Financial Stability and Monetary Policy: How Closely Interlinked?*

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The recent financial crisis has again raised the question to what extent price-stability-oriented monetary policy frameworks should take into account financial stability objectives. In this paper I argue that the answer will depend on three questions: (i) how effective is macroprudential policy in maintaining financial stability? (ii) what is the effect of monetary policy on risk taking and financial stability? and (iii) what is the risk of financial dominance, i.e., the risk that financial stability considerations undermine the credibility of the central bank's price stability mandate? I review the theory and evidence and conclude that while the new macroprudential policy framework should be the main tool for maintaining financial stability, monetary policy authorities should also keep an eye on financial stability. This will allow the central bank to lean against the wind if necessary, while maintaining its primary focus on price stability over the medium term.

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1. Introduction

The 2007–8 financial crisis and its long-lasting legacy have shaken up the macroeconomic policy framework that appeared to be so successful in stabilizing the economy during the Great Moderation period. First, it led to a rethinking of monetary policy frameworks focused primarily on maintaining price stability, as price stability

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has proven not to be a sufficient condition for financial stability and lack of financial stability can have large negative feedback effects on price stability.[1] Second, it accelerated the introduction of a new policy domain called macroprudential policy, inspired by the early contributions of Crockett (2000) and his colleagues at the Bank for International Settlements (BIS).[2] This was based on the realization that ensuring the soundness and safety of individual financial institutions is not enough to guarantee the stability of the whole financial system and that there is a need for a systemic approach to financial stability.

Consistent with the description in International Monetary Fund (IMF) (2013), the newly emerging paradigm is one in which both monetary policy and macroprudential policies are used for countercyclical management: monetary policy primarily aimed at price stability; and macroprudential policies primarily aimed at financial stability, whereas microprudential policy focuses on the safety and soundness of individual financial institutions. Macroprudential policies aim to prevent, or at least to contain, the buildup of financial imbalances and to ensure that the financial system is able to withstand their unwinding and be resilient to shocks.[3,4] The assignment of the monetary and macroprudential policy domains to separate objectives is consistent with Tinbergen's effective assignment principle, which says that (i) one should have as many instruments

[1]Early contributions to this debate include Bean et al. (2010), Blanchard, Dell'Ariccia, and Mauro (2010), and Mishkin (2010). See also Baldwin and Reichlin (2013) for a variety of views and Eichengreen, Prasad, and Rajan (2011).

[2]See, for example, Borio (2003) and Borio and White (2003). For a recent review of the literature on macroprudential policy, see Galati and Moessner (2011).

[3]See Papademos (2009). The relative importance of the twin objectives of counteracting the procyclicality of the financial system (i.e., smoothing the financial cycle) and improving the resilience or fragility of the financial system in response to shocks is still a matter of debate. The answer depends in part on how effective macroprudential policies are expected to be in leaning against the wind, which is discussed in section 4.1 below. In this paper, we mostly focus on the first objective.

[4]For related discussions of the objectives of macroprudential policy and the concept of systemic risk, see, for example, Brunnermeier et al. (2009), De Bandt, Hartmann, and Peydró (2009), European Central Bank (2010), European Systemic Risk Board (2011), and Hanson, Kashyap, and Stein (2011).

as objectives and (ii) the instruments should be assigned to those objectives that they can most efficiently achieve.[5]

In general, the introduction of macroprudential policies can improve the trade-offs for monetary policy and increase its room for maneuver. Maintaining financial stability can help ensure a well-working financial system and an effective transmission process which makes achieving price stability more efficient. Moreover, macroprudential policies can, by managing the financial cycle and increasing the resilience of the financial sector, reduce the probability of systemic stress and therefore the probability that monetary policy becomes constrained by the zero lower bound and needs to resort to non-standard policies to address malfunctioning financial markets. It can also reduce trade-offs that may arise when exiting accommodative monetary policies.[6]

The relationship between monetary and macroprudential policies also hinges, however, on the "side effects" that one policy has on the objectives of the other and how perfectly each operates in the pursuit of its own primary goal.[7] For example, changes in policy interest rates or non-standard monetary policies may affect risk-taking behavior ex ante and the tightness of credit constraints ex post as analyzed in the paper by de Groot published in this issue. In a crisis situation, liquidity policies by the central bank may avoid a collapse of the banking sector, but also reduce the incentive for banks to recapitalize and restructure and promote the evergreening of non-performing loans and regulatory forbearance by supervisors. In principle, well-targeted macroprudential policies can offset the side effects of these monetary policies, but in practice there may be limits.[8] Similarly, changes in macroprudential policy may affect financing conditions, the real economy, and price stability,

[5]Or, as in Bean et al. (2010): "Policies should be assigned to the frictions that they have a comparative advantage in addressing."

[6]See, for example, Bernanke (2013) for a discussion in the current context of exit from expansionary Federal Reserve policies.

[7]See Gerlach et al. (2009), Carboni, Darracq Pariès, and Kok (2013), and IMF (2013).

[8]For example, as discussed in section 4.1, Maddaloni and Peydró (2011) show that the effects of monetary policy on bank lending standards depend on the tightness of the prudential regime.

which monetary policy may want to offset.[9] It is therefore important that both policies are coordinated and take those interactions into account. Conflicts of interest of a "push-me, pull-you" nature may arise when monetary and macroprudential policy instruments are used more aggressively, in opposite directions, leading to a worse outcome than if the instruments had been coordinated.[10] Finally, non-standard monetary policy instruments, like changes in haircuts for central bank operations or changes in reserve requirements, are not that different from macroprudential policy instruments such as liquidity constraints and regulation of margin requirements. It is therefore a legitimate question which instrument should be used for what objective.[11]

The need for coordination raises the question of the appropriate institutional setup. Overall, as a result of the crisis, central banks have been given a larger role in maintaining financial stability.[12] Bringing monetary and macroprudential policies under one central bank roof will tend to solve possible coordination problems that may arise from their interaction. At the same time, it may lead to incentive problems if failure of one policy domain affects the other policy domain. One example of such an incentive problem which may lead to time inconsistency is that monetary policy is kept looser than is necessary for price stability because it helps maintain financial stability. This may lead to an inflation bias—in particular, if the objectives of the macroprudential policy function are not clearly specified, its effectiveness is not ensured, and/or macroprudential policy measures are subject to more intense political scrutiny and pressure. One solution is to maintain a clear separation of objectives, instruments, and communication of the two policy domains. This will make the policymakers accountable for achieving their respective objectives and thereby increase the effectiveness and efficiency of

[9]For an example of such an optimal monetary policy reaction, see Collard et al. (2013).

