BANK OF ENGLAND

Financial Stability Paper No. 21 – May 2013

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The authors are grateful to David Aikman, James Benford, Iain de Weymarn, Andy Haldane, Simon Hall, Sujit Kapadia, David Learmonth, Roland Meeks and Victoria Saporta for comments on earlier drafts.

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ISSN 1754–4262

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How could macroprudential policy affect financial system resilience and credit? Lessons from the literature

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The existing literature suggests that a macroprudential policy authority could affect the resilience of the financial system and the flow of credit to the real economy through two main channels.

The first, the *allocation channel*, operates through the constraints and incentives of financial institutions. By employing regulatory tools that affect the cost-benefit trade-offs of financial decisions, the authority would incentivise financial institutions to reallocate their resources across alternative investments. During credit booms, for example, raising the countercyclical capital buffer would help enhance resilience and could dampen excessive balance sheet expansion. Conversely, lowering this buffer during a downturn would discourage banks from excessive deleveraging, provided that the remaining capital buffer is judged to be adequate to absorb future losses with a sufficiently high probability. In a post-crisis environment, however, some banks' pre-crisis capitalisation may prove to be insufficient to absorb losses and confidence in the sector could, as a result, be low. Low capital levels may hamper banks' access to funding markets and, ultimately, impair bank lending. Requiring undercapitalised banks to raise their capital levels could, in such circumstances, help underpin a sustained recovery of credit growth.

The second is the *signalling channel*. By releasing policy signals about the costs and benefits of alternative actions, the authority would allow institutions to make better-informed financial decisions. In a post-crisis environment of heightened uncertainty, announcing clear and objective standards against which banks' capital adequacy is judged could help lower sound banks' funding costs while forcing weaker banks to recapitalise in order to meet the standards, thus restoring the banking system's ability to provide credit to the real economy.

We argue that there are tight links between the two channels. Policy signals are more likely to have the intended impact on the behaviour of financial institutions if private incentives that give rise to moral hazard are effectively controlled through the allocation channel of macroprudential policy. And by building a track record of employing the allocation channel in a systematic and predictable way, the authority can instill credibility in policy signals and ensure that they are well understood. We also identify gaps in the literature and point to priorities for future research.

Introduction

Following the recent financial crisis, the financial regulatory framework in the United Kingdom is undergoing a major transformation. A key part of the reform is the creation of the Financial Policy Committee (FPC) within the Bank of England to conduct the country's macroprudential policy. The primary objective of the FPC is the identification, monitoring of, and taking action to remove or reduce systemic risks with a view to protecting and enhancing the *resilience* of the UK financial system. The financial system's *resilience* is its ability to withstand shocks and continue providing essential financial services without resorting to taxpayers' support. These services include efficiently allocating credit, providing payment services, and offering insurance. The secondary objective of the FPC is, subject to achieving the primary objective, to support the economic policies of Her Majesty's Government, including those for growth and employment.

The FPC has two main powers. The first is a power to make recommendations, in particular to the Prudential Regulation Authority (PRA) and the Financial Conduct Authority (FCA) on a 'comply-or-explain' basis. The second is the power to direct the PRA and FCA in adjusting specific macroprudential tools, which include the countercyclical capital buffer (CCB) and sectoral capital requirements (SCRs). Bank of England (2013) describes in detail the CCB and SCRs, the likely impact of using these tools on financial stability and growth, and the circumstances in which the FPC might expect to use each tool.

The main purpose of this paper is to articulate channels through which macroprudential policy could influence the resilience of the financial system and the flow of credit to the real economy. In doing so, we synthesise the growing literature on macroprudential policy and identify priorities for future research. Our paper therefore complements both Bank of England (2013) mentioned above and Bank of England (2011), which explored distortions in the financial system and reviewed the specific macroprudential policy tools that could be employed to mitigate systemic risks.

A case for financial regulation arises when so-called 'distortions' in private incentives lead financial institutions to raise systemic risk to a level that is excessively high from a social perspective. For example, implicit or explicit public guarantees on a bank's debt or short-sightedness of its stakeholders and counterparties may lead the bank to take on excessive leverage during times of exuberance. Similarly, when market conditions are benign, financial institutions may rely excessively on cheap but flighty short-term funding in order to finance long-term and inherently illiquid investments. Excessive leverage and fragile liquidity positions leave the financial system vulnerable to shocks and, therefore, undermine its resilience.

Macroprudential policy can affect the resilience of the financial system *directly* by changing the amount of capital or liquidity buffers that financial institutions hold in normal times and can use when hit by a shock. For example, with 20% more capital, banks can, all else equal, absorb losses that are 20% greater. In addition, a macroprudential authority can influence the resilience of the financial system and the flow of credit to the real economy *indirectly* through two main channels:

(i) **Allocation channel**, through which the authority imposes contingent constraints on banks' balance sheets in order to affect their risk-taking incentives. By using risk-sensitive capital and liquidity requirements, for example, the authority would affect the cost-benefit trade-offs that a bank faces in choosing the size, composition and funding of its portfolio. At the same time, the policy authority would also influence the allocation of credit and liquidity risks across the bank's various stakeholders. The majority of the existing literature on macroprudential policy focuses on this channel (see Section 2.1).

(ii) **Signalling channel**, through which the authority provides information (ie policy signals) that financial institutions can use in their cost-benefit analysis and that ultimately shapes financial behaviour. There is currently limited literature which directly discusses this channel for macroprudential policy. Thus, we also consider what lessons can be drawn from other areas of research, such as the literature on banking and finance, game theory with incomplete information and monetary policy (see Section 2.2).

The two channels are tightly linked. For example, the impact of centrally disseminated information about systemic risk on private institutions' behaviour will depend on these institutions' expectations about the concrete policy actions that the information would trigger. This impact would also depend on the extent to which private incentives that give rise to moral hazard are controlled by the allocation channel of macroprudential policy. For example, through the signalling channel macroprudential authorities can increase the awareness of private players about the degree and distribution of risks across the financial system. This could help institutions make better decisions in risk-taking, which could lead to better pricing of risks and support more prudent portfolio allocations. However, the release of information about risk could have unintended consequences. For example, given limited liability, undercapitalised banks with an incentive to 'gamble for resurrection' may use the information about increased riskiness of certain assets in order to increase their exposure to them. And it is through the allocation channel that the authority could weaken the gamble for resurrection motive by ensuring that banks are adequately capitalised and have access to stable funding.

We emphasise that our analysis of the two transmission channels of macroprudential policy is mostly theoretical and that there is a high degree of uncertainty over how these channels would work and interact with each other in practice. Save for illustrative examples that we outline along the way, our analysis refers to the transmission of macroprudential policy *in general*, not to the ways in which the use of any *specific* policy tool could affect economic outcomes. Thus, we do not attempt to reach definitive conclusions about either actual or potential implications of past or current policy actions.

In our discussion, we make frequent references to the existing literature, bearing in mind that it can provide only partial answers. Existing empirical studies on the impact of capital requirements could for example shed some light on the potency of the allocation channel. However, analyses based on past data could be of limited use in estimating future outcomes, given that the introduction of a new regulatory regime will likely change the behaviour of financial institutions (the so-called 'Lucas critique' formulated by Lucas (1976)). Moreover, there is little empirical research on the signalling channel, which depends crucially on market participants' beliefs and their interpretations of information that are fundamentally difficult to measure. Thus, our attempt to articulate the allocation and signalling channels should be seen only as an initial step towards building a more comprehensive picture about the transmission mechanism of macroprudential policy.

