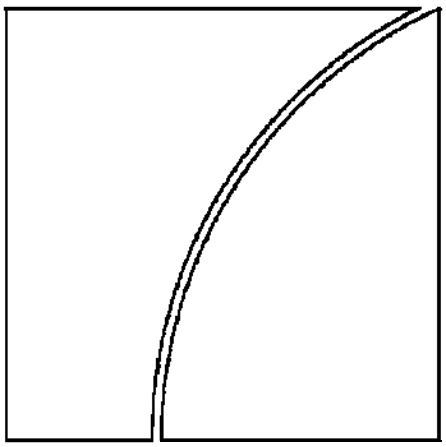
Basel Committee
on Banking Supervision

Working Paper No. 20



The policy implications of transmission channels between the financial system and the real economy

May 2012

BANK FOR INTERNATIONAL SETTLEMENTS

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Copies of publications are available from:

Bank for International Settlements
Communications
CH-4002 Basel, Switzerland

E-mail: publications@bis.org

Fax: +41 61 280 9100 and +41 61 280 8100

This publication is available on the BIS website (**www.bis.org**).

ISSN 1561-18854

Contents

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Prologue

The Research Task Force Transmission Channels Project

The Research Task Force Transmission Channel (RTF-TC) project was conceived before the onset of the recent global financial crisis. From the beginning, RTF-TC was intended to be a long-term project that would involve many RTF member institutions. The primary goal was to generate new research on various aspects of the credit channel linkages in the monetary transmission mechanism. Under the credit channel view, financial intermediaries play a critical role in the allocation of credit in the economy. They are the primary source of credit for consumers and businesses that do not have direct access to capital markets. Among more traditional macroeconomic modelling approaches, the credit view is unique in its emphasis on the health of the financial sector as a critically important determinant of the efficacy of monetary policy.

Subsequent to the start of the RTF-TC, the onset of the global financial crisis focused policymakers' attention on the health of the financial sector. While the RTF-TC did not anticipate the financial crisis, its work did progress as the financial crisis unfolded. Many of the research papers produced in this project made use of new data and insights gained from the work that many RTF member institutions undertook during the course of the financial crisis. Six workshops hosted by the Bank of Italy, by the Bank of France and the French Prudential Supervisory Authority, by the UK Financial Services Authority, by the Bank of Canada and the Canadian Office of the Superintendent of Financial Institutions, by the US Office of the Comptroller of the Currency, and by the Central Bank of Norway provided venues to present innovative research studies, but also, importantly, to receive feedback from RTF member institution colleagues.

The research papers and findings produced by the RTF-TC are in most cases preliminary and still undergoing revision and refinement. Still, RTF-TC research has produced many new insights and analysis that help us to better understand the linkages between the financial sector and real economy. The work of the RTF-TC included detailed econometric analysis of credit data from many RTF member countries, theoretical modelling contributions, dynamic stochastic general equilibrium calibration exercises and experiments, and the investigation of new analytical approaches for financial stability monitoring and systemic risk analysis. The results of these projects should help to inform macroprudential policy development.

The final products of the RTF-TC project are two working papers that summarise the findings of the many individual research projects that were undertaken and discussed in the course of the project. The first working paper, Basel Committee Working Paper No 20, "The policy implications of transmission channels between the financial system and the real economy", analyses the link between the real economy and the financial sector, and channels through which the financial system may transmit instability to the real economy. The second working paper, Basel Committee Working Paper No 21, "Models and tools for macroprudential analysis", focuses on the methodological progress and modelling advancements aimed at improving financial stability monitoring and the identification of systemic risk potential. Because both working papers are summaries, they touch only briefly on the results and methods of the individual research papers that were developed during the course of the project. Each working paper includes comprehensive references with information that will allow the interested reader to contact any of the individual authors and acquire the most up-to-date version of the research that was summarised in each of these working papers.

Paul Kupiec, FDIC and Chairman of the Basel Committee Research Task Force

The policy implications of transmission channels between the financial system and the real economy

Introduction

The recent global financial crisis was a catalyst for regulatory change. Policymakers have strengthened existing micro-prudential tools, such as bank-specific capital and liquidity requirements, and introduced new macro-prudential tools, such as countercyclical capital requirements, capital surcharges for systemically-important financial institutions, and loan-to-value caps to promote financial stability. In addition, stress testing has taken on new importance both as a means for helping policymakers decide on a course of action and as a tool for communication.

At the same time, data emerging from the crisis provides new information about transmission channels between the financial system and the real economy. For example, it is now obvious that economic models and analysis must account for the state of the financial system when forecasting the evolution of the macroeconomy. Moreover, the crisis has shown that linear approximations based on data from normal economic times fail in periods of financial sector stress. Such issues highlight the need to improve our understanding of the role of the financial sector in the monetary transmission channel.

Over the past two years, a subgroup of the Research Task Force, the Transmission Channels (RTF-TC) project, has worked to produce original research that addresses questions and outstanding issues regarding the role the financial sector plays, both for economic growth and as a source of economic instability. During this period, research has been presented by the contributing institutions at several international workshops (described in the Appendix). These workshops have facilitated the communication of ideas and the interaction of researchers working on the relevant topics. Many significant contributions have been made during this time. This document summarises the group's findings. It is important to remember that most of this research is preliminary, and individual authors will continue to refine their analysis and conclusions. So while we offer this summary of the group's findings, we stress their preliminary nature, and caution against using these results to formulate policy without further research and supporting analysis. Moreover, we caution that this document is not a comprehensive literature review, but reflects the specific contributions and insights of the RTF-TC members.

This report is designed as a reference document for policymakers, bank supervisors, and researchers alike and is organised around four topics: (1) the interactions between bank credit, monetary policy and growth in the real economy; (2) costs and benefits of bank capital and liquidity regulation; (3) bank risk taking and monetary policy; (4) asset price bubbles and cyclical properties of regulation. For each of these topics, several key questions have been identified for discussion. We conclude each section by highlighting the new issues and questions that have arisen and identify some remaining gaps in the literature.

1. The interactions between bank credit, monetary policy and growth in the real economy

Brief summary of literature

This section focuses on the interactions between credit, economic growth, the banking sector and the real economy. It is well-known that monetary policy affects the supply of bank credit. Halvorsen and Jacobsen (2009), Hammerlsland and Traee (2010) and Tabak et al (2010) all

confirm that tighter monetary policy has a negative impact on bank lending. Moreover, this effect reflects at least in part a reduction in loan supply as shown by Ciccarelli et al (2010), Black and Rosen (2009), Jimenez et al (2010), Havro and Vale (2011) and Jimborean and Messonier (2010).

The transmission channel of loan supply to the real economy is investigated in Hirataka et al (2010), Dedola and Lombardo (2009), Jimenez et al (2010), de Haas and van Horen (2010) and Black and Rosen (2009). These papers find that bank balance sheet conditions greatly influence the transmission of shocks to the real economy as the health of bank balance sheets affects bank lending and the credit available to bank dependent borrowers.

The efficacy of monetary policy may depend on market conditions. Havro and Vale (2011), Ciccarelli et al (2010), de Haas and van Horen (2010) and Boissay (2011) show that a drop in market liquidity weakens the credit channel of monetary policy and leads to a negative contribution to GDP. Monnin and Jokipii (2010) find a positive link between measures of banking sector soundness and growth in the real economy.

Some RTF-TC research focused on understanding the impact of leverage and liquidity on the provision of credit. The evidence appears to be mixed. Some authors do not find a clear direct effect of leverage on lending (Havro and Vale (2011)), while others provide evidence that better capitalised banks, to a varying degree, are more willing to lend (Berrospide and Edge (2010); Foglia et al (2010)). Further evidence of the importance of bank health is provided by Francis and Osborne (2009) who show that banks with capital in excess of their own capital target lend more than their peers. The impact of liquidity on the provision of credit appears to be similar. Banks with more liquid portfolios appear more willing to lend (Havro and Vale (2011)).

Based on findings by the RTF-TC, this section of the report addresses the following questions: (1) How does monetary policy impact the credit channel? (2) Do financial market conditions impact the credit channel? (3) What is the relative importance of the bank lending and borrower balance sheet channels in the financial transmission mechanism? (4) How do higher capital standards impact economic growth, credit availability and financial stability?

(1) How does monetary policy impact the credit channel?

Empirical studies have found evidence that increases in the central bank policy rate have a negative impact on bank lending. Examples of such papers using macroeconomic data include Halvorsen and Jacobsen (2009) and Hammerlsland and Traee (2010) which study both the UK and the Norwegian economies. Similarly, at the micro (bank) level, Tabak et al (2010) find that bank lending is reduced in response to an increase in the central bank policy rate in Brazil. While such an effect is consistent with the existence of credit channel influences on credit supply, these studies do not prove that credit channel effects are present since they do not identify whether the amount of credit changes because of a shift in credit supply or a change in credit demand.

