimation results in Table 1. The coefficients of the non-core liability growth rate are very similar across different model specifications, in the range of 0.020 to 0.021, with significance at the 1% levels. The values in parentheses are the robust standard errors adjusted for heteroskedasticity. Including other control variables such as the short-term interest rate and the term spread does not seem to affect the role of non-core liability growth. We find positive coefficients on the term spread between long-term and short-term interest rates, implying that a higher term spread has a positive effect on core asset growth. The effects of short-term interest rates on core asset growth are negative. However, the effects of the control variables are statistically insignificant. Our findings suggest that an increase in core asset growth will be induced by a rise in non-core liability growth.

Table 1

Regression of core asset growth on non-core liability growth

(Sample period: 2003–09)

Dependent variable: Core asset growth	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Core asset growth (–1)	0.936***	0.935***	0.937***	0.936***
	(0.008)	(0.007)	(0.009)	(0.008)
Non-core liability growth	0.020***	0.021***	0.021***	0.021***
	(0.004)	(0.005)	(0.005)	(0.005)
Short-term interest rate		–0.050		–0.033
		(0.080)		(0.081)
Term spread			0.054	0.026
			(0.092)	(0.086)
Number of countries	14	14	14	14
Number of observations	1129	1129	1129	1129
AR(2) test (p-value)	0.967	0.969	0.975	0.972
Hansen test (p-value)	1.000	1.000	1.000	1.000

Note: The values in parentheses are robust standard errors. *, **, and *** indicate statistical significances at the 10%, 5%, and 1% levels, respectively.

Effects of non-core liabilities on the monetary base and M2

From Table 2, we find that non-core liability growth has a significantly positive effect on monetary base and M2 growth. They are in a range between 0.031 and 0.034 for monetary base growth and between 0.042 to 0.044 for M2 growth, suggesting that the increase in non-core liability growth does lead to increases in monetary base as well as M2 growth. This means that, under an interest rate-oriented monetary policy framework, the central bank increases the money supply when private credit via non-core liabilities increases rapidly. The models including another control variable (short-term interest rate) show slightly lower

coefficients in comparison with the models incorporating dependent lagged variables and non-core liability growth as explanatory variables. Overall, the results show that an increase in non-core liabilities induces increases in both the core asset (private credit) and monetary variables (monetary base, M2).

Table 2

Regression of monetary base and M2 growth on non-core liability growth

(Sample period: 2003–09)

	Dependent variable: Monetary base growth		**Dependent variable: M2 growth**	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Monetary base growth (–1)	0.771***	0.766***		
	(0.082)	(0.093)		
M2 growth (–1)			0.676***	0.670***
			(0.156)	(0.166)
Non-core liability growth	0.034*	0.031*	0.044*	0.042*
	(0.019)	(0.018)	(0.024)	(0.022)
Short-term interest rate		0.192		0.142
		(0.419)		(0.204)
Number of countries	14	14	14	14
Number of observations	1139	1139	1141	1141
AR(2) test (p-value)	0.223	0.212	0.258	0.250
Hansen test (p-value)	1.000	1.000	1.000	1.000

Note: The values in parentheses are robust standard errors. *, **, and *** indicate statistical significances at the 10%, 5%, and 1% levels, respectively.

Results of panel-VAR model

In addition to the single equation models estimated above, a VAR model could be considered as usual, since one of our main interests is the interactions between non-core liability growth and monetary variable growth. However, our dataset consists of panel data on 14 countries from 2003 to 2009; we should hence use a panel-VAR methodology instead of a traditional VAR model.

A Panel-VAR model is specified as $Z_{it} = \Phi_0 + \Phi_1 Z_{it-1} + f_i + \varepsilon_{it}$ where Z_{it} is the two-variable vector comprising non-core liability growth together with monetary base growth or M2 growth or the money growth factor, f_i the individual fixed effect, and ε_{it} the error term.

In addition to monetary base and M2 growth, we extract their first principal component, which is the common factor in the variations of monetary base and M2 growth. This approach has the benefit of controlling the idiosyncratic shocks to each monetary variable. We order the variables with non-core liability growth placed first, and then the monetary variable. After the individual fixed effects are removed, we estimate the dynamics of the vector as a first order VAR, by GMM.

From the results of the orthogonal impulse responses to one standard deviation shocks, a shock to non-core liability growth significantly increases monetary base growth, M2 growth,

and the money growth factor; this effect peaks after about two or three months and then gradually dies off.

Conclusion and policy implications

Our findings suggest that under the current interest rate-oriented monetary policy framework, which has made monetary policy and macroprudential policy inseparable, the central bank needs to take into account the endogeneity of asset prices and credit cycles when formulating monetary policy. More importantly, this suggestion applies not only to the United States but to a broad range of countries.

Note that our argument so far has centred around the way of setting the policy rate, and has not considered deployment of macroprudential policy tools such as capital requirements and buffers, forward-looking loss provisioning, liquidity ratios etc. In particular, we have argued that the central bank should set the policy rate, giving consideration to its effects on financial procyclicality.[8] Having said this, we also acknowledge that, on some occasions, monetary policy in the form of policy rate adjustments may not be sufficient to ward off asset price bubbles.[9] And we are open to the possibility that the central bank may additionally need a more adequate set of tools, other than the policy rate alone, if it is to sufficiently dampen financial procyclicality.[10]

The fact that the current interest rate-oriented monetary policy is designed to accommodate credit shocks requires that the central bank build up its ability to identify these shocks in a timely manner. Detecting these shocks is not easy in practice and we also acknowledge that both type I and type II errors matter – that is, missing an existing credit shock, or falsely detecting a credit shock that actually does not exist – since these would lead to inappropriate monetary policy. However, this does not necessarily mean that the central bank should develop an early warning system or a Taylor-type policy rule augmented with a variable that represents the status of financial fragility. We doubt that an early warning system that emits a binary signal or a simple rule-based monetary policy can do the job, but suspect rather that the central bank needs to closely monitor a wide range of data and variables showing the status of financial intermediaries and financial markets.

Finally, we would like to add that the central bank needs to beware of the possibility that communication would become more difficult and credibility would be damaged because the central bank might have to set the policy rate at a higher level in order to prevent financial

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[8] Once a financial crisis occurs, even setting the policy rate at zero would not be sufficient in the current interest rate-oriented monetary policy framework. This is because interbank transactions involving MT would stop functioning in the crisis. Supplying high-powered money into the overnight or short term money market would therefore have little impact on the longer term bond markets. The central bank may need to transact directly with financial intermediaries at a wide range of maturities – in Figure 1 on page 5, this implies that the central bank intervenes at all of the maturities, points D, A and L – which justifies the major central banks' responses to the recent financial crisis including their broadenings of eligible collateral and counterparties for open market operations and providing liquidity through longer-term facilities.

[9] Many authors have pointed out that the policy rate is a blunt and sometimes poor instrument for dealing with asset price bubbles and financial stability. See Dale (2009) and Blanchard et al (2010).

[10] It is worthwhile noting that many economists and scholars, Blanchard et al (2010) and the Squam Lake Working Group on Financial Regulation (2009) to name but a few, have recently recommended that the central bank should be given an explicit mandate for financial stability and should be a macroprudential regulator.

procyclicality from strengthening.[11] Enhancing transparency would in this regard be necessary to maintain central bank credibility.

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[11] See Dale (2009).

Boom-bust cycles and stabilisation policy – monetary and macroprudential rules: a loss function approach

Caterina Mendicino and Maria Teresa Punzi[1]

1. Summary

The recent financial crises have posed a challenge to the conduct of financial stability and monetary policy. The international debate mainly focused on the potential benefits of reducing procyclicality in financial intermediation in order to avoid boom and bust cycles in the supply of credit. We study the stabilisation benefits of macroprudential and monetary policy rules that react to indicators of financial imbalances. In particular, we contribute to an investigation of the benefits of dampening credit cycles and explore the effectiveness of alternative policy instruments, such as the interest rate and the loan-to-value ratio (LTV henceforth), for macroeconomic and financial stabilisation.

Lambertini et al (2010) show that expectation of future macroeconomic developments can generate boom-bust cycles in housing prices and credit.[2] Housing-market cycles driven by expectations on future developments in the demand and supply of houses are characterised by boom-bust dynamics in both housing prices and housing investment. However, only expectations of a future reduction in the supply of houses also generate boom-bust cycles in all aggregate quantities such as output, consumption and investment, as in the data.[3]

Relying on a model that allows for macroeconomic booms and busts driven by expectations on the supply of houses, we draw some policy implications. In particular, we evaluate the performance of macroprudential and monetary policy in terms of macroeconomic stabilisation. We postulate that, apart from inflation and output stabilisation, the policymaker also aims to dampen credit cycles. Our findings highlight a role for LTV ratios that respond in a countercyclical manner to indicators of financial imbalances. LTV ratio rules that actively respond to credit growth reduce the volatility of credit-to-GDP and other macroeconomic variables. In the presence of an active LTV ratio policy, we find no gains from an interest-rate response to credit aggregates. Pursuing financial stability goals with policy instruments other than the policy rate delivers a better outcome in terms of both macroeconomic and financial stabilisation.

The goal of this article is to provide insight into the role of monetary and macroprudential policy in leaning against boom-bust cycles. This article relies on recent research by Lambertini et al (2011) that evaluates monetary and macroprudential policy in terms of both macroeconomic stabilisation and welfare. Differently from Lambertini et al (2011), we

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[2] A recent strand of the business cycle literature investigates the importance of expectation-driven cycles in generating economic fluctuations. See, for instance, Beaudry and Portier (2004, 2006, 2007), Jaimovich and Rebelo (2009), and Schmitt-Grohe and Uribe (2008). In particular, Christiano et al (2008) show that macroeconomic boom-bust cycles coupled with similar dynamics in asset prices can be generated by expectations of future development in productivity.

[3] For stylised facts during periods of booms in house prices, see Lambertini et al (2010), Kannan et al (2009), Ahearne et al (2005) and Borio and Lowe (2002).

document the importance of an active LTV ratio policy based on a simplified analysis that relies on a loss function approach. The rest of the paper is organised as follows. Section 2 presents the model. Section 3 illustrates boom-bust cycles as generated by expectations for housing market trends. Section 4 explores the effectiveness of stabilisation policy in the presence of boom-bust cycles.

2. The model

In this section we briefly describe the model economy. The framework follows Iacoviello and Neri (2010). The economy is populated by two types of households: savers and borrowers. They both consume c_t, accumulate housing h_t, and work in the production of consumption goods $n_{c,t}$ and housing $n_{h,t}$. They differ in their discount factor. Borrowers (denoted by ′) feature a relatively lower subjective discount factor that in equilibrium generates an incentive to anticipate future consumption to the current period through borrowing. Hence, the ex-ante heterogeneity induces credit flows between the two types of agents. This modelling feature was introduced in macro models by Kiyotaki and Moore (1997).

Borrowers maximise the utility function

$$U_t = E_t \sum_{t=0}^{\infty} \beta' [\ln(c'_t - \varepsilon' c'_{t-1}) + j_t \ln h'_t - \frac{\tau}{1+\eta'} ((n'_{c,t})^{1+\xi'} + (n'_{h,t})^{1+\xi'})^{\frac{1+\eta'}{1+\xi'}}]$$

subject to the budget constraint

$$c'_t + q_t [h'_t - (1 - \delta_h) h'_{t-1}] - b'_t \leq \frac{w'_{c,t} n'_{c,t}}{X'_{wc,t}} + \frac{w'_{h,t} n'_{h,t}}{X'_{wh,t}} - \frac{R_{t-1} b'_{t-1}}{\pi_t}.$$

Except for the gross nominal interest rate R, all the variables are expressed in real terms; π_t is gross inflation (P_t / P_{t-1}), $w'_{c,t}$ and $w'_{h,t}$ are the wages paid in the two sectors of production, and q_t is the price of housing in real terms. Houses depreciate at rate δ_h. The parameter j_t is an AR(1) shock that represents a shift in preference for housing with respect to consumption and leisure. The degree of habit persistence in consumption is measured by ε'. Borrowers are allowed to collateralise the value of their homes:

$$b'_t \leq m E_t \left(\frac{q_{t+1} \pi_{t+1} h'_t}{R_t} \right).$$

Limits on borrowing are introduced through the assumption that households cannot borrow more than a fraction m of the next-period value of the housing stock.

The savers face a similar problem. However, they also invest in capital and receive the profits of the firms. As in Smets and Wouters (2007), households supply labour to unions that differentiate labour services and sell them to wholesale labour packers in a monopolistic market. Wages can be adjusted subject to a Calvo scheme with a given probability every period. The wholesale labour packers transform the services into homogeneous labour composites, $n_{c,t}$, $n'_{c,t}$, $n_{h,t}$, $n'_{h,t}$, to be sold to final producing firms in a competitive market.

Final good producing firms produce non-durable goods (Y) and new houses (IH) facing Cobb-Douglas production functions and use capital, k, and labour supplied by the savers, n, and the borrowers, n' as inputs of production

$$Y_t = (n^{\alpha}_{c,t} + (n'^{(1-\alpha)}_{c,t})^{1-\mu_c} (z_{c,t} k_{c,t-1})^{\mu_c}$$

$$IH_t = A_{h,t}(n^{\alpha}_{h,t} + (n'^{(1-\alpha)}_{h,t})^{1-\mu_h} (z_{h,t} k_{h,t-1})^{\mu_h} k_b^{\mu_b} l_{t-1}^{\mu_l})$$

The housing sector also uses land l and an intermediate input k_b, to produce new houses. $A_{h,t}$ measures productivity in the housing sector and is assumed to follow an AR(1) process. Firms pay the wages to households and repay the rented capital to the savers. Retailers, owned by the savers, differentiate final goods and act in a competitive monopolistic market. Prices can be adjusted with probability $1-\theta_{\pi}$ every period, by following a Calvo-setting. In contrast, housing prices are assumed to be flexible.

We assume that the central bank follows a Taylor-type rule as estimated by Iacoviello and Neri (2010)

$$R_t = R_{t-1}^{r_R} \pi_t^{(1-r_R)r_{\pi}} \left(\frac{GDP_t}{GDP_{t-1}} \right)^{(1-r_R)r_Y} rr^{(1-r_R)} \frac{u_{R,t}}{A_{s,t}}$$

where rr is the steady state real interest rate, $u_{R,t}$ is a monetary policy shock, GDP is defined as the sum of consumption and investment at steady state prices, and the central bank's target is assumed to be time varying and subject to a persistent shock, $A_{s,t}$.

3. Introducing boom-bust cycles into the model

According to Iacoviello and Neri (2010), fluctuations in the housing market are mainly generated by shocks to the demand and supply of houses. However, housing market shocks lead to an increase in housing prices, but cannot generate either hump-shaped dynamics, or the co-movement in consumption, investment and GDP observed during house price booms.

According to Lambertini et al (2010), expectations of future macroeconomic developments can generate boom-bust cycles in housing prices and credit in accordance with the empirical evidence. In the following, we report the dynamics of the model in response to expectations of future changes in housing demand and supply.[4] Figure 1 shows the model response to expectations of lower productivity in the housing sector. We illustrate the case in which agents anticipate a shock that hits the economy only in period T= *4* that turns out to be wrong and at time T=*4* there are no changes.[5]

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[4] Housing demand and supply shocks follow an AR(1) process $z_t = \rho_z z_{t-1} + u_{z,t}$, where $z = \{j_t, A_{h,t}\}$. We set the persistence and standard deviation of the shocks as in Iacoviello and Neri (2010), such that j_t and $A_{h,t}$ equal 0.0416 and 0.0193, respectively.

[5] We introduce expectations of future macroeconomic developments as in Christiano et al (2008) and assume that the error term of the AR(1) shock consists of an unanticipated component $\varepsilon_{z,t}$, and an anticipated

Expectations of a future decline in housing productivity generate expectations of rising house prices. Borrowers increase their current housing demand for speculative purposes. Household indebtedness increases, reinforcing the increase in current expenditures in both housing and consumption goods. Due to increased housing demand, current housing prices and housing investment rise. Moreover, agents increase their current labour supply in order to smooth the negative future effect of the shock on future labour income. When news about a future change in productivity spreads, firms start adjusting the stock of capital in order to reduce the future cost of adjusting capital as an input of production, induced by the presence of adjustment cost in capital. The stock of capital used as an input of production in the housing sector decreases over time. In contrast, firms in the consumption-good sector start increasing their stock of capital. Despite the decline in capital used in the housing sector, current business investment slightly increases. As a result, GDP rises. A four-period anticipated decline in productivity generates a boom in housing prices, housing investment, consumption, GDP, hours and indebtedness. The peak response of all aggregate variables corresponds to the time in which expectations are realised. If expectations are not realised, there is a dramatic drop in both quantities and prices. Thus, expectations of a negative housing supply shock that are not realised generate a housing market boom-bust cycle.

Expectations of future increases in housing demand generate a boom dynamic in housing prices and investment, but fail to account for co-movement between residential and non-residential investment. In fact, in anticipation of a shift in preference towards consumption, the stock of capital declines in the consumption-good sector. As a result, business investment falls. See Lambertini et al (2010) for further discussion on the sources of booms and busts in the housing market.

4. Macroeconomic and financial stabilisation

In the following, we assume that fluctuations in the model are driven by housing demand and supply shocks. In order to allow for booms and busts in house prices and credit we also introduce expectations related to housing supply. Given the difficulty in identifying the source of fluctuations, we characterise monetary and macroprudential policy under a mixture of changes into both current and expected economic conditions. The model's parameters are set according to the estimated mean values presented by Iacoviello and Neri (2010) for the US economy.

Macroeconomic and financial stability goals are summarised by the following loss function

$$L = k_b \sigma^2_{\Delta_b} + k_\pi \sigma^2_{\Delta_\pi} + k_y \sigma^2_{\Delta_y},$$

where σ^2 is the variance of credit growth, inflation and GDP growth.

First, we investigate the effectiveness of macroprudential policy in providing a stable provision of credit over the cycle. In particular, we explore the role of the loan-to-value ratio that responds counter-cyclically to credit growth as an observable indicator of financial imbalances. Thus,

$$m_t = v_m m_{t-1} + (1 - v_m) m + (1 - v_m) v_x (b_t - b_{t-1})$$

---

change n quarters in advance $\varepsilon_{z,t-n}$, so that, $u_{z,t} = \varepsilon_{z,t} + \varepsilon_{z,t-n}$, where $\varepsilon_{z,t}$ is *i.i.d.* and $z = \{h, j\}$. Thus, at time t, agents receive a signal about future macroeconomic conditions at time $t + n$: if the expected movement doesn't occur, then $\varepsilon_{z,t} = -\varepsilon_{z,t-n}$ and $u_{z,t} = 0$.

where m is the steady state value for the LTV ratio, v_m is an autoregressive parameter that we set equal to 0.5, and v_x is the response to credit growth. We choose the parameters of the LTV rule that minimises the volatility of credit aggregates ($k_b > 0$, $k_\pi = k_y = 0$) assuming that the monetary authority follows the estimated Taylor-type rule (see Table 1).

Responding to credit growth is successful in dampening credit cycles. A strong countercyclical response to credit growth directly counters the boom in credit driven by expectations of rising house prices and the subsequent bust. Thus, compared to the benchmark case, it better stabilises credit aggregates without increasing the volatility of inflation and GDP. Table 2 shows the unconditional standard deviation of few key variables in the model.

Second, we investigate how, in the absence of an active macroprudential policy, monetary policy can reduce macroeconomic fluctuations and affect the magnitude of credit cycles. We consider alternative interest rate rules in which the central bank also reacts to changes in credit aggregates

$$R_t = R_{t-1}^{r_R} \pi_t^{(1-r_R)r_\pi} \left(\frac{GDP_t}{GDP_{t-1}} \right)^{(1-r_R)r_Y} \frac{b_t}{b_{t-1}} rr^{(1-r_R)r_X}$$

Under a passive macroprudential policy, an interest rate response to credit growth yields sizable gains in terms of financial stabilisation. However, interest rate rules that aim at financial stability goals ($k_b \neq 0$) do not deliver the best outcome in terms of macroeconomic and financial stabilisation. The optimal countercyclical LTV rule that responds to credit growth is more successful than an interest rate response to credit growth in reducing the volatility of credit-to-GDP and it also reduces fluctuations in GDP and inflation.

In the interaction between macroprudential and monetary policy we find that pursuing financial stability goals with LTV ratios delivers the lowest volatility of credit-to-GDP. Moreover, it is also more successful in lowering the volatility of inflation and GDP. The use of countercyclical LTV ratio policies improves macroeconomic and financial stabilisation and there are no gains from an interest rate response to credit aggregates. However, compared to the benchmark case, none of these policies significantly affects the volatility of house prices.

To summarise, in the presence of expectation-driven boom-bust cycles in housing prices and credit, the use of the LTV ratio as a macroprudential tool improves upon interest-rate rules that respond to credit growth in terms of both macroeconomic and financial stabilisation. Thus, these findings highlight the beneficial effect of macroprudential tools in mitigating credit cycles. Our results suggest that further work on macroprudential policy frameworks aimed at damping the build-up of financial imbalances should, indeed, remain a priority.

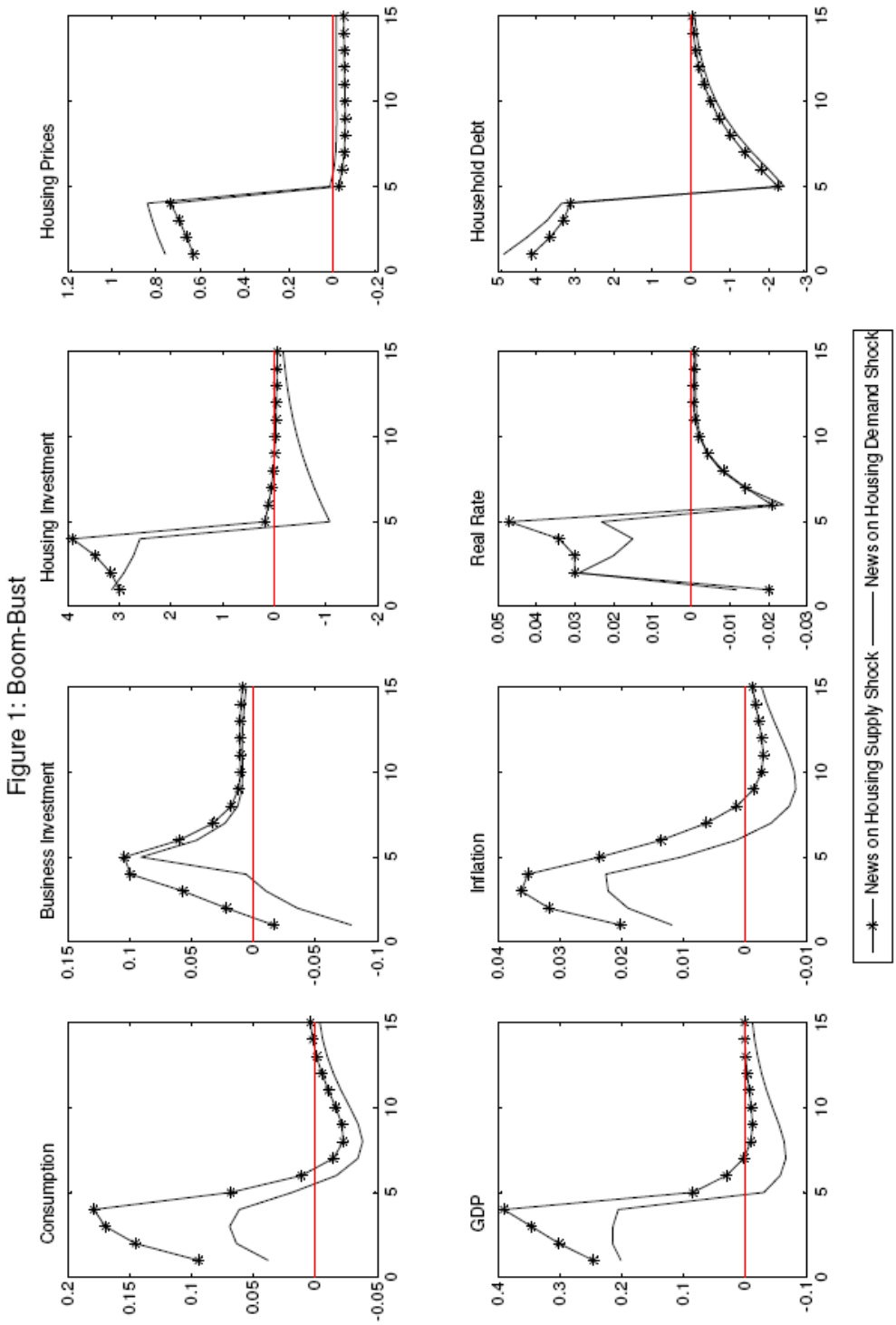
Figure 1: Boom-Bust
Consumption
Business Investment
Housing Investment
Housing Prices
GDP
Inflation
Real Rate
Household Debt
News on Housing Supply Shock
News on Housing Demand Shock

Table 1

Optimal stabilisation policy

Loss functions

LTV	$k_b=1, k_\pi=k_y=0$	$k_b=0, k_\pi=k_y=1$	$k_b=k_\pi=k_y=1$
$\nu_{b=}$ -136.865	1.21371e-007		
R			
α_π= 37.6331, α_y=38.2875		1.5121e-006	
α_π= 16.9345, α_y=12.7969 ($\alpha_R^=$ 0)		1.42644e-006	
α_π= 10.7144, α_y=1.73584			0.00580687
α_π=1.85184 , α_y= -0.333143, α_b=2.71008			0.00022085
R & LTV			
ν_b= -165.406, α_π= 969.023, α_y=971.556			1.50494e-006
ν_b=-10.2081 , α_π= 4.02385, α_y=2.36347 , α_b=-0.932216			2.47229e-005

Table 2

Optimal stabilisation policy

Volatility

Benchmark (estimated interest rate rule)	***b/GDP***	***q***	***π***	***GDP***
α_π= 1.40444 , α_y= 0.51261, $\alpha_R^=$ 0.59913	0.1471	0.2346	0.0010	0.0208
LTV				
$\nu_{b=}$ -136.865	0.0361	0.2349	0.0007	0.0207
R				
α_π= 37.6331, α_y=38.2875 ($\alpha_R^=$ 0.59913)	0.1323	0.2344	0.0009	0.0185
α_π=1.85184 , α_y= -0.333143, α_b=2.71008	0.0518	0.2342	0.0038	0.0253
R & LTV				
ν_b= -165.406, α_π= 969.023, α_y=971.556	0.0320	0.2348	0.0008	0.0187
ν_b=-10.2081 , α_π= 4.02385, α_y=2.36347 , α_b=-0.932216	0.0715	0.2346	0.0014	0.0190

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Optimal macroprudential regulation in a Fisherian model of financial crises

Javier Bianchi and Enrique G Mendoza[1]

1. Introduction

Financial crises of the magnitude that caused the ongoing Great Recession are relatively rare but dramatic and socially costly events. As was the case with the 1990s emerging markets crises or the Great Depression of the 1930s, the Great Recession was preceded by prolonged booms in credit, economic activity and asset prices, followed by a sharp, sudden crash. This observation has made policymakers wary of periods of rapid credit expansion and surging asset prices, and has led to the view that financial regulation is in urgent need of revamping to incorporate a macroprudential focus to contain systemic excessive borrowing in the expansionary phase of the credit cycle. Research on the development of the macrofinancial framework that is required to construct quantitative models to inform the design of this new regulation is at an early stage. We report in this paper on some of the key lessons that follow from the research we are conducting to contribute to fill this gap (see Bianchi and Mendoza (2011) for further details).