1 Rationale for macroprudential policy

Both the micro and macroprudential approaches to supervision and regulation seek to maintain financial stability and, ultimately, improve social welfare by aligning private incentives with social objectives. Indeed, a rationale for macroprudential regulation would not exist if mitigating risks at the level of individual institutions through microprudential regulation was sufficient to prevent the build-up of systemic risk. But microprudential regulation alone may be insufficient to achieve this if it does not fully account for the commonality of exposures across institutions, the interdependency among institutions on, for instance, funding markets, or the negative knock-on effects that the behaviour of individual institutions may have on the rest of the system and the real economy.

Macroprudential policy seeks to maintain financial stability by explicitly accounting for the 'externalities' arising from the behaviour of individual institutions as well as the structure of the financial system. Such policy can be used both to limit the *ex ante* externalities that lead to an excessive build-up of systemic risk, and the *ex post* externalities that can generate inefficient failures of otherwise sound institutions in a crisis:

- An important source of *ex ante* externalities is *strategic complementarity*, ie the incentive of individual players to align their actions with the aggregate action in the market place (see Box 1). For example, financial institutions would have an *ex ante* incentive to take correlated risks by lending to similar industries, thus increasing the risk of several simultaneous failures, if they expect public authorities to intervene when such failures are imminent in order to avoid a financial meltdown *ex post* (Acharya and Yorulmazer (2007)). Likewise, even when financial institutions do not take official interventions into account, they may have incentives to expand their balance sheets for reputational reasons when others are doing the same, thus generating inefficient credit booms and increasing the risk of a crisis (Aikman, Haldane and Nelson (2010); Aikman, Nelson and Tanaka (2012)).

- *Ex post*, commonality of exposures implies that the 'fire sale' of assets by a major financial institution could reduce the value of assets held by other institutions as well, making it harder for them to secure collateralised funding. In addition, financial institutions are intimately connected through the wholesale funding market and other asset markets, such that financial stress in one part of the system, which leads providers of funding to retrench from the market, can generate stress in another part of the system.

Thus, a macroprudential authority has to consider the system-wide impact of its actions and announcements. This might give rise to situations in which macroprudential policy diverges from the strictly institution-specific regulatory approach. For example, an authority that has adopted the latter approach may respond to higher measured levels of risk in a downturn by *raising* the required liquidity or capital ratios in order to protect the interests of the creditors of individual institutions. Under the same conditions, however, a macroprudential authority might, in some circumstances, consider *lowering* these ratios in order to prevent banks from destabilising the system as a whole through asset fire sales and credit contraction. Clearly, relaxing regulatory requirements would be justifiable only if, in the absence of fire sales and a contraction in credit supply, individual institutions can absorb losses on their balance sheets with a sufficiently high probability. If that is not the case, then the preferred outcome from a macroprudential policy perspective could be that banks raise the *level* of their equity capital so as to restore confidence in the system. This would prevent credit contraction and set the stage for a sustained credit growth in the future.

As discussed in Bank of England (2011), there are two distinct aspects of systemic risk: time-varying risk, which depends on the amount of risk that the financial system takes at a point in time relative to its capital and liquidity resources; and structural risk, which depends on the connections between entities within the system and the distribution of risk across the system. The multifaceted nature of systemic risk implies

that an authority should employ a combination of different tools in order to strengthen the resilience of the system.(1) In the discussion below, however, we mainly use time-varying capital ratio requirements as an illustrative example of how a macroprudential policy tool could tackle time-varying systemic risk and influence the provision of credit to the economy. This choice is made for the sake of parsimony and reflects the FPC's directive powers to supplement capital requirements.

2 Effects of macroprudential policy: the current state of the literature

To make appropriate policy decisions, a macroprudential authority needs to understand how policy affects the resilience of the financial system and credit supplied to the real economy. There are three main strands of literature that provide guidance on how macroprudential policy may affect resilience and credit.

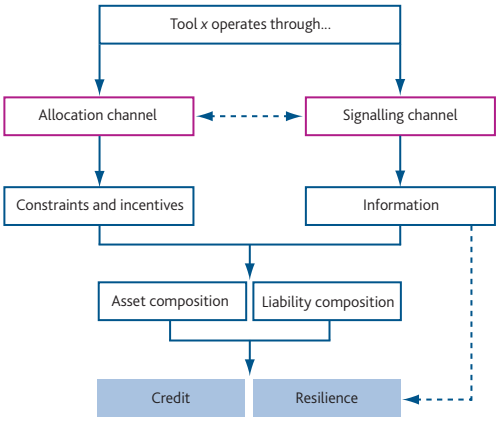
First, there is the microeconomic literature on banking, which articulates various distortions to banks' incentives and their responses to policy in a game-theoretic framework.(2) The main advantage of the microeconomic literature is that it can analyse strategic interactions between banks and the regulator, and among banks themselves, which could have an important impact on the transmission of macroprudential policy. The literature also offers tools for analysing the impact of information provision by policymakers and is useful for conducting both positive ('how can policy affect outcomes?') and normative ('what are the implications for social welfare?') analysis.

The second strand makes use of macroeconomic dynamic stochastic general equilibrium (DSGE) models with financial frictions. Most of the solution methods used to study the existing DSGE models abstract from the possibility that, in the presence of systemic vulnerabilities, a shock may have a disproportionately large impact on the financial system and the economy at large, leading to distress for a prolonged period of time.(3) This renders most standard DSGE models unfit to explain financial crises and thus of limited usefulness for macroprudential policy. Nevertheless, they help to clarify some of the channels through which macroprudential policy may affect macroeconomic variables in the short and long run, and how it may interact with monetary policy (eg Angelini, Neri and Panetta (2011), Christensen, Meh and Moran (2011)). In addition, more recently, promising research — for example by Gertler and Kiyotaki (2012) — incorporates multiple 'steady-state' outcomes within a DSGE set up, with the bad steady-state outcome being preceded by a systemic bank run and asset fire sales. Such a framework could potentially become useful for both positive and normative analysis of macroprudential policy.

The third strand lies somewhere between the other two. It articulates the key financial frictions that call for macroprudential regulation. Having defined the role of such regulation, it examines the impact of macroprudential regulation on output within a relatively simple macroeconomic set up (eg Gersbach and Rochet (2012)).

Synthesising these three strands of literature, we identify two interconnected channels through which macroprudential policy can affect the resilience of the financial system and the flow of credit to the real economy (see **Figure 1**). The first, *allocation channel*, constrains institutions' balance sheet structures and, as a consequence, affects their incentives to undertake risky lending and investment. It is operationalised by regulatory requirements, which put restrictions on the amount of capital buffer available to absorb losses on risky investments (eg countercyclical capital buffer), the maturity of funding and required holdings of liquid assets (liquidity requirements) and other restrictions on the type of investments a financial institution can make (eg loan to value limits). In turn, such restrictions can affect the relative cost of financing alternative investments and so change the profitability of new lending and investment decisions, ie the cost-benefit trade-offs that are at the core of a financial institution's business. Thus, by imposing restrictions on the composition of balance sheets, regulatory requirements shape: (i) the incentives of financial institutions as to how to invest their funds; and, in parallel, (ii) the allocation of risks across their various stakeholders.

