

# MACROPRUDENTIAL POLICY – A LITERATURE REVIEW

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**Abstract.** The recent financial crisis has highlighted the need to go beyond a purely micro approach to financial regulation and supervision. As a consequence, the number of policy speeches, research papers and conferences that discuss a macro perspective on financial regulation has grown considerably. The policy debate is focusing in particular on macroprudential tools and their usage, their relationship with monetary policy, their implementation and their effectiveness. Macroprudential policy has recently also attracted considerable attention among researchers. This paper provides an overview of research on this topic. We also identify important future research questions that emerge from both the literature and the current policy debate.

**Keywords:** Macroprudential policy

## 1. Introduction

The recent financial crisis has highlighted the lack of analytical frameworks to help predict and cope with the global build-up of financial imbalances whose sudden unwinding turned out to have severe macroeconomic consequences. With the benefit of hindsight, there has been a fundamental lack of understanding of system-wide risk.<sup>1</sup> In particular, there has been a failure to appreciate how aggressive risk-taking by different types of financial institutions – against the background of robust macroeconomic performance and low interest rates – supported a massive growth in balance sheets in the financial system. Overconfidence in the self-adjusting ability of the financial system led to underestimate the consequence of the accumulation of growing stocks of debt and leverage, which resulted from booming credit and asset prices – most notably in the housing sector – and were reflected in historically low levels of asset price volatility and risk premia. There was also insufficient recognition of the role of financial innovation and financial deregulation in magnifying both the boom and the unwinding of financial imbalances and their consequences on the real economy.

In terms of policy, the recent financial crisis has highlighted the need to go beyond a purely micro-based approach to financial regulation and supervision. As a consequence, the number of policy speeches, research papers and conferences that discuss a macro perspective on financial regulation has grown considerably. There is a growing consensus among policymakers that a macroprudential approach to regulation and supervision should be adopted<sup>2</sup>:

*[...] we need a new set of macro-prudential policy tools which will enable the authorities more directly to influence the supply of credit [...]. These tools are needed because credit/asset price cycles can be key drivers of macroeconomic volatility and potential financial instability [...]. (Chairman of the UK Financial Services Authority, Turner, 2010a).*

*To this microprudential base policymakers are adding a macroprudential overlay to address systemic risk. This overlay has two important dimensions. First, it seeks to ensure the stability of the financial system over time [ . . . ]. And second, the macroprudential overlay addresses the stability of the financial system at each point in time [ . . . ]. (Deputy General Manager of the BIS, Hannoun, 2010).*

Standard-setting committees have been tasked with working on macroprudential tools:

*Basel III represents a fundamental strengthening – in some cases, a radical overhaul – of global capital standards. Together with the introduction of global liquidity standards, the new capital standards deliver on the core of the global financial reform agenda, and will be presented to the Seoul G20 Leaders Summit in November.*

*The implementation of Basel III will considerably increase the quality of banks' capital and significantly raise the required level of their capital. In addition, it will provide a "macroprudential overlay" to better deal with systemic risk. Lastly, the new package will allow sufficient time for a smooth transition to the new regime. (Caruana, 2010a).*

*'[ . . . ] Taken together, the enhanced Basel II and the macroprudential overlay form the Basel III framework.' (Deputy General Manager of the BIS Herve Hannoun, 2010).*

The policy debate is focusing in particular on the usage, implementation and effectiveness of macroprudential tools as well as their impact on macroeconomic outcomes and their relationship with monetary policy. Until recently, only limited research and analytical tools were available to inform decisions on a macroprudential policy framework. In the wake of the financial crisis, however, macroprudential policy has attracted considerable attention among researchers, and the research literature is now growing fast. This paper provides an overview of this line of research. The focus of our paper is on the macroeconomic implications and aspects of macroprudential policy tools. Such macroeconomic aspects are relevant for designing effective macroprudential tools, and for the setting of macroeconomic policy, especially of monetary policy. Our paper does not focus on primarily microeconomic issues or issues regarding banks individually.<sup>3</sup> The aim of our paper is to help guide researchers in identifying policy-relevant research questions that can inform policy decisions on the design and implementation of macroprudential policy tools going forward and on the interaction with monetary policy, and to provide information for policymakers on existing research that can inform their current policy debates.

In the paper, we draw parallels with the research literature on monetary policy, which over the past decades has informed the evolution of monetary policy frameworks and strategies. In particular, we look at policy objectives, intermediate targets, instruments and the transmission mechanisms. The crisis has highlighted important shortcomings of the literature on monetary policy, and in particular, big gaps in modelling the nexus between the real economy, the financial system and monetary policy. New research on monetary policy is trying to fill this gap. Monetary policy and macroprudential policy seem to be at the same cross-road.

The remainder of the paper is organized as follows. Section 2 discusses the objectives of macroprudential policy, Section 3 goes on to discuss macroprudential policy tools and Section 4 covers the analytical underpinnings and the transmission mechanism. The effectiveness of macroprudential tools, including empirical analysis, is dealt with in Section 5. Section 6 covers coordination of macroprudential policy with monetary policy, as well as governance issues. Finally, Section 7 identifies future research questions based on our review of the existing literature and current policy concerns.

## 2. Objectives of Macroprudential Policy

Over the past two decades and until the crisis erupted, the literature on monetary policy has seen a broad convergence of views on the policy objective.<sup>4</sup> Monetary policy should be geared towards price

stability – defined over a horizon of no longer than 2 years – and, if there is a dual mandate as, for example, in the case of the Federal Reserve, maximum sustainable employment. Operative objectives were typically defined in terms of CPI inflation or some type of core inflation.

The literature on macroprudential policy is still far from such a consensus on its objectives. Broadly speaking, macroprudential policy is seen as aiming at financial stability, but there is no commonly shared definition of financial stability. The different views can be broadly assigned to two groups. The first defines financial stability in terms of robustness of the financial system to external shocks (e.g. Padoa-Schioppa, 2003; Allen and Wood, 2006). The second emphasizes the endogenous nature of financial distress and describes financial stability in terms of resilience to shocks originating within the financial system (e.g. Schinasi, 2004) or the vulnerability to financial distress in response to normal-sized shocks rather than large shocks (Borio and Drehman, 2009a).

In terms of the specific goals of macroprudential policy, the general view is that it is all about limiting the risks and costs of systemic crises, although there are differences in language and emphasis. Brunnermeier *et al.* (2009) argued that one key purpose of macro-regulation is to act as a countervailing force to the natural decline in measured risks in a boom and the subsequent rise in measured risks in the subsequent bust. Table 3 highlights the main differences between a macroprudential and the traditional microprudential perspective.

A controversial issue is whether policy should react to asset price bubbles. While some argued that avoiding bubbles would be both pragmatic and legitimate (Landau, 2009), a key problem is that, in practice, bubbles are difficult to identify in real time. Hence, policy could respond to a wrongly identified bubble that does not, in fact, exist, or policy could be inactive in the face of an actually existing bubble since it was not identified as such. Moreover, asset price bubbles can sometimes not be associated strongly with shifts in (bank) credit supply (Bank of England, 2009).

A critical element in this debate is the interaction between financial instability and the macroeconomy. This element comes out most clearly in the definition of the goal of macroprudential policy as limiting the risk of episodes of system-wide distress that have significant macroeconomic costs (Borio and Drehmann, 2009a). A useful starting point in understanding the nature of macroprudential policy according to this view is the distinction between the macro- and the microprudential perspectives to regulation (Crockett, 2000).<sup>5</sup> Borio (2003) suggested the following stylized characterization of the different nature of the two perspectives.

Another important element of macroprudential policy is that it addresses negative externalities that arise in the financial system. Perotti and Suarez (2009a) viewed macroprudential policy as aiming to discourage individual bank strategies that cause systemic risk, a negative externality on the financial system. According to Hanson *et al.* (2011), macroprudential policy should aim at controlling the social costs of a generalized reduction of assets in the financial system.

### 3. Macroprudential Tools

In the literature on monetary policy, there is a clear-cut consensus on the role of different instruments. The policy rate is seen as the primary instrument, with communication generally playing a supporting role (Blinder *et al.*, 2008). The use of non-conventional tools, which have recently attracted much attention in the policy debate and the research literature (e.g. Bernanke and Reinhart, 2004; Curdia and Woodford, 2009; Gertler and Karadi, 2011; Christiano *et al.*, 2010; Lenza *et al.*, 2010), are confined to extreme situations where policy rates are close to the zero bound.

While the crisis has sparked an extensive policy debate as well as a number of research initiatives in academia and research task forces of policy fora, a comparable consensus is still missing in the literature on macroprudential policy.<sup>6</sup> A range of possible macroprudential measures have been investigated but neither a primary instrument nor a standard taxonomy of instruments have been identified.