[10]Examples of such outcomes are shown in Bean et al. (2010), Angelini, Neri, and Panetta (2011), and De Paoli and Paustian (2013).

[11]Cecchetti and Kohler (2012) provide an extreme example: In their model, it does not matter which authority uses which instrument.

[12]See, for example, the new institutional frameworks in Belgium and the United Kingdom. For an overview, see the recent Ingves report (BIS 2011).

the policies, while allowing for efficient information sharing between the two policy domains.

In the rest of this note, I focus on the question of whether the monetary policy mandate should be enlarged to explicitly include financial stability objectives. I summarize the discussion on this question by distinguishing three different views, respectively called (i) "modified Jackson Hole consensus," (ii) "leaning against the wind vindicated," and (iii) "financial stability is price stability." I also briefly discuss some of the analytical frameworks underlying those views. Then, I argue that which of these views one takes will depend on the answers to three questions: (i) how effective is the new macroprudential policy framework in maintaining financial stability? (ii) how significant is the risk-taking channel of monetary policy or, more generally, the impact of monetary policy on financial stability? and (iii) what is the risk of financial dominance, i.e., the risk that financial stability considerations undermine the credibility of the central bank's price stability mandate? In the next section I briefly review the empirical evidence on the first two questions. Next, I present a simple analytical framework due to Ueda and Valencia (2012) to illustrate the risk of time inconsistency of the price stability objective when the central bank cares about financial stability. Finally, I conclude by arguing for the middle position whereby price stability remains the primary objective of monetary policy and a lexicographic ordering with financial stability is maintained. This will allow the central bank to lean against the wind (if necessary, for example, because macroprudential policies fail), while maintaining its primary focus on price stability in the medium term.

2. Implications of Financial Stability Considerations for Monetary Policy: Three Views and their Conceptual Frameworks

As highlighted above, in order to deal with the financial stability objective, policymakers have introduced a new macroprudential policy domain under the aegis of the G20. There is, however, a continuing debate about whether monetary policy frameworks focused on price stability should be amended to include financial stability objectives. In this section, we describe three different views and their conceptual frameworks. Table 1 gives a schematic overview.

Table 1. Three Views

	Modified Jackson Hole Consensus	**Leaning against the Wind Vindicated**	**Financial Stability Is Price Stability**
Monetary Policy	Framework largely unchanged. Limited effects on credit and risk taking. Blunt instrument to deal with imbalances.	Financial stability as secondary objective; lengthening of horizon. Affects risk taking. "Gets in all of the cracks."	Twin objectives on equal footing. Unblocks balance sheet impairments; avoids financial imbalances in upturns.
Macropru.	Granular and effective.	Cannot fully address financial cycle; arbitrage.	Indistinguishable from monetary policy.
Interaction	Limited interaction and easy separation of objectives, instruments, etc.	Financial fragility affects monetary transmission and price stability.	Financial stability and price stability are intimately interlinked.
Issues	Coordination? Lender of last resort?	Coordination? Overburden mon. policy?	Time-inconsistency problems?
Models	Svensson; Collard et al. (2013)	Borio; Woodford (2012)	Brunnermeier and Sannikov (2012)

2.1 View 1: A Modified Jackson Hole Consensus

The first view argues that the monetary authority should keep its relatively narrow mandate of price stability and stabilizing resource utilization around a sustainable level, whereas macroprudential authorities should pursue financial stability, with each having their own instruments. It can be described as a modification of the popular "Jackson Hole consensus" that prevailed before the crisis: Financial stability concerns are only taken into account by the monetary authority to the extent that they affect the outlook for price stability and economic activity.[13] The biggest need for change as a result of the lessons learned from the financial crisis is the establishment of an effective and credible macroprudential policy framework with the objective of maintaining financial stability. Once this is in place, monetary policy can continue to focus on price stability as, for example, described in the flexible inflation-targeting literature, but taking changes in the working of the economy and the monetary transmission process due to financial factors into account. Financial stability considerations will indirectly enter into monetary policy decisions to the extent that assessments of systemic tail risks change the expected outlook for inflation or real activity. There is therefore still a role for financial stability monitoring and information exchange with the macroprudential authorities (Adrian, Covitz, and Liang 2013).

This view argues that the objectives, the instruments, and the transmission mechanisms of monetary and macroprudential policy can easily be separated. It is based on the judgment that the interaction between monetary policy and macroprudential instruments is limited, that the monetary policy stance did not significantly contribute to the building up of imbalances before the crisis, and that in contrast to macroprudential policy the short-term interest rate is not a very effective instrument to deal with those imbalances. One question is how this view deals with the lender-of-last-resort function of central banks.

Collard et al. (2013) have recently developed a model that very much supports the modified Jackson Hole consensus view. The paper offers a characterization of the jointly optimal setting of monetary

[13]This view goes back to Bernanke and Gertler (1999), Greenspan (2002), and many others. Support for the modified version has been expressed, among others, by Bean et al. (2010), Gerlach (2010), and Svensson (2012b, 2013).

and prudential policies (in a Ramsey sense) in a model with financial and price rigidities and discusses its implications for the business cycle. The source of financial fragility is the socially excessive risk taking by banks due to limited liability and deposit insurance. Interestingly, the model links excessive risk taking to the type of projects that banks may be tempted to fund because limited liability protects them from incurring large losses, and the degree of riskiness may not be reflected in a larger volume of credit. In this model, sufficiently high capital requirements can always force banks to internalize the riskiness of their loans and tame risk taking.[14] Monetary policy, in contrast, is less suited for this task, as it works primarily through the volume rather than the composition of credit and thus has no first-order effect on risk-taking incentives.[15] In contrast to models that emphasize the credit cycle, this framework does not suggest a strong connection between interest rate policy and financial stability. In response to shocks that do not affect banks' risk-taking incentives, prudential policy should leave the capital requirement constant and monetary policy should move the interest rate in the standard way to stabilize prices. In response to shocks that increase banks' risk-taking incentives, prudential policy should raise the capital requirement and monetary policy should cut the interest rate in order to mitigate the effects of prudential policy on bank lending and output. So, in this case, the two policies move in opposite directions over the cycle. The authors also show that if the incentive to take risks increases with the volume of loans, a positive productivity shock may lead to an optimal joint tightening of the capital requirement and the interest rate. In this case, there is a complementarity between both policies in the sense that the optimal interest rate is smaller due to the tightening of capital requirements.[16]

[14]Note that there is no uniform agreement on whether higher capital reduced risk-taking incentives. See, for example, Gale (2010).