Several papers have tried to solve this identification problem. Ciccarelli et al (2010) use the confidential euro area Bank Lending Survey and the publicly-available US Senior Loan Officer Survey to disentangle the effects of loan supply from loan demand. They find loan supply to be more sensitive to monetary policy shocks than loan demand. Black and Rosen (2009) use bank-level data on extensions of business credit to examine how monetary policy affects aggregate loan supply. They examine the distribution of loans across firms of different sizes, the maturity structure of loan originations and the supply of loans from small and large banks. They find monetary policy affects aggregate loan supply by causing variation in the maturities of new originations, with the impact being at least as strong for large banks as for small banks. Jiménez et al (2010) use disaggregated data for analysing the bank lending

channel and conclude that the provision of loans is significantly affected by tighter monetary policy. Havro and Vale (2011) as well as Jimborean and Mésonnier (2010) provide further evidence using Norwegian and French data, respectively.

The empirical findings highlighted above suggest that at least part of the effect on bank lending from tighter monetary policy is supply driven, ie there is a bank lending channel for monetary policy.

(2) Do financial market conditions impact the credit channel?

Financial market conditions appear to affect the strength of the credit channel. More specifically, a decrease in market liquidity weakens the credit channel of monetary policy and results in slower GDP growth for any given level of the policy rate. Even in the presence of very low interest rates, when market liquidity conditions are poor, credit availability is subdued as banks tighten lending standards, especially for uncollateralised borrowers. Recent theoretical models have considered the optimal policy responses to adverse financial shocks; such models suggest that aggressive easing of monetary policy is appropriate and that higher capitalised banking systems can attenuate this liquidity effect.

Norwegian banks were not exposed to subprime-related assets, but they were affected by global market liquidity conditions. Havro and Vale (2011) regard the aftermath of the Lehman crisis as an exogenous liquidity shock for the Norwegian banking system. They find that, following the Lehman bankruptcy shock, Norwegian banks' loan supply curve became considerably steeper and the traditional bank lending channel of monetary policy may not have been working in the crisis period. In a related study, Ciccarelli et al (2010) show that during the recent financial crisis, liquidity problems had a strong negative impact on GDP growth by reducing loan supply to businesses.

The wholesale market plays a central role in determining market liquidity conditions. Boissay (2011) argues theoretically that the wholesale financial market improves the allocation of liquidity inside the banking sector, but becomes fragile when available liquidity exceeds the liquidity absorption capacity of the economy. This leads to a "crisis time" equilibrium that is characterised by deleveraging.

Monetary policies may have to adapt to reflect the condition of the financial sector. De Fiore and Tristani (2009) develop a model that relaxes the assumption of frictionless financial markets and show that an aggressive easing of policy is an optimal response to adverse financial market shocks. Similarly, using dynamic stochastic general equilibrium (DSGE) models with financial frictions, Dib (2010) finds that higher capital requirements can attenuate the real impact of financial shocks on the macroeconomy; and Tomura (2010) demonstrates that liquidity mismatches in bank balance sheets lead to an endogenous demand for bank capital to prevent bank runs.

In a financial crisis, bank behaviour can offset monetary policy stimulus. De Haas and van Horen (2010) examine how the global financial crisis prompted banks to tighten lending standards despite very low policy interest rates. Using data on syndicated loans made to private borrowers in 65 countries over the period 2005–2009, they find tighter lending standards for uncollateralised loans, for loans to first-time borrowers and for financial-sector borrowers in developed countries. Increases in borrower screening and monitoring were less evident for rated borrowers and for loans structured by well-known arrangers.

Analysis of counterparty exposures may help anticipate bank crisis behaviour. Castrén and Kavonius (2009) use euro area flow-of-funds data to construct a sector-level network of bilateral balance sheet exposures, which they extend to risk-based balance sheets. They find that bilateral cross-sector exposures are important channels through which financial

intermediaries affect borrowers in other sectors including the transmission of financial sector shocks.

(3) What is the relative importance of the bank lending and borrower balance sheet channels in the financial transmission mechanism?

The evidence of the importance of bank capital positions for sustaining bank loan growth is mixed but the data supports the importance of household balance sheets as a factor limiting credit. Some studies find that well capitalised banks are more likely to grant credit and are less likely to limit credit. However, other studies find banks that are holding less capital are more willing to lend. On the borrower side of the equation, research shows that balance sheet conditions are the dominant credit channel affecting households. Households with weak balance sheets and credit performance are less likely to obtain credit from a bank.

Bank capital conditions can affect the strength of the credit channel. Foglia et al (2010) use bank loan- and firm-level data to separate bank lending effects from borrower balance sheet effects in order to quantify how loan supply constraints affected real investment spending following the collapse of Lehman Brothers in 2008. They find that well capitalised banks with balanced maturity structures were less likely to ration credit. Moreover, after the Lehman crisis, rationed firms tended to reduce investment spending by a greater amount than non-rationed firms.

Jiménez et al (2010) use an extensive dataset of business loan applications and originations to examine how lending is related to the balance sheet conditions of both the banks as well as the firms seeking credit. They find that both of these balance sheets (banks' and business') play an important role in determining how changes in economic activity or short-term interest rates affect the extension of credit. Unsurprisingly, well-capitalised firms were more likely to be granted credit than their more poorly-capitalised counterparts. However, banks with less capital or liquidity (ie riskier banks) were more, not less, likely to make loans.

Avery et al (2010) use localised measures for bank health and household debt performance to examine how bank and borrower balance sheets affect local economic activity. On the local level, bank capital had a stronger direct link to economic activity (unemployment rates) during the housing boom and bust period than during the previous decade. However, this capital channel does not appear to operate through expanded household lending, a finding that may reflect that national lenders dominate US mortgage and consumer credit markets. This is consistent with the idea that balance sheet conditions are the dominant credit channel affecting households and suggests that, at least at the local level, banks matter mainly for business spending, through commercial and industrial lending.

Theoretical models may help to explain the interaction between bank lending and borrower balance sheet channels that we observe in the data. Hirakata et al (2011) develop a DSGE model where financial intermediaries invest household savings with entrepreneurs. In this model, shocks to borrower creditworthiness are propagated to the real economy through the revisions of credit contracts. When the model is estimated using US data, the authors find that adverse shocks to financial intermediaries cause larger economic downturns than do shocks to entrepreneurs. In another theoretical paper, Dedola and Lombardo (2009) model a two-country economic system with a financial accelerator and an endogenous portfolio choice to show how foreign exposures in the balance sheets of leveraged investors can propagate shocks across countries. In this framework, financial sector shocks can cause large real sector shocks even with minimal balance sheet exposure to foreign risky assets (so long as asset market integration across borders generates an equalisation of external finance premia faced by leveraged investors). In this scenario, a global flight to quality will yield similar (de-)leveraging, financial and macroeconomic dynamics across countries.

Bank lending shocks have important effects on real sector growth and volatility. Halvorsen and Jacobsen (2009) find that bank lending shocks explain a substantial share of output gap variability in Norway and the UK from 1988 through 2009. This period includes both the Norwegian banking crisis (1988–1993) and the more recent financial crisis in the UK. Using data for 18 OECD countries from 1981 through 2008, Monnin and Jokipii (2010) examine the relationship between banking sector stability and the real economy. Using country-level indicators of financial sector health, they find a relationship between banking sector stability and the performance of the real economy. In a related study, Jimborean and Mésonnier (2010) link French bank balance sheet characteristics to macroeconomic fluctuations and find that banking sector conditions matter more for real sector performance during crisis periods. Moreover, since the results show that feedback effects tend to be largely driven by periods of instability, there are likely to be real economic benefits from well-executed macroprudential supervision.

Together these studies suggest several important ways through which financial sector problems magnified real sector volatility. Bank capital and liquidity problems had adverse real consequences through reductions in credit supplied to businesses. At the same time, the severe impairment of households' balance sheets and the deterioration of their credit performance reduced the willingness of even healthy banks to lend to the household sector.

(4) How do higher capital standards impact economic growth, credit availability, and financial stability?

Since the financial crisis, policymakers have focused on regulatory enhancements aimed at preventing future crises. Bank capital regulation has been at the forefront of discussions as a means to ensure the resilience of the global financial system. Despite the obvious benefits of increasing required capital, critics argue that stronger capital and liquidity regulations will reduce bank credit, stifle economic growth and reduce financial stability. In this section, we discuss the RTF-TC's findings regarding bank capital, economic growth, credit availability, and financial stability.

(a) Bank capital and economic growth

Bank capital and liquidity regulations must strike a balance between costs and benefits. Several papers presented at the RTF-TC workshops compare the costs and benefits associated with higher capital and/or liquidity requirements. For example, Francis and Osborne (2010) model the costs of additional capital as an increase in the wedge between lending and deposit rates and estimate the net economic benefits associated with a range of changes in prudential standards. In a related study, Kato et al (2010) show that the optimal level of bank capital varies considerably depending on the level of banks' liquidity as well as macroeconomic conditions.

The optimal level of bank capital may not be constant over the business cycle. In addition to comparing costs and benefits associated with tighter regulations, Kato et al (2010) highlight the need for a countercyclical buffer to better prepare for prospective distress. Repullo et al (2010) offer a specific proposal for a countercyclical capital buffer. Christensen et al (2011) show that absent regulation, bank leverage fluctuates as the macroeconomic environment changes to accommodate the economy's requirements for lending with the natural inertia in bank capital. Regulation that limits, or directs, movements in leverage can thus importantly affect the propagating impact of bank capital.[1]

[1] This topic is addressed more completely in Section 4 below.