**Table 1.** Macro- versus Microprudential Perspectives.

	Macroprudential	Microprudential
Proximate objective	Limit financial system-wide distress	Limit distress of individual institutions
Ultimate objective	Avoid macroeconomic costs linked to financial instability	Consumer (investor/depositor) protection
Characterization of Risk	“Endogenous” (dependent on collective behaviour)	“Exogenous” (independent of individual agents’ behaviour)
Correlations and common exposures across institutions	Important	Irrelevant
Calibration of prudential controls	In terms of system-wide risk; top-down	In terms of risks of individual institutions; bottom-up

Source: Borio (2003).

Tinbergen (1952) put forth what we now call the ‘Tinbergen principle’, that policymakers need at least one independent policy instrument for each policy objective. Since the policy interest rate is used by monetary policymakers to achieve the objective of price stability, at least one other instrument is required to achieve the additional objective of financial stability of macroprudential policy. The situation is complicated by the fact that, in practice, the different policy tools and objectives of monetary, macroprudential and microprudential policy are interrelated, as discussed in Schoenmaker and Wiers (2011).

One important distinction in the debate is between macroprudential tools – defined as prudential tools set up with a macro (in the sense of system-wide/systemic) lens – and other macroeconomic tools that can support financial stability such as fiscal policy (see, e.g. Borio, 2009; Blanchard *et al.*, 2010). IMF (2011a) refines this distinction further by defining macroprudential tools as instruments either specifically tailored to mitigating systemic risk, or not originally developed with systemic risk in mind but modified to become part of the macroprudential toolkit, provided that they fulfill two conditions. Firstly, they should target explicitly and specifically systemic risk. Secondly, the chosen institutional framework is underpinned by the necessary governance arrangements to ensure that there is no slippage in their use. Table 2 gives an overview of alternative sets of tools geared towards financial stability. The idea is that financial regulatory policies are an essential part of the solution, but that they alone will not suffice to address systemic risk in all its complexity (Caruana, 2010b).

Especially for emerging market economies, the macroprudential toolkit could also include measures to limit system-wide currency mismatches, which aim at stemming the domestic financial consequences of capital inflows.<sup>7</sup> Examples are limits on open foreign exchange positions and constraints on the type of foreign currency assets (Turner, 2009). Borio and Shim (2007) document how the build-up of financial imbalances was often accompanied by a growing share of net foreign-currency financing. Korinek (2010) provides an analytical framework for understanding the interaction between financial instability, macroeconomic conditions and capital flows. To the extent that large capital inflows may fuel domestic credit booms, tools at controlling these inflows can be seen as macroprudential tools.<sup>8</sup> One example of such tools is the Pigouvian taxation of international borrowing proposed by Jeanne and Korinek (2010), which forces borrowers to internalize the costs that currency mismatches on their balance sheets can generate in terms of asset price deflation.

The contributions to the literature on specific macroprudential instruments can be categorized in various – in part overlapping – ways. Table 3 provides an example of a taxonomy of macroprudential tools.

**Table 2.** Alternative Sets of Tools to Foster Financial Stability.

Tool set	Goal	Instruments
Prudential policy: Microprudential	Limit distress of individual institutions	e.g. quality/quantity of capital, leverage ratio
Prudential policy: Macroprudential	Limit financial system-wide distress	e.g. countercyclical capital charges
Monetary policy	Price stability Liquidity management  Lean against financial imbalances	Policy rate, standard repos Collateral policies; interest on reserves; policy corridors  Policy rate; reserve requirements; mop-up of liquidity; FX reserve buffers
Fiscal policy	Manage aggregate demand  Build fiscal buffers in good times	Taxes; automatic stabilizers; discretionary countercyclical measures  e.g. measures to reduce debt levels; taxes/levies on the financial system
Capital controls	Limit system-wide currency mismatches	e.g. limits on open foreign exchange positions; constraints on the type of foreign currency assets
Infrastructure policies	Strengthen the resilience of the infrastructure of the financial system	e.g. move derivative trading on exchanges

Source: Adapted from Hannoun (2010).

### 3.1 The Time Dimension

The literature has highlighted several important distinctions. One important distinction is between tools geared towards addressing the time dimension of financial stability – that is, the procyclicality in the financial system – and tools that focus on the cross-sectional dimension – that is, on how risk is distributed at a point in time within the financial system and contributions to systemic risk of individual institutions.

The time series dimension captures the evolution of risk over time, that is, the procyclicality of risk.<sup>9</sup> The literature has highlighted several sources of procyclicality and suggested instruments geared towards them.

One main source is the procyclicality of capital requirements (Saurina and Trucharte, 2007; Repullo *et al.*, 2009). Instruments that address this problem include countercyclical capital requirements (Kashyap and Stein, 2004) and forward-looking statistical provisioning schemes (Shin, 2010). Hanson *et al.* (2011) argue that at times of distress, the regulatory constraint on bank capital might be insufficient to convince markets to continue funding-troubled banks. They therefore argue in favour of minimum capital ratios in good times that substantially exceed the standards that markets might impose in bad times.

A second is the interaction between practices concerning the valuation of collateral and loan-to-value (LTV) ratios, which can be addressed through maximum LTV ratios (Borio *et al.*, 2001).

A third is loan loss provisions, an important channel through which a misassessment of risk can weaken banks' balance sheets and amplify the financial cycle. Borio *et al.* (2001) argue that accounting practices, tax constraints and the methodologies used to measure risk cause provisions to increase during business cycle downturns. Forward-looking provisioning can limit the observed strong procyclicality

**Table 3.** Macroprudential Instruments.

	Examples
1. Risk measurement methodologies <i>By banks</i> <i>By supervisors</i>	Risk measures calibrated through the cycle or to the cyclical trough Cyclical conditionality in supervisory ratings of firms; measures of systemic vulnerability (e.g. commonality of exposures and risk profiles, intensity of inter-firm linkages) as basis for calibration of prudential tools; benchmark values for risk premia, asset price and credit growth; communication of official assessments of systemic vulnerability and outcomes of macro stress tests
2. Financial reporting Accounting standards Prudential filters  Disclosures	Use of less procyclical accounting standards; dynamic provisions Adjust accounting figures as a basis for calibration of prudential tools; prudential provisions as add-on to capital; smoothing via moving averages of such measures; time-varying target for provisions or for minimum provision rate Disclosures of various types of risk (e.g. credit, liquidity) and of uncertainty about risk estimates and valuations in financial reports or disclosures
3. Regulatory capital Pillar 1  Pillar 2	Systemic capital surcharge; higher capital charges for trades not cleared through central counterparties; capital charge on derivative payables; reduce sensitivity of regulatory capital requirements to current point in the cycle and with respect to movements in measured risk; cycle-dependent multiplier to the point-in-time capital figure as macroprudential add-on; countercyclical change in risk weights for exposure to certain sectors (higher risk weights than on the basis of Basel II, for macroprudential reasons) Link of supervisory review to state of the cycle
4. Funding liquidity standards	Cyclically-dependent funding liquidity requirements; liquidity coverage ratio (LCR); net stable funding ratio (NSFR); concentration limits; FX lending restrictions; FX reserve requirements; currency mismatch limits; open FX position limits
5. Collateral arrangements	Time-varying LTV ratios; conservative maximum LTV ratios and valuation methodologies for collateral; limit extension of credit based on increases in asset values; through-the-cycle margining
6. Risk concentration limits	Quantitative limits to growth of individual types of exposures; (time-varying) interest rate surcharges to particular types of loans; powers to break up financial firms on systemic risk concerns
7. Restrictions on permissible activities	Ban on proprietary trading for systemically important banks
8. Compensation schemes	Guidelines linking performance-related pay to <i>ex ante</i> longer horizon measures of risk; backloading of pay-offs; use of supervisory review process for enforcement

Table 3. *Continued.*

	Examples
9. Insurance mechanisms	Contingent capital infusions; pre-funded systemic risk insurance schemes financed by levy related to bank asset growth beyond certain allowance; pre-funded deposit insurance with premia sensitive to macro (systemic risk) in addition to micro (institution specific) parameters; deposit insurance risk premia sensitive to systemic risk.
10. Managing failure and resolution	Exit management policy conditional on systemic strength; trigger points for supervisory intervention stricter in booms than in periods of systemic distress

Source: Adapted from BIS (2008) and IMF (2011a).

of loan provisions (Fernandez *et al.*, 2000), particularly when they take into account the credit risk profile of banks' loan portfolios along the business cycle (Jimenez and Saurina, 2006).

A fourth is haircut-setting and margining practices in securities financing and over-the-counter derivatives transactions, whose system-wide impact has been highlighted by the recent financial crisis (CGFS, 2010a).<sup>10</sup> Policy options for reducing the procyclical effects of those practices on financial markets include countercyclical variations in margins and haircuts, and higher and relatively stable through-the-cycle haircuts for securities financing transactions.