[15]This is a stark assumption, which contrasts, for example, with Stein (2012) who finds that a lower interest rate may encourage banks to take on more risk on the liability side by increasing short-term market funding.

[16]In contrast, Dell'Ariccia, Laeven, and Marquez (2010) argue that a lowering of the short-term interest rate may lead to lower risk taking in a model with limited liability and risk shifting. A lower funding rate may increase profits when the pass-through to lending rates is partial and thereby increase the franchise value of the bank. Under asymmetric information, this may lessen moral hazard and reduce bank risk taking.

In more standard New Keynesian models with credit constraints and a financial intermediation sector, interest rate policy and macroprudential policy (e.g., geared at constraining the loan-to-value ratio or the capital ratio of banks) will naturally interact much more through their common effects on the cost of finance. For example, one striking finding of Cecchetti and Kohler (2012) is that the choice of the instrument itself does not matter (either policymaker could use it), as a capital requirement which affects loan supply and the policy-controlled interest rate which has both a demand and a supply effect are perfect substitutes. Cecchetti and Kohler (2012) show that the optimal outcome can be reached in a coordinated optimization of the two instruments, i.e., a situation where each policymaker takes into account the externality it has on the other policymaker. The papers by Kannan, Rabanal, and Scott (2009), Angelini, Neri, and Panetta (2011), Darracq Pariès, Kok Sørensen, and Rodriguez-Palenzuela (2011), Lambertini, Mendicino, and Punzi (2011), Baillu, Meh, and Zhang (2012), Beau, Clerc, and Mojon (2012), Gelain, Lansing, and Mendicino (2012), and De Paoli and Paustian (2013) have similar features in a dynamic context.[17]

Two interesting recent papers that apply DSGE models with macroprudential and monetary policy to a monetary union (like the euro area) are Brzoza-Brzezina, Kolasa, and Makarsky (2013) and Quint and Rabanal (this issue). Brzoza-Brzezina, Kolasa, and Makarsky (2013) show that countercyclical macroprudential policies may help implement a more homogenous monetary policy stance across countries, while Quint and Rabanal (this issue) find that the introduction of a national macroprudential policy may reduce macroeconomic volatility, improve welfare, and partially substitute for the lack of national monetary policies. These papers highlight the ability of macroprudential policies to be geared towards specific regional financial imbalances.

Overall, these studies conclude that (i) introducing macroprudential policies is useful in leaning against the financial cycle driven

[17]Angelini, Neri, and Panetta (2011), Darracq Pariès, Kok Sørensen, and Rodriguez-Palenzuela (2011), and Beau, Clerc, and Mojon (2012) use ad hoc loss functions, whereas Lambertini, Mendicino, and Punzi (2011) and De Paoli and Paustian (2013) use a welfare-based criterion. See also ECB (2012, p. 33) for an overview of recent research that analyses the interaction between monetary and macroprudential policies.

by overoptimistic expectations or expectations of reduced volatility and risk premia and increase welfare; (ii) there are potential coordination problems due to the "push-me, pull-you" nature of both policy instruments; and (iii) the introduction of macroprudential policies does not change the optimal reaction function of the monetary authorities very much.

2.2 View 2: Leaning against the Wind Vindicated

The second view argues that the narrow focus of many central banks on the inflation outlook over the relatively short term of two to three years prevented them from leaning more aggressively against growing financial imbalances. This view vindicates the "leaning against the wind" strategy proposed by Borio and Lowe (2002), White (2006), and others.[18] It acknowledges that there is a financial cycle that cannot be fully addressed by macroprudential policy and interacts with the business cycle in various potentially non-linear ways. It also acknowledges that the monetary policy stance may affect risk taking by the financial intermediation sector and, conversely, that the fragility of the intermediation sector affects the transmission process and the outlook for price stability. In this view, financial stability concerns should be part of the secondary objectives in the monetary policy strategy. The inclusion of secondary financial stability objectives naturally leads to a lengthening of the policy horizon of the monetary authorities, as the financial cycle is typically longer than the business cycle.[19] It suggests a modification of flexible inflation targeting whereby financial stability concerns are taken into account in deciding on the optimal adjustment path for inflation, introducing a term which resembles "leaning against the wind."

Woodford (2012) develops a stylized model along the lines of Curdia and Woodford (2011) to analyze the implications of financial

[18]See also Rajan (2005) who warned that price stability may not be sufficient for financial stability and suggested that central banks should lean against the emergence of financial imbalances by tightening their monetary policy stances. This view is also closer to the ECB's view as, for example, elaborated by Trichet (2004) and Issing (2011).