(b) Bank capital and credit availability

When a bank faces a capital shock from losses or a change in regulation, it must consider the trade-off between the marginal costs of issuing equity and the marginal cost of cutting back on lending. Kiley and Sim (2010) model this trade-off. Banks respond to a shock through a mix of financial disintermediation and recapitalisation. Agur (2010) analyses the trade-off between financial stability and credit rationing that arises when capital requirements are increased and shows that with greater use of wholesale finance, capital requirements have a stronger impact on the real economy. This impact results from feedback effects between loan rates and funding rates. Since uninsured financiers – who represent wholesale investors – care about the risk of the bank they are lending to, higher loan rates lead to higher funding rates, which amplifies the impact of capital requirements.

The empirical evidence on the effects of capital shocks on lending supports the theory. Francis and Osborne (2010) use data on UK banks and show that better capitalised banks are more willing to supply loans.[2] This feature is especially true in times of crisis (Foglia et al (2010)). Coffinet et al (2010) use micro data on French banks to show that bank capital behaves in a procyclical manner especially when better quality capital is considered. Darracq et al (2010) assess the effects of introducing risk-sensitive and more stringent capital requirements. They show that a bank capital shock results in an increase in bank leverage which, in order for banks to re-establish their target leverage ratio, leads to an increase in banks' loan-deposit margins. This is mainly driven by higher lending rates, which in turn lower loan demand and real activity. They conclude that if banks have more time to adjust their activities and balance sheets to a new environment, they will tend to smooth the impact of the shock.[3]

(c) Bank capital and financial stability

In the aftermath of the recent financial crisis, much debate has been focused on new regulations that were introduced to preserve financial stability. In addition to the need to increase individual bank resilience, a consensus has emerged regarding the need to consider financial stability from a systemic perspective. Some papers studied by the working group estimate models of bank default probabilities as well as the probability of a financial crisis more generally. Osborne et al (2010) and Kato et al (2010) estimate probit/logit models of the probability of a financial crisis occurring. Capital and liquidity ratios are key determinants of the likelihood of a crisis with higher ratios being associated with a reduced probability. Higher capital and liquidity standards lower the probability of a crisis.

Capital regulations may need to consider the potential for contagion. Gauthier, Lehar and Souissi (2010) estimate overall systemic risk by explicitly incorporating contagion externalities present in the financial system. They show that systemic capital allocations can differ substantially and are not directly related to bank size or individual bank default probability. Systemic capital allocation mechanisms are estimated to reduce default probabilities of individual banks as well as the probability of a systemic crisis by about 25%. Their results suggest that financial stability can be enhanced by implementing a systemic perspective on bank regulation.

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[2] Interestingly, the UK study by Francis and Osborne (2010) contradicts Jimenez et al (2010) that uses data from Spain.

[3] This finding may also have implications for the implementation of the countercyclical capital buffer proposed by the Basel Committee. One aspect of that discussion is how long of a grace period should be given to banks to comply with higher capital requirements that arise from the activation of the countercyclical buffer. The results of Darraq et al (2010) suggest that a shorter adjustment period might result in a bigger impact on lending growth.

New questions and issues that have arisen

In assessing this strand of literature, some new questions and issues have arisen.

- What roles do the structures of the bank and the non-bank sectors play in the longer-term development of real estate booms? Evidence suggests that low interest rates were one of the key factors contributing to the leverage build up; however, competition between the un-regulated and regulated financial sectors may have contributed to risk taking in extending credit to riskier borrowers.
- How have credit market developments that increase the degree of lending beyond the banking sector affected linkages between the banking system and the real economy?
- Similarly, how do secular trends in bank credit extensions – such as shifts to asset-based lending in real estate boom periods – affect linkages between banks and the real economy during bust periods?
- Finally, an important dimension of the bank lending channel is the potential for a misallocation of resources in the real economy. Is there some way to quantify the real effects of bank lending in terms of types of investment spending occurring in the real sector of an economy and the attendant misallocation of resources associated with overbuilding in the residential real estate sector?

Remaining gaps in the literature

Several important gaps remain in the literature studying the interaction between credit, growth, the banking sector and the real economy. Evidence on the role of financial markets in the credit transmission channel of monetary policy remains scarce, while the role of market funding and securitisation should also be further researched.

In addition, in light of the vast amount of public funds injected into the financial system during the course of the financial crisis, the efficacy of public (vs private or market-based) capital injections remains relatively unexplored. Such evidence could perhaps inform on the macroeconomic implications of loss absorbency that is provided using contingent capital or bail-in debt instruments to systemically important institutions. Moreover, another interesting question is whether new regulations should account for government shareholders in the bank.

From a methodological point of view – regardless of the methodology used (ie VAR-type models, DSGE models, or theoretical models) – limited attention has been paid to nonlinearities and structural breaks. For instance, the effect of Basel II inception or the specificity of downturn periods has only been scarcely investigated. In light of the recent financial crisis, nonlinearities in relationships in crisis and non-crisis periods have emerged as a key gap in the research. More work is needed to understand differences between how credit channels work in both good and bad times. In addition, there is little evidence on how the financial environment prior to a crisis affects the economic significance of a particular credit channel for economic activity. Further work on these issues would also be fruitful.

Additionally, more work needs to be done to identify shocks to loan supply that are due to changes in loan demand generated by future profit expectations. Credit demand reflects expectations about future investment opportunities as asset values are inherently forward looking. Thus lower asset values can change credit demand by affecting the balance sheets of banks and borrowers, but they may also signal lower expected future returns from holding the asset which may itself reduce the demand for credit.

Finally, more research is needed to understand how linkages between banking sector conditions and real sector activity are related to specific institutional and regulatory features of an economy.

2. Costs and benefits of bank capital and liquidity regulation

Brief summary of literature

Higher capital and liquidity requirements may generate social benefits by reducing the frequency and severity of banking crises and the accompanying loss of economic output, and may generate costs by impacting the price and availability of credit and other financial services, and thereby altering the level of investment and output in the economy. Schanz (2009), Schanz et al (2011), Barrell et al (2009) and Kato et al (2010) aim to quantify the overall costs and benefits of higher capital and/or liquidity standards. The results of these studies are broadly similar, although there are some quantitative differences, reflecting different assumptions about departures from the Modigliani-Miller (M-M) theorem, among other factors.

In terms of the benefits that would result from tighter regulation, Barrell et al (2009) and Kato et al (2010) both find that higher standards should lower the probability of a financial crisis. In contrast, Schanz et al (2011) concludes that the results vary depending on the specific assumptions that are made in the model.

The thrust of the literature on the role of bank capital and liquidity is that more capital and liquidity will smooth credit availability over financial cycles, although whether this outcome can be achieved by imposing fixed requirements remains somewhat less clear.

This section considers the following questions: (1) What are the costs and benefits of higher capital and liquidity requirements? (2) What are the key differences between studies on the costs of increased capital requirements? (3) What are the implications of these liquidity and credit supply findings for the Basel liquidity standards? (4) Is it possible to quantify the benefits of tighter regulation?

(1) What are the costs and benefits of higher capital and liquidity requirements?

Following the recent financial crisis, it has been widely recognised that in order to reduce the risk of future financial crises, both capital and liquidity buffers are needed to withstand shocks. Several papers shed light on the costs and benefits of stricter capital and liquidity regulations and provide significant insight into the new standards.[4]

The costs of higher capital and liquidity requirements are generated by the impact that higher requirements have on the price and the availability of credit, and the effect that this has on the level of investment and output in the economy. One of the benefits of higher capital and liquidity standards is a lower probability of a financial crisis and the associated reduction in the expected cost of such a crisis in terms of lost output. The studies reviewed (Schanz et al (2011), Barrell et al (2009) and Kato et al (2010)) make varying assumptions about each of these elements, leading to somewhat different results in terms of the overall costs and benefits of the more robust standards.

[4] We note that the studies reviewed here have also contributed to the work of the Basel Committee's Top-Down Calibration Group whose report is available on the BIS website.

Osborne et al (2010) enhance the UK Financial Services Authority/National Institute of Economic and Social Research (FSA/NIESR) modelling framework by including micro-foundations that generate individual bank responses to changes in prudential standards. They also include alternative parameterisations of the macroeconomic costs and benefits used in the framework. Macroeconomic costs associated with liquidity are refined using market and regulatory data (between 1999 and 2007) and integrated into the National Institute Global Econometric Model (NiGEM) framework and the model is modified to account for changes in the composition of regulatory capital. The improved model has fewer type 1 errors (ie the failure to identify an observed crisis) and fewer type 2 errors (ie the false identification of a crisis). This finding suggests that capital and liquidity requirements are both important for reducing the probability of and macroeconomic costs of a crisis.

(2) What are the key differences between studies on the costs of increased capital requirements?

Bank capital is costly because of frictions in financial markets that lead to deviations from M-M, which would otherwise predict that higher equity capital would not increase banks' funding costs. In the calculation of the costs, banks are assumed to pass on the extra funding costs from higher capital to borrowers by raising lending rates. This reduces the activities of borrowers, thereby resulting in a loss in GDP. The papers reviewed differ from each other in the assumptions that they adopt regarding the magnitude of the deviations from M-M, resulting in different estimates of the costs of higher capital requirements.