### 3.2 The Cross-Sectional Dimension

The cross-sectional dimension focuses on the distribution of risk in the financial system at a point in time, and, in particular, the common exposures that arise owing to balance sheet interlinkages, similar exposures and associated behavioural responses. In the process, macroeconomic dynamics are taken as exogenous. There is a rich literature on which analysis of the cross-sectional dimension can draw, such as studies of systemic aspects of risk management (e.g. Hellwig, 1995) or theories of systemic risk (e.g. Acharya, forthcoming). Important elements within this perspective include market failures (e.g. Rabin, 1998; Calomiris, 2009) and propagation channels (e.g. Jensen, 1986; Calomiris and Khan, 1991).

Most of the macroprudential tools discussed pertain to the regulation of banks' capital (e.g. Hanson *et al.*, 2011; Goodhart, 2010; Admati *et al.*, 2011; Turner, 2010b). At the same time, the large share of short-term debt in banks' liabilities has been identified as a major source of banks' vulnerability (Brunnermeier, 2009; Shin, 2009; Gorton, 2010; Hanson *et al.*, 2011; Martin *et al.*, 2010; Stein, 2012). These vulnerabilities are often modelled as idiosyncratic shocks amplified through spillovers across the system, as in the studies that focus on credit chains, payment and settlement system links or runs triggered by the inability to distinguish solvent from insolvent institutions.<sup>11</sup>

All these considerations have focused researchers' attention on instruments that distinguish the maturity structure of banks' balance sheets. One such instrument are capital requirement surcharges that are proportional to the size of the maturity mismatch (Brunnermeier *et al.*, 2009). The most prominent examples of such tools are the net stable funding ratio or a liquidity coverage ratio (Basel Committee on Banking Supervision (BCBS), 2009), which have an element of procyclicality. One way to overcome procyclicality, proposed by Perotti and Suarez (2009a,b, 2011), is to affect banks' incentives through liquidity risk charges that penalize short-term funding.



### 3.3 Rules Versus Discretion

As in monetary policy, another distinction is between rules (built-in stabilizers) and discretion in calibrating the tools of macroprudential policy (Borio and Shim, 2007). Both the historical experience of monetary policymaking and the academic literature have highlighted the importance of rules for accountability, transparency and efficacy of monetary policy. As the literature on time consistency shows, discretion-based solutions, which would be first-best in terms of agents' utility, are time inconsistent (Kydland and Prescott, 1977). In models where rational, utility-maximizing agents act strategically, rules can ensure at least a second-best solution. At the same time, there is a common recognition that to be successful, monetary policy has to be flexible and that discretion is needed in special circumstances.

By analogy, rule-based macroprudential tools – for example, automatic stabilizers – appear appealing (Goodhart, 2004). Loan loss provisions, capital requirements and capital surcharges, and LTV ratios can, for example, be designed in a rules-based way. One important built-in stabilizer are risk management practices that internalize the risk of the build-up of financial imbalances and their unwinding (Borio and Shim, 2007).

Contingent instruments can be seen as a form of rule-based tools that are state-dependent, and can be split into two types – ‘contingent reversibles’ and ‘capital insurance’ (Hanson *et al.*, 2011).<sup>12</sup> The former are debt securities that automatically convert into equity if the bank's regulatory capital (or its stock-market value) falls below a fixed threshold (Flannery, 2005; French *et al.*, 2010; Pennacchi, 2010). The latter is an insurance policy that a bank can purchase which pays off in a bad state of the world, according to a pre-specified trigger (Kashyap *et al.*, 2008).

While rule-based tools are generally viewed as important, the policy debate has highlighted that discretionary tools like supervisory review or warnings are also likely to play an important role, not least because the next crisis is likely to take a different form from the recent one. One commonly used discretionary tool is to issue warnings – for example, in speeches or Financial Stability Reports – about the build-up of risk in the system. A drawback of warnings is that they may have adverse effects if they turn into self-fulfilling prophecies (Libertucci and Quagliariello, 2010). Other discretionary tools that could play an important role include supervisory review pressure or quantitative adjustments to the various prudential tools (e.g. Hilbers *et al.*, 2005).

### 3.2 Price Versus Quantity Restrictions

One can also distinguish tools based on quantity restrictions and those based on price restrictions. Three main issues can be identified in the literature. One issue, which has recently received attention, is the relative merit of quantity restrictions and tax instruments. An important general point emphasized in this line of research is the importance of incentives in place of or in addition to buffers. One prominent paper performing such analysis is Perotti and Suarez (2011), who provide a theoretical treatment of price versus quantity-based tools based on the model by Weitzman (1974), who shows that in the presence of externalities, the two types of policy instruments can have different welfare outcomes if there is uncertainty about compliance costs. Price-based tools (taxes) fix the marginal cost of compliance and lead to uncertain levels of compliance, while quantity-based tools fix the level of compliance but result in uncertain marginal costs. Perotti and Suarez (2011) compare the performance of Pigovian taxes aimed at equating private and social liquidity costs to that of quantity regulations such as net funding ratios. They show that when regulators cannot target individual bank characteristics, the industry response to regulation depends on the composition of bank characteristics. Hence, depending on the dominant source of heterogeneity, the socially efficient solution may be attained with Pigovian taxes, quantity regulations or a combination of both.



Among quantity restrictions, the importance of distinguishing ratios and absolute values has been highlighted in the context of bank capital regulation (Hanson *et al.*, 2011). The idea is that targeting incremental amounts of new capital for troubled banks instead of increases in its capital ratio would avoid inducing banks to shrink their assets, and thereby reduce procyclicality.

A second issue that has been explored is the welfare implications of taxes in a context of open economies subject to volatile capital inflows. This research points to welfare-enhancing effects of taxes on capital inflows (Korinek, 2010) or on foreign debt (Bianchi, 2009).

A third issue concerns the possibility of taxing financial intermediation. Financial intermediation is exempted from value-added tax (VAT) in many advanced economies, including in the European Union (Arbak, 2011). In the case of the European Union, this exemption has been explained by technical and practical reasons, but structural changes in the banking industry and advances in information technology have arguably made it possible to readdress this exemption (Huizinga, 2002; Zee, 2004). With collection of VAT on financial intermediation becoming practical, one issue which could be investigated, for example, is whether VAT would be helpful in addressing the too-big-to-fail problem for banks, and how such an approach compares with the solution of higher capital requirements for large systemically important banks or restrictions on their size.

#### 4. Analytical Underpinnings

While the literature on monetary policy has provided a common conceptual framework over the past two or three decades, research on macroprudential policy is still in its infancy and appears far from being able to provide an analytical underpinning for policy frameworks. This may be due to three main reasons. Firstly, as discussed above, the macroprudential approach has come to play a visible role in policy discussions only very recently, and pinning down the definition of financial stability and goal of macroprudential policy is much less obvious.<sup>13</sup> Secondly, we lack a thorough understanding and established models of the interaction between the financial system and the macroeconomy. Thirdly, there is no clear consensus on the relationship and delineation between microprudential policy and macroprudential policy.<sup>14</sup>

In recent years, a number of studies have started to fill this gap.<sup>15</sup> These can be broadly divided into three types of literature. The first, discussed in Section 4.1, starts from a definition of financial stability and systemic risk, and is grounded in the banking/finance literature. From an empirical point of view, it addresses the key issues of how to quantify systemic risk and how to assess the systemic importance of individual financial institutions.

The second, which is described in Section 4.2, relies on network analysis or the theory of complex systems to examine the implications of size, interconnectness and the availability of substitutes in the financial system.

The third, reviewed in Section 4.3, consists of papers that examine the interaction between the financial system and the macroeconomy by embedding financial factors into macro models. Section 4.3 highlights the different insights that can be gained from banking/finance models and dynamic stochastic general equilibrium (DSGE) models.

##### 4.1 Financial Stability and Systemic Risk

In the literature, the notion of financial stability is often discussed in terms of the concept of systemic risk and its sources.<sup>16</sup> While there is a rich literature on this concept, there is no commonly shared definition of either systemic risk or financial stability, towards which macroprudential policies would be geared.

Theoretical work in this area generally relies on banking/finance models, which typically model the state-dependent nature of assets and contracts (e.g. Diamond and Dybvig 1983; Diamond and Rajan, 2001). The key ingredient of these models is financial contracts that are affected by informational asymmetries, commitment and incentives problems that can result in default. These models view financial instability as the result of self-fulfilling equilibria generated by exogenous shocks. Alternatively, it can result from negative shocks that get amplified, for example, through informational and balance sheet linkages.<sup>17</sup> The key idea is that systemic risk is a propagation risk, whereby shocks spread beyond their direct economic impact, resulting in diffused distress and disruption of the real economy (Perotti and Suarez, 2009b).

One important advantage of this setup for studying macroprudential policy is that it provides insights on the complex interaction between borrowers and lenders. At the same time, for tractability reasons, it typically neglects the role of the time dimension of systemic risk. Moreover, it is mostly of a partial equilibrium nature, which may yield different insights on the effect of macroprudential instruments compared to a general equilibrium analysis (Jaffe and Walden, 2011).