Research on this topic is at an early stage primarily because macroeconomics has a lot of work to do in producing sound quantitative models that can incorporate realistic mechanisms explaining the dynamics that turn typical business cycles into full-fledged financial crises. In particular, a good model of macroprudential regulation should pass two litmus tests: first, the model should provide a plausible quantitative explanation of the stylised facts that characterise actual financial crises, and of the frequency with which these crises occur; second, the model should provide a framework for relating policy instruments to the actions of economic agents in a way that can capture the effects by which policy actions taken in "good times" alter the features of financial crises in "bad times." These are challenging tasks, because they involve studying the dynamics of complex nonlinear intertemporal models with financial frictions using global methods that can approximate accurately the incentives (or the lack thereof) of market participants to take prudential action in the face of potentially serious financial risks.

We construct our framework starting with a theoretical foundation based on the theory of financial crises postulated by Irving Fisher in his classic 1933 article on the Debt-Deflation Theory of Great Depressions. Following Mendoza (2010), the engine of our model is a borrowing constraint that limits an individual's borrowing ability for consumption smoothing and for working capital financing to a fraction of the market-determined value of the assets the individual can post as collateral. When the constraint binds, agents fire-sale assets, which leads to a spiralling decline in asset prices and borrowing ability that can greatly amplify the effects of the underlying shocks driving business cycles, just as Fisher described in his work.

The key step in extending the model to make it useful for studying macroprudential policy is to recognise that the borrowing constraint introduces a systemic pecuniary externality in credit markets, which arises because of the Fisherian feedback loop between asset prices and collateral constraints. During booms, increases in asset prices relax collateral constraints

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and boost output. As leverage increases, a small shock can trigger fire sales, a collapse in asset prices and a deep recession. During both the boom and crash phases, however, individual agents fail to internalise the implications of their own actions for market-determined asset prices. In particular, by failing to internalise the Fisherian deflation dynamics they might face in bad times, they choose to borrow "too much" in good times.

We analyse the case for macroprudential regulation by considering how a social planner who internalises the feedback loop between leverage, asset prices and collateral constraints can enhance financial stability and make everyone better off. In particular, we answer two key questions: first, what are the effects of macroprudential regulation on the frequency and magnitude of financial crises? Second, what are the features of the policy instruments that are necessary to implement the planner's constrained-efficient allocations?

We answer these questions using a nonlinear dynamic stochastic general equilibrium model of asset prices and business cycles with credit frictions. As in the model of Mendoza (2010), our model provides a unified framework to study business cycles and financial crises since the latter are events that occur with positive probability and are anticipated by agents during regular business cycles. In the model, collateral assets take the form of an asset in fixed aggregate supply (eg land). Private agents take the price of this asset as given, producing the systemic pecuniary externality mentioned above. The social planner faces an identical set of feasible credit positions, but internalises the effects of debt choices on future asset prices and wages.

When the constraint becomes binding, production plans are also affected, because working capital financing is needed in order to pay for a fraction of labour costs, and working capital loans are also subject to the collateral constraint. As a result, when the credit constraint binds output falls, because of a sudden increase in the effective cost of labour. This affects dividend streams and therefore equilibrium asset prices, feeding back again to the real side of the economy and to credit market access.

We calibrate the decentralised competitive equilibrium to US data and ask how the allocations and prices that characterise it compare with those of the social planner. Our findings suggest that there is significant potential to enhance financial stability and improve social welfare with the introduction of macroprudential regulation, but they also highlight the challenges that policymakers face in the design of optimal macroprudential regulation.

In our experiments, the probability of a financial crash is reduced from 3% in the decentralised equilibrium to less than 1% in the constrained-efficient equilibrium. Asset prices drop about 25% in a typical crisis in the decentralised equilibrium, compared with 5% in the constrained-efficient equilibrium. Output drops about 50% more in the decentralised equilibrium, because the fall in asset prices reduces access to working capital financing. The social planner can induce the decentralised economy to replicate exactly the constrained-efficient allocations by imposing taxes on debt and dividends of about 1% and –0.5% on average, respectively. While in our model this is possible, we also recognise that attaining the same level of optimality with actual macroprudential regulation is a daunting task. Our model is highly stylised, featuring a representative agent with a single borrowing constraint, one source of exogenous shocks, and with perfectly informed agents and regulators. Further work needs to develop richer models to relax these unrealistic assumptions.

2. Model

The model features a representative firm-household that takes production, employment and borrowing decisions to maximise expected lifetime utility given by

$$E_0\left[\sum_{t=0}^{\infty} \beta^t u(c_t - G(n_t))\right]$$

where c_t represents consumption and n_t represents labour supply. Each household can combine land and labour services purchased from other households to produce final goods using a production technology such that $y = \varepsilon_t F(k_t, h_t)$ where k_t represents individual land holdings, h_t represents labour demand and ε_t is a productivity shock that follows a Markov process.

The budget constraint faced by the representative firm-household is:

$$q_t k_{t+1} + c_t + \frac{b_{t+1}}{R_t} = q_t k_t + b_t + w_t n_t + \varepsilon_t F(k_t, h_t) - w_t h_t \quad (1)$$

where b_{t+1} denotes holdings of one-period, non-state-contingent discount bonds at the beginning of date t, q_t is the market price of land, R_t is the real interest rate, and w_t is the wage rate.

Following Mendoza (2010), private agents face a collateral constraint that limits total debt, including both intertemporal debt and atemporal working capital loans, not to exceed a fraction κ of the market value of asset holdings (ie κ imposes a ceiling on the leverage ratio):

$$-\frac{b_{t+1}}{R_t} + \theta w_t h_t \leq \kappa q_t k_{t+1} \ . \quad (2)$$

The interest rate is assumed to be exogenous. This is equivalent to assuming that the economy is a price-taker in world credit markets. This assumption is adopted for simplicity, but is also in line with the evidence indicating that in the era of financial globalisation even the US risk-free rate has been significantly influenced by outside factors, such as the surge in reserves in emerging economies and the persistent collapse of investment rates in Southeast Asia after 1998.

Asset prices and wages are determined in the model's general equilibrium. On the side of wages, when the collateral constraint does not bind, wages are simply determined by the market-clearing condition $G'(h_t) = w_t = \varepsilon_t F_2(K, h_t)$. When the collateral constraint becomes binding, demand for labour decreases since the effective cost of hiring increases and this reduces equilibrium wages and employment. On the side of land prices, the demand for land is driven by the effects of technology shocks on future returns for land and on the stochastic discount factor adjusted to consider the shadow value of land as collateral for debt. A binding collateral constraint triggers a fire sale of land and a substantial drop in asset prices as households rush to reduce their land holdings to repay their debt. This further tightens the collateral constraint generating extra rounds of drops in labour and land demand, which feed again into asset prices.

We study the efficiency of the competitive equilibrium by considering a benevolent social planner who maximises the agents' utility subject to the resource constraint, the collateral constraint and the same menu of credit possibilities of the competitive equilibrium. In particular, we consider a social planner that is constrained to have the same "borrowing ability" (the same market-determined value of collateral assets $\kappa q(b_t, \varepsilon_t)\overline{K}$ at every given state as agents in the decentralised equilibrium), but with the key difference that the planner internalises the effects of its borrowing decisions on the market prices of assets and labour.

The Euler equation for bonds in this planner's problem is

$$u'(t) = \beta R_t \left[E_t u'(t+1) + \mu_{t+1} \Psi_{t+1} \right] + \mu_t \qquad \Psi_{t+1} \equiv \kappa \overline{K} \frac{\partial q_{t+1}}{\partial b_{t+1}} - \theta \frac{\partial w_{t+1}}{\partial b_{t+1}}. \tag{3}$$

The comparable Euler equation for the decentralised equilibrium is given by $u'(t) = \beta R_t E_t u'(t+1) + \mu_t$. Notice that there is an extra term in the Euler equation for the constrained planner's problem. This extra term $\mu_{t+1}\Psi_{t+1}$ represents the additional marginal benefit of savings considered by the social planner at date *t,* because the planner takes into account how an extra unit of bond holdings alters the tightness of the credit constraint through its effects on the prices of land and labour at *t+1*.

Note that, since $\partial q_{t+1} / \partial b_{t+1} > 0$ and $\partial w_{t+1} / \partial b_{t+1} > 0$, Ψ_{t+1} is the difference of two opposing effects and hence its sign is in principle ambiguous. The term $\partial q_{t+1} / \partial b_{t+1} > 0$ is strictly positive, because an increase in net worth increases demand for land and land is in fixed supply. The term $\partial w_{t+1} / \partial b_{t+1} \geq 0$ is positive, because the effective cost of hiring labour increases when the collateral constraint binds, reducing labour demand and pushing wages down. We found, however, that the value of Ψ_{t+1} is positive in all our quantitative experiments with baseline parameter values and variations around them, and this is because $\partial q_{t+1} / \partial b_{t+1}$ is large and positive when the credit constraint binds due the effects of the Fisherian debt-deflation mechanism.

The above expression for the planner's Euler equation for bonds also shows some of the key ingredients of the macroprudential policies necessary to correct the externality. One crucial element is to introduce a wedge in the Euler equation for bonds to reduce the incentive to overleverage. We show in Bianchi and Mendoza (2011) how to implement this wedge with a tax on debt (see Bianchi (2010) for the use of capital requirements and loan-to-value (LTV) ratios as equivalent policy measures).

3. Quantitative analysis

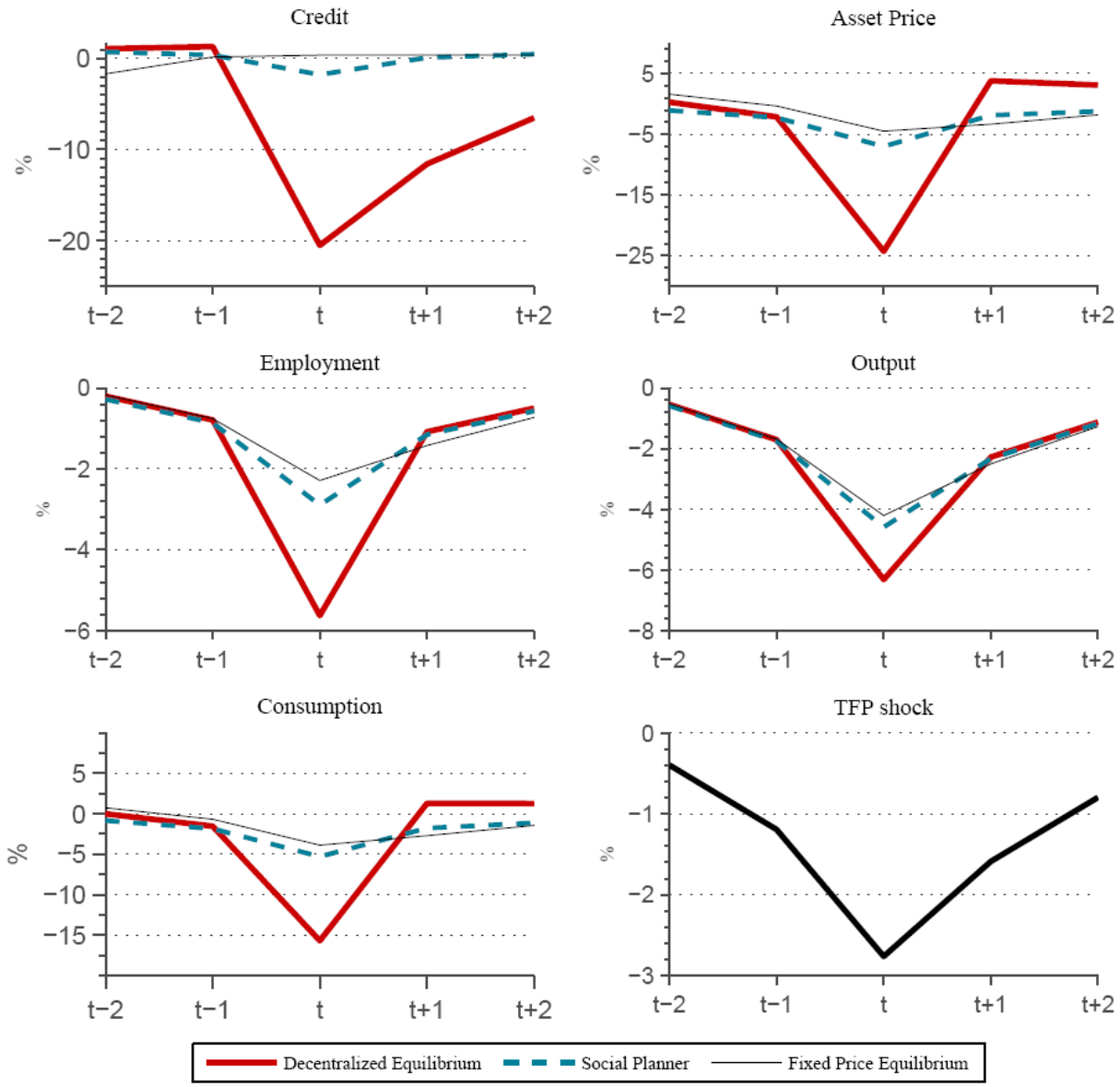
The calibration and the solution method are described in detail in Bianchi and Mendoza (2011). To demonstrate the impact of macroprudential regulation, we construct an event analysis of financial crises with simulated data obtained by performing long stochastic time-series simulations of the competitive and constrained-efficient economies, as well as a fixed-price economy that corresponds to a competitive equilibrium in which the credit constraint becomes $-b_{t+1} / R + \theta w_t h_t \leq \kappa \bar{q}\ k_{t+1}$ where $\bar{q}$ is the average price (that is, effectively this economy has a credit constraint but no Fisherian deflation). A financial crisis episode is defined as a period in which the credit constraint binds and this causes a decrease in credit that exceeds one standard deviation of the first-difference of credit.

The first important result of the event analysis is that the incidence of financial crises is significantly higher in the competitive equilibrium. We calibrated κ so that the competitive economy experiences financial crises with a long-run probability of 3.0%. But financial crises occur in the constrained-efficient economy only with 0.9% probability in the long run. Thus, the credit externality increases the frequency of financial crises by a factor of 3.33.

The second important result is that financial crises are more severe in the competitive equilibrium. This is illustrated in the event analysis plots shown in Figure 1. The event windows are for total credit, consumption, labour, output, TFP and land prices, all expressed as deviations from long-run averages. These event dynamics are shown for the decentralised, constrained-efficient, and fixed-price economies. The event analysis is

constructed so that it captures a median crisis in the decentralised equilibrium and such that the path for the constrained-efficient and fixed-price economies is simulated using the same initial conditions and the same exogenous shocks as in the crisis in the decentralised equilibrium.

Figure 1



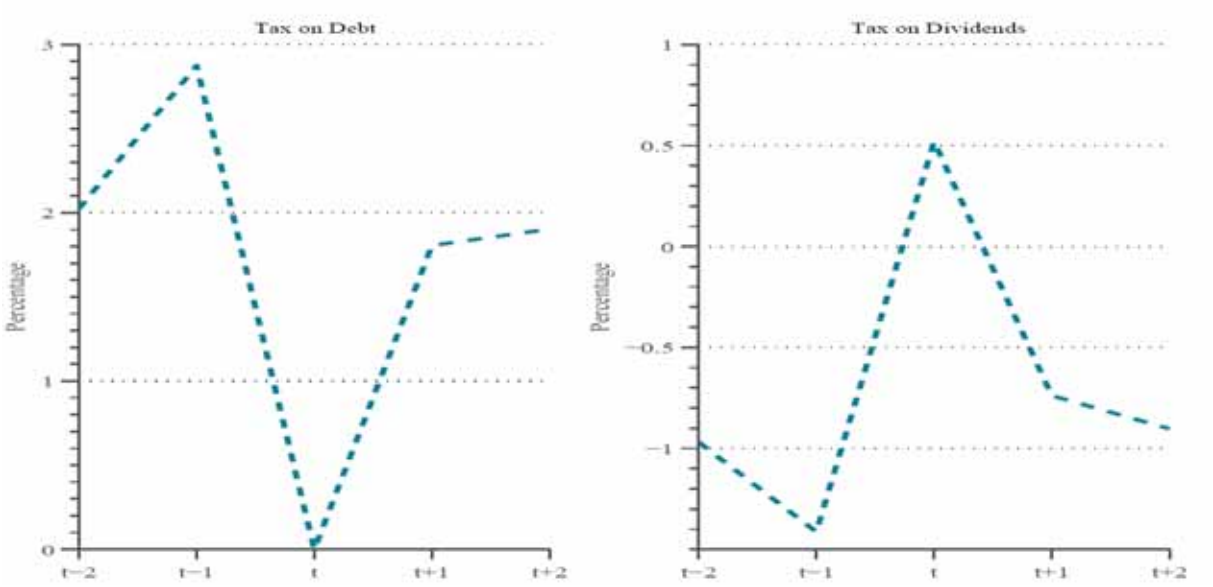
The features of financial crises at date *t* in the competitive economy are in line with the results in Mendoza (2010): the debt-deflation mechanism produces financial crises characterised by sharp declines in credit, consumption, asset prices and output. In this sense, our model aims to comply with the first litmus test we posed in the Introduction.

The five macro variables illustrated in the event windows show similar dynamics across the three economies in the two years before the financial crisis. When the crisis hits, however, the collapses observed in the competitive equilibrium are much larger. Credit falls about 20 percentage points more, and two years after the crisis the credit stock of the competitive equilibrium remains 10 percentage points below that of the social planner. Consumption, asset prices, and output also fall much more sharply in the competitive equilibrium than in the planner's equilibrium. The declines in consumption and asset prices are particularly larger

(–16% against –5% for consumption and –24% against –7% for land prices). The asset price collapse also plays an important role in explaining the more pronounced decline in credit in the competitive equilibrium, because it reflects the outcome of the Fisherian deflation mechanism. Output falls by 2 percentage points more, and labour falls almost 3 percentage points more, because of the higher shadow cost of hiring labour due to the effect of the tighter binding credit constraint on access to working capital.

The dynamics of the debt and dividend taxes around crisis events are shown in Figure 2. The debt tax is high relative to its average, at about 2.7%, at $t-2$ and $t-1$, and this reflects the macroprudential nature of these taxes: their goal is to reduce borrowing so as to mitigate the magnitude of the financial crisis if bad shocks occur. At date t the debt tax falls to zero, and it rises again at $t+1$ and $t+2$ to about 2%. The latter occurs because, being this close to the crisis, the economy still remains financially fragile (ie there is still a non-zero probability of agents becoming credit-constrained next period).[2] By showing these results illustrating the prudential incentives of the taxes that decentralise the planner's allocations, our model also aims to comply with the second litmus test we mentioned earlier.

Figure 2



4. Conclusion

The traditional approach to financial regulation requires the solvency of each and every financial institution to be monitored. This microprudential approach has been recently questioned in light of the recent period of high turbulence in financial markets worldwide. In particular, discussions on international financial reform advocate the need of a macroprudential approach. This approach considers how decisions of individual market participants affect the whole financial sector and how developments in the financial sector can affect the real economy and feed back again into the financial sector. We have described

[2] The tax on dividends follows a similar pattern. Dividends are subsidised at a similar rate before and after financial crisis events, but they are actually taxed when crises occur. The reason is that the social planner needs to support the same pricing function of the competitive equilibrium that would arise without policy intervention.

some recent results that evaluate the macroeconomic and welfare effects of this approach in a Fisherian model of financial crises.

Our findings suggest that there are potentially large benefits from adopting a macroprudential approach. In fact, in our simulations, the frequency of a financial crash can be reduced about threefold and the severity of these episodes is substantially reduced. It is important to note, however, that introducing macroprudential regulation does not eliminate the credit cycles in the economy nor does it eliminate the probability of a financial crisis. This is consistent with the idea that the purpose of macroprudential regulation is not to achieve financial stability per se, but to incorporate in the regulatory framework those systemic effects that individual institutions ignore in their private calculations of risk.

We have focused on the time dimension of macroprudential policy (see Borio (2010)). It would be interesting to consider a richer heterogeneity that would allow us to study how policy instruments should be targeted on different types of institutions and on different forms of risk-taking. In the cross-sectional dimension, the choice on how to correlate risks would be a key determinant of aggregate exposure and it is an important aspect that we leave for future research.

At the same time, we would like to point out that actual implementation of macroprudential policies in financial markets remains a challenging task. For example, we have shown that restoring constrained-efficiency requires a tax on debt that increases with the probability of a financial crisis. Implementing this policy requires real-time monitoring of the build-up of systemic risk in order to appropriately adjust the policy instruments and with a sufficient lead to actually have an effect before the crash occurs. Further work on implementation of macroprudential policy is a critical avenue for future research.

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The long-term economic impact of higher capital levels

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Marc Farag, David Gregory and Sujit Kapadia[1]

1. Introduction

The 2007–08 financial crisis exposed the inadequacy of existing prudential regulatory arrangements, spurring various initiatives for reform.[2] One of the main lessons from the crisis was that the banking system held insufficient capital. A key question for policymakers is how much more capital the system should have. This paper presents a framework for assessing the long-run costs and benefits of increasing capital requirements for the economy. It provides background to the analysis presented in Bank of England (2010).

To determine the benefits, we model the banking sector as a portfolio of credit risks, and present a framework for assessing how the likelihood of a systemic banking crisis depends on the level of capital requirements. On costs, we assume that higher capital requirements increase banks' funding costs. Customers' borrowing costs rise; leading to a fall in investment and the economic stock of capital, thereby reducing the long-run level of GDP. Here, our key assumption is that Modigliani-Miller's theorem (Modigliani and Miller (1958)) does not hold in its pure form. If it did hold, variations in a bank's capital structure would not affect its funding costs. But real-world frictions may imply that funding costs depend on the composition of liabilities. To make our analysis robust against such frictions, we assume that banks' funding costs increase when they increase the share of capital among their liabilities. We provide some indicative bounds to our estimates using a range of different assumptions.

We provide an illustrative quantification of this framework and find that even when Modigliani-Miller's theorem does not hold, there is significant scope for increasing capital requirements. This is primarily because the steady-state costs of higher capital requirements are low, while the benefits can be substantial. Appropriate capital requirements appear to lie somewhere between 10% and 15% of risk-weighted assets, and substantially above that if the costs lie towards the lower bound and the benefits towards the upper bounds of our estimates.[3]

Importantly, we do not attempt to calibrate minimum capital requirements (below which the bank would enter resolution arrangements) but a "cycle-neutral" level of capital – the amount of capital banks would be expected to hold on average over the economic cycle. The main difference between the two concepts is that the minimum is not designed to ensure a bank's viability, but instead to protect creditors from losses once the bank has entered an insolvency regime. This minimum requirement needs to be complemented by an additional buffer of capital that can both be used to absorb unexpected losses and allow banks to maintain lending to the real economy. Figure 1 illustrates these concepts.

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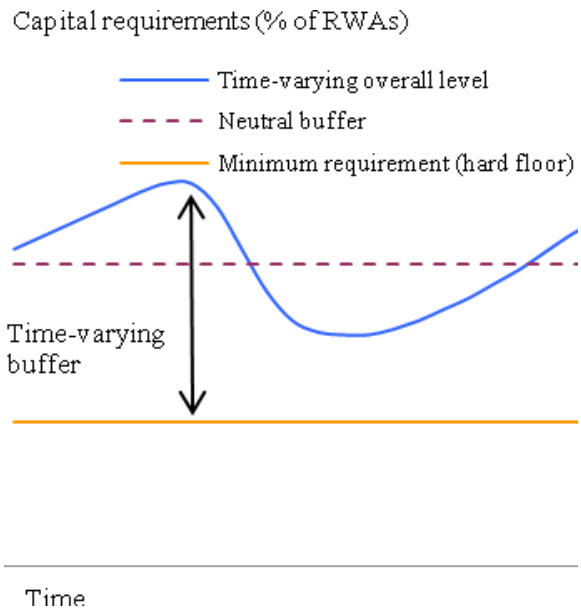
[1] The views expressed in this paper are those of the authors, and not necessarily those of the Bank of England.