To estimate the effects of costly bank capital, Schanz et al (2011) applies a range of assumptions about deviations from M-M to data on the cost of equity and debt in the UK. The paper concludes that the curve showing the marginal benefits of higher capital ratios is quite steep at the intersection with all of the (horizontal) marginal cost estimates, so estimates of the "optimal" capital ratio do not vary much in the cost estimates.

Due to the challenges associated with achieving a definitive parameterisation of the relationship between capital ratios and the cost of credit, Barrell et al (2009) take an empirical approach using an estimate of the long-run relationship between the capital ratio and the cost of credit for the economy of the UK. The parameters they estimate result in an impact of a one percentage point increase in the capital ratio of around 12–15 basis points. Compared to the Schanz et al (2011) results, these represent a relatively conservative parameterisation. The study by Kato et al (2010) uses a formula for welfare loss associated with capital requirements taken from van den Heuvel (2008).

Changes in the cost of bank credit will translate into changes in investment, consumption and GDP. Schanz et al (2011) calculates the long-term impact of the increase in loan rates on GDP using a CES production function with increased firms' cost of capital due to higher loan rates, whereas Kato et al (2010) and Barrell et al (2009) use in-house macroeconomic models for this element of the modelling. The cost of higher liquidity is calculated by a "cost of carry" that is equal to the increase in the cost of credit required to offset the impact of holding a higher proportion of liquid assets with lower yield, such as cash and government bonds, on either return on equity (ROE) or return on assets (ROA).

(3) What are the implications of these liquidity and credit supply findings for the Basel liquidity standards?

The effects of liquidity requirements may depend on monetary conditions. Much of the research considering the impact of higher liquidity standards on financial stability has been limited to empirical models of the probability of a financial crisis. Several recent studies have examined how liquidity conditions affect credit supply under tight monetary conditions. Among these, Jimenez et al (2011) finds that banks with more liquid assets tend to be more

resilient to tight monetary policy and deteriorating economic conditions, while weaker banks tend to contract credit supply. These results may be explained by banks with stronger balance sheets being better able to raise funds during tight monetary conditions, consistent with the finding that higher liquidity is associated with a lower probability of a crisis (and, in the case of Schanz et al (2011), lower probability of individual banks defaulting). These findings are largely consistent with the traditional view of the bank lending channel.

Banks with stronger liquidity positions are more likely to maintain lending, but this may not provide accurate guidance as to the potential impact of minimum liquidity standards. The beneficial impact of higher liquidity during stressed market conditions, together with the already existing literature on the bank lending channel seem to suggest that higher liquidity standards will smooth credit supply over financial cycles. However, we should be cautious about drawing conclusions about liquidity *requirements* from results on the effect of liquidity *conditions*. There are other factors which could explain the results with respect to liquidity conditions. For example, banks that anticipate strong loan demand in the near future, or banks that have a lot of outstanding loan commitments may optimally decide to hold more liquid assets today in order to be ready for the moment the lending opportunities materialise, as in the traditional "pecking order" theory of corporate finance. This could explain the observed correlation, but it does not mean that if banks are required to hold more liquid assets then they will automatically lend more, as they will not have the same investment opportunities. Indeed, requiring higher liquid assets could reduce the supply of credit if it reduces the net present value of lending opportunities.

Consider as well the issue that a bank subjected to a regulatory requirement to hold a specified level of liquid assets may not be able to absorb shocks as well as one not subject to the requirement. The former may be unable to sell its liquid assets because it would fall below the liquidity requirement. In this manner, liquidity held by choice is distinct from liquidity held because of a requirement.

Another possibility recognises that banks may adjust their loans and liquidity to maintain a preferred balance. Suppose exogenous factors could push liquid assets above banks' desired level. The bank may respond by expanding credit to regain its desired balance with liquid assets. Hence, the correlation between liquid asset holdings and credit supply could be just a short-run phenomenon (eg Francis and Osborne (2009) or Berrospide and Edge (2010)). According to this view, higher liquidity standards could reduce credit supply by reducing the amount of excess liquid assets. This view suggests that studies need to closely examine the reasons why some banks have higher liquidity ratios than others in order to be able to understand the effect of higher liquidity standards.

(4) Is it possible to quantify the benefits of tighter regulation?

Estimates of the benefits of tighter regulation depend on whether empirical models incorporate non-linear terms to account for the potential imperfect substitutability between liquidity and capital. Papers by Barrell et al (2009) and Kato et al (2010) model the probability of a financial crisis based on historical data and using capital and liquidity measures as regressors. There are two significant differences between the studies. Barrell et al (2009) model only linear effects for the capital ratio and the liquidity ratio and this assumption can lead to corner solutions where it is optimal to hold either capital or liquidity, but not both. Kato et al (2010) identifies non-linear effects of capital and liquidity, which implies that capital and liquidity may be imperfect substitutes for each other, in the sense that higher capital is more effective in reducing the probability of a crisis if liquidity is high as well. The finding that capital and liquidity are mutually reinforcing may be interpreted as providing support for the introduction of international liquidity standards as a supplement to capital standards. Another important distinction is the use of different measures of liquidity. Whereas Barrell et al (2009) find a role for the ratio of liquid assets-to-total assets, Kato et al (2010) have the same finding

but also find that higher liability-side liquidity (ie the extent to which firms rely on long-term debt) is also a key mitigant of the probability of crisis.

Calculating the net benefits of higher standards means combining the estimates of the reduction in the likelihood of a crisis by the estimated cost of a financial crisis. The difficulties for doing this are well described by Schanz et al (2011) who show both that a wide range of estimates are available, and that very different results can be obtained by varying the assumption of whether financial crises result in a permanent reduction in growth.

New questions and issues that have arisen

The introduction of Basel III has generated substantial interest in understanding the economic consequences of enhanced prudential standards. Many of the costs and benefits associated with the new rules have been addressed in the literature discussed above. However, several new questions and issues have emerged.

- The studies have looked at the potential impact of liquidity standards, which are now based on an internationally agreed standard. While the research suggests that banks with greater liquidity can better maintain lending over the cycle, there is a need for further research on how banks react to liquidity standards, the potential costs of such standards, and the potential impact on banks' risk-taking. Analytical input will be needed to monitor and investigate how the new standards (the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR)) work in practice to reduce the risk inherent in a bank and the banking sector.
- What are the likely behavioural effects of new capital and liquidity standards? In particular, what impact will higher standards have on banks' risk-taking? Could the substantial increase in standards seen in Basel III result in a migration of risk to the nonbank sector, and if so, how can this be addressed?
- How do the costs and benefits of higher standards vary depending on economic and financial conditions? The papers by Schanz et al (2011) and Kato et al (2010) showed that variations in initial conditions had a large effect on the results in terms of optimal calibration of prudential policy and thus it will be important to understand what drives these differences, particularly in light of the increased focus on "macroprudential" policies. Indeed, the net benefits associated with Basel III implementation in each jurisdiction will likely depend on the economic and financial conditions before and during the transition period, which of course can vary across jurisdictions.
- How should feedback effects from the macroeconomy be evaluated, both in the context of whether there are steady-state or transitional costs of higher standards, and how shocks can be amplified by an undercapitalised banking system when standards are in some sense too low?

Remaining gaps in the literature

Together, the papers discussed above provide a useful clarification of the issues relating to bank capital and liquidity regulations, but several gaps in the literature remain. More work is needed to understand the nature of the costs of a financial crisis. In particular, is the effect on economic growth temporary or permanent? Is the loss due to the occurrence of a crisis recoverable? What determines the magnitude of a loss? Do output loss estimates need to be adjusted for the possibility that a financial crisis could potentially be caused by a slowdown of the economy, rather than the other way around?

Moreover, it is still unclear how the probability of a crisis occurring would change when banks with different levels of capital and liquidity – even if the average of the banking sector as a

whole is still the same – are interconnected within a certain jurisdiction and across jurisdictions. In addition, the extent to which banks would pass on the costs from stricter regulation to their borrowers remains unclear. To what extent would the effect come from increasing loan rates and to what extent by credit rationing? How does the impact change depending on the economic environment, the degree of competition in financial service markets, financial structure (the importance of indirect finance), and the size of the borrowers? Finally, even though a leverage ratio has been introduced as part of the Basel III package, most of the studies reviewed focus on risk-weighted capital ratios. In this context, it may be useful to further examine how and when these two different capital regulations might complement or contradict each other for reducing the risks posed to the financial system and the real economy.

3. Bank risk taking and monetary policy

Brief summary of literature

There are three main ideas presented in this section. First, Altunbas et al (2010), Tabak et al (2010), Jimenez et al (2008) and Dubecq et al (2009) conclude that a low interest rate environment increases a bank's risk taking. Second, Maddaloni and Peydro (2010), Altunbas et al (2010) and Dubecq et al (2009) demonstrate that loose monetary policy and weaker bank supervisory standards promote risk taking. Third, Christensen and Meh (forthcoming 2012) show that macroprudential tools and regulation can be used to mitigate financial imbalances. Moreover, Christensen et al (2011) show that countercyclical capital requirements can be used as instruments to lessen risk taking.