A very different paradigm considers financial instability as a manifestation of an endogenous cycle, in the spirit of Minsky (1982) and Kindleberger (1996). Within this perspective, the origin of financial instability does not lie so much in contagion but in the exposures to the evolution of systematic risk through time, which is intimately linked to the business cycle (Borio, 2003). According to this view, risk is fundamentally endogenous and reflects the mutual interaction between the financial system and the real economy that results in overextension in booms, and which, in turn, sows the seeds of the subsequent downturn and financial strains.<sup>18</sup> Note that this notion is dynamic in the sense that risk builds up over time (during the boom) and then materializes as the imbalances unwind in the downturn.

This view has informed an early focus on the need for a macroprudential orientation of regulation and supervision (Crockett, 2000; Borio, 2003). It also underlies a systematic foreshadowing of the recent crisis as far back as the mid-2000s (e.g. BIS, 2005, 2006, 2007). At the same time, the focus on the endogeneity of financial instability and on the non-linear build-up of risk in the financial system makes it difficult to couch this view within standard banking/finance models. As a result, this view has received only little attention in the theoretical research literature.

#### 4.1.1 *Quantifying Financial Instability and Systemic Risk*

From an empirical point of view, one main issue is how to quantify financial instability. A variety of empirical approaches have been followed in the literature, which can be broadly classified into four categories.<sup>19</sup> Firstly, indicators of financial distress based on balance sheet indicators (such as loan loss provisions or non-performing loans) and market indicators (typically based on equity and credit-default-swap or other derivative instruments) have become increasingly popular over the past decade.<sup>20</sup> They suffer, however, from two main shortcomings. First, they are typically backward looking or at most contemporaneous indicators of financial distress. Ratings of individual institutions, for example, are in principle forward-looking but in practice tend to incorporate new information only with a lag. Second, they are micro in nature and thereby fail to highlight vulnerabilities at the level of the whole financial system.

Secondly, early warning indicators for banking crises have been studied extensively.<sup>21</sup> Most of the indicators used in the literature, however, fail to predict events that happen in a more distant future and do not reflect an underlying model of the interaction between the real economy and the financial sector. A more promising avenue of research relies on indicators based on credit and asset markets, which perform relatively well in predicting – even out-of-sample – episodes of financial distress over somewhat longer horizons (1–4 years).<sup>22</sup> This forecasting power is consistent with an endogenous cycle view of financial instability: excessively strong growth in credit and financial asset

prices – possibly accompanied by a marked real exchange rate appreciation – reflects the build-up of financial imbalances that have the potential to unwind in a disruptive fashion with large negative macroeconomic consequences.

Third, vector autoregression (VARs) models are a flexible tool for forecasting financial distress and for tracing the transmission of shocks through the financial system to the economy.<sup>23</sup> At the same time, they offer only very stylized descriptions of the dynamics of the financial sector and of the feedback to the macroeconomy.

Finally, macro stress tests can be used to trace the response of the financial system to unusually large exogenous shocks.<sup>24</sup> The main advantages are that they are by nature forward-looking and – like vector autoregressive models – highlight the transmission of shocks within the system. Moreover, they rely explicitly on an underlying view of the forces that can drive financial distress. However, they generally fail to capture feedback effects between the financial system and the macroeconomy and the key aspect of financial distress that small shocks can have very large effects.<sup>25</sup> This may explain why existing macro-stress tests failed to replicate the dynamics of many past crises, including the recent crisis.<sup>26</sup>

#### 4.1.2 *Assessing the Systemic Importance of Individual Financial Institutions*

Another important line of empirical research on systemic risk investigates the systemic impact of problems of an individual institution or market. This line of research highlights the role of size, interconnectness and the availability of substitutes.

One important contribution to this line of research is the concept of CoVaR, which, for a particular financial institution, measures the value at risk (VaR) of the financial system conditional on that institution being in distress (Adrian and Brunnermeier, 2009). The underlying idea is that spillovers and externalities can lead to excessive risk-taking and leverage during a phase in which financial imbalances are building up. These externalities arise because an individual institution takes potential fire-sale prices as given, while a generalized selling pressure can generate fire sales that affect prices. An individual financial institution's marginal contribution to systemic risk is then captured by the difference between the CoVaR conditional on the distress of an institution and the CoVaR conditional on the 'normal' state of that institution, or  $\Delta\text{CoVaR}$ . Note that under many distributional assumptions, the VaR of an institution is proportional to the variance of the institution, while its CoVaR is proportional to the covariance of that institution and the financial system. This measure crucially depends on leverage, size and maturity mismatch.

The concept of CoVaR is appealing for different reasons. First, it focuses on the contribution of each institution to overall system risk, rather than on the risk of institutions in isolation. Second, it can capture spillovers of risk across all financial institutions in the financial system. At the same time, the CoVaR measure has been criticized on several grounds. First, it is not additive, in the sense that individual contributions do not add up to the aggregate measure of systemic risk (Tarashev *et al.*, 2010). Second, it uses correlation to measure spillover, with the latter implying causation, while the former does not necessarily imply causation. Third, the CoVaR measure, like the VaR measure, is likely to behave very differently in a crisis than in a normal period over which the correlations are measured.

Several alternative approaches have been proposed to measuring the systemic impact of individual institutions.<sup>27</sup> One is to look at the conditional probability of having at least one extra bank failure given that a particular bank fails (Segoviano and Goodhart, 2009). In a multivariate context, this approach can be extended to measuring the expected number of bank failures in the banking system given that one particular bank fails (Zhou, 2010).<sup>28</sup>

A second alternative looks at the marginal contribution of individual banks to systemic risk defined as the insurance cost to protect against distressed losses in a banking system (Huang *et al.*, 2009).

A third approach measures systemic risk in terms of the cost of the financial sector being below a certain percentile of its distribution (Acharya *et al.*, 2009).<sup>29</sup> The contribution of each individual financial institution to this cost – its marginal expected shortfall (MES) – is proportional to its size and the percentage loss or negative return it suffers when the market is below this threshold. A natural macroprudential tool that is grounded in this analysis is a ‘tax’ imposed on each financial institution depending on the average of its MES multiplied by its (dollar) weight in the economy.

#### 4.2 Financial Networks and Complex Systems

Two literature strands on the interconnectedness of financial institutions have recently received increasing attention – network analysis and theories of complex systems.

Network analysis describes the financial system as a complex dynamic network of agents, which are connected directly through mutual exposures in the inter-bank market and indirectly through holding similar portfolios or sharing the same mass of depositors.<sup>30</sup> It provides a tool to document the vulnerability of a banking system to contagion and how this vulnerability depends on the type of interlinkages among banks. Allen and Babus (2009), for example, show that banking systems with a more complete set of connections may be more resilient to contagion than those with an incomplete structure.

Several interesting insights emerge from this line of research. First, it provides another perspective on the fallacy of composition that a sound individual financial institution does not prevent instability of the financial system as a whole. A key market failure in network analysis is that financial institutions choose their individual degree of diversification but do not determine the network structure (Allen *et al.*, 2010). As a result, for a given level of individual diversification, there can be multiple network structures with different implications in terms of systemic risk.

Second, the failure of a large institution can be an important catalyst of financial instability (e.g. van Lelyveld and Liedorp, 2006), suggesting that macroprudential tools need to take the size of financial institutions into account.

Third, size alone is not always the main determinant of systemic importance. Highly interconnected financial institutions (‘too-connected-to-fail’ banks) have been identified as a major source of contagion during the global financial crisis that started in 2007 (e.g. Chan-Lau, 2010). It is therefore important for macroprudential policy to identify and address the systemic risk implied by highly interconnected financial institutions. One such instrument is capital charges geared towards the interconnectedness of a financial institution.<sup>31</sup>

Fourth, the resilience of the financial system depends in a non-linear fashion on its network connectivity: while the likelihood of contagion may be reduced by greater connectivity, the potential impact of a shock has a much larger scale (Gai and Kapadia, 2010; Nier *et al.*, 2008).

Finally, systemic shocks can propagate via strategic behaviour, even in the absence of large disruptive shocks (Cohen-Cole *et al.*, 2010a,b).

The other literature strand on interconnectedness and its implications relies on models of the financial system as a complex system. This research focuses explicitly on the degree of complexity, interconnection, non-linearity, diversity and uncertainty.<sup>32</sup>

In these models, heterogeneous agents with bounded rationality follow learning processes that influence the aggregate dynamics of the system. The interaction between heterogeneous agents can amplify the effect of news about economic fundamentals on financial markets and lead to excess volatility, temporary bubbles and sudden crashes, clustered volatility and long memory (Hommes, 2008). Importantly, the behaviour of asset price fluctuations in these models is highly irregular and unpredictable.