[19]See Drehmann, Borio, and Tsatsaronis (2012) for empirical evidence that the financial cycle is longer than the typical business cycle.

imbalances for monetary policy. In order to address concerns about financial stability in an inflation-targeting regime, he postulates a reduced-form model of the way in which endogenous state variables (like leverage) affect the probability of a crisis, and considers how allowance for such a relationship would change the standard theory of optimal monetary stabilization policy. As in the papers discussed above, the presence of frictions in the financial intermediation sector leads to the inclusion of a financial stability objective in the loss function. This is then taken into account in the optimal targeting rule for monetary policy. The main finding is that the optimal targeting rule now involves not only the output gap but also a financial-stability-related term, in addition to the price-level gap. In particular, the usual optimal output-gap-adjusted price-level targeting rule is augmented with a term that captures the marginal risk of a financial crisis. The implication for the monetary policy framework is that financial stability concerns should be taken into account in the adjustment path, but the overall primacy of maintaining a price stability objective over the medium term is not affected. The model implies that it may be appropriate to use monetary policy to "lean against" a credit boom, even if this requires both inflation and the output gap to be below their medium-run target values for a time. One particular version of the model is Woodford (2011), who embeds Stein (2012)'s setting, in which financial intermediation activity is distorted due to fire sales during a financial crisis, into a traditional New Keynesian model of monetary policy. This model effectively introduces a risk-taking channel of monetary policy into a macroeconomic setting.[20]

In the "leaning against the wind" view, central banks may face additional trade-offs which will require increased credibility of the price stability target. So, monetary policy becomes more complicated, but not different in setup. Woodford (2012) argues that the additional complexity is less of a problem to the extent that the optimal targeting rule implies a commitment to a price-level target. This means that any departure from the price level from its long-run

[20] Angeloni and Faia (2013) analyze optimal policy in a model with a risk-taking channel. When policy eases, bank risk increases because the short-term funding ratio rises and therefore the lending rate drops by less. Agur and Demertzis (2011) also discuss interaction between monetary policy and risk taking.

target path that is justified by an assessment of variations in the projected marginal crisis risk will subsequently have to be reversed. For a number of central banks that already have mandates to contribute to financial stability, such as the European Central Bank, this may not require a big change. Its monetary policy strategy already includes a two-pillar approach involving monetary analysis. The latter has been presented as a way to take into account financial stability concerns and a leaning-against-the-wind approach.[21] Fahr et al. (2013) use macroeconomic simulations in an estimated model with financial frictions for the euro area to show how monetary policy leaning against credit developments may shift the price and output-gap stability trade-off inward and therefore contribute to an overall improvement of macroeconomic performance.

2.3 View 3: Financial Stability Is Price Stability

The third view proposes a more radical change in the objectives of monetary policy. It argues that financial stability and price stability are so intimately intertwined that it is impossible to make a distinction.[22] Under this view, both standard and non-standard monetary policies are in the first place attempts at stabilizing the financial system, addressing malfunctioning financial markets, and unclogging the monetary transmission process. This approach also highlights the time-inconsistency problems involved. Because of threats of financial dominance, the coordination of monetary policy with financial stability policy is crucial.[23]

A model that captures most clearly the intimate interaction between monetary policy and financial stability is the I(ntermediation)-theory of money of Brunnermeier and Sannikov (2012), which puts financial frictions at the center of the monetary policy transmission mechanism. In the words of Brunnermeier

[21]See, for example, Issing (2002, 2003) and Trichet (2004).

[22]Recently, Alan Blinder argued that financial stability should come first in the ranking of objectives because "there is no price stability without financial stability."

[23]Others, like Whelan (2013), argue that the mandates of central banks should be broadened to include financial stability, output-gap stability, and price stability to allow central banks to pursue the most efficient trade-offs. In this approach the time inconsistency is not emphasized.

and Sannikov (2013), "the I-theory of money ... argues that price, financial and fiscal stabilities are intertwined due to financial frictions. In downturns, optimal monetary policy should identify and unblock balance sheet impairments that obstruct the flow of funds to productive parts in the economy. In upturns, diligence is required to avoid imbalances that make the economy vulnerable to liquidity and deflationary spirals."

The close connection between price stability and financial stability comes from the fact that the health of the financial intermediation sector determines the degree of inside money creation and the price of risk in the economy.[24] Monetary policy works by redistributing wealth in such a way that dampens the amplification effects coming from balance sheet constraints. For example, cutting the short-term interest rate can increase the value of long-term bonds, thus stabilizing banks' balance sheets. Similarly, purchasing specific assets such as mortgage-backed securities may support real-estate prices and thereby help households that suffer from excessive debt.

Brunnermeier and Sannikov (2013) conclude:

> "The framework of the I-theory suggests a new way of thinking (gives a new perspective) about optimal monetary policy that goes strictly beyond inflation targeting: In downturns: ex-post crisis management is like 'bottleneck monetary policy'. Central banks have to figure out which sectors suffer from impaired balance sheets. The key question is: where is the bottleneck in the economy? Monetary policy has to work against liquidity and deflationary spirals that redistribute wealth away from productive balance sheet-impaired sectors—especially if fiscal-policy measures cannot be implemented in a timely manner. Second, monetary-policy tools should be employed in such a way as to reduce negative moral-hazard implications in the long run. In upturns: ex-ante crisis prevention is essential in order to avoid being cornered later, and to be forced to conduct ex-post redistributive monetary policy. Central banks have to be aware of the interactions between the three stability concepts (price, financial, fiscal). They also should have a close eye on aggregate and sector-specific credit growth and other monetary aggregates.

[24] See also Adrian and Shin (2010).

> Simply following current interest rates is misleading, quantity aggregates have to be closely watched and acted upon because the economy becomes vulnerable when imbalances are building up. In a worst case, we might enter a regime of 'financial dominance', in which the financial industry corners the central banks to conduct certain policies that restrict their freedom to fight inflation."

2.4 Which of the Three Views?

The three views clearly have different implications for the optimal institutional setup of financial-stability- and price-stability-oriented policies. Under the modified Jackson Hole consensus view, there is no need to bring macroprudential and monetary policies under one roof as long as there is sufficient information sharing amongst the authorities. In contrast, under the view that financial stability and price stability are largely overlapping, it is difficult to separate both objectives and the instruments to achieve those objectives.

Each of those different views acknowledges that there is an important interaction between financial stability and monetary policy in pursuit of price stability. There is, however, a different appreciation of the pervasiveness of this interaction, the effectiveness of independent macroprudential policies, the extent to which monetary policy may be a source of financial instability, and the extent to which monetary policy can avoid being drawn into financial stability concerns—in particular, in times of crisis.