Figure 1 Generic transmission channels of macroprudential policy



(1) A comprehensive list of potential instruments of macroprudential policy has been discussed in Bank of England (2011). These include balance sheet tools, such as time-varying capital and liquidity regulations, tools to influence terms and conditions of new lending, such as limits on loan to value ratio, and tools to influence market structure, such as mandating use of central counterparties for particular financial transactions.
(2) See Freixas and Rochet (2008) for an overview of this literature.
(3) There are two routes to generate crisis-like dynamics with a DSGE model. The first is to treat non-linearities seriously in solving these models. This would generate stronger amplification of shocks and create crisis-like dynamics, although the system would ultimately go back to the original steady state. The second is to incorporate a mechanism that allows large enough shocks to send the economy to a different, and worse, steady state — as the Gertler-Kiyotaki (2012) model does.

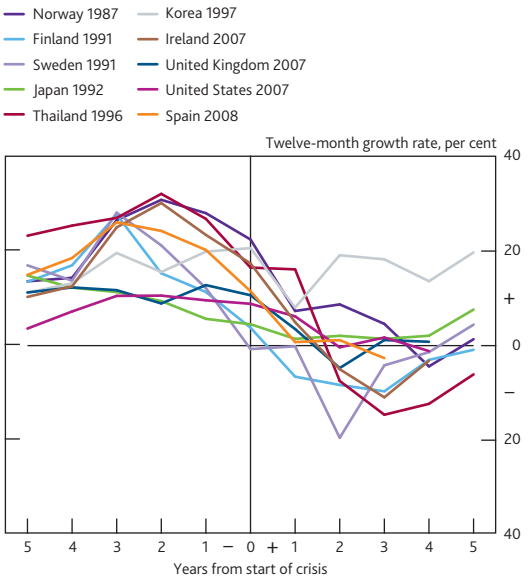
The second is the *signalling channel*, through which a policymaker affects the information available to financial market participants about the cost-benefit trade-offs they are facing. There are three general types of policy signal. Signals of the first type reveal the authority's information about the state of the economy and the financial system. Signals of the second type reveal how the policy authority plans to adjust regulatory requirements in response to changes in economic and financial circumstances — ie what some stylised analyses dub 'the policy reaction function'. Finally, signals of the third type are designed to co-ordinate the market towards the socially optimal outcome when there are multiple possible economic outcomes (ie multiple equilibria).

2.1 Allocation channel

An important feature of past financial crises has been unsustainable levels of credit growth — often on property related lending — which may manifest itself as a relaxation in lending standards and a build-up in leverage that needs to be subsequently unwound (**Charts 1** and **2**). The literature suggests that such swings in credit growth could be driven by externalities in the financial system. First, when they borrow and invest, *individual* financial institutions may not take into account the possibility that their action could increase the likelihood of *collective* asset sales down the road. In turn, such sales could depress collateral values and hence tighten the borrowing constraints throughout the system (Lorenzoni (2008); Bianchi (2011)). Second, banks may have incentives to undertake excessive lending due to strategic complementarities (rooted, for example, in reputational concerns) when other banks are profitable and are expanding lending (Aikman, Haldane and Nelson (2010); Aikman, Nelson and Tanaka (2012)).

Macroprudential policy can influence the resilience of the financial system against shocks. For example, an increase in the required capital ratio during a credit boom would improve resilience *directly* by enhancing the loss-absorbing capacity of the system. In addition, authorities might affect resilience *indirectly* by imposing constraints on financial institutions' funding and lending choices, or by changing the relative costs and benefits of making a particular choice. For example, an increase in the required capital ratio during a credit boom (eg implemented through an increase in countercyclical capital buffer) would tighten the constraint on financial institutions, such that they cannot increase their risk-weighted assets beyond a certain multiple of equity capital. For reasons discussed in Box 1, this policy action could in some circumstances raise the funding costs of financial institutions. And when higher funding costs translate into higher lending rates, credit growth would slow down. In addition to increasing banks' capacity to absorb losses, stricter capital requirements might therefore help moderate an unsustainable credit boom, thereby reducing the probability of a crisis *ex ante*. Similarly, an increase in the capital requirements for loans to a particular sector — such as the real estate sector — would raise the cost of lending to that sector relative to others. An increase in sector-specific capital requirements might thus nip the build-up of sector-specific risks in the bud. Alternatively, by ensuring that banks have sufficient equity relative to their assets that can be used to absorb losses at a time of stress, regulation can also reduce the probability of asset fire sales and creditor runs *ex post*. These are key

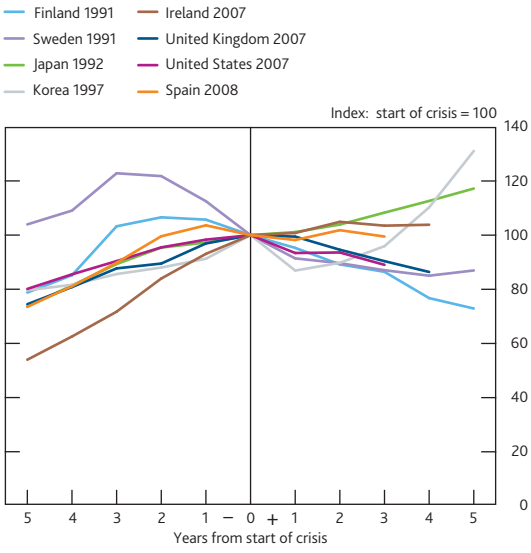
Chart 1 Nominal credit growth before and after major banking crises[a]



Sources: IMF *International Financial Statistics*, ONS and Bank calculations.

(a) The years beside the country names give the dates of the first year of a banking crisis, based on Reinhart and Rogoff (2009).

Chart 2 Household debt-to-income ratios around major banking crises[a]



Sources: Bank of Finland, Bank of Japan, Bank of Korea, Economic and Social Research Institute (Japan), OECD, ONS, Riksbank, Statistics Finland and Bank calculations.

(a) The ratio of the stock of household debt to household income. The definition of debt and income varies slightly from country to country, depending on data availability. The years beside the country names give the dates of the first year of a banking crisis, based on Reinhart and Rogoff (2009).

Box 1
Distortionary frictions

In a frictionless world, the Modigliani and Miller (1958) theorem would hold, implying that an increase in the required capital ratio would have no impact on banks' overall funding costs and hence on the provision of credit. But frictions in the real world, which may vary depending on the state of the economy, invalidate this theorem, and result in changes to regulatory capital requirement affecting banks' funding costs. In this box, we discuss a number of such frictions that the literature has identified, paying particular attention to how they affect banks' cost-benefit trade-offs and the operation of macroprudential policy.

Asymmetric information

Asymmetric information refers to a setting in which the parties to a transaction do not have access to the same information. This can arise either at the time of contracting (*ex ante*), eg if borrowers have private information about the quality of their projects. It can also arise after the contract has been signed (*ex post*), for example if the outcome of the project depends on the borrowers' unobservable effort choice.(1)

The presence of asymmetric information leads to a violation of the Modigliani-Miller theorem, and implies that credit supply could depend both on the borrowers' and financial intermediaries' net worth: banks and borrowers with a high net worth can secure sufficient financing, as they have enough 'skin' in the game to choose good quality projects and invest enough effort in ensuring their success. Since procyclical fluctuations in net worth can give rise to credit cycles, countercyclical policy that stabilises the market value of financial intermediaries' net worth could smooth credit supply in response to shocks (eg Hirakata, Sudo and Ueda (2011)).(2)

Holmstrom and Tirole (1997) study another case where asymmetric information impinges on financial contracts. Here, entrepreneurs with low net worth have to turn to financial institutions to help finance investments. But excessive external finance can generate incentive problems. To solve these, financial institutions may demand collateral from borrowers, or may invest some of their own capital. With the latter action, financial institutions would keep more 'skin in the game' and thus reassure their creditors that they will exercise due diligence in monitoring borrowers. In these circumstances, a negative shock to bank capital could reduce credit supply as households become reluctant to finance undercapitalised banks that have little incentive to monitor the borrowers (Christensen, Meh and Moran (2011)).