One interesting implication of this line of research is that the existence of multiple equilibria and non-linearity, which result from the interaction of heterogeneous and boundedly rational agents, severely limits the predictive power of early warning indicators (Bolt *et al.*, 2011).

A promising new direction of research within this literature strand looks at ways to incorporate banks into an agent-based macro model, modelling their role in the mechanism of exchange. These models importantly allow for default of both firms and banks in a general equilibrium setting as well as for disequilibrium outcomes (Ashraf *et al.*, 2011, building on Howitt and Clower, 2000). This approach focuses on the self-organizing capabilities of the system of markets through which agents interact. An important conclusion is that if the system is displaced far enough from equilibrium, its self-regulating mechanisms can break down (Ashraf *et al.*, 2011).

#### 4.3 *Understanding the Interaction Between the Financial System and the Macroeconomy*

The theoretical approaches that can give insights on the interaction between the financial system and the macroeconomy can broadly be divided into two types of literature.<sup>33</sup> The first approach consists of macro models, and in particular DSGE models. A main advantage of this approach is that it relies on general equilibrium analysis for policy purposes and uses models in which the time dimension plays an important role. Moreover, these models are particularly suitable for simulations, which make them attractive to study the impact of new policy instruments.

At the same time, one important drawback of DSGE models is that they are typically infinite horizons models and therefore are not well suited to incorporate state contingency in a meaningful way. As a result, DSGE models have problems of modelling financial intermediation and frictions (Bean, 2009). In fact, with very few recent exceptions, they implicitly assume that defaults do not occur (Goodhart *et al.*, 2009). Instead, they generally assume complete markets. Moreover, they analyse deviations from steady state – where the steady state is independent of financial regulation – and do not model financial booms and busts (see Buiter, 2009 and Tovar, 2008).

While the literature on macro models with financial frictions and intermediaries is still far from providing analytical frameworks that incorporate full-fledged modelling of systemic risk (Angelini *et al.*, 2011), several recent strands of the literature try to overcome these limitations.

A first strand looks at monetary policy in DSGE models augmented with financial frictions related to credit constraints of non-financial borrowers, building on the financial accelerator mechanism of Bernanke *et al.* (1999).<sup>34</sup> Some papers explicitly use these models to examine the interaction between monetary policy and the macroeconomy during the crisis (e.g. Del Negro *et al.*, 2010). The drawback of such models is that they mainly model financial frictions related to non-financial borrowers, not to lenders. Consequently, they are not very useful in understanding the effects of financial frictions in situations such as the recent crisis when the dominant frictions related to financial intermediaries.

Another strand investigates frictions related to financial intermediaries and studies the role of bank capital in the monetary transmission mechanism.<sup>35</sup> One important finding of this line of research is that policy decisions need to take proper account of the role of different interest rates – the collateralized loan rate, the uncollateralized loan rate, the Treasury bill rate, the net marginal product of capital and a pure inter-temporal rate (Goodfriend and McCallum, 2007). Ignoring these differences could lead to substantial policy mistakes.

A third literature strand studies the implications of capital regulation for bank behaviour and macroeconomic outcomes from a theoretical perspective.<sup>36</sup> Recent work by, among others, Bianchi and Mendoza (2011) and Jeanne and Korinek (2010) builds on a modified Kiyotaki–Moore framework to study the impact of occasionally binding collateral constraints on credit. One important feature in this work is the possible presence of a credit externality that drives a wedge between the competitive equilibrium and the social planner's equilibrium. As borrowers do not fully internalize the impact of

their decision on the price of the collateral, this externality induces overborrowing. Efforts to quantify business cycle effects of bank capital requirements using this type of models suggest that output volatility is significantly larger (and household welfare smaller) in the presence of procyclical capital requirements as in Basel II (Covas and Fujita, 2009).

In terms of policy prescriptions, this literature strand points to the usefulness of a combination of 'mildly anti-cyclical' capital ratios and a monetary policy rule that responds to bank leverage or asset prices (Angeloni and Faia, 2011). Moreover, policymakers' active management of capital requirements may improve the stabilization of economic activity (Angelini *et al.*, 2011).

A second approach to modelling the link between the macroeconomy and the financial system introduces macroeconomic factors in elaborate models of cycles in financial intermediation (Brunnermeier and Sannikov, 2009). Importantly, this research integrates macroeconomic factors and the financial system in an analysis that is not confined around the steady state, and thereby offers several key insights. First, the model embodies an important non-linearity: an economy can remain for a long time around a steady state with normal growth but be vulnerable to sudden episodes of high volatility. In the presence of strong feedback loops, the economy may then be caught for some time in a persistent depressed state. Second, a relevant finding is that the financial sector does not internalize all the costs associated with excessive risk-taking, and hence leverage and maturity mismatch are excessive. Third, securitization allows the financial sector to offload some of the risk but exacerbates excessive risk-taking.

## 5. Effectiveness of Macroprudential Tools

The impact and transmission of macroprudential policy are far from being well understood empirically, for three main reasons. First, it is too early to empirically assess the effectiveness of tools that were introduced only over the past few years. Not only are data needed to conduct empirical research scarce, but there has been very little analysis in the literature on what data are needed for macroprudential policy purposes.<sup>37</sup> Second, empirical work is more difficult in the absence of established models of the interaction between the financial system and the macroeconomy. Third, complicating the assessment of the effectiveness of macroprudential tools is that measures are often not taken in isolation, but in combination with other policies. There is therefore a great need of more systematic empirical evaluation of the effectiveness of macroprudential tools employed recently or historically.

### 5.1 Main Methodologies

In recent years, empirical work has tried to overcome these difficulties and has tested the impact of macroprudential instruments following five main approaches. The first is based on event studies covering different cross sections of countries, and has typically been carried out at central banks (e.g. CGFS, 2010b), the IMF (e.g. Hilbers *et al.*, 2005; Crowe *et al.*, 2011a, b; Terrier *et al.*, 2011) or the BIS (e.g. Montoro and Moreno, 2011).<sup>38</sup>

A second, related approach relies on compiling the assessments of authorities and outside observers on the effectiveness of macroprudential tools (Borio *et al.* 2001; Borio and Shim, 2007). While authorities' assessments provide direct evidence on specific tools, they may reflect subjective views, rather than being based on independent empirical evaluations. Moreover, for individual country experiences, there is a problem of the counterfactual – it is not clear what would have happened in the absence of macroprudential measures. In fact, Borio and Shim (2007) argue that more definite conclusions about the effectiveness of macroprudential tools would need to be based on a more systematic analysis of the different episodes.



A third approach consists of cross-country studies that use reduced-form regression analysis (e.g. IMF, 2011b, c). Compared to event studies, this line of research allows more formal tests of the impact of macroprudential tools. However, one limitation is that reduced-form models do not capture well the interaction between macroeconomic, financial and policy variables. Furthermore, since in most cases, macroprudential tools have been introduced only in recent years in policymakers' toolkit, there is not much data available to perform regression analysis.

A fourth approach uses macroeconomic models – typically DSGE models (e.g. Antipa *et al.*, 2010) or structural models such as the National Institute of Economic and Social Research's large-scale global macroeconomic model (NIGEM) (e.g. Catte *et al.*, 2010) – to perform counterfactual simulations of macroprudential policies.

A fifth approach tests the impact of macroprudential tools with micro data on commercial banks, and in particular data on individual banks' loan books, risk exposures and inter-bank links (e.g. Gauthier *et al.*, 2010).

## 5.2 Main Findings

The limited empirical literature tentatively points to two main findings on the overall impact of macroprudential policy. First, there is some tentative evidence that macroprudential policy may contribute to reducing systemic risk and financial instability. This is based on different empirical approaches, such as cross-country panel regressions of the effects of macroprudential tools on the procyclicality of credit growth, leverage or capital flows (e.g. IMF, 2011c), or estimates of the probability of a systemic crisis based on bank-level data (Gauthier *et al.*, 2010). Cross-country empirical analysis points to macroprudential policy reducing systemic risk by dampening procyclicality, mainly through credit-related measures (e.g. LTV caps) or liquidity-related measures (e.g. reserve requirements) (IMF, 2011c).

Second, there is some evidence that macroprudential policy, if it had been applied ahead of the recent financial crisis, may have affected developments positively. Counterfactual simulations of macroprudential policies based on a DSGE model estimated for the United States, the euro area and the United Kingdom, for example, suggest that macroprudential policy would have been effective in smoothing the past credit cycle and in reducing the depth of the recent recession (Antipa *et al.*, 2010). Results obtained from using a very different approach based on case studies in some major economies are instead less clear-cut. Given the knowledge available at the time, macroprudential policy, for example, via capital or liquidity requirements, could have had positive effects regarding some identified risks in the run-up to the crisis, but not regarding some other risks, such as the dependence on cross-currency funding and the growth of the shadow banking system (FSB/IMF/BIS, 2011).