First, if the interaction is very intense, there will naturally be a larger role for coordination which may be more easily internalized when one institution, the central bank, pursues both objectives with the full set of instruments. Second, if macroprudential tools are ineffective in managing the financial cycle, it may be more appropriate for monetary policy instruments to also pursue a financial stability objective. Third, if pure price stability monetary policy is itself a source of growing imbalances, it may be appropriate to take the financial stability implications of monetary policy into account. Finally, if monetary authorities cannot avoid being drawn into stabilizing the financial system in times of crisis, it may be useful to bring both policies under one roof. De facto, many of the nonstandard monetary policies (e.g., changes in reserve requirements or

in haircuts in central bank operations) could also be seen as macroprudential policy instruments.[25] Moreover, being the first in line to clean up when the bubble bursts, central banks should have the right incentive to lean against the building up of the bubble ex ante.

The main counterargument is that the central bank's involvement in financial stability may undermine the credibility of its pursuit of price stability. This may happen through two main channels. First, the central bank's involvement in financial stability requires a stronger involvement in distributional policies (as highlighted by Brunnermeier and Sannikov 2013) and in quasi-fiscal operations (as emphasized in Pill 2013). This requires a greater accountability and political involvement, which may undermine the independence of the central bank and increase political pressures. Second, involvement in financial stability risks creating important time-inconsistency problems for monetary policy. Central banks may get trapped in providing more liquidity than appropriate for long-run price stability if the fundamental problems of debt overhang following a financial crisis are not addressed.

Next, in section 3 we will review some of the evidence on the effectiveness of macroprudential policy measures and the risk-taking channel of monetary policy. In section 4 we then have a look at the time-inconsistency problem.

3. Empirical Evidence on the Effectiveness of Macroprudential Policy Measures and the Role of Monetary Policy in Risk Taking

3.1 Evidence on the Effectiveness of Macroprudential Policy Instruments

As discussed above, whether macroprudential policy can take over as the first line of defense in reducing the probability of a financial crisis very much depends on its effectiveness. However, assessing effectiveness is difficult because (i) there is a variety of possible macroprudential tools, (ii) there is as yet no widely agreed upon and comprehensive theoretical framework for the optimal choice and calibration

[25] One of the questions this raises is whether central banks should also use non-standard measures to lean against boom periods.

of macroprudential policy tools, and (iii) there is only scant actual experience with such tools in advanced economies.[26] One advantage of macroprudential policy is that, in contrast to monetary policy, the potential instruments are granular enough to address the growing imbalances where they arise. On the other hand, a shortcoming of specific macroprudential policies is that they may be subject to regulatory arbitrage and therefore less effective than thought—in particular, when the policies are not internationally coordinated. The direct intervention in specific markets may also come at a higher political cost if it involves specific interest groups.

What is the evidence on effectiveness? Most of the evidence on its effectiveness comes from experiences in emerging-market economies, which raises the question of how relevant this evidence is for advanced economies. Typically, the existing evidence analyzes to what extent macroprudential measures have been successful in reigning in credit and asset-price growth. Even less evidence is available on the impact on other intermediate targets such as liquidity mismatch or on the overall price of risk and, most importantly, the probability of a systemic crisis.[27]

Borio and Shim (2007) provides an early assessment of fifteen country experiences with prudential measures. They argue that based on the authorities' own assessments as well as on those of outside observers, these measures have, on balance, been regarded as useful. In some cases, they have been reported to have slowed down credit expansion somewhat, at least temporarily, and to have acted as a restraint on imprudent practices. This is confirmed by simple bivariate analysis which suggests that, on average, they did have a restraining effect on credit expansion and asset prices.

[26]See the BIS progress report to the G20 titled "Macroprudential Tools and Frameworks" and dated October 27, 2011; see also ESRB (2011).

[27]An alternative approach to assess macroprudential policy would be to use the unified framework of Adrian, Covitz, and Liang (2013). They see financial stability policies as policies that are designed to change the systemic risk/return trade-off. More stringent regulatory and supervisory policies can raise the price of risk in periods when potential shocks are small in order to reduce systemic risk in the event of large adverse shocks. The balance between the higher pricing of risk (and therefore the higher financial intermediation costs) and the lower level of systemic risk is the crucial policy choice from a financial stability perspective.

More recently, Lim et al. (2011) provide a more comprehensive overview of the evidence on the effectiveness of macroprudential policies using three approaches. One approach is a set of case studies involving an examination of the use of instruments in a small but diverse group of countries (China, Colombia, Korea, New Zealand, Spain, the United States, and some Eastern European countries). Overall, the experience is mixed. To various degrees, the instruments may be considered effective in addressing systemic risk in their respective country-specific circumstances, regardless of the size of their financial sector or exchange rate regime. At the same time, in a number of these countries, the instruments did not prevent a buildup of systemic risk. For our purposes, the experience in Spain is particularly interesting. In Spain, the authorities introduced dynamic provisioning as a macroprudential tool in 2000.[28] The instrument appears to have been effective in helping to cover rising credit losses during the early stages of the global financial crisis, but it did not prevent the big run-up in house prices and mortgage credit and its systemic collapse. This may be partly due to the cap imposed in 2005 on the size of provisions, but it may also point to the fact that the increase in capital requirements during the boom may need to be quite large before it has a restraining effect. Jiménez et al. (2012b) confirm this conjecture. Using detailed micro-level data, they show that countercyclical dynamic provisioning smoothens cycles in the supply of credit and in bad times upholds firm financing and performance, but may not be powerful enough to lean against the boom.

Lim et al. (2011) also examine the performance of the target (risk) variables, such as excessive credit growth, before and after an instrument is introduced to see if they have had the intended effect. They find that throughout the economic cycle, macroprudential instruments seem to have been effective in reducing the correlation between credit and GDP growth. In countries that have introduced caps on the loan-to-value (LTV) ratio, debt-to-income (DTI) ratio, and reserve requirements, the correlation is positive but much smaller than in countries without them. In countries that have introduced ceilings on credit growth or dynamic provisioning,

[28]For a definition and discusson of dynamic provisioning in Spain, see, for example, Saurina (2009).

the correlation between credit growth and GDP growth becomes negative. The change in the correlations is also statistically significant, except in the case of caps on foreign-currency lending and restrictions on profit distribution.