[2] Various international committees provided for the discussion of these issues, with the Basel Committee on Banking Supervision playing a key role on the capital and liquidity adequacy front.

[3] These figures do not take into account the Basel III increases in risk-weighted assets.

Figure 1

Schematic representation of components of capital requirements



The paper is structured as follows. Section 2 provides an overview of related cost-benefit studies. To estimate costs (Section 3), we apply a simple accounting method to analyse the impact of higher capital requirements on the spread between banks' lending and funding rates (Section 3.1). We then translate higher lending spreads into GDP using the simplest possible macroeconomic model: a production function (Section 3.2). We also consider alternative plausible estimates based on different assumptions (Section 3.3). To assess the benefits (Section 4), we make use of a credit portfolio model to translate capital requirements into probabilities of banking crises (Section 4.1). We then draw on estimates of the cost of banking crises to establish a link between capital requirements and GDP (Section 4.2). Section 5 combines these estimates to determine plausible ranges in which appropriate capital requirements might lie. Section 6 concludes.

2. Related literature

A number of recent studies have discussed the costs and benefits of higher capital requirements. As in this paper, some focused on the steady-state impact at a point *after* the banks and the wider economy are assumed to have adjusted to the revised requirements (eg BCBS (2010)); others on the impact during the transition phase to the new requirements (eg BCBS and FSB (2010)).

Among these papers, BCBS (2010) is closest to the analysis contained here. To estimate the costs of higher capital requirements, BCBS (2010) follows a similar framework to the one presented in Section 3 of this paper. To estimate the benefits, BCBS (2010) again follows the same steps as we do, but presents the results of a broader range of models to assess the link between capital requirements and the likelihood of systemic crises. We differ from BCBS (2010) in that our analysis focuses on the United Kingdom, which is simpler and more transparent, and because we investigate the costs of higher capital requirements in more detail.

Other comprehensive cost-benefit analyses include Barrell et al (2009), Kato et al (2010), and Miles et al (2011). The first two studies analyse the effect of varying both liquidity and capital requirements. The third also focuses on capital requirements. Its estimates of appropriate capital ratios are larger, primarily because Miles et al use a different method to calibrate the volatility of banks' assets. It also takes into account the impact of lower leverage on risk-adjusted returns, but this is quantitatively less important. Using a different approach, Kashyap et al (2010) also conclude that the long-run costs of increasing capital requirements are likely to be small.

A number of studies investigate specific elements of the cost-benefit analysis. Using a method close to the one we employ, Elliott (2009, 2010) studies the long-run effect of tightening capital requirements on banks' lending spreads in the United States. Elliott's analysis suggests that these effects are small, in particular if banks are able to offset any increase in their funding costs by other means. King (2011) uses a similar method to investigate the long-run impact of tighter capital and liquidity requirements on bank lending spreads for 13 OECD countries.

3. The economic costs of higher capital

Modigliani-Miller's irrelevance theorem states that if a firms' risk only depends on the riskiness of its assets, variations in its capital structure do not affect its funding costs. If this is true, the response is straightforward: Over a wide range, higher capital requirements would have no real-economy costs.[4]

But to ensure that our conclusions are robust against the criticism that real-world frictions prevent the result from holding in reality, we assume that banks' funding costs increase when the share of capital in their liabilities rises. If banks pass on this increase, the real cost of financial intermediation increases. We therefore determine first how higher capital ratios might influence banks' cost of funding and their lending spreads (Section 3.1), and then how higher lending spreads might influence households' and firms' funding costs and their propensity to invest, and ultimately GDP (Section 3.2).

3.1 Translating higher capital ratios into bank lending spreads

Total assets of the UK banking sector – here proxied by major UK banks – were about £6.6 trillion on average during 2006–09, and risk-weighted assets were about £2.6 trillion. An increase in the capital ratio by 1 percentage point would imply that, in aggregate, banks would have to raise an additional £26.5 billion in equity. If remunerated at 10%, this would cost banks £2.65 billion per year.

But, at the same time, banks could retire debt worth £26.5 billion. Assuming a typical cost of wholesale debt of 5% and a tax rate of 28%, this would result in an after-tax saving of about £0.95 billion (= (1 – 28%) x 5% x £26.5 billion). This would leave banks with an annual increase in funding costs of around £1.7 billion to recoup. If this were recovered solely from global lending to non-bank customers, the lending spread after accounting for taxes would have to increase by about 7.4 basis points (= £1.7bn / £3.2trn / (1 – 28%)).

[4] The qualification "over a wide range" results from the observation that some bank debt (deposits held for transaction purposes) has value not only as a funding instrument, but also as a means for providing liquidity insurance to households and firms. Replacing this by equity could inhibit the payment for and settlement of goods and services and affect the overall level of maturity transformation in the economy. In this paper, we consider variations in capital requirements that would only substitute between equity and debt held for savings purposes.

3.2 Translating higher bank lending spreads into GDP

The long-run impact of higher bank lending spreads on GDP can be assessed using a simple production function. In this framework, an increase in non-financial firms' cost of capital reduces their investment and, ultimately, the level of GDP. Using a constant elasticity of substitution production function, the elasticity of output with respect to firms' cost of capital is $\sigma \times \alpha / (\alpha - 1)$, where σ, the elasticity of substitution between capital and labour, is taken to be 0.4, and α, the output elasticity of capital, is taken to be 0.3.[5] As bank lending represents only part of firms' total external financing, firms' overall cost of capital is likely to rise by only about a third of the increase in banks' lending spreads. A 7.4 bp increase in bank funding costs raises firms' cost of capital – here taken to be 10% – by 7.4 bp / 3 = 2.5 bp or about 0.25%.[6] This suggests that output might fall by about $0.25\% \times \sigma \times \alpha / (\alpha - 1)$, or 0.04%. That is, a 7.4 basis point increase in lending spreads maps into a 0.04% permanent decline in the level of GDP under these assumptions.

3.3 Construction of plausible bounds

As noted above, we consider a few alternative scenarios to derive some plausible bounds of the effect of higher capital requirements on lending spreads and GDP. One variation we consider assumes that Modigliani-Miller's theorem holds apart from the different tax treatment of debt and equity. The predicted increase in lending spreads (1.6 bp) and impact on GDP (–0.01%) of a 1 percentage point increase in capital requirements is, of course, much smaller than in our benchmark. We also consider a scenario whereby banks recover a third of the increase in funding costs through higher fees and commissions (increased by 4%) and by reducing operating costs (by 4%). In this scenario, our estimated impact on lending spreads and GDP would also be lower than our baseline example (4.9 bp and –0.03%, respectively). Other scenarios we consider include a higher equity premium, a higher real cost of capital for non-financial corporate and a lower share of bank finance for non-financial corporate.

4. The economic benefits of higher capital

Higher capital levels should make the banking system more resilient, reducing the probability or severity of financial crises. In Section 4.1, we determine how capital requirements affect the likelihood of a systemic banking crisis before combining this probability with an estimate of the loss in GDP that a crisis causes (Section 4.2).

4.1 Translating capital ratios into the probability of a crisis

Several techniques are available to analyse the relationship between capital requirements and the probability and severity of systemic crises. We focus on the impact of capital requirements on the probability of crises, and combine it in Section 4.2 with an estimate for the average severity of a crisis from the academic literature. Specifically, we use a Merton-style structural credit risk portfolio model based on Elsinger et al (2006) to quantify systemic solvency risks for a stylised representation of the UK banking system.[7] Their framework captures two channels of system-wide risk: (i) the risk that banks fail simultaneously because

[5] Our estimate of α is in line with the literature. See Barnes et al (2008) for estimates of σ.

[6] That is, (10% + 2.5 bp) / 10% –1 = 0.25%.

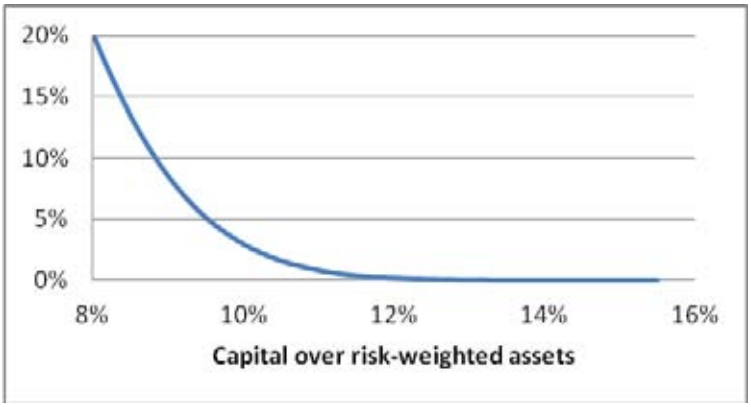
[7] Our model has been developed by Webber and Willison (2011).

their asset values are correlated; and (ii) direct balance sheet links between banks, through which the failure of one bank can cause the contagious failure of other institutions.

We assume that a bank fails if its capital ratio approaches the Basel II minimum of 4%; for purposes of illustration only, a 2 percentage point buffer is used. The model is calibrated using 2007 data for the five largest UK banks, with a systemic crisis defined as the joint default of at least two of these banks.[8] Figure 2 shows the predicted link between the probability of a crisis and the risk-weighted capital ratio.

Figure 2

Probability of systemic crises



4.2 Translating the probability of a crisis into GDP

In order to compare the benefits of higher capital requirements to the costs, we need to translate the probability of crises into expected losses in the level of GDP. Suppose that the initial output loss in a systemic crisis is 10%, with three quarters of this lasting for five years, while the remainder is permanent. Figure 3 shows this crisis pattern relative to a baseline scenario in which no crisis occurred: a decline of 10% in GDP until five years after the crisis occurred, reduced to 2.5% from year six onwards. For reference, the figure also includes an estimate of the mean output path of a typical banking crisis taken from IMF (2009), which considers only losses up to seven years after the crisis.

The expected loss in output per crisis, LPC, can then be computed as

$$\mathrm{LPC} = \left(\frac{3}{4} \frac{1-\delta^5}{1-\delta} + \frac{1}{4} \frac{1}{1-\delta} \right) \cdot 10\%$$

where δ is the discount factor. Using a discount rate of 2.5%, this amounts to a cumulated discounted cost of about 140% of GDP per crisis, and 1.4% of GDP per percentage point reduction in the likelihood of this crisis. As higher capital requirements would not only reduce the likelihood of a single crisis but of all future crises, the expected benefit of higher capital requirements would be

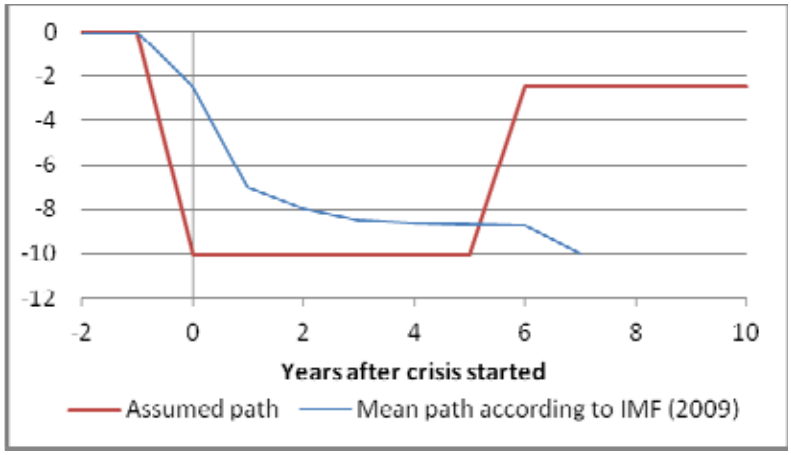
$$1\% \cdot \mathrm{LPC} \cdot \frac{1}{1-\delta}$$

per percentage point reduction in the probability of crises, or about 55% of GDP.

[8] Including other UK banks in the model is unlikely to affect the precision of our estimates materially, because the banks in our sample cover the vast majority of lending to UK households and businesses.

Figure 3

Output paths



5. Lessons for appropriate capital requirements

5.1 A range of appropriate capital requirements

One way of combining the cost and benefit estimates is by comparing the effects of an increase in the capital ratio by 1 percentage point on GDP. Table 1 collects the minimum and the maximum benefits and costs calculated in the illustrative examples and its variations (as discussed in Section 3.3), and adds a column with the average of both to facilitate the comparison. In our approach, the incremental costs of higher capital requirements are independent of the capital ratio, whereas the incremental benefits decrease the higher the capital ratio. We therefore present estimates of the costs and benefits for various capital ratios.

Table 1

Plausible bounds for appropriate capital requirements

	Marginal benefit (% of GDP)			**Marginal cost (% of GDP)**			**Net benefit (% of GDP)**		
Effects of an increase in the capital ratio ...	**low**	**mid**	**high**	**high**	**mid**	**low**	**low-high**	**mid**	**high-low**
from 8% to 9%	192	459	726	–3	–2	–0	189	457	726
from 11% to 12%	4	71	137	–3	–2	–0	1	69	137
from 14% to 15%	+0	3	5	–3	–2	–0	–3	1	5

Even when comparing very pessimistic (low) benefit estimates with pessimistic (high) cost estimates, the results suggest that appropriate capital ratios should be in excess of 11% of risk-weighted assets: at 11%, the benefits (4% of GDP) exceed the costs (3% of GDP). When comparing the midpoints, the results suggest that an appropriate capital ratio might lie in excess of 14% of risk-weighted assets.

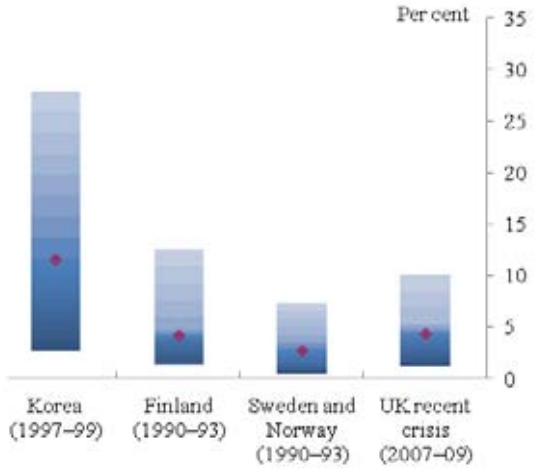
5.2 Banks' losses in past crises

As mentioned previously, the structural approach that we used to assess costs and benefits presents only one of several methods that can be used for a cost-benefit analysis. One way of checking whether our results are broadly sensible is to ask how much capital banks would have needed to survive past crises.

Evidence from such crises suggests that banks typically make losses equivalent to about 5% of risk-weighted assets (Figure 4).[9] But these numbers are likely to be underestimates for several reasons: government support substantially reduces realised losses; there is survivorship bias because losses at failed banks are usually not included; and mark to market losses during the crisis are likely to be substantially higher than the losses that are finally recorded in published accounts.

Figure 4

Cumulative peak losses as a percentage of risk-weighted assets at the start of the crisis



Source: Bank of England (2010).

Finally, the numbers take no account of the fact that additional capital is required to maintain a sufficient amount of lending to the real economy during a downturn. For example, to maintain growth in risk-weighted assets of 8% per year for five years after the start of a crisis, banks would need an additional buffer of about 3% of risk-weighted assets.[10] This back-of-the-envelope calculation suggests that banks would need to hold a capital cushion of about 7–8% above their viability threshold. These figures are broadly consistent with our illustration of our cost-benefit framework.

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[9] Figure 4 includes only those banks that incurred losses. Each shaded band shows 5% (between the 5th and 95th percentiles) of the support of the interpolated distribution across banks. The diamond shows the median. Start of crisis defined as a year before a bank incurred a loss (defined as net income after tax and before distributions). UK figures based on the major loss-making UK banks.

[10] Over five years, loans would grow by (1 + 0.08) x 5 – 1 = 45% of risk-weighted assets. If 6% of this is funded with capital, the required additional capital is about 3% of risk-weighted assets.

6. Conclusion

Two key insights can be taken from this paper. First, loss-absorbing capital is only a small proportion of banks' balance sheets. Increasing this proportion to 10–15% does not materially affect a bank's average cost of funding in the steady state, even if Modigliani-Miller's theorem does not hold. The second is that the net benefits of higher capitalisation can be substantial.

The estimates are subject to substantial uncertainties, in particular on the benefit side. But insurance against systemic banking crises (in the form of higher capital ratios) appears to be comparatively cheap in steady state, and the cost of crises is large.

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Macrofinancial vulnerabilities and future financial stress: assessing systemic risks and predicting systemic events

Marco Lo Duca and Tuomas Peltonen[1]

1. Introduction

The current financial turmoil has demonstrated the importance of understanding and measuring systemic risks and predicting systemic events, ie events *when financial instability becomes so widespread that it impairs the functioning of the financial system to the extent that economic growth and welfare suffer materially*.[2]

Borio and Lowe (2002, 2004) show that widespread financial distress typically arises from the unwinding of financial imbalances that build up disguised by benign economic conditions, such as periods of stable and low inflation. Using annual data for 34 countries for the period 1960–99, they show that sustained rapid credit growth combined with large increases in asset prices increased the probability of episodes of financial instability. Recently, Cardarelli et al (2011), using data for 17 major advanced economies, show that the likelihood that stress in the financial system will cause more severe economic downturns is higher when stress is preceded by the building up of balance sheet vulnerabilities in the form of a rapid expansion of credit, and a run-up in house prices. Moreover, in a paper closely related to our study, Misina and Tkacz (2009) investigate whether credit and asset price movements can help to predict financial stress in Canada by using linear and nonlinear threshold models. According to their findings, business credit emerges as an important leading indicator among all variables considered in their study.

This paper builds upon the above studies and contributes to the financial crisis literature by developing a unified framework for assessing systemic risks, stemming from domestic and global macrofinancial vulnerabilities, and for predicting (out of sample) systemic events ie periods of extreme financial instability with potential real costs. Within this framework it is possible to assess the relative importance of the factors contributing to the probability of a systemic event. It is also possible to identify potential vulnerabilities on the basis of a scenario analysis of the evolution in the domestic and global macrofinancial environment.

We extend the existing literature on predicting financial crises in several ways. First, we identify past systemic events by using a composite index measuring the level of systemic tensions in the financial system of one country. Second, in predicting the identified systemic events, we evaluate the joint role of domestic and global vulnerabilities as sources of financial instability. Third, we evaluate both "standalone" macroprudential indicators of vulnerabilities and composite indicators calculated using discrete choice models. The evaluation of the two categories of indicators is done with a common methodology that takes into account policymakers' preferences between issuing false alarms and missing systemic events.

The remainder of the paper is organised as follows: Section 2 introduces the measure for financial stress and defines systemic events, Section 3 reports the empirical analysis and Section 4 concludes.

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[1] ECB.

[2] See the definition of the concept of systemic risk in the *ECB Financial Stability Review*, December 2009.

2. Measuring financial stress and identifying systemic events

We identify past systemic events using a composite index to measure the level of systemic tensions in the financial system of a given country. This approach provides an objective criterion for the definition of the starting date of a crisis and it contrasts with the standard way of identifying crises based on qualitative information (see eg Laeven and Valencia (2008)).

Furthermore, systemic events are identified as episodes of extreme financial stress that have led to negative real economic consequences on average. In this way, we avoid the selection bias that would occur if we chose only cases where extreme financial stress has always led to negative real economic consequences. The selection bias could emerge because a policy action (that we do not control for) might have prevented the negative economic outcome.[3]

In our benchmark case we identify systemic events when the Financial Stress Index (FSI) crosses the 90th percentile of the country distribution. We adopt this threshold because on average it anticipates real consequences in terms of negative deviation of real GDP from trend. Following this approach, we identify a set of 94 systemic events in a sample of 28 countries over a period spanning from 1990 Q1 to 2009 Q4. We find the following starting dates for well known crisis episodes in the 1990s and 2000s: 1994 Q1 for Brazil, 1994 Q4 for the Mexican crisis; 1997 Q2 for the Asian crisis in Thailand, 1997 Q3 for Hong Kong and other main Asian countries, 1998 Q3 for the Russian crisis, 1999 Q1 for the Brazilian crisis; 2001 Q3 for the Argentinean crisis; 2007 Q3 for the most recent financial crisis in the United States. In many cases, these episodes spread to several other economies. For example, after starting in 2007 Q3 with severe problems in money markets and volatility in other market segments in the United States and in the euro area, the latest crisis spread internationally in successive waves in 2008 Q1 and 2008 Q3, finally reaching the emerging markets in 2008 Q4. Several of the episodes that we identify are also in the list of crises compiled by Laeven and Valencia (2008).

Our approach to identifying systemic events can be seen as an extension of Eichengreen et al *(*1996), where an index of exchange market pressure is used to identify currency crises. Compared to Eichengreen et al (1996), our financial stress index is broader than the exchange market pressure index because it includes several market segments. This enables us to identify episodes that are truly systemic and not segment-specific. In addition, by defining systemic events as episodes of extreme financial stress with potential real economic consequences, we focus on financial crises that are relevant for policymakers who want to avoid real costs. The real cost dimension is absent in Eichengreen et al (1996), where a simple statistical rule is used to identify crisis periods.

[3] The detailed description of the index is in Lo Duca and Peltonen (2011). In short, our Financial Stress Index (FSI) is a country-specific composite index, covering the main segments of the domestic financial market. It is calculated as the average of following five components after they are standardised: (1) the spread of the three-month interbank rate over the three-month government bill rate; (2) negative quarterly equity returns (multiplied by minus one, so that negative returns increase stress; positive returns are disregarded and set to zero); (3) the realised volatility of the main equity index; (4) the realised volatility of the nominal effective exchange rate; and (5) the realised volatility of the yield on the three-month government bill.

3. Predicting systemic events

Definition of the dependent variable

The objective of the study is to predict the occurrence of systemic events within a given time horizon that in our benchmark specification is set to six quarters.[4] To do this, we proceed in three steps to calculate our dependent variable.

First, we transform the Financial Stress Index into a binary variable that we call "systemic event". The variable takes value 1 in the quarter when the FSI moves above the predefined threshold of the 90th percentile of the country distribution.

Second, we set the dependent variable to 1 in the six quarters preceding the systemic event and to 0 in all the other periods. The dependent variable mimics an ideal leading indicator that perfectly signals "systemic events" by "flashing" in the six quarters before the event.

Finally, we drop from the sample all the observations that are not informative about the transition from tranquil times to systemic events. This means that we drop the periods when financial stress remains above the predefined threshold that identifies systemic events. We also drop tranquil periods that are not longer than six quarters, as the short distance between the extreme stress episodes delimiting them suggests that we should not consider these periods as "normal".[5]

Predicting systemic events

We test the performance of standalone indicators of vulnerabilities and discrete choice models in predicting systemic events. Our empirical analysis covers a set of 28 emerging market and advanced economies with quarterly data between 1990 Q1 and 2009 Q4.

Regarding standalone indicators, we test several domestic and global measures of vulnerabilities inspired by the literature on early warning systems (for example, Bussière and Fratzscher (2006)) and leading indicators of crises (for example, Borio and Lowe (2002)). The standalone indicators that we test are based on asset price (equity and property prices), credit (credit and monetary aggregates) and macro (GDP, inflation, government deficit, current account deficit) developments. Our analysis is conducted as much as possible in a real-time analysis fashion.[6] At each point in time, only information available to the policymakers up to that point in time is used. This implies that we take into account that certain variables, such as GDP, are not available to the policymakers in real time because of publication lags. To take into account publication lags, we use lagged variables. For GDP,

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[4] The time horizon of six quarters is chosen because within this time interval policy makers can adopt measures to prevent the materialisation of systemic events. Shorter time horizons are less relevant for policy making because the potential for effective pre-emptive actions is lower. For robustness check, we also try time horizons of two, four and eight quarters. The results are discussed at the end of this section on the robustness tests.

[5] Bussière and Fratzscher (2006) point out that including in the estimation of early warning models the period of economic recovery after a crisis produces the so called "post-crisis bias". In recovery periods, economic variables go through an adjustment process before reaching again the path they have during tranquil periods. The recovery period therefore should be excluded from the analysis as it is not informative of the path leading from the pre-crisis regime to the crisis.

[6] The literature on early warning models deals with large datasets of macro data for many countries, several of which are emerging markets. "Real-time datasets" that contain information on the revisions of data after the first publication do not exist yet for several countries in our sample. Our analysis is therefore a real-time analysis in the sense that we take into account publication lags, as in other early warning models (Alessi and Detken (2011)).

money and credit related indicators, the lag ranges from one to two quarters depending on the country. The real-time analysis also implies that de-trended variables are computed using only real-time information. Therefore, we recursively calculate trends at each time *t*, using only the information available up to that moment.

We also evaluate the performance of several discrete choice models including different sets and different combinations of the standalone indicators of vulnerabilities. Specifically, we test whether considering jointly domestic and international vulnerabilities improves the performance of the model in predicting systemic events. In particular, we test the following models:

- "Currency crisis" model: includes explanatory variables often used in the currency crises literature, as for example the real exchange rate, macro conditions and credit growth.
- "Macroprudential" model: adds equity price growth and valuation to the set of explanatory variables of the "currency crisis" model.
- "Domestic" model: includes the explanatory variables of the "macroprudential" model with the addition of (i) the general government deficit, (ii) the interaction between equity growth and equity valuation, and (iii) the interaction between credit growth and leverage.[7]
- "Domestic and international (no interactions)" model: includes the explanatory variables of the "domestic" model with the exclusion of the interactions terms. It also includes global growth and inflation, global credit growth and leverage, and global equity growth and valuation.
- "Benchmark" model: among the explanatory variables, this includes all the domestic and international indicators of fragilities of the previous model, as well as the interactions among the international and domestic variables.