Limited commitment

The Modigliani-Miller theorem is violated under so-called 'limited commitment', which means that the borrower cannot pledge the full return of the project to the lender, or the borrower cannot commit to the lender to complete the project. This gives rise to collateralised lending, because the presence of collateral can, for example, prevent the borrower from repudiating the debt contract by withdrawing his human capital, when specialised skills are required to complete an investment project (Hart and Moore (1994)). It also generates procyclical credit supply as the value of collateral, which limits the amount of borrowing, tends to vary cyclically. Kiyotaki and Moore (1997) show that even temporary shocks to productivity can have amplified effects due to the linkages between collateral values, borrowing, and investment. Macroprudential policy needs to take into account this amplification channel to prevent inefficient credit booms which could lead to a crisis, as well as a rapid collapse in credit which can deepen the crisis.(3)

Deposit insurance and policy bias favouring debt

An important role of financial intermediaries is liquidity transformation, whereby they issue demandable debt (deposits) and invest in long-term assets. This structure, however, makes banks vulnerable to inefficient runs, as a sudden mass withdrawal of deposits will force them to liquidate their assets at a loss, potentially forcing otherwise solvent institutions into insolvency (Diamond and Dybvig (1983)).(4) Moreover, the interconnectedness of banks through various asset markets means that a collapse of a large institution can have domino effects and quickly lead to a systemic collapse.

To prevent such a situation, many countries have explicit government guarantees on deposits; and large institutions also enjoy implicit guarantees on other debt as they are considered 'too big to fail'.(5) But the presence of guarantees reduces the risk-sensitivity of debt prices, thus creating incentives for banks to increase leverage. By extension, the presence of guarantees also implies that a higher capital ratio requirement will increase banks' overall funding costs, potentially reducing lending.

In addition, tax systems in most countries favour debt over equity, so that an increase in capital ratio requirements is likely to raise banks' funding costs and reduce lending. However, if the distortions created by taxes favouring debt over equity have led to a banking sector that is excessively large from a social perspective, the contractionary effect of higher capital ratio requirements on lending would be beneficial (Admati *et al* (2010)).

Strategic complementarity

In the presence of strategic complementarity, the marginal return to taking a given action increases in the number of other players who also take the same action, implying that financial institutions have incentives to take similar actions.(6)

Under complete information, this can generate multiple equilibria some of which are preferable from a social perspective to others. For example, a socially suboptimal outcome arises when strategic complementarity leads each financial institution to go on a lending frenzy when there is a credit boom and risk is 'on', and to exacerbate asset sell-offs when risk is 'off'.

Under incomplete information, strategic complementarity can give rise to a unique, but fragile equilibrium with a small change in economic fundamentals leading to drastic shifts in outcomes. In such a situation, policy that affects the behaviour of one firm will also affect the strategies of other firms, implying that the policy in question has extra bite over and above its direct effects on payoffs. Strategic complementarity also implies that beliefs about other market participants' beliefs and strategies — higher-order beliefs — matters in determining outcomes (see Morris and Shin (1998)). Thus, the provision of public information can have a large impact on outcomes, as we discuss further in Section 2.2.

(1) See Mas-Colell, Whinston and Green (1995), Chapters 13 and 14.
(2) For example, Bernanke, Gertler and Gilchrist (1999) show that when lenders have to incur a cost in verifying the outcome of borrowers' projects, the external financing premium varies inversely with borrowers' net worth to ensure that lenders are compensated for the agency costs.
(3) More recently, a form of limited commitment has been incorporated in macroeconomic models incorporating intermediation by Gertler and Karadi (2011), Gertler and Kiyotaki (2010), and Gertler, Kiyotaki and Queralto (2011). As above, net worth is a key determinant of the financial sector's ability to provide credit, and hence shocks to net worth can amplify credit cycles. Instruments that hedge shocks to a financial institutions — such as a higher level of outside equity — help to maintain intermediation in the face of negative macroeconomic shocks (see Gertler, Kiyotaki and Queralto, *ibid*).
(4) It is also possible that banks suffer runs due to solvency concerns, see eg Morris and Shin (2001); Goldstein and Pauzner (2005). See also evidence in Gorton (1988).
(5) The distortions in debt pricing created by the 'too big to fail' problem could, to some extent, be addressed through a properly designed and transparent bank resolution regime.
(6) See eg Cooper (1999) for a review of so-called co-ordination games. Morris and Shin (2001) study these games in the presence of noisy information, yielding 'global games'.

underlying objectives of both the capital conservation buffer and the countercyclical capital buffer in Basel III.(1)

The effect of adjusting a given macroprudential policy tool may depend on the prevailing circumstances. As discussed above, a tightening in the regulatory capital ratio could both build resilience and potentially slow credit growth in the face of an unsustainable credit boom. Symmetrically, allowing a reduction in previously accumulated capital buffers may support credit supply in a downturn, if banks' remaining capital is judged to be sufficient to absorb future losses with a high probability. By contrast, in a post-crisis period when the threats to resilience remain particularly high and, therefore, market confidence in the system's ability to absorb unexpected losses is low, requiring an increase in the level of equity capital could restore market confidence, lower funding costs and help to underpin a sustained pick-up in credit growth.

The literature has also identified a number of structural factors that influence the allocation channel of macroprudential policy. First, distortionary frictions — such as asymmetric information, limited commitment and subsidies for debt financing — are present both in the short and long run. They invalidate key assumptions of the Modigliani and Miller (1958) theorem(2) and imply that changes in the share of equity financing would affect the overall cost of funding for financial institutions (Box 1). This in turn means that balance sheet tools, such as restrictions on capital and leverage ratios, can be used to prevent inefficient credit cycles that are driven by excessive risk-taking during booms and rapid deleveraging during busts, which would enhance the resilience of the financial system. Of course, irrespective of whether some of the above frictions exist or not, a balance sheet tool would change the allocation of a financial institution's risk across its various stakeholders, which would change the capacity of the system to absorb losses.

Second, the role of the allocation channel is amplified by the so-called *financial accelerator* mechanism, whereby borrowing constraints — due to the same distortionary frictions — act to amplify the impact of a shock on the macroeconomy. For example, Gertler, Kiyotaki and Queralto (2011) show that a small shock to the net worth of the financial sector could have a large impact on credit (and output) when the sector is subject to a borrowing constraint. This implies that, when a negative shock depletes bank capital, recapitalisation is needed in order to prevent a sharp contraction in credit.

Third, in the presence of strategic complementarity and incomplete (and heterogeneous) information (see Box 1), a given equilibrium could be *unique but fragile* in the sense that small changes to the pay-off structure could drive large changes in economic outcomes (Morris and Shin (1998), (2001)). In such an environment, a small change to macroprudential requirements could alter the behaviour of financial institutions substantially, for example, by preventing an inefficient credit boom and thus enhancing financial resilience (Aikman, Nelson and Tanaka (2012)).