One notable example is Korea, which introduced LTV and DTI ratios in 2002 and 2005, respectively, and more recently imposed leverage caps on foreign exchange (FX) derivatives positions and a financial stability levy on non-core FX liabilities of banks to prevent currency and maturity mismatches in the banking sector from developing. Kim (2013) presents evidence that a tightening of LTV or DTI regulations tends to be associated with a statistically significant decline in the speed at which house prices and/or mortgage lending increases (Kim 2013, figure 10, p. 4). Also, the other measures taken in 2010 seem to have been effective in the FX derivatives positions of, particularly, foreign banks and lengthening the term structure of external debt. However, Kim (2013) also warns of unintended consequences which may worsen systemic risk.[29]

Finally, Lim et al. (2011) also perform cross-country regression analysis, which suggests that caps on the loan-to-value ratio, caps on the debt-to-income ratio, ceilings on credit or credit growth, reserve requirements, countercyclical capital requirements, and time-varying/dynamic provisioning may help dampen procyclicality of credit or leverage. The results also suggest that common exposures to foreign-currency risk and wholesale funding can be effectively reduced by limits on net open positions in foreign currency and limits on maturity mismatch.

Overall, the empirical literature tentatively supports the effectiveness of macroprudential tools in dampening procyclicality, notably LTV and DTI caps to tame real-estate booms, but also ceilings on credit or credit growth, reserve requirements, and dynamic provisioning.[30] To what extent such measures are effective enough to significantly reduce systemic risk is, however, as yet unclear. An example of a study that examines both costs and benefits of capital

[29]See also Igan and Kang (2011).

[30]Overviews of the evidence are also available in Crowe et al. (2011) and Committee on the Global Financial System (2012, annex 4).

and liquidity regulation is Basel Committee on Banking Supervision (2010).

3.2 Evidence on Monetary Policy and Risk Taking

Whether monetary policy should take an active, preventive role in maintaining financial stability also depends on how effective the standard monetary policy instrument is in leaning against growing financial imbalances and their unwinding and to what extent the short-term interest rate is a key variable in driving the risk-taking capacity of financial intermediaries.

Adrian and Shin (2008, 2009) argue in favor of a key role for the short-term interest rate, building on a central nexus between shifts in the short-term policy rate, future bank profitability, the risk-taking capacity of financial intermediaries, and real activity. In this view, relatively small changes in short-term interest rates can have a large impact on risk taking.[31] Moreover, the monetary policy stance affects risk taking of the financial system as a whole. While macroprudential policies typically are designed to target specific vulnerabilities on an ex ante basis, monetary policy affects the cost of finance for all financial institutions, even the ones in the shadow banking system that are more difficult to target via typical supervisory or regulatory actions.[32] Due to their narrow focus, supervisory and regulatory tools may simply end up pushing vulnerabilities into other parts of the financial system where only monetary policy is an effective policy tool.

[31] This follows from the fact that the business of banking is to borrow short and lend long. For an off-balance-sheet vehicle such as a conduit or SIV (structured investment vehicle) that finances holdings of mortgage assets by issuing commercial paper, a difference of a quarter or half percent in the funding cost may make all the difference between a profitable venture and a loss-making one. This is because the conduit or SIV, like most financial intermediaries, is simultaneously both a creditor and a debtor—it borrows in order to lend. See also Adrian and Shin (2010).

[32] Proponents of monetary policy leaning against the wind often rely on this argument, as is illustrated by the following quotes: Monetary policy "sets the universal price of leverage and is not subject to regulatory arbitrage" (Borio and Drehmann 2009); it allows central banks "to influence the behaviour of institutions that escape the regulatory perimeter" (Cecchetti and Kohler 2012), and it "gets in all of the cracks and may reach into corners of the market that supervision and regulation cannot" (Stein 2013).

The main counterargument points to the blunt nature of standard monetary policy tightening and the large collateral damage that could result from attempts at reigning in growing asset-price bubbles. In this view, short-term interest rates would have to be increased by a large amount to lower double-digit credit growth and effectively lean against overly optimistic expectations (see, e.g., Blanchard, Dell'Ariccia, and Mauro 2009, Gerlach 2010, and Svensson 2012a). Moreover, in this view, interest rate changes are a poor tool for targeting tail outcomes, whereas regulatory and supervisory tools may be able to more directly address financial vulnerabilities that emanate from specific markets or institutions.[33]

Following Rajan (2005) and Borio and Zhu (2008), an increasing number of papers have both theoretically and empirically investigated the link between the monetary policy stance and the risk-taking behavior of banks and other investors. A recent survey can be found in De Nicolò et al. (2010).[34] In this section we review some of the evidence for the euro area. This evidence is related to the question of whether monetary policy was too loose in the most recent boom and has contributed to the building up of imbalances.

Before doing so, it is worth distinguishing between two main channels of transmission. One is working through leverage and the riskiness on the asset side. In their review, De Nicolò et al. (2010) distinguish between (i) portfolio reallocation such as asset substitution, search for yield (Rajan 2005), and procyclical leverage (Adrian and Shin 2009) channels, which will tend to increase the share of risky assets and (ii) risk shifting, which will tend to lower risk taking. The latter effect will be larger, the better capitalized the financial sector is and the more skin in the game there is. The other main channel is working mainly through the funding side like in Stein (2013). Easy monetary policy increases incentives to use more short-term funding.[35] Adrian and Shin (2010) provide evidence that increases in the federal funds target are associated with declines in short-term funding liabilities. In reality, both channels are likely to

[33]It is worth noting that in crisis times, non-standard monetary policy measures may be more appropriate for addressing some of those tail risks.

[34]Holmström and Tirole (1998) is a classic reference on the impact of liquidity injections.