The evaluation of standalone indicators and discrete choice models is done following the procedure suggested by Alessi and Detken (2011).[8] For each indicator (either a standalone indicator or the probability estimated with a discrete choice model), we calculate thresholds signalling that a systemic event is going to occur within six quarters. These thresholds for policy action (or early warning thresholds) are calibrated on the basis of their performance in predicting past systemic events. More precisely, they are optimised on the basis of a measure of utility (named "usefulness") that takes into account policymakers' preferences between Type I and Type II errors.[9] Indicators are therefore ranked according to the "usefulness" score that they achieve.

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[7] All interactions are calculated as the product between the relevant indicators.

[8] Bussière and Fratzscher (2008) also address the issue of policymakers' preferences in calibrating the optimal early warning thresholds and the timing of policy interventions.

[9] Regarding policymakers' preferences, in our benchmark analysis we take the point of view of a policymaker who is equally concerned about issuing false alarms and missing systemic events. This could be considered the point of view of a neutral external observer who does not want to commit any mistakes and is only concerned about correctly calling a systemic event. The point of view of local policymakers or international institutions in charge of giving policy recommendations could be different, as the costs of missing systemic events and issuing false alarms are different (eg through reputational costs or real costs). It is likely that the last financial crisis increased the concerns of policymakers about missing systemic events. However, it is difficult to assess whether policymakers could be assumed to be relatively more concerned about missing crises than about issuing false alarms.

Table 1

Performance of the different indicators and models in predicting systemic events

Model\Indicator	U	NtSr	% predicted	Cond prob	Prob diff
e	0.33	0.22	84.73%	63.24%	35.99%
Benchmark	0.32	0.20	80.95%	65.83%	37.83%
Benchmark (no interactions)	0.31	0.31	88.80%	55.52%	27.52%
Domestic	0.26	0.28	71.71%	57.79%	29.79%
Macroprudential	0.24	0.34	74.23%	53.32%	25.32%
Percentage deviation of the ratio of equity market capitalisation to GDP from Hodrick-Prescott (λ=400000) trend	0.21	0.45	76.91%	48.44%	18.72%
Percentage deviation of the ratio of private credit to GDP from Hodrick-Prescott (λ=1600) trend	0.21	0.43	73.09%	49.36%	19.63%
Currency crisis	0.19	0.38	60.33%	49.16%	22.33%

Note: Forecasting horizon is six quarters. The preferences of policymakers are assumed to be balanced between missing crisis warnings and false alarms. The table reports in columns the following measures to assess the efficiency of indicators: (1) usefulness "U" (according to Alessi and Detken (2011)); (2) noise to signal ratio (NtSr) ie the ratio between (i) false signals as a proportion of periods in which false signals could have been issued and (ii) good signals as a proportion of periods in which good signals could have been issued; (3) the percentage of correct signals predicted by the indicator (% predicted); (4) the probability of a crisis conditional on a signal (Cond prob); (5) the difference between the conditional (to a signal) and the unconditional probability of a crisis (Prob diff).

Table 1 summarises the results of our study by reporting the measure of "usefulness" (U) and other statistics to evaluate the efficiency of the indicators. For brevity, we report the results of discrete choice models, and we include in the table only the two best performing standalone indicators.

Overall, our results show that standalone measures of asset price misalignments and credit booms are in general useful leading indicators of systemic events. Interestingly, global measures of credit expansion and asset price developments perform better than indicators of domestic fragilities.[10] Interactions between domestic variables as well as between global and domestic variables are among the best standalone indicators. However, our results (Table 1) highlight the importance of considering jointly various indicators in a multivariate framework, as we find that discrete choice models outperform "standalone" indicators in predicting systemic events. We find that jointly taking into account domestic and global macrofinancial vulnerabilities greatly improves the performance of discrete choice models in forecasting systemic events. In addition, consideration of the interactions between domestic and global macrofinancial vulnerabilities further improves the performance of the model.

All these results survive a battery of robustness tests, including changes in the way vulnerabilities are measured. The insertion of additional explanatory variables capturing

[10] These results are also supported by the conclusions of Borio and Lowe (2002), Gerdesmeier et al (2009) and Alessi and Detken (2011).

contagion effects and net capital inflows neither alters the results nor improves the performance of the models. The models have good forecasting performance over different time horizons (two, four, six and eight quarters) and the results are stable under different assumptions for policymakers' preferences, as long as the preferences are not too strong either against missing crises or against issuing false alarms.

4. Conclusions

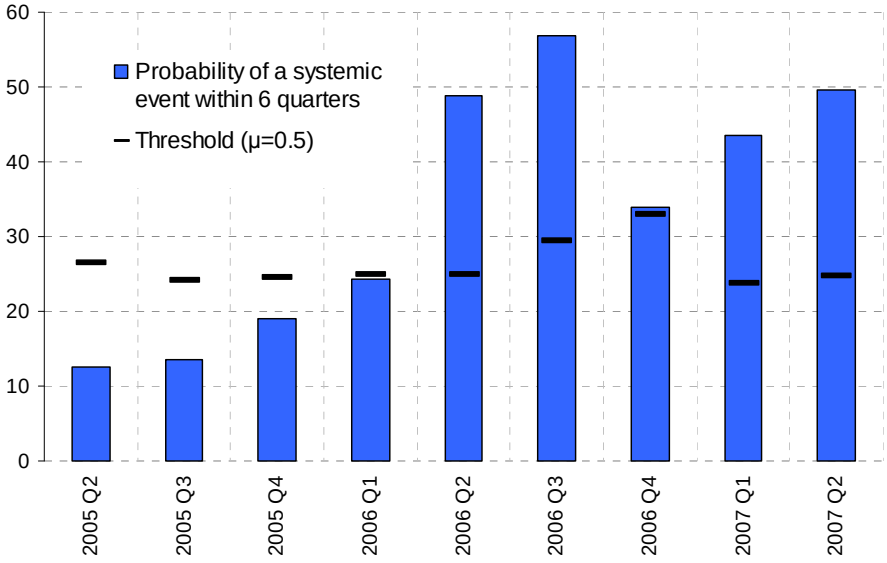
This paper contributes to the financial crisis literature by developing a unified framework for assessing systemic risks, stemming from domestic and global macrofinancial vulnerabilities, and for predicting systemic events, ie periods of extreme financial instability with potential real costs.

We extend the existing literature on predicting financial crises in several ways. First, we identify past systemic events by using a composite index measuring the level of systemic tensions in the financial system of one country. Second, in predicting the identified systemic events, we evaluate the joint role of domestic and global vulnerabilities. In addition, we also analyse the role of the interactions between domestic factors and the interplay of global developments with the domestic conditions. Third, we evaluate both "standalone" macroprudential indicators of vulnerabilities, and composite indicators calculated using discrete choice models. The evaluation of the indicators is done with a common methodology that takes into account policymakers' preferences.

Our empirical analysis covers a set of 28 emerging market and advanced economies with quarterly data since 1990. Our results highlight the importance of considering jointly various indicators in a multivariate framework, as we find that discrete choice models outperform "standalone" indicators in predicting systemic events. We find that jointly taking into account domestic and global macrofinancial vulnerabilities greatly improves the performance of discrete choice models in forecasting systemic events. In addition, consideration of the interactions between domestic and global macrofinancial vulnerabilities further improves the performance of the model.

Figure 1

Predicting (out of sample) the latest financial crisis in the United States



Note: The X-axis represents time (in quarters), while the Y-axis represents the probability of a systemic event within the next six quarters (threshold optimised for μ=0.5). The probability is the output of the benchmark logit model.

Our framework displays a good out-of-sample performance in predicting the last financial crisis. Our model would have issued an early warning signal for the United States in 2006 Q2, five quarters before the emergence of the tensions in money markets that started the crisis in August 2007 (Figure 1). Our analysis reveals that both domestic (credit cycle and macro-overheating) and global factors (equity valuations and macro-overheating) were important determinants of systemic risk in the United States in the period before the crisis. Knowing the sources of systemic risk can guide the policymaker in choosing policy responses. Some risks can be mitigated by domestic policies. However, the importance of global factors as sources of systemic risk suggests that international cooperation and coordinated policy actions are crucial in preserving global financial stability.

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Getting effective macroprudential policy on the road: eight propositions

Dietrich Domanski and Tim Ng[1]

Introduction

It is widely agreed that effective macroprudential policy needs to be part of the stabilisation policy arsenal. Macroprudential policy aims to limit systemic risk, primarily by regulating financial institutions. Its rationale is that individual financial firms can create negative externalities for other parts of the financial system and these externalities can threaten the stability of the financial system as a whole, even if individual firms appear sound.

The challenge now is to translate these abstract imperatives into practical operational frameworks. In doing so, policymakers must judge which framework elements most need development. Much of the literature on macroprudential policy describes obstacles relating to analytical gaps, institutional limitations and political economy.[2] This paper's contribution is to assess progress in overcoming the obstacles and to suggest priorities for development.

The elements of any policy framework are an objective, diagnostic tools, instruments, an operating strategy, and governance arrangements. Many examples of these elements now exist.[3] Some observers see the macroprudential technology, especially the diagnostic tools and instruments, as lacking.[4] We instead suggest that it is not individual framework elements themselves, but their integration in a way that resonates with the public, which most needs attention. There should be an explicit macroprudential mandate, an operating strategy that includes leaning against the financial cycle, centralised and transparent decision-making, and simple communication of policy decisions linked clearly to systemic risk assessments.

A coherent and easily understood integration – a core policy narrative – will be essential for building a durable political constituency for financial stability. Such a constituency will be especially important as memory of the crisis fades and as policy errors and misjudgments are inevitably made. Public understanding of the framework might also bolster its effectiveness by promoting stabilising expectations.

In the rest of this paper we articulate this argument more precisely, in the form of eight propositions about the focus of the development work needed. We discuss the technology first and then move to institutional and communications matters.

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[1] Dietrich Domanski is at the Bank for International Settlements. Tim Ng is at the Reserve Bank of New Zealand and was at the Bank for International Settlements at the time of the conference.

[2] See, for example, Borio and Shim (2007).

[3] Oosterloo and de Haan (2004) survey central banks' duties regarding financial stability. Cihak (2006) reviews financial stability reports. BIS (2010) discusses experience with macroprudential measures.

[4] See, for example, Volcker (2010) and Haldane (2010).

Eight propositions about effective macroprudential policy

Proposition 1: Existing indicators can support effective systemic risk diagnosis.

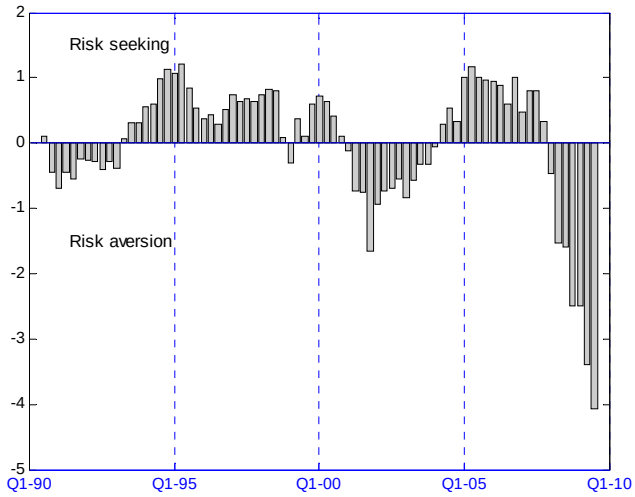
A substantial body of research studies the evolution of systemic risk factors, measured at a fairly aggregated level, over time. Newer research links systemic risk to more disaggregated factors such as common exposures and financial system interlinkages.[5] In either case, policymakers need to know how reliably the indicators can predict financial crises or major output fluctuations. At the aggregate level the evidence is better established. Above-trend aggregate credit and asset prices, for example, can predict crises reasonably well.[6]

For diagnostic purposes it helps that the many systemic risk indicators seem mostly to be positively correlated. This correlation suggests that there is an underlying "financial cycle", or ebbing and flowing of general risk sentiment. Figure 1 illustrates with a financial cycle indicator for the United States, constructed as the first principal component (PC) of a diverse range of variables variously cited as measures of risk-seeking.[7] This PC has a correlation coefficient of 0.7 or 0.8 with most of the underlying indicators and explains around half their total variance, suggesting that it is indeed picking up a generalised financial cycle.

The concept of the financial cycle is similar to "financial conditions" examined in other empirical work,[8] with the key difference that our indicator excludes variables that would be heavily influenced by monetary policy. Financial conditions indices summarise all influences on the general cost and availability of funding, whereas the financial cycle measure is intended to extract the contribution to systemic risk of the private financial sector.

Figure 1

A composite financial cycle indicator for the US



Source: authors' calculations.

[5] See Galati and Moessner (2010) for a review.

[6] Borio and Drehmann (2009).

[7] Variables used were real house price inflation, real equity price growth, the gap between 10-year and five-year government bond yields, the junk-to-government spread, commodity price inflation, bank lending standards, the loan-to-deposit ratio, and bank lending growth. Full details are available on request.

[8] See eg Hatzius et al (2010).

Proposition 2: Suitable and familiar instruments exist and should be used.

Many instruments suitable for macroprudential use are available and familiar from traditional microprudential policy. Hard limits can be imposed on the risk associated with specific activities, such as loan-to-value (LTV) or debt service ratios, currency mismatches or sectoral credit concentrations. Or, risk-taking by financial institutions can be influenced more generally through capital or liquidity requirements.

There are many instances of interventions of the specific sort, particularly in emerging economies. For example, several Asian economies have used LTV ratios for the past decade or so to protect their banking systems from property market downturns.[9]

The Basel III capital framework includes as macroprudential instruments a countercyclical capital buffer, higher loss absorbency for systemically important banks, and a leverage ratio.[10] New tools are also being developed in response to the problems associated with shadow banking and wholesale funding markets during the crisis.[11] While of course one should be open to the possibility of new and better tools in the future, building the toolkit now around readily available and familiar tools would limit the risks associated with novel instruments.

Proposition 3: Policymakers should operate instruments to lean against the financial cycle as well as applying fixed limits to risk-taking.

Policymakers can either leave the instrument settings mostly fixed over time, or actively adjust them to anticipate and counteract (that is, lean against) the financial cycle. Fixed settings are technically simpler, but they cannot guarantee that systemic risk will be acceptably constrained under all circumstances. Policymakers therefore need to monitor emerging developments and to be prepared to adjust the settings if necessary.

Diagnostic efforts supporting a leaning strategy should focus on the risky behaviour during upswings, rather than waiting for signs of actual deterioration in financial strength. By the time these signs appear, it will probably be too late to act. Moreover, financial strength could well be overstated towards the end of upswings, due to procyclicality in mark-to-market accounting practices and optimistic risk modelling.

Tightening when things seem to be going well will not be popular. And to be fair, genuine positive productivity shocks often underpin rising asset prices and credit early in the financial cycle. The diagnostic issue is identifying the point when risk-seeking rather than economic fundamentals become the main driver of the financial upswing. This point necessarily occurs before traditional indicators of balance sheet robustness start turning.

Proposition 4: The macroprudential mandate should be explicit.

Explicit mandates bolster policymakers' legal and moral authority to take unpopular actions. They also clarify, even for regulatory staff themselves, who is doing what and why. Mandates help resolve principal/agent and communications problems if the macroprudential agency also takes microprudential or monetary policy decisions, if some officials are involved in decisions in more than one policy area, or if different policy functions use the same type of regulation (for example, capital requirements).

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[9] Similarly, CGFS (2010b) proposes the use of minimum margin requirements as a means to manage risks in wholesale funding markets.

[10] See BCBS (2010).

[11] See CGFS (2010a) for more detail.

Jurisdictions across the world are increasingly issuing explicit and high-profile mandates for macroprudential policy. In the United States, United Kingdom and European Union, for example, these mandates have the force of statute. The US and UK examples appear most specific in pointing to "leaning" strategies. The US text includes a function "to respond to emerging threats to … [stability]", while the UK highlights "damping the credit cycle". The EU case is less specific in requiring the authority to "allow for risk assessments to be translated into action by the relevant authorities".[12]

Independence of the macroprudential decision-making from the political process strengthens the moral force of mandates. The composition of the UK macroprudential committee appears to emphasise independence most strongly (Table 1). The Treasury is present, but non-voting. The United States is at the other end of the scale, with the Treasury chairing the committee. The European Union is in the middle, with the European Commission supplying a voting member and the EU Economic and Financial Committee a non-voting member.

Table 1

Macroprudential authority membership and powers

Authority	Membership	Powers over instruments
UK Financial Policy Committee	Chair: central bank/supervisor governor. Officials from: central bank/supervisor, consumer protection and markets regulator, external members. Non-voting: Treasury official.	Direct powers
EU European Systemic Risk Board	Chair: central bank governor. Officials from: ECB and national central banks, European Supervisory Authorities, European Commission. Non-voting: EU ECOFIN Committee representative, others.	To issue comply-or-explain recommendations
US Financial Stability Oversight Council	Chair: Treasury Secretary. Officials from: central bank/supervisor, other supervisory agencies, consumer financial protection agency, markets supervisor, deposit insurer, commodities regulator, housing finance agency, insurance expert. Non-voting: various.	To issue comply-or-explain recommendations

Sources: HM Treasury (2010); Commission of the European Communities (2009); US Congress (2010).

Proposition 5: Decision-making should be centralised, but draw on a broad range of information.

Since macroprudential policy is system-focused, its decision-making should be centralised in an identifiable agency that has full control over the macroprudential instrument(s).[13] In cases where another authority also uses the same type of intervention, such as a capital requirement, the macroprudential agency should have full authority to apply its own requirement on top of that of the other agency. Such centralisation sends supervised firms clear and uniform messages, and simplifies international coordination.

[12] Sources for legislative provisions are listed in the Note to Table 1.

[13] A clear analogy can be drawn with monetary policy, in which a single interest rate is clearly and unambiguously set by a single agency.

Centralisation of decision-making does not imply centralisation of information-gathering. On the contrary, supervisory information and market intelligence about risk-taking or herding behaviour in the upswing could be key evidence supporting early action. The US, UK and EU approaches all involve a wide variety of financial agencies in decision-making, including at least the central bank, supervisors and securities regulators (see Table 1). However, the degree of centralisation of decision-making power varies significantly across the three cases. The UK committee can give directions regarding instrument settings, whereas the US and EU committees can issue comply-or-explain recommendations only. The comply-or-explain approach decentralises decision-making to the regulators receiving the recommendations, thus leaving open whether a recommended macroprudential intervention will be applied evenly across the financial system.

Proposition 6: Policymakers need political support to tighten during upturns.

Like any forward-looking policy, macroprudential policy must deal with noisy signals. Among other things, noisy signals create a bias against tightening during financial upswings. A partial solution is to link instrument settings to reliable risk indicators where available, to help create a presumption of policy action during the upswing. Few indicators, though, can be expected to send unambiguous signals early in the cycle.

Moreover, noisy signals imply diagnostic errors and policy mistakes. Mistakes threaten the political acceptance and therefore also the durability of the macroprudential regime. The inevitability of mistakes and errors underlines the importance of dealing with political problems at source, by building a constituency for financial stability.

Proposition 7: Macroprudential policy cannot eliminate the possibility of crises.

The inevitability of policy mistakes also means that crises will happen again. This reinforces the need for the public to understand the rationale and limitations of macroprudential policy. It also means that three policy areas complementary to macroprudential policy will remain perennially relevant. First, the financial system infrastructure needs to be strong. Second, procyclicality due to accounting and microprudential policy standards needs to be reduced as much as possible. Third, tools to manage crisis and financial failure need to be effective.

Proposition 8: Macroprudential communications should be simple.

The technical and political economy challenges of macroprudential policy underline the essential role of effective communication. It is needed to counteract the bias against tightening during upswings and to build a long-lasting constituency for financial stability that understands the limits of policy. Influencing financial behaviour systemically also depends on simple policy communication. Well-informed public discourse could then strengthen the efficacy of policy by promoting the stabilisation of expectations and the legitimacy of the regime.[14]

However, getting the public discourse right will not be easy. The costs of intervention can be easily highlighted, but the benefits of limiting the risk of crises are much less tangible. The core policy narrative must therefore express the link from systemic risk diagnosis to instrument settings clearly and logically using straightforward concepts.

Monetary policy communication offers a model. Its core policy narrative is that if aggregate demand runs ahead of aggregate supply, inflation will rise, and the central bank will hike the

[14] See Haldane (2010) for an elaboration of this argument.

policy rate. This idea is widely understood as the way in which low and stable inflation is maintained. Monetary policy in practice is of course more complicated, but the narrative is nevertheless close enough for useful public dialogue about monetary policy to ensue.

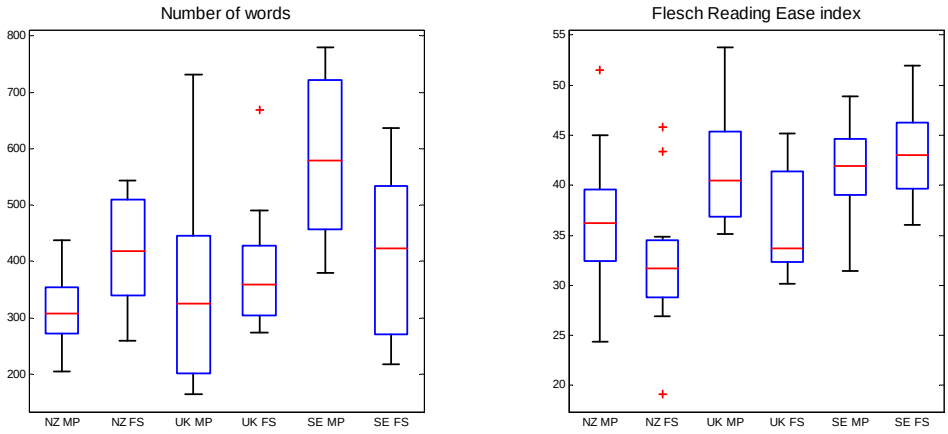
A core macroprudential policy narrative can be readily constructed around the analytical materials reviewed above. Ease and coherence of communication is another reason why we advocate building the young regime around a small number of fairly familiar risk concepts and instruments already in use.

Communications about financial stability do currently exist, of course, but they need to be adapted to a world with policy instruments and mandates for action. They also need to be made more accessible. Even with their relatively narrow focus on the diagnosis part of the narrative, the typical contemporary financial stability communication could be simpler.

As examples, we compared the financial stability and monetary policy press releases of three central banks recognised for their transparency of monetary policy: the Reserve Bank of New Zealand (RBNZ), the Bank of England (BoE) and the Swedish Riksbank. Graph 2 shows, for the period 2005–10, the word count and Flesch Reading Ease index (FRE) for press releases accompanying official interest rate decisions and Financial Stability Report (FSR) disseminations. The FRE summarises how difficult a text is to read, penalising sentences with many words and words with many syllables, such that a lower FRE indicates greater reading difficulty.[15] The RBNZ seems to have the most work to do, with its financial stability releases noticeably longer and harder to read than its monetary policy releases.

Graph 2

Length and reading ease of monetary policy and financial stability press releases



Source: authors' calculations.

The relative accessibility of central banks' more specialist-oriented communications in each field is similarly contrasting. Inflation reports (IRs) tend to be shorter and to have an economically logical structure that essentially follows the lines of the core policy narrative. By

[15] See the explanation of the FRE in Flesch (1951), cited in Harding (1967, p 41). Full details are available on request.

contrast, FSRs currently tend to be very long and dense, with many dozens of charts and tables, and, to our minds, with less of an obvious organising principle.[16]

Encouragingly, recent empirical work suggests that FSRs do influence financial conditions.[17] Policymakers already spend considerable effort trying to use communications to influence risk-taking. And, thorough conjunctural documentation serves to show that the central bank's policy decisions have involved careful deliberation. This contributes to stabilisation by promoting credibility and legitimacy and by providing expert opinion, which assists private-sector decision-making. When the diagnostic material in current communications becomes clearly and expressly linked to current or likely future policy actions pursuant to explicit mandates, the communications might well become more effective.

Conclusions

This paper has surveyed a wide range of issues involved in getting practical macroprudential policy on the road with a reasonable chance of working. The technology available is not the biggest obstacle. Building a constituency for financial stability that understands the diagnostic difficulties and technical limits is both materially more urgent and essential to the durability of the framework as memory of the crisis fades.

The policy problem needs to be simplified into a core narrative simple enough to engage the public. The core narrative can be readily constructed by emphasising the relatively familiar parts of the framework and linking diagnosis to action.

Monetary policy communications offer a model. In that case, relatively simple communications have helped embed the policy regime and enabled expectations management to improve the effectiveness of the regime.

To develop the core macroprudential policy narrative further, we suggest the following priorities.

- The financial cycle should be defined and measured better, and modelled jointly with macroeconomic variables.
- For now, instruments should be based on familiar tools such as capital and liquidity ratios and LTV limits.
- A centralised authority should fully control the policy instruments under a clear mandate.
- Communications need to be clarified, while avoiding the impression that the risk of crises can be eliminated.

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[16] See Cihak (2006) for a review of FSRs and comparison to IRs.

[17] Born et al (2010).

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Countercyclical tools: a comparative assessment

Sang Chul Ryoo and Cheol Hong[1]

1. Introduction

Since procyclicality has diverse sources and mechanisms, we also need a variety of countercyclical tools. We may categorise them in accordance with the asset, liability and capital sides of the balance sheet that they primarily affect.

This paper provides a comparative assessment of countercyclical tools through the establishment of an assessment criterion: controllability, which we think is most relevant to policy objectives. We select a representative tool from each side of the balance sheet and conduct an assessment. We show that the assessment results vary depending upon the financial conditions of financial institutions and markets, and that different tools may be more effective under different conditions. Given a certain set of financial conditions, therefore, multiple tools may be deployed in a complementary fashion.