In the empirical research on the effectiveness of specific macroprudential instruments, five main findings stand out. First, much of the existing research on the effects of macroprudential instruments looks at tools geared at housing booms, and documents a positive relationship between limits on LTV or debt-to-income (DTI) ratios – particularly when they are actively managed – and house price dynamics.<sup>39</sup> This link is found to be significant in both industrial and emerging market countries. However, as mentioned by Crowe *et al.* (2011a), important caveats for these results are that many countries do not have data on LTV ratios available for different points in time, that maximum LTV ratios were allowed to vary over time only in a few countries and that maximum LTVs are often not mandatory but rather just guidelines. In terms of the transmission mechanism of LTV ratios, there is some evidence that they affect the financial accelerator mechanism, to the extent that they influence the procyclicality of debt capacity through a collateral constraint (Almeida *et al.*, 2006).

Second, there is some evidence that macroprudential capital allocation mechanisms can play an important role in moderating excessive swings in the financial cycle. BCBS (2010a) finds that there are net long-term economic benefits from increasing the minimum capital and liquidity requirements



from their current levels. These benefits result from higher capital and liquidity requirements reducing the probability of financial crises and the output losses associated with such crises. Research on U.S. data suggests that raising capital requirements might limit the growth of a bubble (Nadauld and Sherlund, 2009). Work on both industrial and emerging market countries suggests that time-varying capital requirements tended to smooth large swings in credit and bank capital.<sup>40</sup>

Policymakers and market participants have debated extensively whether additional capital requirements for globally systemically important banks have substantial negative side effects on growth, particularly in the transition phase when these requirements are phased in. The existing empirical evidence suggests that raising capital requirements on globally systemically important banks causes only a very modest drag on growth (Macroeconomic Assessment Group, 2010, 2011).

Third, there is evidence that dynamic provisioning might have enhanced the resilience of individual banks and the banking system as a whole, even though they appear to have had only a modest restraining effect on credit growth (Caruana, 2005; Saurina, 2009a,b).<sup>41</sup> Empirical evidence of more lenient credit standards during boom periods, both in terms of screening of borrowers and collateral requirements, points to the usefulness of forward-looking loan-loss provisions that take into account the credit risk profile of banks' loan portfolios along the business cycle (Jimenez and Saurina, 2006).

Fourth, foreign-exchange-related macroprudential measures aimed at reducing banks' foreign currency exposure, including higher reserve requirements on foreign-currency deposits, and other macroprudential measures to address financial stability concerns that did not discriminate between residents and non-residents were found to have been generally associated with some moderation in net capital inflows; but this impact was significant only for the latter type of measures (IMF, 2011b).

Finally, there is tentative evidence – typically from emerging market countries – that reserve requirements used in part for financial stability purposes may have been successful in smoothing private sector credit growth and in stabilizing capital flows (Montoro and Moreno, 2011). There is also evidence that reserve requirements helped strengthen the monetary transmission mechanism (Vargas *et al.*, 2010).

## 6. Coordination and Governance

### 6.1 Coordination Across Jurisdictions and Types of Financial Players

One important open issue is how one can deal most effectively with the international dimension. Monetary policy has grappled with this dimension in the context of high capital mobility and asynchronous business cycles. For macroprudential policy, a main problem is the asynchrony of financial cycles – and in particular credit cycles – across economies. In the presence of significant differences in both micro- and macroprudential policy, a main risk is that regulatory arbitrage – for example, through lending via foreign branches or direct cross-border lending – erodes the effectiveness of macroprudential instruments.<sup>42</sup> For the Eurosystem, this is a particularly relevant issue, which has driven much of the discussions on the European Systemic Risk Board.

The risk of regulatory arbitrage through lending via foreign branches or direct cross-border lending has been addressed in the formulation of guidelines for countercyclical capital buffers to be introduced under Basel III. These provide for jurisdictional reciprocity in order to obtain a level playing field between domestic and foreign banks in a particular country. While the host authority takes the lead in setting countercyclical buffer requirements applying to credit exposures by local entities in their country, the home authority ensures that banks under their supervision respect the countercyclical buffers set in other countries as a minimum for their exposures to that country (Basel Committee on Banking Supervision, 2010b). The home authority is also allowed to require a higher buffer than that required by the host regulator. This approach of jurisdictional reciprocity could serve as a model for international coordination of other kinds of macroprudential tools.

Macroprudential policy could also become less effective if risk-taking and exposures move outside the regulated banking sector, as happened ahead of the recent crisis. Some historical examples of leakages in regulation are provided in Bank of England (2009), and Hilbers *et al.* (2005) considered this to be a relevant factor for the experience of some economies in central and Eastern Europe. It is therefore important to monitor the perimeter of regulation, and if necessary extend it to include parts of the 'shadow banking system'. Hanson *et al.* (2011) emphasize that highly leveraged financial firms – and in particular those that rely primarily on short-term debt – tend to fire-sell assets simultaneously in response to a common shock but do not properly internalize the costs of these fire sales when deciding on their capital. They therefore plead for financial regulation covering not only banks but any type of financial firm whose combination of asset choice and financing structure has the potential to contribute to fire sales when a common shock hits the financial system. In particular, they argue in favour of imposing similar capital standards on a given type of credit exposure, irrespective of what type of firm ultimately holds the exposure.

## 6.2 How Might Macroprudential Tools Interact With Monetary Policy?

One key issue in the design of a framework for macroprudential policy is how it interacts with monetary policy, since ultimately both types of policy target macroeconomic stability and affect real economic variables. This interaction depends to an important extent on whether financial imbalances play a role in the monetary policy framework.

Before the crisis erupted, the consensus was that monetary policy should not be geared towards anything but price stability, which was typically defined over a horizon of around two years – and, if there is a dual mandate as, for example, in the case of the Federal Reserve, maximum sustainable employment.<sup>43</sup> A minority of researchers instead supported the possibility of using a tightening of monetary policy to lean against the build-up of financial imbalances (e.g. Kent and Lowe, 1997; Borio and White, 2004; Filardo, 2004).<sup>44</sup>

The crisis has rekindled the debate on whether monetary policy should be used to counter the accumulation of financial imbalances.<sup>45</sup> As noted by Trichet (2009), there appears to be a shift in favour of the adoption of some form of leaning against the wind both in the policy debate and in the academic literature. In a recent speech, for example, Bernanke (2010) suggested that in exceptional circumstances, monetary policy may have to go beyond targeting macroeconomic stability.

In terms of the channels through which monetary policy can influence financial imbalances, the literature has focused mainly on the so-called risk-taking channel and the signalling channel.<sup>46</sup>

What does a leaning-against-the-wind approach imply for the monetary policy stance, compared with an approach that is exclusively focused on price stability at a horizon of two years? Agur and Demertzis (2010) examine the interaction between optimal monetary policy and endogenous bank risk and find that leaning-against-the-wind will, on average, lead to tighter monetary policy. The idea is that banks' risky projects are relatively illiquid and raise the probability of default. If a monetary authority puts sufficient weight on preventing defaults, it follows a V-shaped policy: during downturns, rates are cut more deeply but for a shorter period than under a Taylor rule; interest rates are raised to limit excess risk-taking during booms.

The challenge of coordinating monetary policy and macroprudential policy, since they both affect real economic variables, is similar to the challenge faced in attempts to coordinate monetary and fiscal policy. While economic outcomes would be superior if monetary and fiscal policy were coordinated, governance issues and a lower frequency of fiscal policy decisions have led, in practice, to fiscal policy being the Stackelberg leader, with monetary policy decisions at higher frequency taking fiscal policy as given.<sup>47</sup> Lambertini and Rovelli (2003) find in a theoretical model of fiscal-monetary policy interaction that each policymaker prefers to be the second mover in a Stackelberg game. They find that both Stackelberg solutions are preferable, for each policymaker, to the Nash solution. They argue that there

is a natural way to choose among the two Stackelberg games, implying that the government should act as the Stackelberg leader and adopt a fiscal policy rule based on the minimization of a loss function, which internalizes also the objective of price stability.

In our view, the problem of coordinating macroprudential policy and monetary policy might be addressed similarly to fiscal policy-monetary policy coordination, by monetary policy taking macroprudential policy as given when setting short-term interest rates, given that the frequency of decisions on macroprudential policy is likely to be lower than on monetary policy decisions. This suggestion is consistent with the results of Beau *et al.* (2011), who study the interaction between macroprudential and monetary policy within a DSGE framework. They find that in most cases, macroprudential policy has only a limited effect on inflation. They also find that which policy or combination of policies is chosen matters mainly in the case of shocks to asset prices and credit. In that case, they find that it is preferable to have a combination of independent monetary policy and independent macroprudential policy (where independence refers to separate objectives), with monetary policy taking the macroeconomic effects of macroprudential policy into account in setting interest rates.