(1) Basel III requires banks to hold a minimum common equity of 4.5%, plus capital conservation buffer of 2.5% of risk-weighted assets and a countercyclical capital buffer. Constraints on a bank's discretionary distributions will be imposed when its capital conservation buffer falls below 2.5%. The authorities can adjust the countercyclical buffer when they judge that credit growth is resulting in an unacceptable build-up of systematic risk.
(2) This so-called the Modigliani-Miller theorem states that the value of a firm is unaffected by how it is financed — ie by the mix of debt and equity. The theorem holds only if there are no taxes, bankruptcy costs, agency costs and asymmetric information, and if markets are efficient. A violation of the Modigliani-Miller theorem is a necessary but not a sufficient condition for a balance sheet tool (eg a capital requirement) to affect the cost-benefit trade-offs at a bank through the allocation channel.

There may be other frictions that affect the policy transmission mechanism in the *short run*. An example is the short-run stickiness of financial contracts: financial institutions may not be able to renegotiate all their lending terms immediately in response to a change in policy. If so, macroprudential policy tightening could initially have a disproportionately large impact on new borrowers and the most flexible financial contracts. However, unlike frictions that distort private incentives, the impact of this friction should dissipate over time as all assets are repriced. This means that the long-run impact of macroprudential policy on the level of new lending is likely to be smaller than the short-run impact.

For macroprudential policy, such as time-varying capital requirements, to affect the behaviour of financial institutions and the systemic resilience through the allocation channel, a number of conditions have to be met. Box 2 discusses such conditions in detail in the specific case of capital requirements.

2.2 Signalling channel

A macroprudential authority may also be able to affect the behaviour of market participants through signalling. Taking the cost-benefit trade-offs of financial institutions and their private incentives as given, the authority can influence their lending and funding choices by providing information about the risks associated with alternative actions. Equally, in a post-crisis environment of heightened uncertainty, a macroprudential authority could boost investor confidence in the banking system by announcing clear and objective standards against which banks' capital adequacy is judged. This could help lower sound banks' funding costs through the signalling channel while forcing weaker banks to recapitalise in order to meet the standards, thus underpinning sustained recovery in credit growth. To operationalise the signalling channel the authority could, for example, deliver public speeches, and publish records of policy meetings and reports on financial stability. A policy authority can provide three types of signals to the market which could potentially improve outcomes. We discuss these signal types in turn.

2.2.1 Signals about the state of the economy and the financial system

A signal of the first type provides information about the state of the economy and the financial system. Such information could be communicated via reports on financial stability, publications of stress-test results and speeches that convey policymakers' views about the state of the financial system.

Evidence from the years leading to the crisis indicates that individual financial players relied excessively on historical patterns and neglected the overall volume of investment in particular asset classes and the aggregate positioning of their peers. As a result, financial institutions failed to spot the build-up of vulnerabilities in particular segments of the market and the amplitude of the abrupt price reversals during the crisis caught them by surprise (Gennaioli, Shleifer and Vishny (2011); Gerardi *et al* (2008); Reinhart and Rogoff (2009); McGuire and von Peter (2009)).

Since policy authorities have access to confidential data on the investment and funding positions of regulated institutions, they have a unique bird's eye view on the system. This makes public authorities better placed to spot the build-up of risks across the system than individual financial institutions. By providing information on market-wide positions, a macroprudential authority could help individual institutions identify and correct behaviour that makes them particularly vulnerable to a potential reversal of market sentiment. In this way, policy signals could lead to a better pricing of risk and lead markets to nip imbalances in the bud (Avdjiev, McGuire and Tarashev (2012)).

Similarly, uncertainty over asset valuations following a severe banking crisis can cause bank investors to be willing to lend to banks only at elevated interest rates. Disclosure of the results of stress tests and asset valuation exercises — as was done in the United States under the Supervisory Capital Assessment Program — would help mitigate investor uncertainty and lower bank funding costs (see Box 1 of Bank of England (2013)).

These effects would operate partly through strategic complementarities between market participants. In the presence of strategic complementarity, small changes to common perceptions of economic fundamentals could have a disproportionately large impact on market outcomes. The reason is that such changes affect individual financial players' perceptions of other players' likely actions. In turn, this affects perceptions of the pay-off structure, which has a drastic impact on the optimal action from a private point of view. For example, Aikman, Nelson and Tanaka (2012) study an environment in which each bank's decision to expand its balance sheet is rooted in the incentive to signal its strength to the market when others do the same. In such a case, an authority's announcement that economic fundamentals are deteriorating could create a self-reinforcing common perception that it is in the interest of all banks to stop expanding credit.(1)

(1) A precise policy signals could also be self-defeating, for a number of reasons. First, releasing very accurate public policy signals — on which everyone could free ride — would discourage market participants from collecting private information, with the end result being less overall information in the system (Grossman and Stiglitz (1980)). Second, precise policy signals could give rise to multiple equilibria when strategic complementarity exists. In the presence of multiple equilibria, the actual outcome materialises at the whim of economically meaningless 'sunspots' and could thus be quite different from the socially optimal one (Morris and Shin (1998), (2001)).

Box 2
The impact of increasing the required capital ratio during a credit boom: an illustrative example

To illustrate how macroprudential policy may be able to influence resilience and credit through the two channels discussed above, we consider a specific scenario in which the authority raises the required capital ratio by increasing the Basel III countercyclical capital buffer in order to mitigate systemic risks stemming from an unsustainable and inefficient credit boom. We first discuss how the allocation channel may operate, before examining how the presence of a strong signalling channel might change banks' choices.

Allocation channel

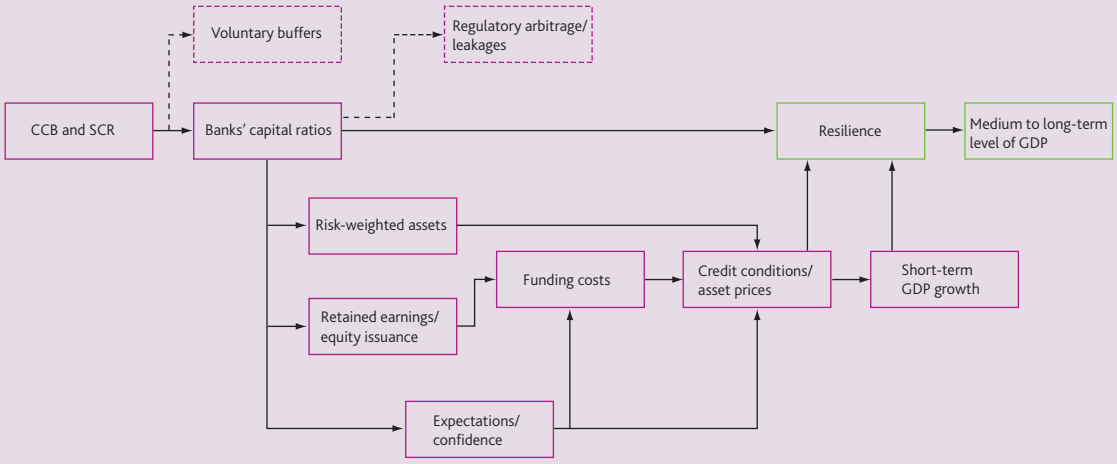
An increase in the countercyclical capital buffer would enhance the resilience of the system through the allocation channel to the extent that it actually induces banks to increase their capital ratios, which enhances their ability to absorb losses. In other words, the new regulatory requirement needs to be binding, such that banks do not meet it fully by simply adjusting their voluntarily held buffers. For an increase in the capital buffer to influence credit, it has to also influence banks' funding costs. This requires a violation of the Modigliani and Miller (1958) theorem due to the frictions outlined in Box 1.