This paper is organised as follows. First, we examine the countercyclical tools proposed from the perspective of the balance sheets of financial institutions. Second, we discuss the assessment standards. Third, we compare and evaluate the effectiveness of these countercyclical tools, based upon their ability to control financial institutions' assets. Fourth, we conduct a comparative assessment of various countercyclical tools with data on financial institutions in Korea. Finally, we explore some policy implications.

2. Countercyclical policy tools

The procyclicality inherent in the financial system may be exacerbated by various microprudential regulations and accounting standards. Minimum capital requirements, loan loss provisioning, liquidity regulations and fair value accounting can be pointed to as examples. It is therefore necessary to come up with various tools to counter and mitigate procyclicality originating from different sources. Since factors affecting procyclicality bring about changes in the balance sheets of financial institutions, we may categorise countercyclical tools based upon the sides of the balance sheet they primarily target, that is, capital, liabilities and assets.

In our paper, we select a representative tool from each side of the balance sheet (Table 1). We choose the capital buffer, a countercyclical tool from the capital side, to reduce procyclicality arising from regulatory capital and loan loss provisioning. As a tool to counter the procyclicality originating from liquidity regulation, through fluctuations in funding, the liquidity buffer is selected on the liability side. Finally, for procyclical movements in asset values, particularly in relation to fair value accounting, we choose the asset-based reserve requirement (ABBR), which directly targets the asset side.

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[1] Bank of Korea. The views expressed in this paper are those of the authors, and are not necessarily the views of the Bank of Korea.

Table 1

Countercyclical policy tools

Funding perspective	Capital side	• Capital buffer
	Liquidity side	• Liquidity buffer
Investment perspective	Asset side	• ABRR

The capital buffer is a policy tool that can alleviate procyclicality through the accumulation of additional capital countercyclically, in addition to the minimum capital ratio. In other words, the authorities increase the capital reserve burdens of financial institutions by raising the capital buffer ratio requirement during economic booms, and by doing so deter credit expansion in the financial system. During an economic recession, the authorities can then lessen the extent of deleveraging by reducing the capital buffer ratio to allow a decline in financial institutions' total capital ratio requirement.

$$K = (1 + \alpha)K^* \tag{1}$$

$$K^* = \frac{E}{w \cdot A}$$

where K stands for the total capital requirement ratio, K* the minimum capital requirement ratio, α the buffer ratio, E regulatory capital, w the average risk weight, and A total assets.

The liquidity buffer is a tool that regulates a liquidity coverage ratio (LCR)[2] countercyclically, mandating that a financial institution holds high-quality liquid assets against the possibility of massive funding outflows under an acute short-term stress scenario. The way in which the liquidity buffer is managed is similar to that with the capital buffer. Credit expansion during an economic boom is curbed by setting the LCR higher than 100%, while a credit crunch during a downturn is prevented by setting it lower than 100%.

$$L = (1 + \beta)LCR \tag{2}$$

$$LCR = \frac{A^h}{s \cdot D} \geq 100\%$$

where L stands for the overall liquidity ratio, β the buffer ratio, A^h high-quality liquid assets, s the run-off rate, and D net cash outflow for 30 days.

The ABRR is a tool by which reserve requirements are imposed on total assets or specific assets of financial institutions when asset prices in the financial markets fluctuate sharply. It is similar to the loan-to-value (LTV) ratio in that it aims to control financial institutions' assets directly, but different from the capital and liquidity buffers that seek to control assets indirectly through restricting the capital and liquidity ratios.

$$R = r \cdot A^{NR} \tag{3}$$
$$A^{NR} = f(P - P^*);\ f' > 0$$

where R stands for reserve requirements, r the reserve requirement ratio, A^{NR} non-reserve requirement assets (total assets or specific assets), P the asset price growth rate, and P* the long-term average asset price growth rate.

[2] LCR is the global liquidity standard that has been introduced by the BCBS, based upon the assumption of a stressed period continuing for 30 calendar days.

3. Assessment framework

3.1 Criteria for countercyclical tool assessment

We may assess countercyclical tools in terms of their cost-effectiveness. For effectiveness, the assessment criteria may include the controllability over financial institutions' assets – the direct source of credit in the financial system – and the implementability of tools through lower resistance from financial institutions. Meanwhile, countercyclical regulations also entail costs to both financial institutions and markets, because they limit business activities and distort market prices.

In our study, however, we assess countercyclical tools based solely upon their effectiveness in controlling asset fluctuations at individual financial institutions. Above all, countercyclical policy tools should be effective in achieving the policy goal, ie leaning against the excessive build-up of lending and investment in assets by financial institutions, which is the culprit behind asset price and credit aggregate fluctuations in the financial system, so as to alleviate credit and business cycle amplitude. Controllability over the assets of financial institutions should therefore be the main assessment criterion.

3.2 Framework

In order to assess the controllability of countercyclical tools, we need to set up a framework for analysing the response function of financial institutions. The effects of countercyclical regulations may vary depending upon how financial institutions respond to them. We assume that financial institutions maximise economic value added (EVA)[3] and derive optimal levels of assets (A), liabilities (D), and capital (E) at equilibrium as follows:

$$\text{Max EVA} = rA - (c_1 D + c_2 E) \tag{4}$$

$$\text{In equilibrium : EVA}^* = rA^* - (c_1 D^* + c_2 E^*)$$

where r stands for the return on assets, A assets, c_1 the unit cost of debt, c_2 the unit cost of equity, rA net operating profits after taxes, $c_1 D$ the cost of debt, and $c_2 E$ the cost of equity. We treat as given the market conditions: r, c_1 and c_2.

When regulations are imposed, financial institutions have to make portfolio adjustments in their balance sheets. This causes assets, liabilities and/or capital to deviate from their optimal levels. They then have an EVA lower than EVA* and incur adjustment costs. If different options for responding to the regulations are available to financial institutions, for instance if they either raise capital, lower assets or lower risk weights in response to the imposition of a capital buffer, they will choose the option with the lowest adjustment costs.

$$\text{Min Adjustment Cost}(\kappa) = \{\text{EVA}^* - \text{EVA}(\kappa)\} \tag{5}$$

where κ is the option chosen by the financial institutions.

Table 2 shows the EVA for each option that financial institutions can take in response to the impositions of higher capital buffers, liquidity buffers and reserve requirements during an economic boom. Notice that three options are available for responding to a capital buffer: ΔE, ΔA and Δw. Financial institutions can lower the average risk weight w by reducing the proportion of risky assets A_2. In order to meet a higher liquidity buffer requirement, they may either increase high-quality liquid assets A_h, or decrease net cash outflows by reducing the

[3] EVA, a measure of economic profit, is calculated as the difference between net operating profit after taxes and the opportunity cost of invested capital. This opportunity cost is determined by the weighted average cost of debt and equity (WACC). See www.sternstewart.com and Salmi and Virtanen (2001).

average net run-off rate s, which can be done through shifting wholesale funding D_2 to retail deposits D_1. For ABRR, the only option available is to reduce non-reserve requirement assets A^{NR} in proportion to the reserve ratio α. We exclude the possibility of raising liabilities to fund higher reserves ΔR, because it also increases A^{NR} and hence ΔR.

Table 2

EVAs of financial institutions' options

regulation	κ (option)	EVA(κ)	
		Revenue	**Cost**
capital buffer	ΔE[1]	$r(A^* + \Delta E)$	$c_1 D^* + c_2(E^* + \Delta E)$
	ΔA[2]	$r(A^* - \Delta A)$	$c_1(D^* - \Delta A) + c_2 E^*$
	Δw[3, 4]	$r_1(A_1^* + \Delta A_2) + r_2(A_2^* - \Delta A_2)$	$c_1 D^* + c_2 E^*$
liquidity buffer	ΔA_h[5]	$r_h(A_h^* + \Delta A_h) + r_o(A_o^* - \Delta A_h)$	$c_1 D^* + c_2 E^*$
	Δs[6]	rA^*	$c_{11}(D^* + \Delta D_2) + c_{12}(D_2^* - \Delta D_2) + c_2 E^*$
ABRR	ΔA_{NR}[7]	$r_R(A_R^* + \Delta A_{NR}) + r_{NR}(A_{NR}^* - \Delta A_{NR})$	$c_1 D^* + c_2 E^*$

Note [1] $\Delta E = (wA)\Delta K$

[2] $\Delta A = -(A/K)\,\Delta K$

[3] $\Delta w = -(w/K)\,\Delta K$

[4] $A = A_1(\text{riskless assets}) + A_2(\text{risky assets}), \Delta A_2 = \gamma \Delta w$

γ: conversion factor $(\Delta w \rightarrow \Delta A_2), \gamma = f(w_1 - w_2),\ f' < 0$

r_1: return on riskless assets, r_2: return on risky assets

[5] $A = A_h(\text{high} - \text{quality liquid assets}) + A_o(\text{other assets}),\ \Delta A_h = (sD)\Delta L$

r_h: return on high − quality liquid assets, r_o: return on other assets

[6] $\Delta s = -(s/L)\Delta L, \Delta D_2 = \delta \Delta s$

$D = D_1(\text{core liabilities}) + D_2(\text{noncore liabilities})$

c_{11}: cost of debt on core liabilities, c_{12}: cost of debt on noncore liabilities

[7] $A = A_R(\text{reserve assets}) + A_{NR}(\text{non} - \text{reserve assets})$,

r_R: return on reserve requirement assets, r_{NR}: return on non − reserve requirement assets

* Asterisks indicate optimal portfolio balances of financial institutions before regulation.

Table 3 shows the adjustment costs, the difference between EVA* and EVA, for each option for responding to the different policy tools. They are the product of adjustment size and unit cost. The adjustment size is determined by the structure of the balance sheets of financial institutions and the unit cost by market conditions. Looking at the capital buffer, for instance, the adjustment costs of the three options depend on the adjustment sizes – ΔE, ΔA, and ΔA_2 – and the unit costs – r, c_1, c_2, r_1 and r_2. We therefore argue that financial conditions, which determine the adjustment costs facing financial institutions in their response to regulations, are

key to the effectiveness of tools in controlling asset fluctuations. Figure 1 provides an illustration of the responses of financial institutions to regulations depending upon financial conditions.

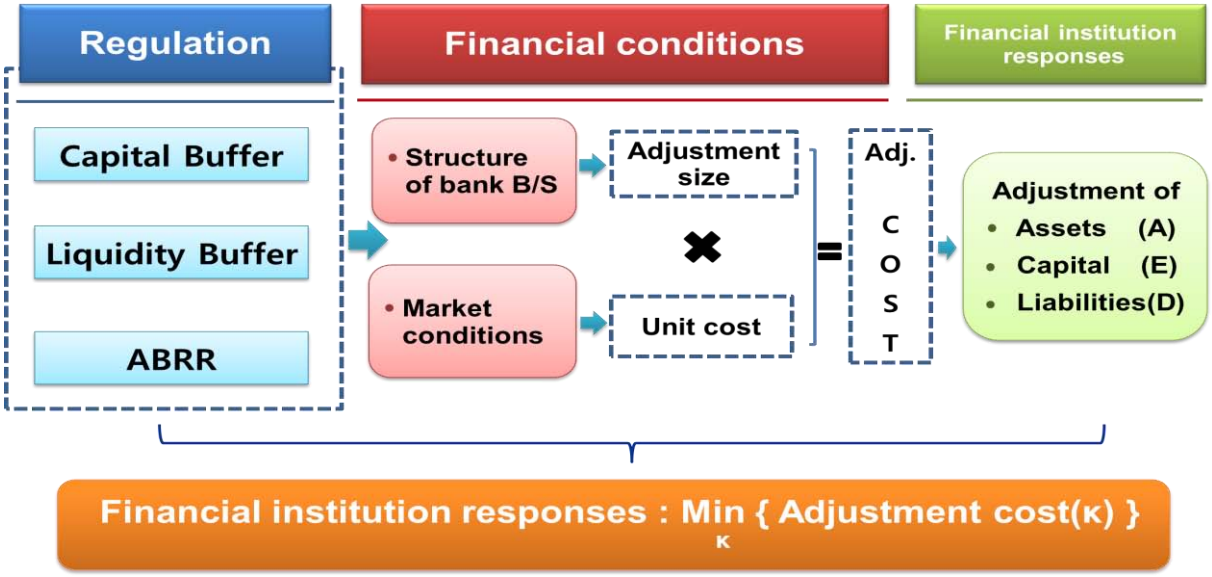
Table 3

Adjustment costs (EVA*– EVA)

Tool	capital buffer			liquidity buffer		ABRR
Adjustment size (a)	ΔE	ΔA	ΔA_2	ΔA_1	ΔD_2	ΔA_{NR}
Unit cost (b)	$c_2 - r$	$r - c_1$	$r_2 - r_1$	$r_o - r_h$	$C_{11} - c_{12}$	$r_{NR} - r_R$
Adjustment cost (a*b)	$\Delta E(c_2 - r)$	$\Delta A(r - c_1)$	$\Delta A_2(r_2 - r_1)$	$\Delta A_h(r_o - r_h)$	$\Delta D_2(c_{11} - c_{12})$	$\Delta A_{NR}(r_{NR} - r_R)$

Figure 1

Financial institutions' responses to imposition of regulations



4. Comparative assessment of tools in controlling the target

In accordance with the criterion and the framework set up above, we would like to assess the controllability of each policy tool over the asset side of financial institutions' balance sheets.

The controllability over financial institutions' assets may differ depending upon the type of policy tool being employed. That is, depending upon whether the policy tool can control assets directly or indirectly, and upon how many variables are subject to control, financial institutions can make choices differently from the authorities' intentions. For instance, the less directly assets are controlled by using capital and liabilities, and the larger the number of variables subject to control, the less the degree of controllability. However, the specific ability to control may also differ depending upon the financing and investment structure of each individual financial institution, as dictated by financial conditions.

4.1 Capital buffer imposition

We would like to consider how far the authorities can control the assets of financial institutions effectively when it adjusts the capital buffer ratio countercyclically.

In Equation (1), when the authorities choose the policy of revising up K, the aggregate regulatory capital ratio, a financial institution may increase its K by reducing A. However, it can also increase K by expanding E or by reducing w. In the latter case, the assets of the financial institution do not decrease, while when E is expanded its assets could rather rise.

Which variables among A, E, and w that financial institutions choose in response to an upward revision of the aggregate regulatory capital ratio may differ, depending upon the financing and investment structures of the financial institutions and the cost of capital. We would like to examine this in detail below.

4.1.1 Adjustment cost comparison: expanding E and reducing A

First, we investigate which method financial institutions would select for responding to capital buffer imposition, between a capital increase and an asset reduction. Using the adjustment cost as summarised above in Table 3, financial institutions could compare the adjustment cost of a capital increase with that of an asset reduction.

$$①\text{adjustment cost of } \Delta E - ②\text{adjustment cost of } \Delta A = (c_2 - r)\Delta E - (r - c_1)\Delta A \quad (6)$$

$$\therefore\ ① < ②, \qquad \text{if } \frac{(c_2 - r)}{(r - c_1)} < \frac{\Delta A}{\Delta E}$$

In Equation (6), we can see that the higher the leverage (A/E) of financial institutions and the lower the risk premium ($(c_2–r)/(r–c_1)$) in the financial market[4], the more likely financial institutions are to choose the capital increase instead of the asset reduction.

4.1.2 Adjustment cost comparison: reducing w and reducing A

In the same way, in response to a rise in the capital buffer ratio, financial institutions could compare the adjustment cost of a decrease in risk weightings with that of an asset reduction:

$$①\text{adjustment cost of } \Delta A - ②\text{adjustment cost of } \Delta w = (r - c_1)\Delta A - (r_2 - r_1)\Delta A_2 \quad (7)$$

$$\therefore\ ① > ②, \qquad \text{if } \frac{(r - c_1)}{(r_2 - r_1)} > \frac{\Delta A_2}{\Delta A} (= \gamma \frac{w}{A})$$

In Equation (7), we find that the smaller γ, ie the bigger the difference between riskless assets and risky assets, and the smaller w/A, then the smaller $\Delta A_2/\Delta A$, and the more likely financial institutions are to choose to reduce w. Meanwhile, looking at the relative adjustment cost ($=(r–c_1)/(r_2–r_1)$), we can see that the lower the risk premium ($=r_2–r_1$) in the financial markets, and the higher the rate of return on assets against the cost of debt ($=r–c_1$), the more likely financial institutions are to take actions to reduce their risk weights by changing asset composition (eg cutting down SME loans and attracting more mortgage loans) rather than to reduce assets.

[4] c_2 (= cost of equity) can be estimated by using the Capital Asset Pricing Model. Looking at this framework, it can be seen that the expected return (ie the cost of equity) is a linear function of the risk premium.

4.2 Liquidity buffer imposition

Let us now look into how effectively countercyclical adjustment of the liquidity buffer ratio by the authorities can control financial institutions' assets. For convenience of analysis, we simplify the liquidity buffer as Equation (2); the only differences compared to the capital buffer ratio are that we impose weights on liabilities rather than assets, and that we hold high-quality liquid assets in order to absorb shock.

Looking at Equation (2), when the authorities raise L, financial institutions can respond by increasing A^h or decreasing s or D. One way of reducing s is to replace riskier liabilities such as wholesale funding with riskless ones including cash. If financial institutions increase A^h, they should reduce other assets (investments and loans), on the condition that A is constant. When they reduce D, A declines on the condition that E is constant. After considering the adjustment costs of these options, financial institutions will choose the option with the lowest cost.

Let us look at which strategy, between an increase in A^h or a reduction in s, financial institutions will choose in response to liquidity buffer imposition, depending upon financial conditions. In order to comply with this liquidity regulation, they can raise A^h or reduce s, and will as a result compare the adjustment costs of those two options:

$$①\text{adjustment cost of } \Delta A^h - ②\text{adjustment cost of } \Delta s = (r_o - r_h)\Delta A^h - (c_{11} - c_{12})\Delta D_2 \qquad (8)$$

$$\therefore\ ① > ②, \qquad \text{if } \frac{(r_o - r_h)}{(c_{11} - c_{12})} > \frac{\Delta D_2}{\Delta A^h} \left(= \delta \frac{s}{A_1}\right)$$

The lower δ, which means the difference between the run-off rate of core liabilities and non-core liabilities, and the lower the average run-off rate s, the higher the possibility of reducing non-core liabilities rather than increasing high-quality liquid assets. Meanwhile, looking at the relative adjustment cost ($=(r_o–r_h)/(c_{11}–c_{12})$), the higher the opportunity cost of expanding liquid assets, and the larger the difference between the funding rates of core and non-core liabilities, the higher the possibility of reducing non-liabilities rather than increasing high-quality liquid assets. In this condition, the effectiveness of the liquidity buffer could be limited.

5. Empirical analysis

In Section 4 we made a comparative assessment of the effectiveness of countercyclical tools based upon this criterion: controllability over financial institutions' assets. We showed that this controllability varies with financial conditions including the cost of capital and the structure of funding and investment. In this section, we provide an empirical analysis on financial institutions' responses to capital buffer and liquidity buffer impositions in boom times, using the "minimisation of EVA adjustment costs" model and the data for financial conditions of banks in Korea at the end of 2009 (Table 4).[5]

[5] We compiled data for analysing the capital buffer from seven nationwide banks, six local banks and four special banks. For the liquidity buffer, we acquired data from the QIS conducted by the BCBS, which are from four nationwide banks, two local banks and two special banks.

Table 4

Data from banks in Korea

(at end-2009)

(won trillions)

Regulatory capital ratio (K)	Regulatory capital (E)	Assets (A)	Average risk weight (w)
11.9%	123	1,769	63.7%

L	High-quality liquid Assets (A^h)	Net run-off rate (s)	Net run-off liability (D)
100%	105.4	34.9%	302.5

Source: Financial Supervisory Service of Korea.

5.1 Capital buffer's controllability

We know that if the authorities adjust K upward, banks will choose to either reduce A, raise E, or reduce w – based upon the adjustment cost. As shown in Table 5, in the case where regulators increase K by 1%p, financial institutions should respond by either increasing E by 11.3 trillion won, decreasing A by 148.3 trillion won, or decreasing A2[6] by 104.9 trillion won. The unit cost of ΔE, measured by the difference between the cost of equity and the rate of return on assets, is at the 2.6%p level. The unit cost of $-\triangle$A, the difference between the rate of return on assets and the cost of debt, is meanwhile approximately 0.2%p, and the unit cost of $-\Delta$w, the difference between the three-year corporate bond and three-year Treasury bond yields, is at the 1.1%p level.

Table 5

Adjustment cost comparison

(won trillions)

Option	ΔE	ΔA	Δw	ΔA_2
Adjustment size (a)	11.3[1]	–148.3[2]	–5.3%p[3]	–104.9[4]
Unit cost (b)	2.6%p	0.2%p		1.1%p
Adjustment cost (a*b)	0.2	0.3		1.2

[1] $\Delta E = (wA)\,\Delta K = 63.7\% \times 1{,}769$ trillion won $\times$ 1%p = 11.3 trillion won

[2] $\Delta A = -(A/K)\,\Delta K = -(1{,}769$ trillion won $\div 11.9\%) \times 1\%p = -148.3$ trillion won

[3] $\Delta w = -(w/K)\Delta K = -(63.7\% \div 11.9\%) \times 1\%p = -5.3\%$

[4] $\Delta A_2 = \Delta w\{A/(w_2 - w_1)\} = -5.3\% \times \{1{,}769$ trillion won $\div\ (1.0 - 0.1)\} = -104.9$ trillion won

[6] With the 1%p increase of K, banks should cut w by 5.75%p. To do so, they should replace risky with riskless assets.

Thus, the adjustment cost incurred by △E is 0.2 trillion won (= 11.3 × 2.6%p), that incurred by –△A is 0.3 trillion won (=148.3 × 0.2%p), and that incurred by –△w is 1.2 trillion won. △E is therefore the option with the lowest adjustment costs. Because of high leverage, "reducing assets" entails much larger adjustment sizes than the optimal option, despite the lower unit costs. Overall, for Korean banks, it is a rational choice to expand E instead of reducing either A or w.

5.2 Liquidity buffer's controllability

In response to an increase by the authorities in the level of L, financial institutions may either increase their proportions of A^h or reduce their s. In Korea, L has been under 100% – the minimum level required by the BCBS – and we thus adjust L to 100% by raising A^h, D and s proportionally. As shown in Table 4, A^h is 105.4 trillion won, D is 302.5 trillion won, and s is 34.9%. In the cases where the authorities increase L by 10%p, banks can respond by either increasing A^h by 10.5 billion won or reducing s by 3.2%p (Table 6). In order to reduce s, they should change their non-core liabilities, which have high run-off rates, into core liabilities such as deposits that have low run-off rates. The amount of x transferred into core liabilities in order to reduce s by 3%p can be calculated as follows:

$$\Delta s = 0.05\frac{x}{D} - 1.0\frac{x}{D} \tag{9}$$

In equation (9), the 0.05 and 1.0 are the run-off rates of core liabilities and non-core liabilities, respectively, estimated conservatively. x is then 10.1 trillion won. This amount is close to that of ΔA^h, and the choice of whether to increase ΔA^h or reduce s thus depends upon the adjustment costs of ΔA^h and of converting non-core into core liabilities.

The unit cost of ΔA^h, measured by the difference between the one-year Treasury bond yield and the one-year bank lending rate, is at the 1.1%p level. The unit cost of converting non-core liabilities with the one-year bank debenture rate into core liabilities with the one-year bank deposit rate is meanwhile around 0.4%p. Thus, the adjustment cost of ΔA^h is 11.6 trillion won (= 10.5 × 1.1%p), and that of converting non-core into core liabilities 4.0 trillion won (= 10.1 × 0.4%p). It is therefore more effective for financial institutions to choose reducing s over increasing ΔA^h, since the adjustment cost of ΔA^h is greater.

Table 6

Adjustment cost with LCR 10%p increase

(won trillions)

option	ΔA^h	Δs	ΔD_2
Adjustment size (a)	10.5[1]	–3.2%p[2]	–10.1[3]
Unit cost (b)	1.1%p		0.4%p
Adjustment cost (a*b)	11.6		4.0

[1] $\Delta A^h = sD\Delta L$ = 34.9% x 302.5 trillion won x 10%p = 10.5 trillion won

[2] $\Delta s = -(s/L)\Delta L = -(34.9\%/110\%) \times 10\%p = -3.2\%p$

[3] $\Delta D_2 = -(w/K)\Delta K = -(63.7\%/11.9\%) \times 1\%p = -5.3\%$

6. Policy implications

In this paper, we find that the effectiveness of countercyclical tools will vary depending upon financial institutions' responses to the regulations. Financial institutions have diverse options for dealing with charges for the capital buffer and the liquidity buffer.

Financial institutions aiming to maximise EVA will choose the option with the lowest portfolio adjustment costs. The portfolio adjustment costs depend upon the balance sheet structures of financial institutions and market conditions.

Countercyclical tools such as the capital buffer and the liquidity buffer could not work as expected when financial institutions, given all of the economic and financial conditions, choose the option with the lowest adjustment costs. Thus, in order to maximise the effectiveness of countercyclical tools, we should implement various tools in a complementary way, in consideration of financial conditions.

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Macroprudential policy and central bank communication

Benjamin Born, Michael Ehrmann and Marcel Fratzscher[1]

1. Introduction

In response to the financial crisis, many central banks are taking on significant new responsibilities for macroprudential supervision. Based on the experience of central banks with financial stability reports (FSRs) and other financial stability-related statements, this article argues that such central bank communication can be highly effective, especially during periods of financial stress. The findings underline the importance of designing a well differentiated communication strategy on macroprudential issues.

2. Theoretical considerations

Several arguments have been put forward to justify why central banks are taking on a prominent role in macroprudential supervision: combining financial supervision with monetary policy tasks can lead to synergies and a more effective conduct of monetary policy (Borio (2009)); it may be usefully connected to the central banks' lender of last resort function (Blinder (2010)); or because central banks could benefit from incorporating systemic risk considerations in the monetary policy process given the costs of asset price bubbles (Feldstein (2010)).