This section of the report considers the following questions: (1) Does monetary policy affect banks' willingness to take risks? (2) Can macroprudential tools and regulations be used to mitigate risk taking spurred by monetary policy? (3) Do tighter capital requirements make banks reduce their risks?

(1) Does monetary policy affect banks' willingness to take risks?

There has been considerable focus on the role of monetary policy in the recent financial crisis. In particular, did low interest rates spur greater risk-taking? Altunbas et al (2010) point out two important mechanisms that may encourage banks to increase their risk positions in a low interest rate environment. In one mechanism, low interest rates boost asset prices, reduce asset price volatility and lead to lower estimated risk which may in turn encourage firms to invest in riskier assets. The second mechanism operates via incentives for asset managers to "search for yield" to meet their performance targets and bonus payments when interest rates are low. Both effects may be amplified if agents anticipate that monetary policy will be relaxed when asset prices decrease in a financial downturn. Moreover, Dubecq et al (2009) argue that regulatory arbitrage in conjunction with fuzzy capital requirements may lead to poor risk assumptions by market participants. In their theoretical model, low interest rates amplify the underestimation of risk that arises due to other distortions in the financial system.

Empirical findings for banks operating in the euro area and in the US presented in Altunbas et al (2010) provide support for the hypothesis that banks increase risk-taking when interest rates are low for an extended period of time. Moreover, the longer interest rates are below those implied by a benchmark model, the greater the impact on bank risk-taking. Jiménez et al (2008) identify the impact of short-term interest rates on credit risk-taking by analysing a comprehensive credit register from Spain. The results suggest that lower overnight rates prior to loan origination lead banks to lend more to borrowers with a worse credit history and to grant more loans with a higher per period probability of default. Lower overnight rates

during the life of the loan reduces this probability. Using Brazilian data, Tabak et al (2010) also find that lower monetary policy rates increase the risk-taking of banks. Evidence suggesting a link between loose monetary policy and weaker bank supervisory standards has also been presented in Maddaloni and Peydró (2010) and Agur (2010).

(2) Can macroprudential tools and regulations potentially be used to mitigate risk taking spurred by monetary policy?

Recent policy discussions have examined regulations and macroprudential tools as a means to change the structure of the regulatory environment in which banks operate. The ultimate goal of macroprudential policy is to mitigate risks to the functioning of the financial system as a means to prevent widespread financial or banking system distress and ultimately real losses in terms of economic performance. Research that assesses the virtues of using macroprudential tools rather than traditional monetary policy in responding to financial imbalances has only recently emerged. Evidence suggests that macroprudential tools targeted at housing finance have an advantage over the standard monetary instrument in mitigating financial imbalances (see Christensen and Meh (forthcoming 2012) discussed in Section 4 below). There is much less evidence on the effects of countercyclical capital requirements but some evidence shows that the cyclical properties of capital requirements does matter (eg Christensen et al (2011) also discussed in Section 4 below). Moreover, a strong interconnection between monetary policy and bank regulation policy suggests that close cooperation between policy makers is likely to be fruitful.

New questions and issues that have arisen

In the aftermath of the recent global financial crisis, central banks have been widely criticised for having kept interest rates too low for too long. As a consequence, research has emerged focused on understanding the relationship between monetary policy and bank risk taking. The following questions have arisen from the discussion above.

- What does evidence suggest about bank lending and risk taking and the structure of bank funding liabilities?
- Does regulatory arbitrage play a key role in the link between low interest rates and increased risk-taking of banks?

Remaining gaps in the literature

More work is needed on how monetary policy and macroprudential policy interact with one another. It is also unclear how supply-side tools, such as capital requirements, would fare against demand-side tools, such as loan-to-value (LTV) ratio restrictions. Future work is needed to compile evidence regarding the macroprudential tools that are most effective in mitigating risk, and how these tools work together and with traditional monetary policy. Moreover, research is needed to further explore how monetary policy interacts with the risk-taking behaviour of banks. The argument for delegation of macroprudential policies to an independent agency also warrants investigation because it is unclear to what extent some theoretical reasoning is similar for both monetary as well as macroprudential policy.

The evidence reviewed finds that higher capital implies less risk taking as well as greater loss absorption. Future research should also study the short- and long-run effects of increased capital requirements on bank risk taking.

Finally, a greater understanding of the relevance of the capital structure is needed. The key questions that remain include the following: What is the appropriate level for capital requirements? Should they vary over the cycle? How should countercyclical capital requirements interact with the monetary policy? Given the theoretical results in Dubecq et al

(2009), more research on the interaction of regulatory arbitrage and low interest rates is necessary, in particular, whether their theoretical findings hold more generally.

4. Asset price bubbles and cyclical properties of regulation

Brief summary of literature

Asset bubbles are quite problematic because even though they create a beneficial boom in the short run, they make the economy less efficient and more exposed to risk especially when the bubble is in the "bust" phase as shown by Dubecq et al (2009) and Aoki and Nikolov (2010). Moreover, housing bubbles are significant because housing is a large portion of most nation's wealth and leveraged financial institutions' portfolios hold a considerable amount of securities that rely on house prices as noted in Aoki and Nikolov (2010) and Dubecq et al (2009). Christensen and Meh (forthcoming 2012) and Antipa et al (2010) conclude that macroprudential tools, such as the loan-to-value (LTV) ratio multiplier, can be used to mitigate the feedback effects driven by household balance sheets. There is a concern raised by Dubecq et al (2009) that a better capitalised system could be more prone to bubbles due to regulatory arbitrage. This does not mean that regulation will cause a bubble. Rather, a bubble has to be in place already and monetary policy can exaggerate this bubble while regulation could hide its presence. This is consistent with the conclusions found by Altunbas et al (2010) and Maddaloni and Peydro (2010).

As discussed in the previous section, Christensen et al (2011), de Haas and van Horen (2010) and Antipa et al (2010) find that countercyclical macroprudential tools may be able to reduce the amplitude of business cycles. Furthermore, Goodhart et al (2009), Francis and Osborne (2010) and Kato et al (2010) analyse how monetary policy can be coupled with macroprudential policies and regulations to encourage financial stability. At the same time, Christensen and Meh (forthcoming 2012) argue that there are some macroprudential tools that have a comparative advantage over the standard monetary instruments used to preserve financial balance, ie the LTV ratio.

This section of the report considers the following questions: (1) Why are asset bubbles so problematic? (2) Should we care about all bubbles, or just housing bubbles? Why is housing so important? (3) What types of macroprudential tools would mitigate the feedback effects driven by household balance sheets? (4) Are better capitalised banking systems more prone to bubbles? (5) What are some possible causes of bubbles? (6) Would countercyclical capital standards likely help to reduce the amplitude of the business cycle? (7) What are the potential interactions between monetary policy and macroprudential policies and regulations? (8) Do macroprudential tools have advantages over monetary policy instruments in terms of increasing financial stability?

(1) Why are asset bubbles so problematic?

The recent financial crisis has shown that bubbles in asset prices can inflict great economic damage when they "burst". The historical experience suggests that the economic damage can be especially large when leveraged financial institutions hold large amounts of assets whose values depend on the bubble. For the recent crisis, this was certainly the case as many banks were exposed to the global housing bubble through their holdings of mortgages or mortgage-backed securities. This contrasts with the bursting of the dot-com bubble of the late 1990s, when the losses were not concentrated among leveraged financial institutions and the economic damage was much milder, at least compared to the more recent (global) recession.

Asset price bubbles are exacerbated by limited liability. Dubecq et al (2009) present a model in which leveraged financial intermediaries are exposed to bubbles. Bubbles arise because of the limited liability of bank shareholders, which creates risk-shifting incentives if depositors do not have full information about the bank's investments causing banks to overinvest in a risky asset. (In spirit, this risk-shifting incentive is similar to the moral hazard problem associated with mispriced deposit insurance or the "too-big-to-fail" problem.) The resulting asset overvaluation relative to its fundamental value is the "bubble". The authors show that this bubble makes the economy less efficient and more exposed to risk: There is a bigger downturn if the risky assets turn out to perform poorly.

Asset bubbles can arise because of misaligned incentives. The idea that imperfections in financial intermediation can lead to bubbles is also a central theme in the model of Aoki and Nikolov (2010). Here bubbles arise because incentive problems prevent entrepreneurs from borrowing as much as they would like from banks. Meanwhile similar incentive problems in financial intermediation imply that bankers cannot raise the optimal amount of funds from households. As a result, the rate of return for savers and bankers can be depressed in equilibrium, which is what can cause a bubble: an asset is overvalued because it is expected to be overvalued in the future as well. When a bubble arises, this creates a beneficial boom in credit and GDP in the short run, but it sets the stage for a future bursting of that bubble, leading to a "bust" phase. Interestingly, Aoki and Nikolov's theory also implies that a bubble held by banks poses more risks to financial stability than a bubble held by unleveraged savers.

While not dealing explicitly with bubbles, many other papers address the importance of banks to the real economy. Section 1 of this report on the interaction between credit, growth, the banking sector and the real economy provides an overview of the key lessons learned in this area.