In principle, banks can attain higher capital ratios by: (i) increasing retained earnings; (ii) issuing new equity; or (iii) reducing risk-weighted assets by either reducing the size of their asset portfolios or changing the composition of their balance sheets. These options are illustrated in **Figure A**, taken from Bank of England (2013). Banks' choice is likely to depend on the relative cost of these options, which in turn depends on the state of the economy and the structure of the financial sector. For example, evidence suggests that dividend payments are likely to be sticky (see, for example, Haldane (2010)), and banks are unlikely to cut remuneration, particularly during an upswing associated with a credit boom and perceived high profitability. Raising fresh equity may be more attractive during a boom when investor demand for bank equity is likely to be high. Theoretical literature suggests, though, that equity issuance is costly when it signals bank managers' private information that equity is overvalued (Myers and Majluf (1984)). This negative information effect could arise if banks can choose *how* to arrive at the new capital ratio — either by changing the level of capital and/or by adjusting their risk-weighted assets.

An increase in the capital buffer need not lead to a reduction in credit if it does not increase banks' overall funding cost. But to the extent that it leads to an increase in funding costs, banks are likely to pass this on to the borrowers by raising interest rates on loans, while reducing the quantity of credit extended. Given that banks cannot reprice their entire loan book in the short run, they might have to raise rates for new lending and repricable loans by more, amplifying the impact on new credit extended. Given this repricing friction that is likely to be present only in the short run, an increase in the required capital ratio is likely to reduce new lending by more in the short run than in the long run.

Existing empirical studies have generally found that increases in microprudential capital ratio requirements tend to lead to a reduction in bank lending growth. For example, Aiyar, Calomiris and Wieladek (2012) find that bank lending growth falls in response to a tighter microprudential capital ratio requirement. Moreover, the Macroeconomic Assessment Group (MAG) of the Financial Stability Board and Basel Committee on Banking Supervision estimated that a permanent 1 percentage point increase in the required capital ratios implemented over two years leads to a 15.3 basis point increase in credit spreads and a 0.1% fall in the level of GDP in the long run.(1)

Figure A The impact of the CCB and SCR on resilience and growth



The evidence on how banks adjust their balance sheets in response to a higher required capital ratio is mixed. De-Ramon *et al* (2012) find that based on their 1997–2007 sample, UK banks responded to an increase in the required capital ratio by making about half the required change through a reduction in risk-weighted assets and about half through an increase in capital. And the MAG report notes that banks cut their non-core assets to a greater extent than their loan books. However, using UK bank data during 1989–95, Ediz, Michael and Perraudin (1998) present evidence that banks' typical response to a tightening of capital ratio requirement has been to increase their capital rather than to change their asset composition by shifting away from assets with high risk weights to hold more assets with lower risk weights. That said, these studies estimate the effects of permanent changes to microprudential framework or changes in bank-specific Pillar II capital requirements that are not publicly disclosed. Thus, caution is needed in gauging the potential impact of changing macroprudential capital requirement based on these studies.

Signalling channel

The effect of using the signalling channel would depend on whether the policy authority reveals information in order to avert an unsustainable credit boom in the future or in order to reverse an ongoing boom. In the former case, alerting private players to potential risks and the rise in capital ratio requirements that banks' continued exposure to such risks would lead to, could be sufficient to set in motion self-correcting mechanisms in the marketplace without the need for a change in macroprudential requirements.

By contrast, if the authority wishes to reverse an ongoing boom, it is more likely to actually adjust macroprudential policy, eg by hiking capital ratio requirements. In such a situation, the communication accompanying such a hike is likely to play an important role in determining the way in which banks adjust. If the macroprudential authority states that the reason for raising the capital ratio requirement is to mitigate risks resulting from an unsustainable credit boom, shareholders may wake up to these risks and require banks to cut back on risky lending. Moreover, such policy communication is likely to increase the cost of new equity issuance, thus making it more likely that banks will cut back on risk-weighted assets. This would be a desirable outcome if the policymaker was concerned about an excessive boom in risky lending in the first place.

Potential leakages and undesirable consequences

The effectiveness of higher capital ratio requirements in taming inefficient credit booms may be limited if banks can manipulate the reported level of their risk-weighted assets. This could be possible, for example, if banks use opaque internal models for the calculation of risk weights. Such manipulation could potentially enable banks to boost their regulatory capital ratio without actually reducing the riskiness of their asset portfolio or the size of their assets, and without increasing the level of capital. A risk-insensitive regulatory requirement that is based on the leverage ratio, forthcoming under Basel III, will be needed as a backstop in this case.

The impact of higher capital ratio requirements imposed on UK banks on aggregate credit supply may also be limited if UK borrowers can obtain credit from foreign firms and non-banks. Aiyar, Calomiris and Wieladek (2012) find, for example, that about a third of the reduction in credit supply resulting from an increase in microprudential capital ratio requirements on UK-regulated banks was offset by increased lending by foreign branches. That said, international reciprocity arrangements under Basel III should provide a remedy for this as far as the countercyclical capital buffer is concerned. Concretely, under Basel III, foreign authorities will apply the countercyclical capital buffer prevalent in a certain country for their own banks' exposures to that country (up to at least 2.5% of risk-weighted assets). And, regardless of the response of foreign authorities, higher capital will still bolster the resilience of UK banks by increasing their capacity to absorb losses.

A potentially undesirable consequence of higher capital ratio requirements is that they might induce banks to take greater risks in order to maintain a high return on equity: this could happen both under stricter leverage limits or higher risk-weighted capital requirements if risk weights do not accurately reflect the true riskiness of the assets. The existing theory is inconclusive on the impact of a higher capital ratio requirement on risk-taking (Gale (2010)). It should also be noted that in the case of an increase in macroprudential capital ratio requirements affecting all financial institutions, asset price adjustments may mitigate their risk-shifting incentives: if many financial institutions try to invest in high-risk assets, their asset prices will be driven up while the prices of low-risk assets are driven down, thus making risk-shifting unattractive.

(1) See Tables 1 and 2, Interim Report of Macroeconomic Assessment Group (2010), median impact.

2.2.2 Signals about the policy 'reaction function'

A signal of the second type is about the reaction of macroprudential policy authorities to changes in their perception of the state of the economy and the financial system: this is known as the 'policy reaction function' in the theoretical literature. The existing literature on monetary policy emphasises the importance of commitment to a 'policy rule' in order to achieve low inflation by anchoring private agents' inflation expectations (Barro and Gordon (1983)). By contrast, the literature on macroprudential policy rules is scant. This is in part because articulating a formal macroprudential rule is inherently difficult given the multifaceted nature of macroprudential objectives and the limited experience of macroprudential policy making.