Yet numerous risks in assigning such a task to central banks have also been emphasised: it may at times lead to conflicts among different goals (Goodhart and Shoenmaker (2005), De Grauwe and Gros (2009)); and it may be costly for the reputation of central banks if they fail in their macroprudential tasks, a point that was originally made in the context of microprudential tasks (Goodhart (2002)), but is equally valid here.

However, what has been missing in this debate so far is evidence about whether, and under what conditions, central banks may actually be effective in guiding financial markets through their role in macroprudential supervision. New research (Born et al (2010)) attempts to address this question by exploiting the fact that many central banks have had some financial stability role in the past, and have communicated extensively on this through the publication of FSRs and financial stability-related speeches and interviews.

3. Empirical results

This research creates a novel database comprising more than 1,000 FSRs and speeches/interviews by central bank governors across 36 countries, and based on their semantic features, grades these along optimism and activity dimensions. In line with the aims put forward by Blinder et al (2008), such communication is defined to be effective if the views

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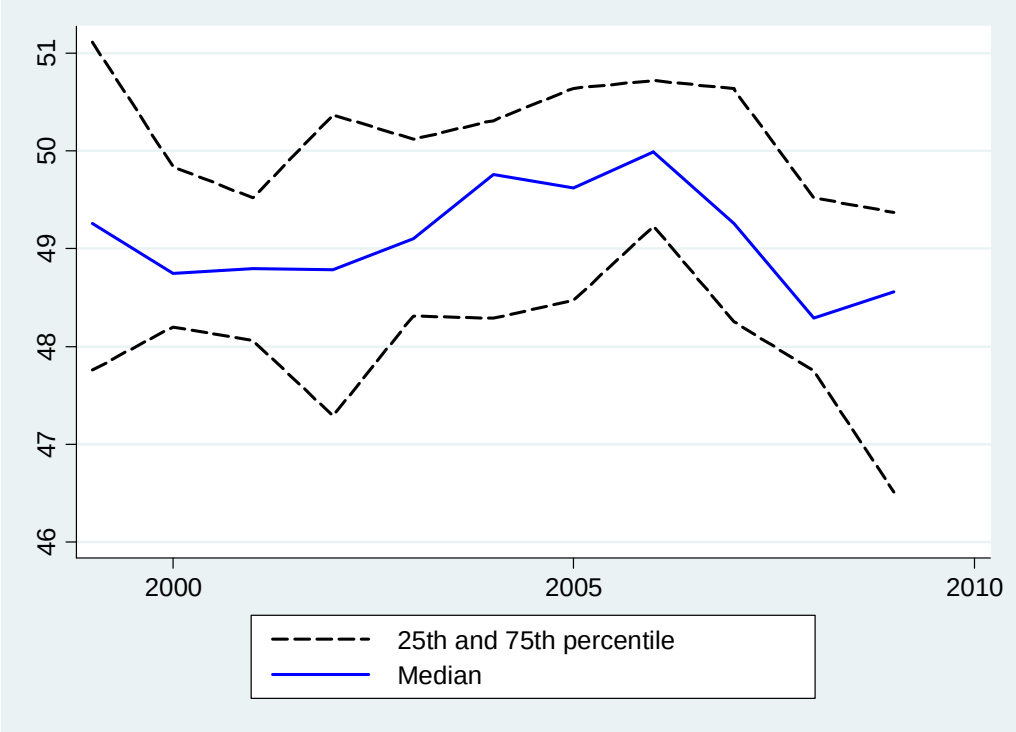
that it contains are reflected in the markets; either by "creating news" – moving the level of asset prices – or by "reducing noise" – reducing market volatility and uncertainty.

A first striking finding from this classification is that the tone of FSRs became continuously more optimistic after 2000, but reached a peak in early 2006, thereafter becoming more pessimistic (see Figure 1). This suggests that FSRs, across the 36 countries in the sample, may also contain a forward-looking assessment of risks and vulnerabilities, which flagged a weakening financial stability environment well before the start of the financial crisis in August 2007.

Figure 1

The evolution of optimism in FSRs over time



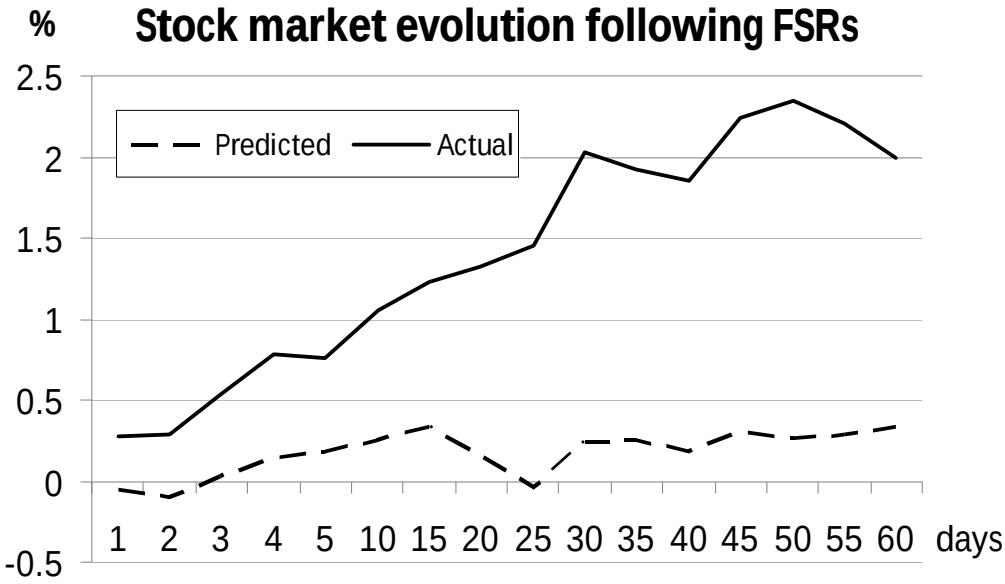
Notes: The figure plots the median, 25th and 75th percentile of the optimism scores for FSRs in any given year.

Moreover, the empirical findings of this work suggest that communication about financial stability has important repercussions for financial sector stock prices. FSRs clearly create news in the sense that stock markets move in line with the views expressed in FSRs. This effect is quite sizeable as, on average, FSR releases move equity markets by 2% during the subsequent month, as shown in Figure 2, relative to the counterfactual. Another important finding is that FSRs also reduce noise, as market volatility tends to decline in response to FSRs.

By contrast, speeches and interviews are, on average, less effective instruments. In particular, while having only modest effects on stock market returns, they tend to *increase* rather than reduce market volatility (in particular during the crisis). However, the effectiveness of FSRs and speeches crucially depends on market conditions. Importantly, speeches by central bank governors were effective in guiding financial markets during times of financial stress. Moreover, the results indicate that the financial stability communication of central banks influences financial markets primarily via a coordination channel, ie it provides relevant information which exerts a significant and persistent effect on markets.

Figure 2

Predicted versus actual evolution of stock markets after FSR releases



Notes: The figure compares the actual evolution of cumulated stock market returns (in per cent) following the release of FSRs to the predicted trend on the basis of the benchmark model. The solid line plots the average actual cumulated returns starting from day 1 after the FSR release and up to day 60. The dashed line shows the expected cumulative returns that would result from the benchmark model in the absence of an FSR. The cumulative returns are multiplied by –1 for pessimistic FSRs, whereas they are left unchanged for optimistic FSRs.

How can we explain that FSRs overall reduce noise, ie lower stock market volatility, whereas speeches and interviews generally have the opposite effect? A crucial difference between these communication tools is that the release schedule of FSRs is typically pre-announced, whereas the timing of speeches and interviews is much more flexible. Given this flexibility, speeches and interviews might carry some surprise element, simply due to the fact that a governor feels compelled to raise financial stability issues in a speech or an interview. In contrast, due to the fixed release schedule for FSRs, financial markets expect statements about financial stability issues on the release days. There might be surprising elements in their content, but the mere fact that the FSR is released does not come as a surprise. This difference might be at the heart of the different effects of the two instruments on market volatility.

4. Conclusion

The empirical findings of this new work raise a number of important policy issues. Communication on financial stability issues by a central bank with a macroprudential policy role will certainly be watched very closely by financial markets, and thus are potentially an important influence on financial markets. Does this imply that central banks should limit transparency and their communication on certain macroprudential risks, as argued by Cukierman (2009), or does this make the case for enhanced transparency and accountability, as argued by others? The findings of the work show that communication by monetary authorities on financial stability issues can indeed influence financial market developments. Yet the findings also show that such communication entails risks as it may unsettle markets. Hence central bank communication on macroprudential issues needs to be employed with the utmost care, underlining the difficulty of designing a successful communication strategy on financial stability.

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Thoughts on the proper design of macro stress tests

Petr Jakubík and Gregory D Sutton[1]

1. Introduction

This paper provides an introduction to macro stress tests and argues that these exercises could be an important part of enhanced macroprudential policies.[2] Macro stress tests are executed by financial sector supervisors and central banks usually with (1) the aid of key financial institutions and (2) objectives that are different to those of stress tests run by financial firms for internal risk management purposes. For example, macro stress tests were undertaken during the recent international financial crisis with the aim of restoring confidence in financial systems (Bank of England (2008); Board of Governors of the Federal Reserve System (2009a, 2009b); Committee of European Banking Supervisors (2010)). Macro stress tests are also conducted during "good times" to search for potential sources of systemic risk. No matter when they are undertaken, macro stress tests usually estimate the losses that a group of financial institutions considered key to the proper functioning of a financial system, usually a group of large banks, could suffer under adverse macroeconomic developments or other shocks.

Macro stress tests could be an important part of enhanced macroprudential policies, because the recent financial crisis has shown the stress testing practices of a number of large banks to be seriously flawed. The difficulties some of them had dealing with the risks that emerged proves this. However, it was suggested even earlier that there were problems with financial firms' stress testing practices. In particular, the UK Financial Services Authority (2006) indicated that it was surprised by the mildness of the firm-wide stress tests undertaken by some financial firms, and the agency concluded that financial institutions might be underestimating the likelihood of severe events. This might be considered a logical consequence of short human memories and the prolonged period of favourable economic conditions prior to the crisis. Interestingly, the possibility that short memories can undermine successful risk management is consistent with the findings of Jiménez and Saurina (2006).

While "short memories" might explain why the stress tests run by a number of financial institutions were not severe enough, and thus left them too exposed, we believe that another flaw in stress testing practices also played an important role. This is the tendency for banks' firm-wide stress tests to focus on either the trading or loan book but not the combined market and credit risk losses associated with adverse shocks. Yet banks with sizable trading positions could suffer significant losses in both their trading and loan books following large macroeconomic shocks. This is because large swings in financial market prices and rates, such as steep increases in interest rates and exchange rate depreciations, have the potential to negatively impact the creditworthiness of households and firms, in addition to causing significant trading book losses. It is also because severe economic downturns that would be expected to lead to substantial loan-book losses are often associated with sharp declines in equity prices, sharp increases in credit spreads and other changes in financial markets.

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[2] For discussions of macroprudential policies see, for example, Kashyap et al (2008), Bank of England (2009), Committee on the Global Financial System (2010) and Moreno (2011).

Therefore, stress tests of a single book have the potential to seriously underestimate the total losses a bank could suffer under adverse macroeconomic developments.

In our view, these two flaws in the stress testing practices of large banks represent a serious threat to financial stability. This is in part because the other main way that banks measure and manage their market and credit risks, the use of quantitative risk management models (QRMMs) such as value-at-risk, does not adequately measure risks associated with extreme events. The proper management of these so-called tail risks must therefore rely on effective stress testing. Moreover, QRMMs usually focus on either market or credit risk but not the combined losses across trading and loan books.[3] We therefore believe that macro stress tests that are based on sufficiently severe, yet plausible, macroeconomic shocks and that induce large banks to estimate (at least) the sum of their market and credit risk losses could improve the resilience of financial systems. Macro stress tests of this type could thus be a useful part of enhanced macroprudential policies. This is the motivation for the discussion of macro stress tests and sources of systemic risk that follows in Sections 2 and 3. Section 4 provides a brief conclusion.

2. General macro stress testing methodology

A macro stress test can be bottom up, top down or a combination of the two approaches. A bottom-up macro stress test is based on the results of individual stress tests conducted by the financial institutions themselves; however, all the institutions involved would rely on the same assumptions about future economic developments that are produced by the supervisor (or central bank), who also exercises some control over the many assumptions and bank internal models underpinning the exercise. In contrast, a top-down macro stress test is completely designed and performed by the supervisor and the same assumptions and models are applied to all institutions' balance sheet data.

These issues, and others, are discussed in greater detail in the large literature concerned with macro stress testing. Because macro stress tests have been performed for a number of years under the Financial Sector Assessment Programmes (FSAPs) of the IMF and World Bank, these institutions have published much of this literature (see, among others, Blaschke et al (2001), Jones et al (2004), IMF and World Bank (2005) and Čihák (2007)). Of course, financial sector supervisors and central banks also conduct macro stress tests outside FSAPs as part of their efforts to safeguard financial stability. The key underlying assumptions and results of macro stress tests, both conducted within and outside FSAPs, are sometimes published in financial stability reviews.[4] As the literature on macro stress testing makes clear, insurance companies and other non-bank financial institutions are sometimes included in the group of firms covered by a macro stress test. However, because of the important role of banks in the provision of credit, and also their reliance on short-term funding, macro stress tests usually focus on a country's banking sector. Perhaps not surprisingly, therefore, an analysis of credit risk is usually an important part of a macro stress test. Because macroeconomic risk is arguably the main common source of loss for many credit exposures, macro stress tests almost always estimate the impact an economic downturn (or slowdown) would have on banks' credit losses. Other risks may also be covered by the exercise, as we discuss in Section 3.

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[3] An exception is the systemic risk model employed by the Central Bank of the Republic of Austria (see Boss et al (2006)).

[4] See, for example, Boss (2002), Hoggarth and Whitley (2003), De Bandt and Oung (2004), Bunn et al (2005), European Central Bank (2009) and the Central Bank of Norway (2010).

Sensitivity tests and scenario analysis

There are two main ways to form the adverse shocks that underpin stress tests.[5] One approach assumes that only a single risk factor undergoes a significant change. These are known as sensitivity tests. An advantage of these tests is that, because only a single variable is shocked, they may be relatively easy to implement. Unfortunately, however, sensitivity tests may lack plausibility, because in a stress event it is unlikely that only a single key variable will be significantly affected. Nevertheless, many macro stress tests still rely on a single-variable shock as their starting point.

A more plausible approach to stress testing is a scenario analysis that examines the impact of changes in a number of key variables. Because it is a more plausible approach, and more likely to lead to an accurate estimate of the sum of credit and market risk losses under adverse developments, it is our preferred starting point for a macro stress test. Of course, it is more difficult to specify how a number of variables would move together during a stress event. The use of macroeconomic models can help address this challenge, because they can restrict the co-movements of variables to be consistent with economic theory.

The variables typically shocked in macro stress tests, in either sensitivity tests or scenarios, are interest and exchange rates, measures of inflation and unemployment, GDP and property prices. A central bank's official macroeconomic forecast, obtained from its macroeconomic model, usually serves as the starting point for deciding on shock sizes. Shocks should be, while plausible, also large. This is because large shocks are more likely to pose a significant threat to financial stability and also because they may not be adequately reflected in firms' internal risk management practices.

Assessing the impact of a shock

Whether a single- or multi-variable shock underpins a macro stress test, it is important to specify an appropriate time horizon over which the effects of the disturbance will be traced. An appropriate time horizon will balance competing forces. On the one hand, it probably takes a relatively long time for most of the credit losses associated with an adverse shock, such as a significant decline in domestic economic activity, to be realised. Given that most macro stress tests aim to include estimates of losses from credit exposures, this argues for a relatively long time horizon. On the other hand, a shorter time horizon makes it less important to model changes in financial institutions' portfolios. In practice, the time horizon of a macro stress test is usually between one and three years.

Another issue is the metric used to evaluate whether a financial institution or system would be able to absorb a particular measure of loss, be it expected loss or the maximum loss with some probability. The standard metric is to assess the measure of loss relative to capital or assets, taking into consideration estimates of current and future net income of financial institutions. Forecasts of net income are commonly based only on past average income. While it would be preferable to model how a large number of components of income would evolve under the stress scenario, this is no easy task. This is because the incomes of financial institutions depend in complicated ways on a large number of factors, including the extent to which income sources are diversified. This is unfortunate because, in the event of losses, net income protects capital.

[5] The same two approaches underpin macro stress tests and the stress tests financial institutions run for internal risk management purposes.

3. Sources of systemic risk

Macro stress tests are useful for shedding light on potential sources of systemic risk. Systemic risk can be appreciable when important financial institutions have large, common exposures to macroeconomic developments, financial market prices or real estate prices. "Short memories" could play an important role in the build-up of large, common exposures (especially after a prolonged period of favourable economic conditions). Systemic risk can also arise from self-reinforcing feedback loops. In the remainder of this section we discuss a number of these risks in greater detail and, for the less difficult to quantify, how a macro stress test might attempt to measure them.

Interest and exchange rate risk

Financial institutions are likely to have common exposures to interest rate, and perhaps also exchange rate, risk. Most trading portfolios of financial institutions would probably suffer from unexpected increases in interest rates. The financial impact of parallel upward (and downward) shifts of government yield curves (base rates) can be approximated, following Macaulay, as the product of the interest rate change, duration and original value of securities. The financial impact of sharp rises in credit spreads should probably also be investigated, because large increases in spreads are more likely than large declines.[6] An estimate of exchange rate risk can be obtained by multiplying the net open FX positions of financial institutions, both on- and off-balance sheet, by assumed changes in key exchange rates. There is also an element of interest rate and exchange rate risk that shows up as credit risk for financial institutions, as will be discussed below.[7]

Real estate price risk

Real estate price movements can also be a source of systemic risk, in part because of the importance of real estate as collateral for loans from banks and other creditors. While financial sector losses are usually associated with declines in the prices of commercial and/or residential real estate, systemic risk can be increasing during a prolonged period of rising real estate prices. This is especially the case if real estate markets get caught up in a bubble and prices rise significantly more than justified by economic fundamentals. In this case the eventual bursting of the bubble would likely be associated with marked falls in the prices of real estate, an elevated incidence of default by owners of residential and commercial properties and perhaps also reduced recoveries for financial institutions and other creditors in the case of default.

Rising systemic risk associated with an inflating house price bubble was arguably the situation in the United States in the years just prior to the recent international financial crisis. As the bubble began to deflate after 2006, an unexpectedly large number of homeowners found themselves in a position of negative equity and chose to default. Given the high loan-to-value ratios of many subprime home loans, the US subprime sector was where problems first emerged. However, as housing prices continued to fall in the United States, defaults also rose significantly for homes purchased with traditional mortgages.

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[6] In the case of banks, there is also interest rate risk in their loan books which shows up in volatility of net interest income.

[7] Exchange rate risk can also emerge as funding liquidity risk, a risk that we do not cover. For discussions of approaches to incorporate funding liquidity risk into macro stress tests, see Čihák (2007) and Aikman et al (2009).

Credit risk in the loan book

Another key risk from a systemic perspective is the credit risk in large banks' loan (or banking) books. Significant declines in real estate prices can be an important cause of losses in loan books; however, the most important influence is often the state of the macro economy, reflected in large part by the growth of domestic national income and perhaps also national income abroad through its effect on exports.[8] All else being equal, more rapid income growth both at home and abroad would arguably make it easier for corporate and household borrowers to service their debts. Changes in interest and exchange rates can also influence the creditworthiness of banks' counterparties. In the case of households and non-financial firms, increases in interest rates might be expected to decrease their creditworthiness, especially if a significant amount of their debt is in floating rate agreements.[9] It is less clear what moves in exchange rates might do most damage to a bank's loan book. In the absence of complete currency hedging, exporters with negligible foreign currency debts would likely become greater credit risks when the domestic currency appreciates. However, when companies and households have significant foreign currency debts, but insignificant foreign currency income, a depreciation of the domestic currency can seriously damage their creditworthiness.[10]

One way of measuring credit risk in loan books is to project losses under an adverse macroeconomic scenario. In bottom-up macro stress tests, calculations are based on banks' own internal models using common scenarios for all of them. In top-down macro stress tests, regression methods applied to aggregate data can be used to project how the particular measure of credit losses, for the economy as a whole or a group of banks, would evolve under assumed paths for key macroeconomic variables such as GDP, real estate prices, interest rates and exchange rates.[11] Often the ratio of non-performing loans (NPL) to total loans is the measure of credit losses in top-down tests; however, this indicator can significantly underestimate credit risk in the case of rapid credit growth, because it usually takes time for bad loans to reveal themselves.

Another approach to measuring credit risk in loan books is macroeconomic credit risk modelling. This approach, pioneered by Wilson (1997), relates credit risk to the "health" of the domestic economy as revealed by a number of macroeconomic variables. In the default mode application of the model, probabilities of default (PDs) for different classes of borrowers are related to macroeconomic variables, and the time series dynamics of the macroeconomic variables are also modelled. The approach is thus capable of predicting how PDs will evolve in the future under alternative macroeconomic scenarios, given initial macroeconomic conditions. These starting conditions could be the actual values of macroeconomic variables or those that would be associated with a particular stress scenario. Using further simulations, the conditional loss distribution associated with a bank's loan book can be derived.

In the case of corporate exposures, it may be possible to perform a more refined analysis of expected losses under a stress scenario with the use of statistical credit rating models.

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[8] The state of the macro economy is of course an important determinant of real estate prices, in addition to being a key determinant of credit risk more broadly.

[9] Even if this is not the case, the fact that interest rate increases mean that new borrowing would have to take place at higher rates reduces creditworthiness, because it reduces an entity's ability to survive adverse shocks.

[10] Of course, importers without significant foreign currency debts could also see their creditworthiness decline in response to a depreciation of the domestic currency.

[11] Pesola (2001), Shu (2002), Pain (2003) and Jakubík and Schmieder (2008) provide examples of statistical models relating measures of loan-book losses to macroeconomic variables.

These models associate with each exposure a score which is then related to the exposure's PD. An expected loss for the exposure can be calculated as a product of the PD, the exposure at default (EAD) and the loss-given-default (LGD). Statistical credit rating models include obligor-specific data when generating scores. When these models also incorporate macroeconomic variables, they can be used to compute "stressed" scores and PDs for obligors that would be associated with adverse macroeconomic developments.[12] These stress losses for individual exposures can be aggregated to obtain total stress losses for the corporate loan book.

Credit risk parameters

Short time series and structural breaks can prevent the use of some of the methods for evaluating credit risk discussed above. In this case, expected credit losses for an entire portfolio can be calculated as the product of the portfolio-average PD and LGD and the total portfolio EAD. Perhaps the biggest challenge with this approach is to determine appropriate LGDs, and this parameter is very often determined mainly by expert judgment. Real estate prices can often inform this judgment, because of real estate's important role as collateral.

EAD can be expressed as the difference between outstanding loans and NPL. Expected NPL depend on the inflow to NPL (determined by PD estimates), outflows (as written-off or sell-out of existing NPL) and the current stock of NPL. Formally,

$$NPL_{t+1} = NPL_t + PD_t \cdot (Loans_t - NPL_t) - r \cdot NPL_t \quad (1)$$

where *r* represents the average write-off (or sell-out) rate of existing NPL.[13]

Expert judgment can also be used to link the PD of a portfolio to a single macroeconomic variable; alternatively, when a regression model for the growth of NPL is estimated, the PD for the portfolio can be easily approximated. This can be very helpful in the case of emerging economies where aggregate data on defaults are very often not available, but aggregate data on NPL are available. To see this, assume that the stock of NPL is relatively small compared to the stock of loans, so that equation (1) can be approximated by:

$$NPL_{t+1} \approx NPL_t + PD_t \cdot Loans_t - r \cdot NPL_t \quad (2)$$

Rearranging (2) gives:

$$PD_t \approx \left(\frac{\Delta NPL_{t+1}}{NPL_t} + r\right) \cdot \frac{NPL_t}{Loans_t} \quad (3)$$

The approximation (3) demonstrates that the average PD depends on the growth rate of NPL, the average write-off rate and the initial level of NPL relative to outstanding loans.

Self-reinforcing feedback loops

Self-reinforcing feedback loops can also be a source of systemic risk. One such loop can arise when banks and other financial institutions experience large, unexpected losses. It would be natural to expect that lending standards might be tightened in response, in part to rebuild capital buffers but also as a consequence of the increase in perceived risk, and perhaps also elevated risk aversion, that would likely follow such losses. This could lead to a

[12] See, for example, Vallés (2006).

[13] This parameter is often set to its average value over a previous period, usually several years, although this is recognised to be only a rough approximation to actual bank behaviour.

further deterioration in the real economy, additional financial sector losses and further cuts in credit availability.[14] A self-reinforcing feedback loop can also result from asset fire sales.[15]

Although potentially important, self-reinforcing feedback loops are typically not taken into formal consideration in macro stress testing exercises, in part because such nonlinearities are difficult to model. Concern about them, and the systemic risk they potentially generate, can nevertheless be a motivation for macro stress tests. As noted by Bernanke (2010), one of the objectives of a macro stress test recently carried out in the United States (SCAP) was to ensure that large US banks would continue to lend to creditworthy households and firms even if economic conditions turned out worse than expected. To the extent that the SCAP was credible in this respect, expectations were more likely concentrated on a more favourable future macroeconomic trajectory, with lower financial sector losses, increasing confidence in the health of the US financial system.