(2) Should we care about all bubbles, or just housing bubbles? Why is housing so important?

There are at least two reasons why housing bubbles are particularly important. First, in general, housing is a large fraction of national wealth and residential investment is a nontrivial and volatile part of GDP. Second, leveraged financial institutions hold a significant fraction of their portfolio in assets, such as mortgages or mortgage-backed securities, whose values depend greatly on movements in house prices. As mentioned, both historical experience and theory (see Aoki and Nikolov (2010) and Dubecq et al (2009)) suggest that the economic damage of a collapsing bubble can be especially large when leveraged financial institutions are exposed to the collapse.

(3) What types of macroprudential tools would mitigate the feedback effects driven by household balance sheets?

Antipa et al (2010) compare monetary policy to a macroprudential policy that leans against credit using a loan-to-value (LTV) ratio. The comparison is made in the context of a macroeconomic model with financial intermediaries who may take excessive risks due to a moral hazard problem. After estimating their model for the euro area, the US and the UK, these authors find benefits to using the macroprudential tool in addition to monetary policy. In fact, they argue that macroprudential policy would have been very effective in smoothing the last credit cycle, thereby reducing the depth of the Great Recession. A similar conclusion is reached in Christensen and Meh (forthcoming 2012) which is discussed in the following questions.

(4) Are better capitalised banking systems more prone to bubbles?

Dubecq et al (2009) find a negative answer to this question. In their model, raising bank capital requirements can limit bubbles, at least if those requirements are imposed on the risky assets that are prone to overvaluation. Bank capital requirements make holding bubble prone assets less attractive both because bank equity is costly and because there is less to be gained from risk-shifting at the expense of depositors. However, if there is scope for regulatory arbitrage (modelled in the paper through random variation in the capital requirement), then the beneficial role of such regulations is more limited. In fact, the regulatory arbitrage could lead investors to underestimate the risk in the banking sector, thereby resulting in the "under-pricing" of that risk. The authors argue that this is reminiscent of the run up to the recent financial crisis. Moreover, although this is outside the scope of their model, it seems possible that more onerous capital requirements could lead to increased incentives for engaging in such arbitrage.

(5) What are some possible causes of bubbles?

Dubecq et al (2009) argue that loose monetary policy can exacerbate bubbles if the financial system is prone to such bubbles in the first place and there is underestimation of regulatory arbitrage. In their model, the ultimate cause of the bubble is a risk-shifting problem that arises due to limited liability of bank shareholders, combined with lack of full information on the part of depositors. If in addition there is scope for regulatory arbitrage, then capital requirements may not be able to prevent this problem and in fact could lead to under pricing of risks. In that environment, low interest rates worsen the risk-shifting problem. Thus, monetary policy does not cause the bubble, but can make it larger. Similarly, regulations are not the ultimate cause either, but they can "hide" the bubble if regulatory arbitrage is a serious problem. The theoretical mechanism in Dubecq et al (2009) appears to be consistent with empirical findings of Altunbas et al (2010) and Maddaloni and Peydró (2010). Both papers present evidence that during the last decade unusually low interest rates contributed to an increase in banks' risk-taking.[5]

(6) Would countercyclical capital standards likely help to reduce the amplitude of the business cycle?

In December 2010, the Basel Committee issued guidance for national authorities operating the countercyclical buffer regime.[6] The primary aim of the countercyclical capital buffer regime is to achieve the broader macroprudential goal of protecting the banking sector from periods of excess aggregate credit growth that have often been associated with the build-up of system-wide risk. Moreover, the regime is designed to ensure that the banking sector (in aggregate) has sufficient capital on hand to maintain the flow of credit in the economy when the broader financial system experiences stress after a period of excessive credit growth. To the extent that countercyclical bank capital regulations help smooth the business cycle, such a regime could achieve these two objectives.

Christensen et al (2011) employ a theoretical model of bank capital to consider how bank leverage regulations affect the transmission of shocks to the economy and also whether the cyclical properties of such regulations matter. A new Keynesian DSGE model is used to highlight that bank leverage can affect the intensity of monitoring, screening and inspection of bank loans. More specifically, the Christensen et al (2011) model is based on two sources

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5 See the discussion in section 3 on the relationship between bank risk-taking and monetary policy.

6 See Basel Committee on Banking Supervision, *Guidance for national authorities operating the countercyclical capital buffer*, December 2010.

of moral hazard: (i) entrepreneurs may privately choose low return projects to enjoy private benefits, and (ii) banks may have an incentive not to monitor loans in order to reduce costs. It is used to consider a favourable technology shock, a monetary policy easing, and a negative bank capital shock with time-invariant leverage regulations, with countercyclical leverage regulations, and with procyclical leverage regulations. Their findings suggest that regulations that limit, or direct, leverage will alter the propagating impact of bank capital that naturally results from the accumulation of capital from retained earnings so that the effects of technology and monetary policy shocks are dampened, but the effects of shocks to bank capital are exacerbated. Using their theoretical model, Christensen et al (2011) conduct experiments that demonstrate that a countercyclical leverage policy would dampen the impact of shocks, but time-invariant leverage regulation can exaggerate the effects of financial shocks. In principle, a countercyclical leverage requirement for banks would help smooth the business cycle.

Is there evidence to support the view that banks have an incentive to curtail monitoring to reduce costs? De Haas and van Horen (2010) use information from the syndicated loan market to demonstrate that banks significantly stepped up monitoring and screening efforts during the recent financial crisis. Using information on 4,435 syndicated loans to non-financial borrowers in 62 countries, these authors find that retention rates on such loans significantly increased during the crisis even after controlling for changes in interbank liquidity (following the Lehman bankruptcy) and for borrower risks (measured using familiarity of the lender with the borrower and with the sector). Moreover, retention rates increased by a larger amount for the loans categorised as those with a higher level of information asymmetry. These empirical findings are consistent with the theoretical model of Christensen et al (2011). The idea is that the retention of risk provides the incentive to monitor. Moreover, the sharp increase in retention rates can partly explain the sharp decline in bank lending that occurred during the crisis.

Turning to an empirical analysis with housing and credit, Antipa et al (2010) assessed the relative efficiency of macroprudential policies, which lean against “excess” credit using an LTV multiplier, compared to monetary policy, which uses a Taylor rule. Using 1985–2009 data from the euro area, the US and the UK, estimates suggest that such a macroprudential policy (when combined with rule-based monetary policy) would have slowed credit, economic growth and inflation. Indeed, their analysis suggests that implementation of an LTV macroprudential policy would have avoided the recent sharp downturn.

Other researchers – Darracq Pariès et al (2010) – have considered macroeconomic propagation under alternative regulatory capital regimes (eg a flat-rate Basel I regulatory capital regime and a risk-based Basel II regulatory capital regime), in the euro area using a three-agent, two-sector economy with a financial accelerator, endogenous defaults, and an imperfectly competitive banking sector facing capital constraints. These authors conducted simulations that used an estimated Taylor rule and high capital adjustment costs together with an assumption that balance sheet adjustments would take place through loan deposit margins that curb loan demand and replenish capital buffers. Interestingly, such simulations can reproduce business cycle facts for the euro area and provide evidence of the amplifying effects of financial frictions on economic fluctuations. In addition, such simulations can be used to demonstrate that a countercyclical regulatory regime can support macroeconomic stabilisation and also to illustrate the potential complementary roles of monetary and macroprudential policies.

As detailed in Basel III, jurisdictional reciprocity will be applied as the host authorities will take the lead in setting the countercyclical buffer requirement that would apply to credit exposures held by local entities. These host authorities would also be expected to promptly inform their foreign counterparts of a capital buffer decision so that authorities in other jurisdictions can require their banks to respect them. The research on the efficacy of such

jurisdictional reciprocity remains in a nascent stage. That said, Correa et al (2010) did consider the role of international banks in the cross-border transmission of business cycles. Their study highlights the effects of regulatory changes on global banks' ability to transform domestic deposits into loans abroad using a two-country DSGE framework with global banks and heterogeneous firms. Using their theoretical model, Correa et al demonstrate that a positive total factor productivity shock in the home country can increase firms' ability to access foreign deposits, which amplifies the expansion. Indeed, as more small firms gain access to international loans further amplification occurs. Analogously, a negative total factor productivity shock in the home country would result in a withdrawal of international bank lending thereby exacerbating the contraction. These findings suggest that cross-border lending can exacerbate business cycles and that jurisdictional reciprocity could potentially help curtail this effect.

(7) What are the potential interactions between monetary policy and macroprudential policies and regulations?

Some observers have argued that monetary policy can be used instead of macroprudential policies and regulations to curb the leverage cycle. Researchers have just begun to rigorously consider the interactions between these two types of policies. For example, Goodhart et al (2009) have developed a model of housing crises. Their general equilibrium model incorporates money, collateral and a (heterogeneous) banking sector. Margins in their model not only depend on the possibility and severity of default, but also on monetary policy. Indeed, contractionary monetary policy may not only adversely influence the funding situation of agents, but also make default more probable and severe because of future deflationary pressures. This result suggests that the leverage cycle can be partially controlled via monetary policy.