[35]See also Allen and Gale (2007), Diamond and Rajan (2009), and Acharya and Naqvi (2010).

interact and strengthen each other (as in Brunnermeier and Pedersen 2009).[36]

In light of the review of developments in the euro area in section 2, one of the most interesting pieces of research is a series of papers by Jiménez et al. (2012a, 2014) which use detailed credit register data to investigate the risk-taking channel in Spain. Ongena and Peydró (2011) summarize the impact of short-term interest rates on the risk composition of the supply of credit. They find that lower rates spur greater risk taking by lower-capitalized banks and greater liquidity risk exposure. They highlight three main results for a decrease in the overnight interest rate (even when controlling for changes in the ten-year government-bond interest rate):

(i) On the intensive margin, a rate cut induces lowly capitalized banks to expand credit to riskier firms more than highly capitalized banks, where firm credit risk is either measured as having an ex ante bad credit history (i.e., past doubtful loans) or as facing future credit defaults.
(ii) On the extensive margin of ended lending, a rate cut has, if anything, a similar impact, i.e., lowly capitalized banks lend credit to riskier firms less often than highly capitalized banks.
(iii) On the extensive margin of new lending, a rate cut leads lower-capitalized banks to more likely grant loans to applicants with a worse credit history, and to grant them larger loans or loans with a longer maturity. A decrease in the long-term rate has a much smaller effect or no such effect on bank risk taking (on all margins of lending).

The results in Jiménez et al. (2012a, 2014) suggest that, fully accounting for the credit-demand, firm, and bank balance sheet channels, monetary policy affects the composition of credit supply. A lower monetary policy rate spurs bank risk taking. Suggestive of excessive risk taking are their findings that risk taking occurs especially at banks with less capital at stake—i.e., those afflicted

[36] Angeloni, Faia, and Lo Duca (2013) test, in a VAR context, for the two channels of increased bank risk by including measures of funding risk and borrower risk and overall bank risk. They argue that the transmission works primarily through funding risk. They also show that overall bank risk as measured by volatility of bank equity prices has a large impact on output.

by agency problems—and that credit risk taking is combined with vigorous liquidity risk taking (increase in long-term lending to high-credit-risk borrowers) even when controlling for a long-term interest rate.[37]

These findings are confirmed by related research by Gambacorta and Marques-Ibanez (2011), Altunbas, Gambacorta, and Marques-Ibanez (2012), Paligorova and Santos (2012), Dell'Ariccia, Laeven, and Suarez (2013), and Popov (2013). For example, using an equity-market-based probability of default as a bank risk indicator, Altunbas, Gambacorta, and Marques-Ibanez (2012) show that easy monetary policy reduces bank risk in the short run, but increases it in the longer run. Paligorova and Santos (2012) investigate banks' corporate loan-pricing policies in the United States over the past two decades and find that monetary policy is an important driver of banks' risk-taking incentives. They show that banks charge riskier borrowers (relative to safer borrowers) a smaller premium in periods of easy monetary policy compared with periods of tight monetary policy. Using individual bank information about lending standards from the Senior Loan Officers Opinion Survey, they unveil evidence that the interest rate discount that riskier borrowers receive in periods of easy monetary policy is prevalent among banks with greater risk appetite. This finding confirms that the observed loan-pricing discount is indeed driven by the bank risk-taking channel of monetary policy.

The important conclusion from this research is that monetary policy interacts with bank regulation. Banks that are sufficiently capitalized do not suffer from the risk-taking incentive when interest

[37]These results are confirmed by Ioannidou, Ongena, and Peydró (2009) who focus on the pricing of the risk banks take in Bolivia (relying on a different and complementary identification strategy to Jiménez et al. 2014 and studying data from a developing country). Examining the credit register from Bolivia from 1999 to 2003, they find that when the U.S. federal funds rate decreases, bank credit risk increases while loan spreads drop (the Bolivian economy is largely dollarized and most loans are dollar denominated, making the federal funds rate the appropriate but exogenously determined monetary policy rate). The latter result is again suggestive of excessive bank risk taking following decreases in the monetary policy rate. Despite using very different methodologies—and credit registers covering different countries, time periods, and monetary policy regimes—both papers find strikingly consistent results.

rates are low, consistent with the theoretical findings of the risk-shifting channel by Dell'Ariccia, Laeven, and Marquez (2010).

One important question is whether these results are macroeconomically relevant. Maddaloni and Peydró (2011) use a data set of euro-area and U.S. bank lending standards to show that low policy-controlled interest rates soften standards for household and corporate loans. The absolute impact of a one-standard-deviation decrease of Taylor-rule residuals on lending standards is more than five times higher than the softening due to a comparable increase of real GDP growth. This softening—especially for mortgages—is amplified by securitization activity, weak supervision for bank capital, and monetary policy rates that stay too low for a long period. They also provide some suggestive evidence on the linkages between the excessive softening of lending standards and the costs of the crisis. Countries that prior to the financial crisis had softer lending standards related to comparatively low monetary policy rates experienced a worse economic performance afterwards, measured by real, fiscal, and banking variables. Finally, the evidence that low long-term rates do not have this impact may suggest that one important channel works through the funding side, as financial intermediaries rely mostly on short-term funding.

Moreover, there is quite a bit of evidence that changes in bank lending standards also have significant effects on both credit growth and economic activity. Ciccarelli, Maddaloni, and Peydró (2010, 2013) further explore the link between monetary policy, bank lending standards, and economic activity and inflation in the euro area using a panel VAR model. They decompose changes in total lending standards in two variables using the answers related to the factors affecting these changes. Innovations to changes of credit standards due to banks' changes in balance sheet strength and competition are interpreted as a measure of credit supply (bank lending channel), and an innovation to change of credit standards due to firms' (households') changes in balance sheet strength as a measure of borrowers' quality (firm/household balance sheet channel). Overall, they find that a monetary policy easing has a significant effect on economic activity and inflation through both the bank lending and the balance sheet channel. Somewhat surprisingly, they find that the pure bank lending channel is more relevant for loans to businesses than to

households. Ciccarelli, Maddaloni, and Peydró (2013) show how the amplification effects through, respectively, the broad balance sheet channel and the bank lending channel change over time in line with the conditions affecting the banking sector and the non-standard policies supporting liquidity provision. Overall, they find that outside the heat of the financial crisis, the broad balance sheet channel is more important than the bank lending channel.