4. Conclusion

This paper provides an introduction to macro stress tests and some of the risks that they attempt to assess. It also argues that these exercises could improve the resilience of financial systems because, in our view, banks' stress testing practices are seriously flawed. One reason is that the assumed developments underpinning stress tests appear not to be severe enough. Another is the tendency for banks' stress tests to focus on either the trading or loan book but not the combined market and credit risk losses likely to accompany adverse macroeconomic shocks. We believe that macro stress tests that have severe, yet plausible, multi-variable macroeconomic shocks as their starting point and estimate (at least) market and credit risk losses could therefore support the preservation of financial stability. Macro stress tests of this type could thus be a useful part of enhanced macroprudential policies.

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[14] As discussed by Borio, Furfine and Lowe (2001), risk-sensitive regulatory capital requirements and the dependence of collateral values on the state of the macroeconomy may also play a role in this self-reinforcing feedback loop.

[15] For a discussion of an approach to incorporate asset market liquidity and fire-sale effects into macro stress tests, see Aikman et al (2009).

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Macroprudential policy framework

Hoo-Kyu Rhu[1]

Thank you, Governor Ingves. In this panel, I would like to cover some issues concerning the establishment of a macroprudential policy framework, including its necessity and objective, macroprudential policy tools, and institutional arrangements.

1. The necessity and objective of macroprudential policy

The first part is the necessity and objective of macroprudential policy. Before the global financial crisis, the primary purpose of traditional market policy was price stability, in the belief that focusing on price stability would eventually deliver financial stability. At the same time, financial supervision focused on the soundness of individual financial institutions, in the expectation that this would ultimately underpin the stability of the financial system as a whole.

After the crisis, we learned that financial stability cannot be achieved by traditional monetary policy or microprudential policy alone. It is now clear that the objective of macroprudential policy is to prevent the accumulation of financial systemic risks. However, not enough research has been done on methodologies to identify and measure systemic risk factors.

2. Macroprudential policy tools

Until now, the capital ratio, liquidity ratio and leverage ratio have been at the centre of our discussions on macroprudential policy tools. These are actually based upon microprudential tools with adjustments to contain potential sources of systemic risk such as procyclicality and interconnectedness.

We need to develop and utilise a variety of additional policy instruments because, first, the final Basel III package is scheduled to be fully implemented by 2019 and, second, the available tools, especially capital, liquidity and leverage ratios, may be limited in their effect. Although the agreed policy tools including capital, liquidity and leverage ratios are available, central banks should still play a role in preventing financial crises and developing appropriate policy tools in times of crises.

In this sense, we need further study on the effectiveness of using monetary policy as a means of promoting financial stability. In this regard, reserve requirements and loan-to-value (LTV) ratios need to be our top priority. They may be useful tools for controlling the funding and operating behaviour of financial institutions. Reserve requirements may also be used as an effective tool for controlling system liquidity if their target is expanded from bank deposits to the liabilities of financial institutions, especially wholesale funding. The LTV ratio and

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asset-based reserve requirements could also be useful tools for targeting the asset side, given that procyclicality is driven by asset fluctuation at financial institutions.

3. Institutional arrangements

Several major developed countries have recently set up separate bodies for macroprudential policy, as distinct from their microprudential supervisory bodies. These are mostly structured as a committee, a council or a board, in which the central bank, government and supervisory authorities all participate.

Macroprudential policy committees tend to be formed either under the central bank (Type 1) or as an independent body (Types 2 and 3). The chairman of this committee can be either the central bank governor as, for example, in the United Kingdom, Belgium and the European Union; or the Secretary of the Treasury (as in the United States); or the head of other relevant bodies based on a rotation scheme, as in, for example, Hungary.

Table 1 shows the different types. Type 1 countries have an integrated microprudential supervisory framework, and the macroprudential policy committee was established under the aegis of the central bank. Examples of this type include the United Kingdom and Belgium: the governors of the Bank of England and the National Bank of Belgium chair these committees. Type 2 countries have a diversified microprudential supervision framework, and these countries have established an independent macroprudential policy committee. Examples include the United States and 27 countries in the European Union. Type 3 countries have an integrated microprudential supervision framework and have set up an independent macroprudential policy committee. Hungary exemplifies this approach.

Table 1

Major developed countries' macroprudential supervision framework

Type 1	Type 2	Type 3
• An integrated microprudential supervision framework	• A diversified microprudential supervision framework	• An integrated microprudential supervision framework
• MPP[1] committee under central bank	• An independent MPP[1] committee	• An independent MPP[1] committee
• UK (chairman: BOE Governor)	• USA (chairman: Secretary of the Treasury)	• Hungary (chairman rotates every year)[2]
• Belgium (chairman: NBB Governor)	• EU 27 countries (chairman: ECB President)	

[1] Macroprudential policy. [2] Central bank, treasury department, financial supervisory authority.

Concerning the pros and cons of setting up a macroprudential policy committee inside or outside the central bank, a committee under the central bank is better positioned for a faster decision-making process, clearer lines of responsibility, and political and fiscal neutrality. On the other hand, an independent body can be a better option for its ability to focus specifically on financial stability. At the same time, the central bank's credibility is safeguarded. Table 2 sketches out the pros and cons of these two schemes.

Table 2

A comparison of pros and cons: external committee versus an internal committee of the central bank

	Central bank internal committee	Independent external committee
	(UK, Belgium)	(US, EU, Hungary)
Prompt decision-making	○	X
Clear role and responsibility	○	X
Political and fiscal independence	○	△
Expertise in related institutions	X	○
Central bank's credibility	△	○

Whatever type of macroprudential policy framework is chosen, the central bank should play a key role in assessing systemic risks, because central banks have expertise and analytical capacity in a comprehensive overview of the financial system and macroeconomy.

Second, central banks play the role of lender of last resort, bearing the massive costs of crisis management as evidenced by the greatly expanded balance sheets of central banks in major developed countries since the recent crisis. Table 3 shows that the balance sheet of the Federal Reserve has expanded 2.4 times between 2008 and 2009. For their part, the Bank of England and the Sveriges Riksbank have expanded their respective balance sheets by 3.1 and 3.3 times.

Table 3

Expansion of central bank balance sheets during the global financial crisis[1]

(unit: multiple)

FED	ECB	BOE	Canada	Switzerland	Sweden
2.4	1.1	3.1	1.3	1.6	3.3

[1] From December 2007 to December 2009.

Third, we need to find an appropriate policy mix between monetary and macroprudential policies as they are highly complementary.

And fourth, price stability is a narrow mandate for central banks compared to their potential capacity for financial stability. Also, it is critical to make a proper role assignment and establish a cooperative relationship between the central bank, the government and supervisory policy authorities during normal times. Central banks can effectively function as a lender of last resort in times of crisis when provided with sufficient information on financial institutions during normal times.

Lastly, in the case of Korea, there has not yet been a full-blown discussion of the macroprudential policy framework. Rather, we are just taking steps to improve the current policy coordination framework.

The Bank of Korea seeks to monitor systemic risk factors, issue early warnings and recommend policy responses to a crisis. However, the Bank has no explicit mandate for financial stability, and these efforts will not bring about any changes in relevant policies.

Among G20 member countries, only Korea and Australia do not state “financial stability” as an explicit objective of their central bank acts. So, including financial stability as an explicit objective in the Bank of Korea Act will be the first baby step to ensuring financial stability.

I will finish here. Thank you.

Macroprudential policy framework

Christine Cumming[1]

I'd like to thank the conference organisers and our hosts at the Bank of Korea for the opportunity to participate in this excellent conference. As Governor Kim discussed at the conference start, the recent financial crisis presents an opportunity for us to deepen our understanding of the financial system's dynamics and to reshape our thinking about financial stability policy. I am especially pleased that so many economists invited here are scholars early in their careers. The recent financial crisis and great recession, with the hardships they created, will undoubtedly shape the thinking of the economics profession for many decades to come, much as the Great Depression did. The contributions over the last two days are an important stimulus for advancing our thinking.

Let me begin with the usual disclaimer: these are my own views, not those of the Federal Reserve Bank of New York or the Federal Reserve System.[2]

I would like to make four points. My first is to offer a proposition: that financial instability is always and everywhere a credit phenomenon. It's an analogy to the observation invaluable in central banking: that inflation is always and everywhere a monetary phenomenon. That observation clarified that monetary authorities have the power to influence inflation expectations and must exercise it, whatever the underlying source of inflation pressure. If financial instability is always a credit phenomenon (a proposition open to challenge, of course), it clarifies why central banks have a crucial role in ensuring financial stability and might help us focus on how we shape our role.

A related proposition is that a "big" expansion of credit cannot occur without lowering credit standards. There may be some exceptions in economic history, such as the creation of the consumer credit market in the 1920s in the United States, a Pareto-improving financial innovation that created lending standards where none had existed before. Those instances are uncommon, however.

To be systemic, the expansion of credit needs to be "big" relative to the size of the economy. The expansion often occurs as a sectoral phenomenon, one with a substantial direct or indirect impact on the real economy. That means that such expansions should be noticeable well in advance of the credit collapse we associate with financial instability.

Finally, credit expansions need augmented sources of funding. I posit that such augmented funding must, like credit standards, go "downmarket". That is, the augmented sources of funding are less stable through the financial cycle than traditional sources and more like the "hot money" that is traditionally of concern to bank supervisors.

Are there exceptions to the proposition that financial instability is a credit phenomenon? The tech bubble of the late 1990s and early 2000s was ostensibly an equity-driven cycle. A deeper look suggests that, in many ways, it too could be characterised as a credit bubble.

Expansion in the tech sector was fuelled not by bank lending or bond issuance, but by equity issuance and trade credit, that is, lending by companies to their suppliers and customers. The recent movie "The Social Network" reminds us how in the 1990s equity investors were

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[1] First Vice President, Federal Reserve Bank of New York.

[2] I am grateful to John Clark, Gerard Dages and Monica Sanz of the Federal Reserve Bank of New York for their suggestions for and comments on this presentation.

willing to place money in companies that had negative income and no revenue. Trade credit from the largest tech companies funded corporate purchases of their products, the inventories of their distributors, and some producers of related products. The abrupt reduction of equity and trade credit funding when the tech bubble burst reinforces Professor Shin's point in his opening remarks that categorising the liabilities of financial institutions into core and non-core is a key judgment in monitoring financial stability.

My second point is that fostering good underwriting and preventing the erosion of underwriting standards is integral to preventing financial instability. Central banks and financial supervisors, with their knowledge and historical experience, can confidently make judgments about good underwriting, and therefore can and should promptly take action when they see underwriting standards weakening. In many ways, stemming the erosion of underwriting standards offers a concrete and solid foundation for action, relative to overcoming the well known analytical difficulty of identifying asset bubbles or the political difficulty of taking actions to moderate financial crises already in train. If we have lacked sufficient evidence about the cost of poor underwriting, we now have the bitter experience of the United States to illustrate the risk of severe recession that arises in such circumstances.

Central bankers can similarly identify the dangers embedded in the structure of funding at financial institutions and here too can act with confidence when unstable sources of funding or non-core liabilities become too dominant in the overall liabilities of a financial institution.

My third point is to endorse the need for a framework to think about managing systemic risk. As Governor Kim pointed out yesterday, a major challenge is to bring microprudential and macroprudential policy actions together in a common framework, with a clear understanding of how the policies interact. At this conference we've heard some exciting work that brings us closer to a framework, such as the paper by Domanski and Ng, and will hear David Longworth's remarks on this panel. We may soon coalesce around some key elements of a framework.

I would like to offer two concepts that might be useful in developing the framework. The first is a concept familiar in information security, defence in depth. Defence in depth rests on the belief that no single measure can protect an information technology network from intrusion; rather, a combination of measures is required. The multiple layers of protection trip up an intruder, slow it down, and increase the probability of detection.

Defence in depth is feasible for central banks and supervisors, since our collective policy toolbox has many tools, as Governor Ingves said earlier today. I would view one key line of defence to be strong incentives for financial institutions to manage themselves well, such as a robust resolution regime for failing financial firms and public disclosure of financial statements and comprehensive, forward-looking risk accounting by financial firms. Microprudential activities include robust capital and liquidity regulation, with an emphasis on loss absorbency within the capital structure; and proactive examination activity at financial firms that assesses the underwriting quality, funding strategy, risk management processes, and the incentive structure of compensation. Further measures include macroprudential policies applied at a financial system-wide level, such as loan-to-value limits, targeted higher capital requirements, countercyclical loan loss reserves and the incorporation of stress testing into underwriting requirements (such as testing the robustness of foreign currency mortgage loans to foreign exchange rate changes at loan inception, as is required in Poland). Macroeconomic policy actions likely also have a role.

Defence in depth may also involve an element of progressive escalation in the use of policy tools, for example, if concerns develop despite a sound first line of defence. The escalation could include targeted examinations of the activity with follow-up corrective supervisory programmes if needed, such as new supervisory standards, additional capital requirements or higher market margins or haircuts, among others. Additional escalation could involve compulsory corrective measures at firms, increased penalties and other restrictions, including prohibitions on activity.

The recent macroprudential policy actions taken by the Korean authorities to address the risks in certain large inflows of capital from abroad – through new limits on foreign exchange derivatives and a subsequent proposed levy on non-deposit foreign currency liabilities – can be seen as an example of escalation. Large capital inflows from abroad, especially short-term borrowing by Korean institutions, created concerns about rapidly growing exposures to foreign exchange and maturity transformation in banking institutions. At the same time, the Bank of Korea escalated its macroeconomic response by tightening monetary policy.

The second concept for consideration is an explicit incorporation of the life cycle that past credit overexpansion has tended to exhibit. The papers in the conference's first session sought to detect the emergence of systemic risk. The authors were clearly disappointed that the measures of systemic risk that they had developed worked well in identifying the risk in 2007 and in tracing its growth in 2008 and early 2009, but didn't really signal the build-up of risk that occurred before 2007, when forestalling actions by supervisors may have been most powerful.

More research illuminating the stages of the life cycle of a credit overexpansion would clearly contribute to developing good diagnostics of early-stage potential for systemic risk. Understanding those stages and the effectiveness of tools in the policy toolkit at each stage of the cycle are essential elements of a fully articulated financial stability policy framework.

Taken together, the concepts of defence in depth and the life cycle of credit overexpansion can help more fully articulate a framework for financial stability policy. The goal, of course, is to forestall the development of the excessive credit expansion and reliance on unstable funding that characterise the run-up to a financial crisis. I believe this helps explain why the tools most frequently identified as "macroprudential" often are aimed at discouraging the erosion of underwriting standards or over-reliance on unstable funding.

As Governor Kim stated, research on the combined impact of microprudential and macroprudential measures is essential to developing the financial stability framework. Understanding the interaction of micro- and macroprudential measures and their calibration would represent an important breakthrough in the analysis of policies to manage system risk. The interesting empirical studies presented yesterday afternoon examined in a streamlined context the impact of combinations of microprudential and macroprudential measures both in the short run and in the medium term. This work has the potential to help policymakers address very practical policy questions. What measures work most effectively at different stages of credit overexpansion? How do we estimate Type 1 and Type 2 errors in the assessment of systemic risk and thereby understand the price of action in the application of micro- and macroprudential measures and the price of inaction?

My fourth and final point is to highlight three key features of the recent US financial reform legislation, the Dodd-Frank Wall Street Reform and Consumer Protection Act enacted in July 2010. It is a large, complex law, but the three features I will highlight are important innovations in the management of systemic risk in the United States.

The first is the creation of the Financial Stability Oversight Council, or FSOC. It is chaired by the Secretary of the Treasury and its members include essentially all the principal US regulatory bodies. A large part of the FSOC's work is to share knowledge across the regulatory bodies, identify emerging systemic risks and coordinate their efforts with respect to controlling major risks in the financial system. The regulatory powers of the constituent members of the FSOC are undiminished. The difference from the past is that the agencies have a forum to discuss emerging risks in the financial system and how best to address them.

Domanski and Ng pointed out that the FSOC is large and the power decentralised among more agencies than the design of financial stability authority in many countries. A strength of the FSOC relative to the structure of the US financial system is that it provides broad coverage of the financial sector through its member agencies, with an ability to drill down in each sector in detail, and it makes available the combined toolkit of micro- and

macroprudential tools across the agencies, enabling the design of a defence in depth if one is deemed desirable.

To realise the value of the FSOC, the members have been developing comprehensive surveillance of the financial system for emerging and incipient systemic risks. In that regard, I endorse Governor Ingves' admonition to "follow the money". The erosion of credit standards often occurs because the returns to a specific activity are so much higher than returns elsewhere in the market; the temptation to generate more business at those rates of return becomes irresistible.

In addition, developing insights into emerging systemic risk requires a willingness to challenge conventional wisdom. Governor Kim noted that some of our most fundamental economic tenets about the efficiency of markets have been shaken by the financial crisis. In the economics profession, we need to take into account more fully that many models are observationally equivalent. Identifying and pursuing the alternative theoretical explanations for an observed pattern of data and drawing out the alternative implications could inject some healthy scepticism and richer analysis into policy papers.

To realise the value of the FSOC structure, the leaders of the member agencies also need to have a "bias to action". Once an emerging systemic risk has been identified, the regulatory authorities must be prepared to act – and must be willing to absorb the criticism they are likely to receive as they restrain activities with extraordinary returns. Certainly one lesson from the recent past is that the bias to inaction in the deregulatory decades before the financial crisis did not serve us well. And, within the FSOC, member agencies need to be willing to critique one another if the actions of individual agencies are insufficient.

A second important feature of the Dodd-Frank Act is that it provides a key power to the FSOC, the power to designate systemically important financial institutions, most especially non-banks. The shadow banking system, long lauded for its contributions to innovation and dynamism in the US financial system, proved to be one of its most vulnerable aspects in the financial crisis. The propensity for substantial amounts of financial activity to take place in firms outside the core banking and securities sectors, beyond official oversight, sheltered poor risk judgments and controls, and more, from adequate scrutiny.

Under Dodd-Frank, once a financial institution is designated systemically important, the financial institution is subject to the supervision of the Federal Reserve. That is, it is subject to the same supervisory regime as large banking companies. That ensures consolidated oversight of the financial institution's activities, eliminates some potential for regulatory arbitrage, and potentially subjects the firm to an FDIC-managed resolution regime. The Dodd-Frank Act also provides the FSOC some capacity to designate activities as systemically important.

A third important provision of the Dodd-Frank Act is the creation of the Office of Financial Research. The importance of that provision is easily underestimated. Its significance is threefold. First, it sponsors and conducts systemic risk analysis; eventually it will bring together analysts, academics and practitioners to provide analysis for the FSOC as well as fundamental research on systemic risk. Second, the OFR has very broad powers to collect financial data related to systemic risk, much greater than any regulatory agency in the United States. Third, the OFR has a mandate to achieve standardisation of data at the transaction level.

This last is especially important. A significant problem for risk managers, supervisors, securities analysts and counterparties is the lack of standardisation of the elements of transaction data. This often makes it impossible to compare or aggregate data across financial firms, and in not a few cases, where information systems are inadequate, even within firms. The lack of detailed information about individual financial institutions and transaction flows and the difficulty of comparison are impediments not only to market discipline and supervisory oversight, but also to firm-level risk management, whether the firm

is assessing financial counterparties or assessing how the firm is positioned relative to others in the market.

In a short contribution I made to the September 2010 Chicago Fed and IMF conference, I elaborate on this risk management point. The financial industry, and not just the financial authorities and the investing public, have a large stake in better, more comparable and more usable financial information. The excellent research on systemic risk done by Professor Shin, by my colleague Tobias Adrian, and by Princeton professor Marcus Brunnermeier, among others, provides a well-developed rationale why firms need greater information about the distribution of risk in the market in order to manage their own risk.

Good data is essential for central banks and supervisors striving to maintain financial stability. A robust method of collecting, analysing, and assessing data, as well as methods for renewing data sources and developing new ones, is important given the pace with which changes occur in the financial system and with which problems develop. Governor Ingves talked about the run-up phase of the financial cycle of three to five years; I would note that the largest part of the subprime boom and its excesses took place in that time frame.

As the OFR is established, a priority will be to reach out to the international community, especially as the OFR considers data standardisation. I believe we have a once-in-a-lifetime opportunity to do for financial market and institution data something similar to the development of the national accounts in the late 1940s and early 1950s. This is an opportunity that we should fully utilise.

Thank you for your attention.

Key issues for the success of macroprudential policies

Ignazio Visco[1]

1. Macroprudential objectives and tools

While the objectives of monetary and fiscal policies are clearly defined, and often precisely quantified, the situation is less clear in the case of financial stability. A broad consensus has emerged on the idea that "macroprudential" policies directed to preserving financial stability should limit systemic risk by addressing both the cross-sectional dimension of the financial system, with the aim of strengthening its resilience to adverse real or financial shocks, and its temporal dimension, to contain the accumulation of risk over the business or financial cycle. The first dimension seems to me to be of paramount importance. The second dimension emphasises the need to contain the procyclicality of the financial system, ie to "lean against the financial cycle".[2] Other authors argue that policy should be assigned more specific objectives, such as combating fire sales and credit crunches.[3]

A key problem is that, whether a broad or a specific mandate is chosen, we are still far from an operational definition of these objectives. We do have an ample array of indicators and early warning signals, but we still lack a coherent framework to interpret them, to assess the need for macroprudential intervention, and to measure the success of the policies adopted.

While the notion implicit in all definitions of macroprudential objectives is that what warrants a macroprudential regulatory intervention is systemic risk (a negative externality), systemic risk presents a number of challenges to the policymaker. First, it is hard to measure, because of its various dimensions: procyclicality; network or contagion risk – the spillover effects of a single institution's distress on the rest of the financial system; correlation risk, which reflects the common exposures of all financial institutions to the same risk factors; and concentration risk, due to the presence of a few dominant institutions in key financial markets and activities. Second, systemic risk may be extremely difficult to spot ex ante. For instance, in the late 1990s, the hedge fund industry was considered a main source of systemic risk, and a candidate for regulation, but this risk did not materialise. By contrast, the recent crisis provides several examples of triggers that did have systemic consequences but were not seen as crucial ex ante: the behaviour of certain insurance companies; the supposedly safe mortgage market of the world's financially most developed system; the European sovereign debt market.[4]

These difficulties in measuring systemic risk have important implications for the practical implementation of macroprudential policy and for the accountability of the macroprudential authority. As the new authorities start working, they will have to base their decision-making on operational arrangements. The year that has just begun will be very important in this respect.

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[1] Governor, the Bank of Italy. At the time the conference was held, Ignazio Visco was Deputy Director General, the Bank of Italy. I would like to thank Paolo Angelini and Sergio Nicoletti Altimari for highly useful discussions and assistance.

[2] See, for example, Bank of England (2009) and Borio (2003), (2010).

[3] See Hanson, Kashyap and Stein (2010).

[4] See Carosio (2010).

Similar difficulties emerge in the definition of the appropriate macroprudential tools. Financial crises are often associated with wide fluctuations in credit and asset prices. Recent analyses indicate that such tools as countercyclical capital requirements or loan-to-value ratios can dampen both the volatility of credit and asset prices and the procyclicality of the financial system, helping to reduce the likelihood of financial crises.[5] At the same time, because systemic financial risk can emerge from many sources, different instruments may be required, to be chosen case by case. Furthermore, instruments may be under the control of different authorities, for example those responsible for microprudential, fiscal or other economic policies. This might significantly add to the complexity of the policy process, reducing its timeliness and hence the likelihood of success.

In Europe, responsibility for macroprudential policies has been assigned to a new body, the European Systemic Risk Board (ESRB), within the context of a comprehensive reform of the European supervisory architecture approved by the European political authorities in the autumn of 2009 following an in-depth analysis conducted by the De Larosière Committee and the European Commission. The reform also introduces a European System of Financial Supervision (ESFS) comprising, besides the macroprudential authority, three new European Supervisory Authorities (ESAs) for the banking, securities and insurance sectors. The new authorities started operating in January 2011.

Regulation No. 1092/2010 of the European Parliament and of the Council assigns a broad mandate to the ESRB, charging it with macroprudential oversight of the financial system within the European Union in order to contribute to the prevention or mitigation of systemic risks to financial stability in the Union.[6] To this end the ESRB is to conduct analyses of the European financial system, issue risk warnings and, when called on, make recommendations that it will submit to one or more member states or national supervisory authorities, the EU Council, the European Commission and the newly established ESAs. It will decide, after consulting with the Council, whether to make its recommendations public and will monitor follow-up, informing the Council and the ESAs where it finds the action taken to be inadequate.

The ESRB itself does not have direct enforcement power; it will act mainly through other (European or national) authorities, essentially via an "act or explain" mechanism. Its lack of direct enforcement powers is a key difference with respect to the arrangement in the United States, where the new macroprudential body, the Financial Stability Oversight Council (FSOC), is assigned direct intervention tools, including at the micro level. As the new authorities begin working, it will be important to monitor how this difference influences the policy outcomes. A key challenge for the ESRB is to ensure that its recommendations have teeth, that the "act or explain" mechanism produces a good balance between the "act" and the "explain". A second important challenge for the ESRB will be to ensure that country-specific and/or sectoral warnings or recommendations, when required, are adopted in a timely fashion. The European experience of the last three years suggests that recommendations of this type would probably have been more effective than general recommendations to counter developments that turned out to have implications for European financial stability. The complexity of the ESRB's structure might make it difficult to reach a consensus on national recommendations. A third challenge for the ESRB will be to ensure

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[5] See Angelini, Neri and Panetta (2010) and Lambertini, Mendicino and Punzi (2011).

[6] Article 3(1) of the Regulation: "The ESRB shall be responsible for the macro-prudential oversight of the financial system within the Union in order to contribute to the prevention or mitigation of systemic risks to financial stability in the Union that arise from developments within the financial system and taking into account macroeconomic developments, so as to avoid periods of widespread financial distress. It shall contribute to the smooth functioning of the internal market and thereby ensure a sustainable contribution of the financial sector to economic growth."

effective cooperation with the authorities of the new European System of Financial Supervision.