Goodhart et al (2009) also consider the case when contractionary monetary policy is combined with a higher appetite for risk by banks (eg looser underwriting standards). When these adverse shocks occur at the same time, expected repayment on mortgages falls more than the aggregate change when either contractionary monetary policy or increased risk appetite by banks happen independently. That is, default on mortgages increases disproportionately when contractionary monetary policy is combined with a higher appetite for risk by banks. Because contractionary monetary policy coupled with an attempt to gamble to resurrect by banks exacerbates a mortgage crisis and increases financial instability, macroprudential policies and regulations designed to stem excessive risk-taking by banks can potentially be beneficial.

Following the Basel Committee's publication of *An assessment of the long-term economic impact of stronger capital and liquidity requirements*, some researchers have refined and improved upon their work that was used to assess the costs and benefits of various macroprudential policies. For example, Kato et al (2010) focus on welfare costs. These authors argue that various macroprudential tools can be used in combination to improve the resilience of the banking sector at a lower net welfare cost, and that the requirements should vary with macroeconomic conditions.

(8) Do macroprudential tools have advantages over monetary policy instruments in terms of increasing financial stability?

Christensen and Meh (forthcoming 2012) address this macroprudential issue by adding a countercyclical cap on the LTV to a DSGE model with housing and borrowing secured by housing collateral. They consider two types of shocks that could be behind a credit boom: (1) A shock that increases the borrowing limit to constrained households, and (2) a productivity shock. Then they examine the merits of using the traditional monetary policy instrument (short-term interest rates) against the alternative of a regulatory mortgage LTV ratio. When

the boom is driven by a shock that revalues collateral and increases the borrowing capacity of households, they find that a reduction in the regulatory LTV will dampen the increase in household debt and curtail the expansion in housing prices and residential investment. When monetary policy responds to the boom by augmenting an estimated historical policy rule with a response to household debt (a rule that adjusts monetary policy to achieve the same dampening in debt that was achieved by the LTV reduction) the policy rate required to match the impact on debt is almost 10 times as large as when no policy is targeting a reduction in debt. As a result of the large increase in interest rates, consumption, the housing market, GDP and inflation all drop sharply. Using their model, the authors conclude that the regulatory LTV ratio is able to dampen the increase in household debt with considerably less macroeconomic consequences. This suggests that macroprudential tools targeted at housing finance have a comparative advantage over the standard monetary instrument in mitigating financial imbalances in that sector.

New questions and issues that have arisen

As discussed above, recent work has explored the development of asset bubbles, their potential relation to financial regulations, as well as the macroprudential tools that could be used to mitigate their effects. Additionally, the new regulations on bank capital, which address the pitfalls associated with those in force during the recent global financial crisis, have sparked a significant research agenda on better understanding the cyclical properties of regulation and their potential effect on the real economy and monetary policy. Some new issues and questions that have arisen in this regard include the following:

- Can asset bubbles be detected before they cause problems? If so, how? How confident do policymakers need to be about the presence of a bubble before taking action? For example, is it sufficient to identify the conditions under which bubbles have emerged in the past (ie even if a definitive identification of a bubble is not possible)?
- How targeted can macroprudential policy be? If there is concern about a bubble, is it better to change loan-to-value (LTV) ratios or to alter asset-specific risk weights in capital requirements? Are LTV ratio regulations needed in the presence of capital risk weights that are sensitive to probabilities of default and loss-given-default?
- While some evidence suggests that macroprudential policy can alleviate some of the risk, it remains unclear what types of macroprudential tools would mitigate the feedback effects that are driven by household balance sheets. How many macroprudential tools are really needed in addition to monetary and fiscal policies?
- Are macroprudential tools effective if there is a large unregulated financial sector? Could higher capital or liquidity requirements have the unintended consequence of leading to more regulatory arbitrage?

Remaining gaps in the literature

Progress has been made in shedding light on the characteristics and consequences of asset bubbles. However, we still need a better understanding of what starts a bubble, and what determines its size and duration. Moreover, a better integration of models of bubbles, or systemic risk more broadly, within standard DSGE models used for evaluation of monetary policy would provide substantial benefits. How much can be accomplished within a DSGE framework remains an open question.

In understanding the relationship between business cycles and regulation, several outstanding issues remain to be addressed by future research. In particular, if central banks rely on several tools to cope with systemic risks/credit bubbles, then a metric may be needed to compare the efficacy of the tools for these purposes. Moreover, inter-linkages and

channels of risk transmission between agents in the financial system need to be better modelled and understood. Better micro-data would be useful for developing the micro-foundations of risk transmission. Macroeconomic models have generally ignored the financial sector and some progress has been made to incorporate banks into such models. Much work remains, however, since macroeconomic models need to incorporate regulated and unregulated financial sectors to more fully reflect reality and the potential for policies to reduce the likelihood of a financial crisis or banking sector problems.

Conclusions

In this document we have addressed the main findings of the RTF-TC. Taken as a whole, the research supports the idea that better capitalised and more liquid banks are better able to maintain lending over the business cycle. The findings also highlight the need for researchers to continue addressing relevant questions. Policymakers need better tools and a deeper understanding of the inter-linkages between the financial and the real sectors of the economy. Our work has discussed both the potential costs and benefits associated with introducing tighter capital and liquidity regulations. However, several important issues would benefit from continued study. For example, the steady-state and transitional effects on economic growth and on the probability of banking crises remain an important topic for research. These issues are important for policy makers and bank regulators in ensuring standards are set both with the right objectives in mind and at appropriate levels. In analysing the interaction between capital, credit and growth, the literature has developed substantially but further work is needed to better understand the role of financial markets in the credit transmission channel of monetary policy, as well as the roles of wholesale market funding and securitisation.

Looking at the interactions between the banking sector and the real economy, it seems evident that banking sector conditions matter more for real sector performance during crisis periods, highlighting the necessity to acknowledge nonlinearities in key relationships. Moreover, we have found that the different channels through which financial conditions can affect credit and output may imply different policy responses to different sources of stress. However, more work shedding light on how the credit channel works during crisis and non-crisis periods, as well as how the financial environment prior to a crisis affects the significance of a particular credit channel would be particularly useful.

We have further highlighted the importance of focusing on housing bubbles relative to other asset bubbles, because of their importance for household wealth and leveraged financial institutions, and investigated the role that regulation and monetary policy can play in generating bubbles. Evidence suggests that a loose monetary policy can exacerbate bubbles if the financial system is prone to such bubbles in the first place. There is much to learn about the causes and mechanisms that lead to a build-up of systemic risk (an asset price bubble is one example) and what determines its size and duration. These questions are crucial for the design of regulation to mitigate their build up and also for making real time policy decisions (eg to activate a macroprudential tool).

Finally, we have highlighted the role that loose monetary policy can play in providing incentives for risk taking. Moreover, we discuss how macroprudential tools and regulations could mitigate this effect. While work assessing the cyclical properties of capital regulations and the manner in which macroprudential policies interact with monetary policy has contributed to the lively debate discussing macro perspectives on financial regulation, this strand of literature remains in its infancy. Future work should focus on providing a clearer understanding of the ways in which macroprudential policy and monetary policy can oppose, or reinforce one another.

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Appendix

Workshops of the RTF-TC Group

Rome Workshop, July 2009

hosted by Bank of Italy

Session 1: Empirical analysis of the financial-real links

Session chair and discussant: Katherine Samolyk (Federal Deposit Insurance Corporation)

"Bank risk-taking, securitization, supervision, and monetary policy: evidence from the euro area bank lending survey", José Luis Peydró (European Central Bank) and Angela Maddaloni (European Central Bank)

"Firm default and aggregate fluctuations", Jesper Lindé (Sveriges Riksbank)

"An empirical model of subprime mortgage default from 2000 to 2007", Sean Chu (Board of Governors of the Federal Reserve System)

Session 2: Macro implications of banks' capital requirements

Session chair and discussant: Leonardo Gambacorta (Bank for International Settlements)

"Regulation, capital and credit supply in the UK banking industry: an empirical investigation and simulation of countercyclical capital requirements", Matthew Osborne (Financial Services Authority)

"*The stabilizing effects of risk-sensitive bank capital",* Frederic Boissay (European Central Bank)

"Mitigating the procyclicality of Basel II", Jesús Saurina (Bank of Spain)

Session 3: Macro modelling of the transmission channels between the financial and the real sector

Session chair and discussant: Stefano Neri (Bank of Italy)

"Distress in the financial sector and economic activity", Thomas King (Board of Governors of the Federal Reserve System)

"Optimal monetary policy in a model of the credit channel", Fiorella De Fiore (European Central Bank) and Oreste Tristani (European Central Bank)

"Capital injection, monetary policy and financial accelerators", Naohisa Hirakata (Bank of Japan)

Paris Workshop, June 2010

hosted by the Bank of France and the French Prudential Supervisory Authority

Session 1: The credit channel of monetary policy

Session chair and discussant: Benoit Mojon (Bank of France)

"Credit availability: identifying balance-sheet channels with loan applications and granted loans", Gabriel Jiménez (Bank of Spain), Steven Ongena (Tilburg University and CEPR), José-Luis Peydró (European Central Bank) and Jesús Saurina (Bank of Spain)