Recent papers on monetary and macroprudential policy suggest that they should be coordinated, since they are not merely substitutes. However, this line of research indicates that the issue of coordination needs to be studied further. Within a simple static macroeconomic model including banks, Cecchetti (2009) finds that coordination between monetary policy and capital adequacy policy is essential, since they can act as substitutes: the more monetary policy is used for stabilization purposes, the less capital adequacy policy needs to be used, and vice versa. Bean *et al.* (2010) study how the use of macroprudential policy tools might affect the conduct of monetary policy within a New-Keynesian DSGE model adapted from Gertler and Karadi (2011). As a macroprudential tool, they consider a lump-sum levy or subsidy on the banking sector, which can be used to affect the amount of capital that banks carry forward. Their results suggest that 'to the extent that movements in bank capital and leverage are key factors driving risk-taking and aggregate lending, the deployment of macro-prudential policy is likely to be more effective than trying to 'lean against the wind' using monetary policy'. Their results also suggest that monetary policy and macroprudential policy should be coordinated, since they are not merely substitutes, but they mention that the issue of coordination needs to be studied further.

Angelini *et al.* (2011) use a DSGE model with a banking sector estimated for the euro area (based on Gerali *et al.*, 2010). They find that macroprudential policy can improve macroeconomic stability, but with important caveats: (i) in 'normal' times when the cycle is mainly driven by supply shocks, macroprudential policy yields negligible additional benefits over only using monetary policy, even if the two authorities cooperate; and non-cooperation may even produce excessive volatility of the policy tools; (ii) the benefits of introducing macroprudential policy become sizeable when economic fluctuations are driven by financial or housing market shocks, and are still greater when the central bank and the macroprudential authority cooperate closely.

The monetary-macroprudential interaction takes a special twist within a monetary union, where macroprudential policy instruments set at the national level can be used to affect national credit growth at a time when policy rates are no longer controlled nationally. The introduction of dynamic provisioning in Spain in July 2000 allowed the Bank of Spain to use this instrument to build up buffers after entering EMU when the power to set policy interest rates was passed to the ECB ( Fernández de Lis and Herrero, 2009).

### 6.3 Institutional Setup and Governance Issues

There is no consensus in the literature on whether the monetary policy and the banking regulation and supervisory functions should be combined in a central bank, or performed by separate institutions (Lastra, 2003). Goodhart and Schoenmaker (1995) find no overwhelming arguments for either model. Blanchard *et al.* (2010) discuss how coordination is achieved between monetary and regulatory

authorities, and whether the central bank should be in charge of both.<sup>48</sup> They argue that for three main reasons, the past trend towards separating decision-making for these two policies may well have to be reversed. First, their advantage in monitoring macroeconomic developments makes central banks an obvious candidate as macroprudential regulators. Second, centralizing macroprudential responsibilities within the central bank would avoid problems of coordinating the actions of separate agencies during a crisis such as those highlighted during the bailout of Northern Rock. Third, monetary policy decisions have potential implications for leverage and risk-taking.

Another important question in implementing macroprudential policy is how committees deciding on macroprudential policy instruments should be composed. Usually, memberships of committees dealing with monetary and financial stability issues at central banks are not identical, although there may be overlap. An interesting counterexample is provided by the Riksbank, where one committee, the Executive Board, decides on both monetary policy and financial stability issues. Previous literature on committee decision-making has mainly focused on monetary policy decision-making.<sup>49</sup> Eslava (2006) studies the potential effects of collective decision-making and government appointments on the choices of individual central bankers in monetary policy committees; some of these results might be useful for designing committees deciding on macroprudential policies. Sibert (2010) proposed to have macroprudential policy being conducted by a committee consisting of five members – a macroeconomist, a microeconomist, a research accountant, a financial engineer and a practitioner – composed of members outside of government bodies and international organizations. She stressed that the board should not include supervisors and regulators. The idea is that this composition would favour objective and independent judgement.

## 7. Conclusions

The recent financial crisis has highlighted the need to go beyond a purely micro-based approach to financial regulation and supervision, and there is a growing consensus among policymakers that a macroprudential approach to regulation and supervision should be adopted. However, the current urgent drive for decisions on macroprudential policy has occurred against a background of only limited research and analytical tools and data available so far that could inform these policy decisions in a meaningful way. Based on our review of the existing literature, and in light of current policy concerns, we identify several key messages and questions as important future research questions that would be particularly useful to address in order to aid in the implementation of macroprudential policy instruments.

First, there is a fundamental distinction between the objectives of macroprudential policy and microprudential policy. Microprudential policy aims at reducing the probability of default of individual institutions, taking systemic risk as given. In contrast, macroprudential policy aims at preventing the macroeconomic costs of systemic financial distress, taking into account feedback effects that the behaviour of individual financial institutions have on each other, and on the whole economy. In turn, macroprudential policy instruments can be distinguished into instruments specifically tailored to mitigating systemic risk, or instruments not originally developed with systemic risk in mind but modified to become part of the macroprudential toolkit.

Second, according to the ‘Tinbergen principle’, policymakers need at least one independent policy instrument for each policy objective. Since the policy interest rate is used by monetary policymakers to achieve the objective of price stability, at least one other instrument is required to achieve the additional objective of financial stability. Macroprudential policy is the primary candidate for such an instrument. However, the literature on macroprudential policy highlights that, in practice, the different policy tools and objectives of monetary, macroprudential and microprudential policy are interrelated.

Third, much of the literature and the policy debate in the 1990s and early 2000s centered on the issue of asset price bubbles, how they can be identified and whether they should be countered. In

recent years, however, the emphasis has shifted on quantifying the much broader concept of financial instability. A variety of empirical approaches have been used to address this issue but so far have had more limited value in informing policy decisions. A promising avenue of research focuses on early warning indicators based on credit and asset markets, and reflect a view of financial instability that is based on the interaction of endogenous financial and real cycles. This view sees excessive growth in credit and asset prices as a reflection of growing financial imbalances, whose sudden unwinding can potentially have a very large negative impact on the macroeconomy.

Fourth, an important open issue concerns the relative merits of tax instruments and quantity instruments, and whether tools that influence incentives are more useful in addressing negative externalities of individual banks' optimizing behaviour than tools that support the building of buffers. While recent research suggests that the socially efficient solution depends on the drivers of bank heterogeneity, further work in this line of research is needed.

And fifth, does regulatory arbitrage, most notably through lending via foreign branches or direct cross-border lending, imply that some of the instruments or rules need to be harmonized, or at least, even if dissimilar, set by international agreement? Moreover, how can this be made to work satisfactorily if there is an element of local state contingency built into them, reflecting local cycles in credit or real estate prices, for example? The agreement on jurisdictional reciprocity for countercyclical capital buffers under Basel III could serve as a model for the international coordination of other macroprudential tools.

In terms of key sets of research questions, a first is to study the effectiveness of macroprudential tools, including quantifying the effect of macroprudential policy instruments on credit growth, leverage, asset prices and asset price bubbles, and importantly on measures of systemic risk; evaluating the practicality of proposed macroprudential measures derived from theoretical considerations, such as CoVaRs; an assessment of data that should be collected to allow a meaningful analysis of macroprudential policy to be carried out; and more systematic empirical analysis of the effectiveness of macroprudential tools in avoiding financial instability, including historically where macroprudential measures have been employed.

A second set of research questions is to study how monetary policy and macroprudential policy should be coordinated, including the question of the interaction between macroprudential policy and monetary policy; and modelling of financial intermediation and frictions therein in macroeconomic models used for monetary policy purposes, including away from the steady state.

## Acknowledgements

We would like to thank Itai Agur, David Aikman, Bill Allen, Claudio Borio, Maria Demertzis, Marvin Goodfriend, Kristin Gulbrandsen, Philipp Hartmann, Pierre Lafourcade, Iman van Lelyveld, Enrique Mendoza, Kasper Roszbach, Victoria Saporta, Ingvild Svendsen, Philip Turner, Birger Vikoren, Haibin Zhu, an anonymous referee, and participants at a seminar at the Banque de France, and at the Norges Bank Financial Markets Day on Macroprudential Policies for helpful comments and discussions. The views expressed are those of the authors and should not be taken to reflect those of the BIS or De Nederlandsche Bank. A previous version of this paper has been published as BIS Working Paper No. 337

## Notes

1. See, for example, Catte *et al.* (2010).
2. Clement (2010) carefully documents the evolution over time of the term 'macroprudential'. He traces the origins of the term back to unpublished documents prepared in the late 1970s by the Cooke Committee (the precursor of the present Basel Committee on Banking Supervision) and the Bank of England.
3. Gorton and Winton (2003) provide a detailed survey of this literature.