However, the authority may be able to make their actions more predictable by relying on a set of publicly known 'presumptive indicators' that would help identify emerging threats to resilience to set and communicate policy. Goodhart (2011), for example, proposes that, when a number of these indicators signal building vulnerabilities, the macroprudential authority might be required to either act on the signal or explain why it chooses not to. By building a track record of implementing policy in a predictable way, the authority should be able to better influence private agents' expectations and help them adjust their behaviour in anticipation of future policy. Clearly, such information is relevant and has an impact on market behaviour only if the authority has the power to implement policy via the allocation channel. Bank of England (2013), Norges Bank (2013) and Swiss National Bank (2013) suggest which indicators might be regularly reviewed for setting time-varying capital requirements (eg CCB), and how they might be used. The Basel III framework gives a prominent role for the credit to GDP gap in setting the countercyclical capital buffer.

The effect of publishing the authority's assessment about the state of the economy and the financial system would be stronger the better is market participants' understanding of the authority's behaviour. For example, an official assessment that there is excessive lending to the real estate sector may be interpreted as a signal that the authority will raise sectoral capital requirements on real estate lending unless financial institutions curtail lending to that sector. If the authority is able to influence financial institutions' expectations in this way, it may be able to stop an unsustainable lending boom without having to tighten policy. This argument, which echoes discussions that the effectiveness of monetary policy hinges on well-anchored private expectations, underscores the value of a clear mandate and a well-articulated course of action of a macroprudential policy authority. To extend this argument, Box 2 considers how the allocation and signalling channels may reinforce each other in a specific scenario in which the authority raises the countercyclical capital buffer to stem an unsustainable credit boom.

An interesting, but yet unexplored question is whether there is a role for forward guidance in macroprudential policy — ie sending signals about the future path of the regulatory policy in order to influence financial institutions' expectations about long-term policy and thus their behaviour. For example, simply lowering the required capital ratio (eg through a reduction of countercyclical capital buffer) may not discourage excessively rapid deleveraging in a post-crisis environment if financial institutions respond by increasing the voluntarily held capital buffer. However, the authority could *also* make a forward-looking announcement that it will not increase the countercyclical capital buffer until credit volumes have recovered. To the extent that some of the voluntary buffer is held as a protection against the risk of future regulatory tightening, this announcement could induce banks to run down their capital buffer and help prevent deleveraging. This is analogous to a central bank seeking to ease monetary conditions when the policy rate has reached the zero bound by committing not to raise the interest rate for an extended period and thereby aiming to reduce long-term yields (Bernanke, Reinhart and Sack (2004)). Although the role of forward guidance in monetary policy is extensively analysed, its potential role for macroprudential policy — particularly when market forces induce banks to hold capital buffers above the level required by the macroprudential authority — is yet to be examined in the literature.

There are two necessary conditions for policy signals to lead to desirable outcomes. First, policy signals need to be credible. Box 3 discusses why credibility problems may arise and how they could be resolved. Second, for policy signals to have the desired impact, the incentives of financial institutions that give rise to moral hazard need to be effectively controlled. If incentives are distorted, private players may pay attention to information about systemic risk perversely, in order to increase their exposure to such risk, not reduce it. The reason is that, from a private point of view, it could be better to find yourself in trouble when the rest of the system is in trouble: the likelihood that an institution is bailed out is higher in the event of systemic distress, as such an event would prompt official intervention to ward off an economic meltdown (Acharya *et al* (2010), Gorton and Metrick (2010), Rajan (2006) and Acharya (2009)). Effective implementation of macroprudential policy through the allocation channel plays a role in curtailing such 'moral hazard' incentives by ensuring that banks hold sufficient loss-absorbing capital at all points in the credit cycle and therefore have little incentive to take excessive risks at the expense of their creditors. That said, macroprudential policy alone is clearly insufficient to correct all distorted incentives, and other regulatory and structural policies — such as improved resolution regimes — may be needed in order to

Box 3
Credibility of policy signals

When there is a conflict between private and public interests, the macroprudential authority may have an incentive to overstate or understate risks. That could cause policy signals to lose credibility. For instance, if financial institutions tend to overreact to perceptions of benign economic fundamentals by increasing leverage and balance sheet size to socially suboptimal levels,(1) a prudential authority may be tempted to portray the fundamentals as worse than it actually believes them to be. Likewise, the authority may have an incentive to withhold information about deteriorating fundamentals in order to ward off a market panic. However, if market players understand these incentives of the prudential authority, they would stop acting on policy signals and thus render them redundant.(2)

There are different options to restore the credibility of policy signals in such a context. One is to introduce 'constructive ambiguity' in policy announcements. Alternatively, if there is a commitment to a 'policy reaction function', then specific policy actions would truthfully reveal the authority's information about economic fundamentals.

The literature on 'cheap talk' shows that when the incentives of the sender and the receiver of information are misaligned, credible announcements are imprecise, ie constructively ambiguous (eg Crawford and Sobel (1982); Stein (1989)). To see why, note that the misalignment of incentives increases with the precision of the announcement. If the receiver (market player) perceives a precise announcement as credible, she would react strongly to it. This would create a strong incentive for the information sender (regulator) to manipulate the announcement. Understanding this incentive, rational market players would ignore or discount the announcements. If the announcement is less precise, however, the rational reaction by the market participants to it would be weaker and so would be the incentives of the regulator to manipulate the information. Eventually, at a sufficiently low level of announcement precision, the incentives of the sender of information are aligned with those of the receiver of information: the sender releases imprecise information that contains the truth, and the receiver believes it and acts upon it.

Alternatively, policy actions themselves could release credible policy signals. The mechanism for revealing information of the authority through a policy action would be similar to the mechanism through which market-clearing prices reveal some of traders' private information (Grossman (1989); Tarashev (2007)). A precondition, however, is that the authority should commit to a stable policy rule, or a reaction function, that is clearly understood by the market. Such a function would call for a concrete policy action on the basis of: (a) the policy authority's information; and (b) common beliefs in the private sector, including beliefs about policy signals, that determine private actions. Thus, since a market player would be aware of the common beliefs in the private sector, she would be able to infer the authority's information from the observed policy action. Explicitly committing to a stable policy rule is unlikely to be practical given the multifaceted objectives of a macroprudential authority, which can evolve over time. Nevertheless, a macroprudential policy authority could establish credibility by communicating the factors influencing its decisions clearly and building a track record of operating in a systematic way.

(1) See Adrian and Shin (2010) for discussion.
(2) This situation parallels that of dynamic inconsistency in monetary policy (eg Barro and Gordon (1983)).

ensure that policy signals released by the macroprudential authority have the intended impact.

2.2.3 Signals as a 'co-ordination device'

Signals of the third type are those designed to co-ordinate private agents' behaviour towards an outcome preferred by the authority. For example, it is possible that policy recommendations can act as a powerful mechanism for equilibrium selection when multiple equilibria exist. Consider, for example, a situation in which banks need to raise capital in order to support new lending. Individual banks may be unwilling to increase retained earnings through dividend cuts because they fear that doing so could be interpreted as signalling weak prospects for future earnings (Miller and Rock (1985)). And banks are likely to be more worried about this negative signalling effect when others are not cutting dividends either.(1) In such a situation, a publicly announced recommendation by the authority that all banks restrict their dividend payouts could potentially mitigate the adverse signalling effect that banks fear, thus helping them to co-ordinate towards the socially desirable equilibrium in which more earnings are retained to rebuild capital. This potential mechanism for influencing financial institutions' behaviour needs to be explored in the literature, both empirically and theoretically.