"The effect of monetary policy on the availability of credit: how the credit channel works", Lamont Black (Board of Governors of the Federal Reserve System) and Rich Rosen (Federal Reserve Bank of Chicago)

"Trusting the bankers: a new look at the credit channel of monetary policy and hints for the crisis", Matteo Ciccarelli (European Central Bank), Angela Maddaloni (European Central Bank) and José-Luis Peydró (European Central Bank)

Session 2: The risk-taking channel of monetary policy

Session chair and discussant: Itai Agur (Netherlands Bank)

"Does monetary policy affect bank risk-taking?", Yener Altunbas (Bangor University), Leonardo Gambacorta (Bank for International Settlements) and David Marques-Ibanez (European Central Bank)

"Fuzzy capital requirements, risk-shifting and the risk taking channel of monetary policy", Simon Dubecq (Bank of France and CREST), Benoit Mojon (Bank of France) and Xavier Ragot (Bank of France and Paris School of Economics)

Session 3: Analyses of current policy proposals

Session chair and discussant: Carmelo Salleo (Bank of Italy)

"Countercyclical loan-to-value ratios and monetary policy", Ian Christensen (Bank of Canada) and Cesaire Meh (Bank of Canada)

"The cyclical impact of capital requirements: Evidence from French banks' panel data", Jerome Coffinet (FPSA), Virginie Coudert (Bank of France), Adrian Pop (University of Nantes) and Cyril Pouvelle (Bank of France)

Session 4: Financial institutions and macroeconomic dynamics

Session chair and discussant: Bent Vale (Central Bank of Norway)

"Banks' financial conditions and the transmission of monetary policy: a FAVAR approach", Ramona Jimborean and Jean-Stéphane Mésonnier (Bank of France)

"Financial stability and monetary policy – the case of Brazil", Benjamin M Tabak (Central Bank of Brazil), Marcela T Laiz and Daniel O Cajueiro

"The impact of banking sector stability on the real economy", Pierre Monnin (Swiss National Bank) and Terhi Jokipii (Swiss National Bank)

London Workshop, September 2010

hosted by the Financial Services Authority, London

Session 1: The macro costs of financial crises

Session chairs and discussants: Christian Castro, Mette Nielsen and Paul Collazos (Bank of England)

"*The crisis as a wake-up call: Do banks tighten lending standards during a financial crisis?",* Neeltje van Horen (Netherlands Bank) and Ralph de Haas

"*Modelling a housing and mortgage crisis",* Charles A E Goodhart (London School of Economics), Dimitrios P Tsomocos (University of Oxford) and Alexandros P Vardoulakis (Bank of France)

"*Liquidity transformation and bank capital requirements",* Hajime Tomura (Bank of Canada)

Session 2: Calibrating capital requirements and macro considerations

Session chair and discussant: Laurent Clerc (Bank of France)

"*Revisiting the macroeconomic costs and benefits of prudential standards: additions to the FSA/NIESR impact assessment framework",* Matthew Osborne, Michael Straughan, Zanna Iscenko and Sebastian de Ramon (Financial Services Authority)

"*Calibrating the level of capital: the way we see it",* Ryo Kato, Shun Kobayashi and Yumi Saita (Bank of Japan)

"*The long-term economic impact of higher capital levels",* Bank of England Research Team

Session 3: The bank capital channel of lending supply

Session chair and discussant: Alastair Milne (Cass Business School)

"*Capital requirements and credit rationing",* Itai Agur (Netherlands Bank)

"*The importance of the bank balance sheet channel in the transmission of shocks to the real economy",* Antonella Foglia, Francesco Piersante and Roberto Santoro (Bank of Italy)

"*The effects of bank capital on lending: What do we know? And, what does it mean?",* Jose Berrospide and Rochelle Edge (Board of Governors of the Federal Reserve System)

Ottawa Workshop, October 2010

hosted by the Bank of Canada and the Office of the Superintendent of Financial Institutions Canada

Session 1: The use of DSGE models for macroprudential policy

Session chair and discussant: Gregory de Walque (National Bank of Belgium)

"Bank leverage regulation and macroeconomic dynamics", Ian Christensen, Cesaire Meh (Bank of Canada) and Kevin Moran (Laval)

"Dynamic effects of bank capital in general equilibrium", Michael Kiley and Jae Sim (Board of Governors of the Federal Reserve System)

"Capital requirement and financial frictions in banking: macroeconomic implications", Ali Dib (Bank of Canada)

Session 2: Tools for macroprudential supervision

Session chair and discussant: Prasanna Gai (ANU)

"When liquidity becomes a macroprudential issue: empirical evidence of bank behaviour", Jan Willem Van Den End and Mostafa Tabbae (Netherlands Bank)

"Balance sheet interlink ages and macro-financial risk analysis in the euro area", Olli Castrén and Ilja Kavonius (European Central Bank)

"Macroprudential regulation and systemic capital requirements", Celine Gauthier (Bank of Canada), Alfred Lehar (Haskayne School of Business, University of Calgary) and Moez Souissi (Bank of Canada)

Session 3: Macro stress testing

Session chair and discussant: Thomas Kick (Deutsche Bundesbank)

"Macro stress testing of credit risk focused on the tails", Wagner P Gaglianone and Ricardo Schechtman (Central Bank of Brazil)

"Stress testing French banks' income subcomponents", Jérôme Coffinet, Surong Lin and Clément Martin (Bank of France)

Washington Workshop, December 2010

hosted by the Office of the Comptroller of the Currency

Session 1: Macro stress testing

Session chair and discussant: Til Schuermann (Federal Reserve Bank of New York)

"Stress testing German banks against a global credit crunch", Klaus Duellmann and Thomas Kick (Deutsche Bundesbank)

"The financial accelerator and the real economy", Roger Hammersland and Cathrine Bolstad Træe (Central Bank of Norway)

Session 2: Tools for macroprudential supervision

Session chair and discussant: Andrei Sarychev (UK FSA)

"Systemic real and financial risk: measurement, forecasting and stress testing", Gianni De Nicolò (IMF) and Marcella Lucchetta (University of Venice)

"Banking risk and regulation: does one size fit all?", Jakob de Haan (Netherlands Bank) and Jeroen Klomp (Netherlands CPB)

Session 3: Liquidity channel and systemic risk

Session chair and discussant: Michael Gibson (Board of Governors of the Federal Reserve System)

"Understanding systemic risk: the trade-offs between capital, short-term funding and liquid asset holdings", Céline Gauthier, Zhongfang He and Moez Souissi (Bank of Canada)

"Global imbalances and financial fragility", Frederic Boissay (European Central Bank)

Session 4: The use of DSGE models for macroprudential policy

Session chair and discussant: Matteo Iacoviello (Board of Governors of the Federal Reserve System)

"Would macro-prudential policies have avoided the crisis?", Pamfili Antipa, Eric Mengus and Benoît Mojon (Bank of France)

"Macroeconomic propagation under different regulatory regimes – evidence from an estimated DSGE model for the euro area", Matthieu Darracq Pariès, Christoffer Kok Sørensen and Diego Rodriguez Palenzuela (European Central Bank)

Oslo Workshop, January 2011

hosted by Central Bank of Norway

Session 1: Bank lending shocks and the macro economy

Session chair and discussant: Jean-Stéphane Mésonnier (Bank of France)

"Are bank lending shocks important for economic fluctuations?", Jørn I Halvorsen (Central Bank of Norway and Norwegian School of Management) and Dag H Jacobsen (Central Bank of Norway)

"Housing cycles, household credit performance, and economic activity", Robert Avery, Ken Brevoort (Board of Governors of the Federal Reserve System) and Katherine Samolyck (Federal Deposit Insurance Corporation)

Session 2: Transmission of shocks

Session chair and discussant: Skander van den Heuvel (Board of Governors of the Federal Reserve System)

"Bank lending channel during an exogenous liquidity shock", Bent Vale and Gøril Havro (Central Bank of Norway)

"Stock market volatility, consumption and investment: an evaluation of the uncertainty hypothesis using post-war US data", Burkhard Raunig (Austrian National Bank) and Johann Scharler (University of Linz)

Session 3: Macro-conditions, credit risk and bank profitability

Session chair and discussant: Henrik Borchgrevink (Central Bank of Norway)

"Bank profitability during recessions", Wilko Bolt, Leo de Haan, Marco Hoeberichts, Maarten van Oordt and Job Swank (Netherlands Bank)

"Bubbles, bank and financial stability", Kosuke Aoki (Bank of Japan) and Kalin Nikolov (European Central Bank)

Session 4: International real-financial transmission channels

Session chair and discussant: Benjamin Tabak (Central Bank of Brazil)

"Running for the exit: international banks and crisis transmission", Ralph De Haas (European Bank for Reconstruction and Development), Neeltje van Horen and Jeromin Zettelmeyer (Netherlands Bank)

"Financial frictions, financial integration and the international propagation of shocks", Luca Dedola and Giovanni Lombardo (European Central Bank)

"International banks and the cross-border transmission of business cycles", Ricardo Correa, Horacio Sapriza and Andrei Zlate (Board of Governors of the Federal Reserve System)