4. See, for example, Borio *et al.* (2003) and Orphanides and Williams (2010) for a discussion of the evolution of views on monetary policy objectives.
5. Along the same lines, Caruana (2010b) describes the objective of macroprudential policy as 'to reduce systemic risk by explicitly addressing the interlinkages between, and common exposures of, all financial institutions, and the procyclicality of the financial system'.
6. The ESCB recently launched a macroprudential research network (Mars) aimed at establishing conceptual frameworks, models and tools that would improve macroprudential supervision in the EU (Constâncio, 2010; Hartmann, 2011).
7. For an overview of emerging market economies' experience with macroprudential instruments, see Borio and Shim (2007), Hilbers *et al.* (2005) and CGFS (2010b).
8. Ostry *et al.* (2010) and CGFS (2009) view market-based regulations designed to reduce the incentives for capital inflows and other tools aimed at controlling large capital inflows that may fuel domestic credit booms not as macroprudential tools per se but rather as measures that can buttress prudential regulations.
9. See BIS (2001); Borio *et al.* (2001); Danielsson *et al.* (2001); Borio and Zhu (2008); Brunnermeier *et al.* (2009); Brunnermeier and Pedersen (2009) and Shin (2009). The literature on the procyclicality of the capital framework known as Basel II is surveyed in ECB (2009).
10. For a discussion of margins, see Borio (2004).
11. See, for example, Kiyotaki and Moore (1997); Allen and Gale (2000); Rochet and Tirole (1996); Freixas and Parigi (1998); McAndrews and Roberds (1995) and Aghion *et al.* (1999).
12. Sundareshan and Wang (2010) provide an overview of papers that examined the design and usefulness of contingent capital instruments.
13. See, for example, Tucker (2009) and Borio (2009).
14. An analogy from economic theory might be the aggregation problem concerned with the relationship between microeconomic theory and macroeconomic theory. Peston (1959) suggests that macro-theory and micro-theory should be seen as complements, not substitutes, suggesting that 'since [...] it is not necessarily possible to make a logically rigid distinction between macro and micro-variables, a distinction between the two sorts of theory may not always be easy to make, or even be worth making'.
15. For an overview of models of macroeconomic implications of financial frictions, see Brunnermeier *et al.* (2012).
16. For a careful overview of the literature on systemic risk and its sources, see de Bandt and Hartmann (2000) and de Bandt *et al.* (2009). ECB (2010) analyses the identification and assessment of systemic risks in the process of macroprudential supervision. Bullard *et al.* (2009) provide an overview of systemic risk in the context of the current financial crisis.
17. For a more detailed discussion, see Borio and Drehmann (2009a).
18. For a related view that emphasizes the endogeneity of risk, see Danielsson *et al.* (2010).
19. See Borio and Drehmann (2009a).
20. For well-known examples of the former, see Carson and Ingves (2003), Bordo *et al.* (2000), and the IMF's Financial Soundness Indicators (Moorhouse, 2004; IMF, 2008). Examples of the latter include Illing and Liu (2006) and Tarashev and Zhu (2006, 2008). For a critical assessment, see, for example, Bongini *et al.* (2002) and Fell (2007).
21. See, for example, Hutchinson and McDill (1999), Kaminsky and Reinhart (1999), Bell and Pain (2000), Demirgüç-Kunt and Detragiache (2005), Davis and Karim (2008), Dell'Arricia *et al.* (2008) and Von Hagen and Ho (2007). The large body of studies on early warning indicators of currency crises (e.g. Kaminsky *et al.*, 1998) is beyond the scope of this paper.
22. See Borio and Lowe (2002), Alessi and Detken (2009), Borgy *et al.* (2009), Borio and Drehman (2009b), Gerdesmeier *et al.* (2010) and ECB (2010).
23. See, for example, Drehmann *et al.* (2006) and Misina and Tessier (2008). A variant of this approach that has recently attracted attention models the underlying joint dynamics of output growth and indicators of



- system-wide financial risk through a factor-augmented VAR (FAVAR) model (De Nicolò and Lucchetta, 2010).
24. Surveys of the macro-stress testing literature are provided by Sorge (2004), Drehmann (2009), van Lelyveld (2009) and Foglia (2009).
  25. Recent work by Aikman *et al.* (2009) is an important exception.
  26. This point is documented in detail in Alfaro and Drehmann (2009).
  27. See Tarashev *et al.* (2010) and Gauthier *et al.* (2010) for an overview.
  28. In addition to this 'systemic importance index', Zhou (2010) also looked at a so-called 'vulnerability index', which he defined in terms of the probability of a particular bank failure, given that at least one other bank in the system fails.
  29. See also Acharya *et al.* (2010).
  30. Allen and Babus (2009), Haldane (2009) and ECB (2010) provide an overview of this literature.
  31. See, for example, Adrian and Brunnermeier (2009), Tarashev *et al.* (2010), Gauthier *et al.* (2010, 2011) and Bluhm *et al.* (2011).
  32. See Hommes (2006, 2008, 2009), Hommes and Wagener (2009) and LeBaron and Tesfatsion (2008).
  33. A discussion of the finance literature on the relationship between the term structure of interest rates and macroeconomic factors is beyond the scope of this paper. Rudebusch (2010) provides a careful survey of this literature.
  34. See, for example, Curdia and Woodford (2009), Christiano *et al.* (2010), Christiano *et al.* (2011), Gerali *et al.* (2010), Dellas *et al.* (2010), Kannan *et al.* (2009) and Vlieghe (2010).
  35. Contributions to this literature strand include Goodfriend and McCallum (2007), Cohen-Cole and Martinez Garcia (2008), Gertler and Karadi (2011) and Gertler and Kiyotaki (2010). A number of papers have also provided more detailed models of the banking sectors, importantly allowing for default of banks, but incorporating less detailed macroeconomics (Goodhart *et al.*, 2005, 2006; Uhlig, 2009; De Walque *et al.*, 2010; de Walque and Pierrard, 2010).
  36. See, for example, Zhu (2008), Meh and Moran (2008), Repullo and Suarez (2010), N'Diaye (2009) and Van den Heuvel (2008). Borio and Zhu (2008) provide a detailed review of studies on the role of bank capital in monetary transmission.
  37. Recent proposals on data collection and requirements are provided in Lo (2009), Sibert (2010) and Brunnermeier *et al.* (2011).
  38. Advantages and disadvantages and empirical evidence on the effectiveness of various macroprudential tools are discussed in Bank of England (2011).
  39. An overview of the impact of macroprudential measures aimed at dealing with real estate booms is provided in Crowe *et al.* (2011a, b). See also Borio and Shim (2007) and Hilbers *et al.* (2005). Wong *et al.* (2004), Crowe *et al.* (2011a) and Igan and Kang (2011) provide empirical evidence on the impact of LTV or DTI ratios.
  40. Aiyar *et al.* (2011) show how in the case of the United Kingdom, changes in minimum capital requirements can have large effects on the supply of credit by banks. Uribe (2008) documents strong effects in the case of Colombia.
  41. Most of this empirical work uses data from Spain, since this is one of the few countries where regulators had introduced dynamic provisioning before the crisis. In an interesting exercise, however, Fillat and Montoriol-Garriga (2010) investigate the hypothetical need for government TARP funds by U.S. commercial banks if they had followed the Spanish dynamic provisioning system, and find that about half of these banks would not have needed TARP support.
  42. This is discussed, for example, in Borio and Shim (2007) and Hilbers *et al.* (2005) based on individual country experiences. For a detailed analysis of this issue, see Bank of England (2009).
  43. The standard references are Bernanke and Gertler (2001), Goodfriend (2002), and, for an overview of the arguments, Giavazzi and Mishkin (2006).



44. Cecchetti *et al.* (2000) argue that monetary authorities should at times react to asset prices in order to stop bubbles from getting out of hand. Assuming that the central bank can observe that an asset bubble is in progress, they conclude that pricking the bubble will lead to better macroeconomic outcomes. A somewhat more nuanced view is found in Bean (2003, 2004, 2007, 2009) and Detken and Smets (2004). Bean (2003) argues that a forward-looking flexible inflation targeting central bank should bear in mind longer run consequences of asset price bubbles and financial imbalances on macroeconomic variables in the setting of current interest rates, without a need for an additional response of monetary policy.
45. For a recent overview of the debate, see Agénor and Perreira da Silva (forthcoming).
46. On the risk-taking channel, see, for example, Borio and Zhu (2008), Altunbas *et al.* (2009), Gambacorta (2009) and Ionnadou *et al.* (2008). Loisel *et al.* (2009) model the signalling channel within a DSGE framework.
47. Since fiscal policy employs taxpayers' money, democratic governance implies that fiscal policy decisions should be taken by elected politicians, rather than by unelected officials at independent central banks. In practice, inflation targeting regimes often take fiscal policy as given in their inflation forecasting models, as is the case, for example, at the Bank of England.
48. Central Bank Governance Study Group (2011) and Nier *et al.* (2011) discuss alternative approaches for governance of macroprudential policy, and issues of coordination if different agencies are involved.
49. See Blinder (2008) and Schulte *et al.* (2005) for an overview.

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