2. Interaction between macroprudential and monetary policies

The objectives of macroprudential policies should be kept separate from those of more traditional policies. There is a consensus that there is no need to change central banks' current mandate of preserving price stability over the medium term. The benefits of a sound monetary framework have become more – not less – evident during the crisis. Had central banks failed to control inflation, and inflation expectations, monetary policy would have had much less room for manoeuvre.

However, the increasing emphasis on financial stability and macroprudential policies poses challenges to monetary policy. Central banks should not have to stand by idly until a crash occurs before intervening. There is evidence that a loose monetary policy can stimulate excess risk-taking and leverage, or liquidity transformation, thus increasing systemic fragility and ultimately putting price stability itself at risk.[7] Just how this should affect the conduct of monetary policy is still unclear. At the very least, however, we have learned that monetary policymakers should be aware of these channels and monitor a broad range of indicators, such as buoyant credit growth, increasing leverage of financial institutions and, in general, leading indicators of financial instability. Some authors argue that monetary policy should react to financial variables and more generally to leading indicators of financial distress.[8]

Over longer horizons there is no evident trade-off between price stability and financial stability objectives – indeed, there are probably synergies. We need to lengthen the horizon of monetary policy by taking into account the interactions and feedbacks between the real and the financial sectors and the non-linearities that emerge especially during crises. Many of the effects associated with financial and asset prices imbalances are likely to be highly non-linear and complex. The reaction of monetary policy should then also be non-linear and respond to asset price misalignments and financial imbalances. When the probability of a crisis becomes non-trivial, the interest rate path towards ensuring price stability might be different than in normal circumstances. These aspects are not well captured in the empirical models currently used to support monetary policy decisions, or, I would argue, in the prevailing flexible inflation targeting framework.[9] There is a great need for further research to overcome these limitations.

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[7] Borio and Zhu (2008) argue that such a channel exists. Altunbas, Gambacorta and Marqués-Ibáñez (2010), Maddaloni and Peydró (2010) find empirical evidence consistent with this channel.

[8] See Woodford (2010), Cúrdia and Woodford (2010), and Lambertini, Mendicino and Punzi (2011), among others.

[9] On the contrary, it is generally accepted that a flexible inflation targeting (FIT) approach, if sufficiently forward-looking, should (perhaps informally) take account of the fact that "significant financial instability invariably will also have a significant impact on activity and inflation" (Bean, 2003, p 18). In practice, however, in the design of monetary policy actions it might be very difficult to take account of developments that are subject to considerable uncertainty and may materialise with long lags due to the cumulative and non-linear effects of financial imbalances. Since "the real world is generally complex and non-linear, [even] within a well specified FIT framework, the *implicit* monetary policy reaction function would then also be non-linear (and possibly very complex, as it would not be possible to rely on certainty equivalence)" (Visco, 2003, p 24), Indeed, considering a Taylor rule as a description of the normal conduct of monetary policy, I argued that for some purposes a linear rule with the interest rate expressed as a function also of asset price misalignments could be a simple and linear approximation (a Taylor "approximation", after Brook Taylor the mathematician, within the Taylor "rule" introduced by John Taylor the economist!) of how central banks would behave (or perhaps should have behaved) in a non-linear and complex environment.

Monetary policy and financial stability policy interact and influence one another. Monetary policy affects asset prices and credit, whose developments are crucial for financial stability, and the propensity to take risks. At the same time, macroprudential policies will likely react to, and affect, credit growth and asset prices, influencing the monetary policy transmission mechanism. These interactions need to be well understood and taken into account in formulating the two policies.

Two research projects recently carried out at the Bank of Italy have focused on the interaction between monetary policy and macroprudential policy. The first study concentrates on the recent housing bubble in the United States.[10] The results indicate that a tighter monetary policy by the Fed between 2002 and 2006 would have not been sufficient to avoid the bubble. However, by appropriately combining a tighter monetary policy with additional credit restraint by means of an aggressive use of countercyclical macroprudential tools, policymakers could have dampened the housing boom. The second study suggests the need for coordination between monetary policy and countercyclical macroprudential policy to avoid conflicts in the use of their respective instruments (eg interest rates and bank capital ratios).[11] While the benefits of such coordination are small in "normal" times, they can become substantial when the economy is hit by financial shocks that severely impair the ability of the banking sector to provide credit to the economy. In this case, it may be optimal for the central bank to "lend a hand" to macroprudential policy, partly deviating from its primary objective of price stability in order to improve the overall stability of the economy.

To what extent do countercyclical macroprudential policy and monetary policy have the potential to affect the economy independently of each other? Answering this question requires the development of new analytical frameworks. The ideal framework should be simple enough to allow a proper understanding of the basic underlying mechanisms; at the same time, it should be sufficiently realistic to permit the two policies to usefully coexist, at least in principle. Clearly, this would be impossible in a very simple framework. For instance, in a standard AS-AD New Keynesian model, the two policies would be perfectly linearly dependent, as they both end up influencing the only control available to the policymaker, the interest rate, either through open market operations or via the macroprudential instrument.

In one possible modelling of the two channels, suggested by Angelini, Neri and Panetta in the above-mentioned Bank of Italy paper, monetary policy would set the level of the nominal interest rate, as in standard models, while countercyclical macroprudential policy would influence the differential between the interest rate on bank loans and the rate on deposits by setting a capital ratio. Is this channel powerful enough to make a difference? Are there other possible channels? In my view, these issues will require a substantial research effort.

In Europe, consistency between monetary and macroprudential policies should be ensured by the structure of the ESRB, characterised by its close relationship with the European System of Central Banks, which represents the backbone of the new institution.[12] In practice,

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[10] Catte, Cova, Pagano and Visco (2010).

[11] Angelini, Neri and Panetta (2010).

[12] The ESRB General Board is composed of the president and the vice president of the ECB, the governors of the 27 central banks of the European Union, a representative of the European Commission, the chairs of the three ESAs, the chair of the Advisory Technical Committee (an advisory body made up of the representatives of all institutions participating in the ESRB) and three external members (the chair and the two vice-chairs of the Advisory Scientific Committee, a new advisory body made up of experts), all with voting rights. In addition, the representatives of the national supervisory authorities and the chair of the EU Economic and Financial Committee (EFC) will participate in the meetings without the right to vote. The chair of the ESRB is assigned to the president of the ECB for the first five years (for subsequent mandates, possible amendments to this provision will be assessed by the European Parliament and the Council by December 2013). A Steering Committee is in charge of preparing meetings and ensuring efficient ESRB operations. The Steering

29 of the 37 voting members are central bankers, so central bankers alone can ensure the simple majority required for General Board approval, as well as the qualified majority of two thirds required to adopt a recommendation or to make a warning or recommendation public.

The scope for potential conflicts between policies should also be limited to the extent that the tools and actions of macroprudential policies are normally more selective, sectoral and geographically defined. For example, dealing with house price booms in a region or country in the currency union will be an issue for macroprudential policy; a generalised credit boom, on the other hand, will likely be a matter of concern for monetary policy as well.

3. Interaction between macroprudential and microprudential policymakers

A number of practical examples show that microprudential tools (capital and liquidity requirements, loan-to-value ratios etc) may be appropriately calibrated to serve macroprudential goals as well. If the tools are broadly the same but must serve two purposes and be used by two different authorities, the potential for conflict arises. It is not hard to imagine a scenario of an economic downturn in which the macroprudential regulator would want to run down the equity buffers built up during good times in order to avoid a credit crunch, while the microprudential regulator, concerned with preserving the safety and soundness of individual institutions, might be reluctant to let that happen.

Overall, there are both strong complementarities between macro- and microprudential policies – it is hard to imagine the success of one policy without the success of the other – and potential short-term conflicts and overlaps. Whatever the institutional arrangements, it is crucial to ensure a continuous exchange of information and to set up well defined mechanisms to resolve any conflicts between the two functions.

From this viewpoint, the US system appears well designed. In Europe, the interaction between macroprudential and microprudential authorities may be relatively complicated: the latter include the Basel Committee, the European Banking Authority, the other European supervisory authorities and the national supervisors. Cross-participation in the governing bodies of the different authorities should limit coordination problems, but it is clear that the European regulators will be called upon to make efforts in this direction. Indeed, a proposal for a memorandum of understanding between the ESRB and the ESAs on the division of responsibilities between micro- and macrosupervisors is now being discussed.

Access to micro data may be problematic for the ESRB. Successful analysis will probably require the ESRB and its Secretariat to act as a hub, devising meaningful projects, decentralising much of the analytical work to national authorities, and ensuring harmonisation of the research protocols.

4. Coordination among macroprudential bodies

The new macroprudential regulatory framework will feature a primary role at the global level for four “global” players – the IMF, the Financial Stability Board (FSB), the ESRB and the

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Committee consists of the ESRB chair and vice-chair, five central bank members of the ESRB, the chairs of the ESAs, the chair of the EFC and the Commission member.

FSOC – and for a number of national macroprudential authorities. Effective action will require a stepped-up interaction and cooperation among these authorities.

The IMF and the FSB are developing a monitoring process (the so-called Early Warning Exercise) that permits a more integrated and comprehensive view of emerging global developments and the corresponding risks. Using an integrated macrofinancial and regulatory perspective, the process should provide a first example of an organised, structural attempt to identify and prioritise systemic macrofinancial risks at global level and to propose policy responses. The ESRB will also conduct a regular assessment of systemic risk and, when necessary, translate it into recommendations for the adoption of mitigating policies. The potential for overlap seems ample. Given the global mandates of the FSB and the IMF, effective collaboration could have these two organisations focusing on the analysis of linkages and contagion channels across the main macro areas and on developing policy options to contain spillover risk. The ESRB, the FSOC and analogous national and regional institutions elsewhere could focus on sources of risk arising within their jurisdictions and devise policy measures to address domestic developments. The coming years will be crucial in assessing the effectiveness of the new framework and in mitigating potential inefficiencies.

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Remarks on macroprudential policy frameworks

David Longworth[1]

I would like to thank the organisers of this conference for inviting me to participate in this panel. It is obvious from this conference that central banks continue to be the leaders in the development and discussion of macroprudential regulation and policy.

"Every financial crisis is the same."

"Every financial crisis is different."

Both are "true" in their own way. As Kindleberger wrote in his famous book on financial crises, "For historians each event is unique. In contrast economists maintain that there are patterns in the data and particular events are likely to induce similar responses."[2] Policymakers should focus mostly on what is "the same," as Tim Ng argued this morning.[3] Like historians, however, they cannot neglect what is unique because (i) our economic theories may not capture all that is relevant and (ii) the details may – if examined in the light of the aggregates – help us to understand what is going on.

I want to argue today that the need to be aware both of the similarities and differences in financial cycles and crises has implications for macroprudential policy.

In particular, it has implications for:

- The framework for macroprudential policy;
- The governance of macroprudential policy;
- Cross-cutting policy issues which are of relevance to macroprudential policy, monetary policy, fiscal policy and consumer protection. I will illustrate this final point by a look at the area of housing and housing finance.

I will begin with implications for the framework of macroprudential policy. I like to think of the heart of this framework as being illustrated in the following diagram (Figure 1).

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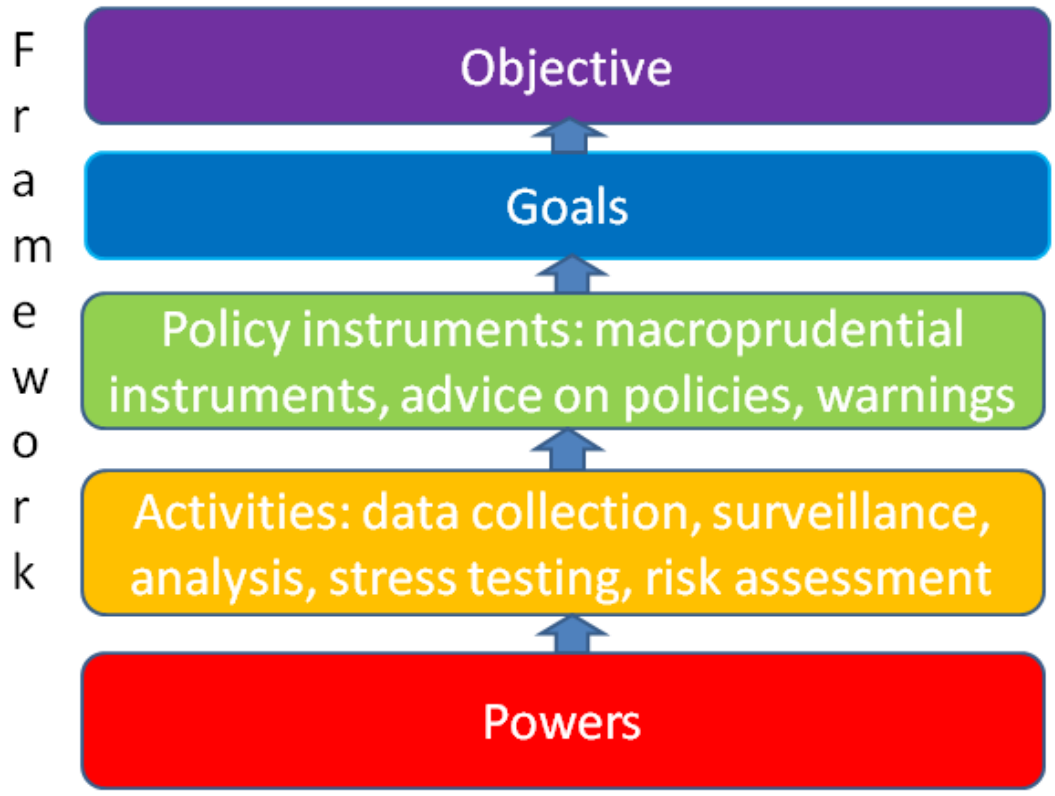
[1] Adjunct Research Professor, Carleton University; John Weatherall Distinguished Fellow, Queen's University; Fellow, C D Howe Institute.

[2] C Kindleberger and R Aliber, *Manias, Panics, and Crashes*, John Wiley & Sons, 2005, fifth edition.

[3] Ng made these comments in his presentation of D Domanski and T Ng, "Getting effective macroprudential policy on the road: eight propositions", this volume, 2011.

Figure 1



The legislature grants certain powers to a macroprudential authority, which may be a committee, a standalone agency or a central bank. These powers allow the authority to undertake certain activities and to use certain policy instruments to attain certain goals. Attaining these goals will help it to achieve an objective such as having a low probability of financial disruptions in the economy.

Today, I would like to focus on the elements of the framework having to do with activities and policy instruments. The key activities for a macroprudential authority are data collection, surveillance of the financial sector, analysis, stress-testing of the sector and risk assessment. Based on those activities – particularly risk assessment – and given its goals, the macroprudential authority uses the policy instruments at its disposal. These will typically take the form of macroprudential instruments, advice on policies to individual regulators or to the government, and warnings to regulators or financial system participants. Of course, the macroprudential instruments may not be under the direct control of the macroprudential authority, but it may have the power to direct their use by others or to issue "comply or explain" orders.

Because of the sameness of financial cycles and financial crises, there must be an essential element of data collection that focuses on important credit aggregates, important asset prices, important interconnections between financial institutions and common exposures of financial institutions – especially exposures that are growing rapidly. An important element of surveillance, analysis, and risk assessment must also focus on these. Benchmarks for countercyclical macroprudential tools will typically be derived from historical studies of the behaviour of credit aggregates and important asset prices.

Because of the uniqueness of financial crises, however, there will be another important element of data collection that focuses on what is happening because of financial innovation and, perhaps, changes in regulation. There will be new instruments, new products, and new

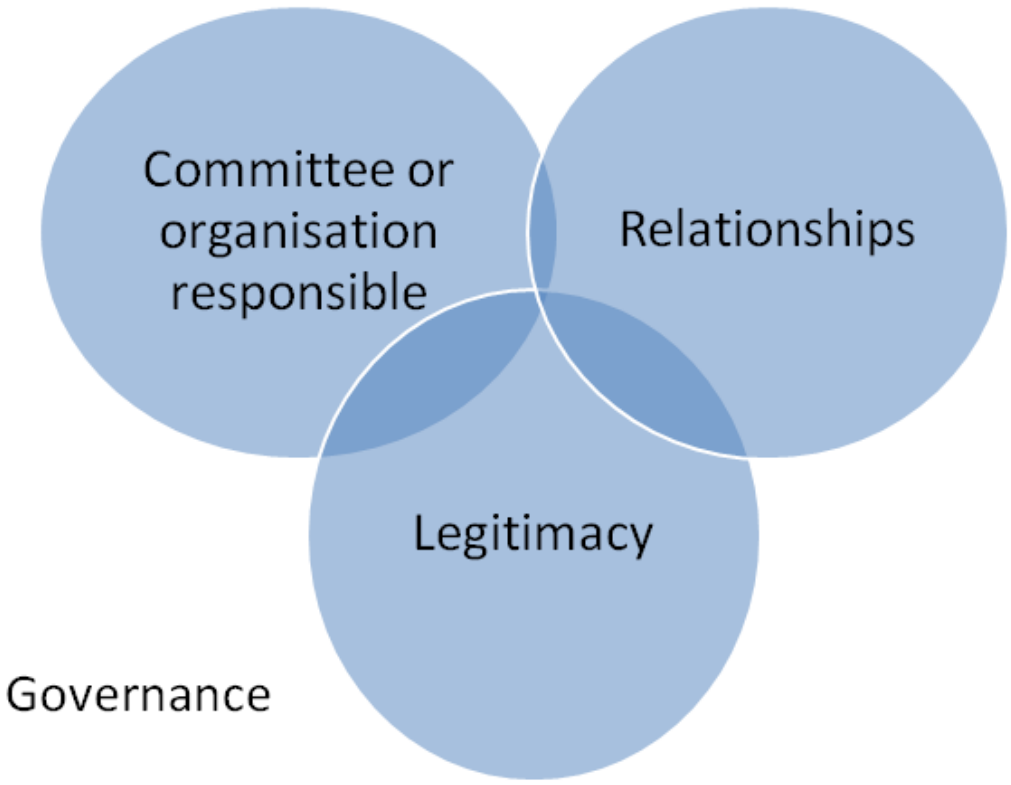
procedures to track. Again, an important element of surveillance and risk assessment must also focus on these. As well, the judgement in setting macroprudential instruments will come from surveying, analysing and assessing – very carefully! – what is different this time. Policy advice and warnings may also come from tracking what is new and unregulated.

I would now like to turn to the governance of macroprudential policy.

Three important elements of governance (Figure 2) are the following:

- Legislating which committee or organisation will be the responsible macroprudential authority;
- The relationships (both legal and informal) between the macroprudential authority and other domestic regulators, and between the macroprudential authority and international bodies, including, importantly, international standard setters;
- The legitimacy of the macroprudential authority, which stems from its accountability, communication, staff quality and overall reputation – and is essential to the maintenance of any independence that it has been granted.

Figure 2



I believe that, because every financial crisis differs in some respects from previous crises, committees can be especially valuable in macroprudential governance.

Canada has not yet announced its macroprudential governance regime. It has had, however, a reasonably good experience with federal inter-agency committees over the past 15–20 years or so. Let me explain.

There is a Financial Institutions Supervisory Committee, chaired by the Superintendent of Financial Institutions (who is the supervisor of banks, insurance companies and pension funds). This committee also consists of the Governor of the Bank of Canada, the Deputy

Minister of Finance, the Chair of the Canada Deposit Insurance Corporation and the Commissioner of the Financial Consumer Agency of Canada. It meets at least quarterly to give advice to the Superintendent (who is not required to take it), and to coordinate policy actions when necessary. During some stages of the recent crisis, it was meeting almost daily. Because the senior members of the agencies are almost always present, they get to know each other well. This is very important in normal times, so it is easier to communicate when a crisis comes.

There is also a Senior Advisory Committee (on financial regulation), chaired by the Deputy Minister of Finance, which consists of the same members and gives advice to the Department of Finance on financial regulation and legislation.

Alan Blinder's work with John Morgan on committees and governance,[4] which focused on monetary policy committees, also suggests the value of committees: "Group decisions are on average better than individual decisions."[5]

Macroprudential policy touches deposit-taking institutions, insurance companies, broker-dealers, markets and market infrastructure. Given this diverse nature, cross-institutional committees should enhance legitimacy, as long as it is clear who is responsible and – most importantly – the committee keeps a true macroprudential orientation. It is also true that cross-institutional committees in large and medium-sized countries will, through their members, have appropriate international contacts at the G20, FSB, the BIS, the BCBS, and IOSCO.

I would now like to move to the third element of my presentation: cross-cutting policy issues, which I will illustrate by the area of housing and housing finance.

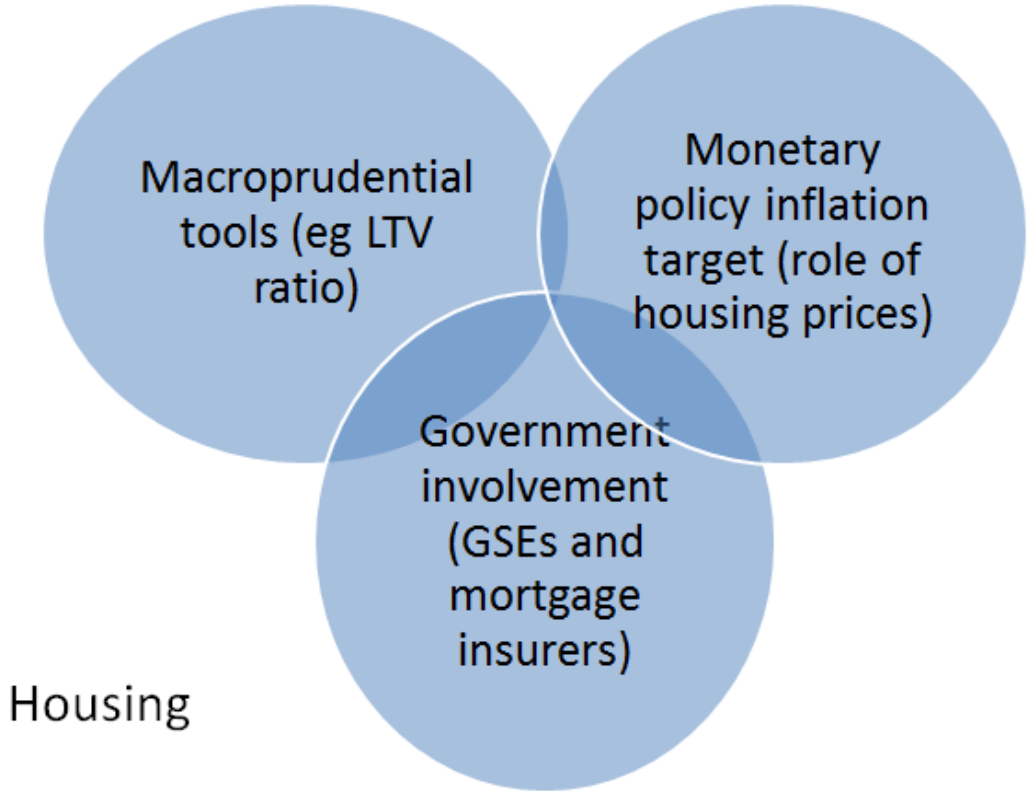
Housing finance and its regulation differ greatly across countries. As in the most recent crisis, many crises have been associated with bubbles in house prices and mortgage credit. There are at least three areas (Figure 3) where house prices and housing finance are important in thinking about the prevention of future financial crises:

- There are macroprudential tools, such as the use of maximum loan-to-value ratios;
- There is government involvement in the mortgage finance area, through insuring mortgages or securitised products, perhaps through a government-sponsored enterprise (GSE);
- There is the question of which inflation measure should be targeted or monitored by monetary policy and whether housing prices are included in that measure.

[4] A Blinder and J Morgan, "Are two heads better than one? Monetary policy by committee", *Journal of Money, Credit and Banking*, vol 37, no 5, 2005, pp 789–812.

[5] The authors noted that this result was true whether the groups made decisions based on majority rule or unanimity.

Figure 3



Given the "sameness" of crises, and given that the last crisis was closely related to mortgage finance that fed a housing price bubble in more than one country, it is somewhat disconcerting that most countries have not yet dealt with one or more of the following:

- The formal development of macroprudential tools associated with mortgage credit and housing prices (including countercyclical ones). More examination is necessary of the relative roles, for example, of loan-to-value ratios and debt-service-to-income ratios.
- The re-examination of the overall governance of GSEs, state-owned enterprises, and government insurers in the mortgage area, including how the terms and conditions that they set for insurance affect the behaviour of the mortgage and housing price cycle. These terms and conditions need to be examined at the same time as macroprudential tools in this area.[6]
- The re-examination of how housing prices should be incorporated in the overall inflation index targeted or monitored by the central bank. I would note that the Canadian CPI contains a few housing-related components that move closely with Statistics Canada's New House Price Index. This has been very helpful to Canadian monetary policy. Dropping housing from the targeted index in the United Kingdom in the move from the RPI to the harmonised index seems to have been distinctly unhelpful.

[6] The governance of the process of adjusting requirements for obtaining mortgage insurance in Canada needs to be improved by clearly laying out the objectives.

Much is left to do from a policy point of view in the housing and housing finance area.

It is time to conclude.

Macroprudential policy should marry the best macro perspective with the use and significant tweaking of traditional microprudential policy instruments. The wedding gown at the marriage should have the traditional "something old, something new, something borrowed, something blue". The "something old" represents the focus on the things that are the same in financial cycles and financial crises. The "something new" represents the focus on innovations – new products, new products, new procedures. The "something borrowed" in many countries will be governance by committee, which should bring strength through diversity. At the moment, the "something blue" is that much more progress is needed on policy issues related to mortgage credit and housing prices. Those central banks that play an advisory role to their treasuries should not hesitate to speak up with good policy advice in this cross-cutting area. This will lead to a "blue sky" for the wedding day.