In addition, in the presence of self-fulfilling beliefs, a public policy authority may be able to influence the equilibrium

(1) In technical terms, it means that strategic complementarity may exist in banks' decision to determine the dividend payout ratio because of the reputational cost of cutting dividends which is increasing in other banks' dividend payouts. In such a situation, multiple equilibria (with low and high dividend payouts) could exist. The authority's recommendation could potentially reduce the reputational cost of cutting dividends and thus guide the market outcome towards an equilibrium with low dividend payouts and high retained earnings.

selection mechanism by changing the *perceived riskiness* of alternative pay-offs. Suppose that risk-averse traders can invest in one of two assets and that the private return on each asset increases in the aggregate investment it attracts, but one asset generates greater social benefits. If so, investment in either asset is a possible equilibrium but one equilibrium is preferred by the public authority. Releasing a policy signal about the fundamentals of the preferred asset and no signal about the other asset would lower the perceived risks surrounding the former relative to those surrounding the latter. Thus, as far as the risk-averse traders are concerned, the policy signal would increase the relative expected utility from investing in the socially preferred asset. This would steer market behaviour towards the desired equilibrium.(1)

3 Discussion: where next?

In contrast to the wealth of literature on monetary policy, the literature on the transmission mechanism of macroprudential policy is growing but still at an early stage. As such, there is a high degree of uncertainty and large gaps in our knowledge about how macroprudential policy may operate in practice. We therefore highlight a number of avenues for future research which would help fill these gaps.

First and most importantly, our understanding of how the allocation channel operates in practice is limited by the difficulty of anticipating financial institutions' reaction to changes in macroprudential policy. For example, the existing literature is divided over whether a higher capital ratio requirement increases or decreases banks' risk-taking (see Box 2). Understanding of the likely reaction of financial institutions to policy is also hindered by the fact that changes in the regulatory regime may have altered their behaviour, and by the possibility that their reaction may depend non-linearly on the state of the economy. These considerations limit the usefulness of past data in informing policy. This suggests that policymakers may need to complement results from research with information obtained from survey data and other sources (eg information gathered from market participants through informal dialogues) in order to build a more complete picture about how policy may operate.

Second, an examination of the role of expectations in macroprudential policy in a dynamic model is needed to improve our understanding of the signalling channel. In particular, we need to better understand under what conditions policymakers can influence expectations of financial institutions so as to modify their behaviour in a desirable way. A related question is how expectations affect the impact of macroprudential policy. For instance, it is possible that banks build up a capital buffer above the regulatory requirement in anticipation of a future increase in the required capital ratio. And if this helps to achieve the desired level of systemic resilience, this may limit the need for the policy authority to raise capital requirements. This also illustrates that the communication by a macroprudential authority with powers to alter regulation is likely to have a more powerful impact on banks' behaviour through its impact on policy expectations than similar communication by an authority without such powers. Unfortunately, there is currently no research that has tried to tackle these important issues in a satisfactory manner.

Third, there is a need for theoretically and empirically grounded analytical frameworks that could suggest indicators for macroprudential policy. While there is agreement to use a measure of 'excessive' credit — such as the credit to GDP gap proposed in Basel Committee on Banking Supervision (2010) — as an indicator for adjusting the countercyclical capital buffer, this approach has not yet been tested in practice. The literature has yet to deliver a well-defined equilibrium concept for the credit market, such as 'a sustainable level of credit growth' — and the system's distance from it, analogous to 'the output gap' used in setting and communicating monetary policy. In many ways, the absence of a theoretical underpinning for indicators for macroprudential policy reflects the multifaceted nature of financial stability. However, the lack of clear analytical frameworks to explain why policy needs to be changed under particular conditions could potentially hinder policy setting and communication.

Fourth, the potential sources of policy leakages should merit more serious consideration in models for macroprudential policy analysis. The potential sources of leakages, which may weaken the impact of macroprudential policy include regulatory arbitrage, international leakages and migration of credit market activities to unregulated sectors (so-called 'shadow banks').(2) These leakages are likely to change over time as financial institutions try to find ways around new regulations, adding to the uncertainty surrounding the transmission mechanism of macroprudential policy.

Fifth, we need better understanding of how macroprudential policy interacts with monetary policy. There is some existing research that sheds light on this issue by examining the interaction of the two policies in a standard DSGE model (eg Christensen, Meh and Moran (2011); Angelini, Neri and Panetta (2011)). However, these standard DSGE models are not well suited for analysing how the two policies interact in a post-crisis environment and what might be the best policy combination to help the economy escape the post-crisis downturn.

Finally, further work is also needed on the interactions between various macroprudential policy tools. Given that there are numerous distortions in markets in which banks play

(1) This argument is an extension of the main message in Ennis and Keister (2005).
(2) Goodhart *et al* (2012) is one of the few papers which consider the potential leakage of macroprudential policy due to the presence of shadow banks.

a central role, there is a need to improve our understanding of which tool best addresses a particular distortion and how various tools jointly affect financial institutions' incentives and the resilience of the system. Recent research by Vives (2012), for instance, suggests that there may be a degree of substitutability between liquidity and capital requirements in enhancing systemic resilience.

These considerations suggest that macroprudential policy analysis would need to rely on an eclectic mix of analytical frameworks, drawing on the literature discussed above. The analytical model needs to be developed and selected depending on the policy issue at hand and the frictions that are considered most salient. Furthermore, new analytical methods for financial stability analysis outside the existing strands of literature should be explored. One example comes from so-called agent-based models, which do not impose rational 'model-consistent' expectations and hence could, in principle, shed light on the consequences of complex interactions between heterogeneous agents. To be of practical use for policy analysis, however, these models would need to be sufficiently tractable so that the mechanisms through which policy influences resilience and credit could be clearly understood.

4 Conclusions

This paper has articulated the channels through which macroprudential policy could affect the resilience of the financial system and the flow of credit to the real economy. We drew on the growing literature on macroprudential policy as well as on lessons from game theory and monetary policy research.

We identify two channels through which macroprudential policy can operate. The allocation channel, operating through changes in the incentives and constraints faced by financial intermediaries, provides a route through which increases in the countercyclical capital buffer in a boom and its release in a downturn can boost system resilience and help maintain a stable flow of credit to the real economy. If, however, banks are judged to be inadequately capitalised following a severe crisis, requiring banks to raise the level of capital would be needed in order to restore system resilience and create the conditions for a sustained recovery of credit.

The signalling channel, by contrast, would operate through the effects that macroprudential policy signals have on the beliefs and, ultimately, actions of financial institutions and market participants. The revelation of information by the macroprudential authority, which can take various forms, would affect financial stability. For example, in a post-crisis environment of heightened uncertainty, announcing clear and objective standards against which banks' capital adequacy is judged could help lower sound banks' funding costs while forcing weaker banks to recapitalise in order to meet the standards, thus restoring the banking system's ability to provide credit to the real economy.

We emphasise that there is considerable uncertainty over how these theoretical channels operate in practice. Unlike monetary policy, we lack a track record on the effects of varying macroprudential tools. Thus, our analysis should be seen as a first step towards building a fuller picture of how macroprudential policy may operate.

The literature on the impact of macroprudential policy is growing but remains fragmented, and there are several important gaps in our understanding of how it might operate. Given the number of frictions that need to be taken into account in formulating policy, macroprudential authorities would need to rely on a suite of well-articulated, tractable models for policy analysis, shaped by the issues at hand.

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