While the literature review above suggests that the risk-taking channel is active, various authors have argued that standard estimated multipliers of a monetary policy tightening on asset prices, credit, and economic activity would suggest that attempts at reigning in asset-price bubbles would require large interest rate changes with negative consequences for economic activity. For example, simulations by Bean et al. (2010) suggest that to stabilize real house prices in the United Kingdom from 2004 on, interest rates would have to have been several percentage points higher and, by mid-2007, GDP 3.3 percent lower. Bean et al. (2010) conclude: "But, at least most of the time, monetary policy does not seem like the most appropriate instrument to call on—it is not targeted at the key friction and involves too much collateral damage to activity." Moreover, as argued by Broadbent (2013), domestic mortgages, the most interest-rate-sensitive part of their domestic balance sheets, accounted for less than a quarter of UK banks' assets immediately prior to the crisis and have contributed only a tiny fraction of their losses. Instead, it was losses on overseas assets—including U.S. mortgages—that did most of the damage. So while stabilizing domestic house prices would probably have involved material costs in foregone output, it's less clear it would have done much to reduce the likelihood or costs of the financial crisis. Similarly, Gerlach (2010) argues that the effect of a policy tightening on house prices is much less than on output, suggesting large collateral damage of leaning against house-price bubbles.

The existing empirical analysis is, however, mostly performed using linear regression methodologies. In order to make a more thorough cost-benefit analysis, it is important that non-linear approaches are developed which capture the possibly time-varying nature of interest rate changes on credit and house prices and their effect on the probability of a crisis. Some early attempts at estimating such

models are Hubrich and Tetlow (2012) and Hartmann et al. (2013). Similarly, the focus on credit and asset prices in this analysis ignores the important link with increasing fragility due to a shortening and much more complex liability side. One challenge for both analytical and empirical approaches is to combine the buildup of vulnerabilities on the asset side with those on the liability side.

4. Time Inconsistency and the Institutional Framework

A recent BIS report (the "Ingves report," BIS 2011) discusses the variety of ways in which central banks fulfill their macroprudential functions alongside their other roles. In some countries (like Malaysia and the United Kingdom), the central bank has clear responsibility for both macroprudential and microprudential policy. In others, central bankers account for a large share of the votes in the committee (as in the ESRB). In the U.S. arrangements, the Federal Reserve is one of ten voting members of the Financial Stability Oversight Council (FSOC), but it is charged with the regulation of systemically important banks and non-bank financial institutions, as designated by the FSOC.

Giving the central bank a strong macroprudential policy objective (with the appropriate instruments) in addition to its price stability objective has a number of advantages. It allows for better information sharing and coordination amongst both policy domains. It ensures that macroprudential policy is pursued by an independent institution with a lot of expertise in macroeconomic and financial surveillance. Finally, as lenders of last resort, central banks have an incentive to reduce the probability of a financial crisis, because they will be the first in line to clean up when the risks materialize. At the same time, there are two main challenges. First, as macroprudential policy is unlikely to fully prevent financial crises, there is a risk that the reputation of the central bank is damaged, which may affect its independence and credibility also with respect to its monetary policy mandate. Second, when both objectives are equally ranked, it may give rise to time-inconsistency problems, as ex post monetary policy will have an incentive to inflate away some of the debt overhang and ex ante macroprudential policies may succumb to political pressures

not to lean too much against the boom and rely on monetary policy to solve part of the debt overhang.[38]

In order to illustrate the latter risk, we use a simplified version of the static model analyzed in Ueda and Valencia (2012). In this model, the objective of policymakers is to minimize the following loss function:

$$\frac{1}{2}(\pi)^2 + \frac{a}{2}(y - y^*)^2 + \frac{b}{2}(\theta - \theta^*)^2, \tag{1}$$

where π is inflation, y is output, θ is leverage, and the starred variables are optimal targets. We assume the inflation target is zero. The first two terms of the loss function are standard. The last one captures the cost of a real debt overhang and the associated financial crisis.

The economy is given by the following two equations:

$$y = \hat{y} + \alpha(\pi - \pi^e) + \beta\delta \tag{2}$$

$$\theta = \hat{\theta} - (\pi - \pi^e) + \delta \tag{3}$$

Equation (2) is a standard Phillips curve with an additional term reflecting the impact of macroprudential policy, where α and β are positive. Output is positively affected by unexpected inflation and by an easing of macroprudential policy. Think of δ as a macroprudential instrument positively affecting credit growth or negatively affecting the cost of finance. Changes in macroprudential policy work like a cost-push shock. For example, a lowering of capital requirements (or an increase in the threshold for leverage) reduces the cost of capital, which in turn increases output and reduces inflation (e.g., through a working capital channel). The second equation determines ex post leverage. Higher unexpected inflation (and possibly output) will tend to reduce the debt overhang, whereas looser macroprudential policy will tend to increase the debt overhang.

[38]Macroprudential calibrations are often based on discretion and judgment rather than rules, although some countries have used rule-based instruments. While rules have merits—they can help to overcome policy inertia, enhance accountability, and create greater certainty for the industry—designing them may be difficult, especially when multiple instruments are being used in combination. This is why rules are often complemented with discretion.

Furthermore, we assume that $\hat{y} < y^*$, reflecting the fact that potential output is lower than the efficient level of output, a standard assumption in the Barro-Gordon literature, which gives an incentive to boost output, and that $\hat{\theta} > \theta^*$, reflecting the assumption that there is a tendency for the financial sector to overaccumulate debt, for example, because of pecuniary externalities due to fire-sale dynamics in the bust.[39]

This static model can be seen as illustrating the steady-state effects of a financial stability objective on monetary policy. We analyze two cases. First, assume that the central bank sets both monetary and macroprudential policy to minimize the loss function and can commit to these policies. This setting will give rise to the first best in this simple example. In this case, the central bank can credibly affect inflation expectations and we can set $\pi^e = \pi$ in equations (2) and (3). The central bank minimizes loss function (1) subject to equations (2) and (3). The first-order conditions with respect to monetary policy (π) and macroprudential policy (δ) are, respectively,

$$\delta = \frac{\alpha\beta}{\alpha\beta^2 + b}(y^* - \hat{y}) - \frac{b}{(\alpha\beta^2 + b)}(\hat{\theta} - \theta^*) \tag{4}$$

$$\pi = 0. \tag{5}$$

Monetary policy sets inflation equal to zero (the inflation target) and macroprudential policy is set so as to optimally trade off the advantages of higher output versus the costs of a higher debt overhang. A higher steady-state distortion in output will lead to looser macroprudential policy, whereas a higher tendency to overaccumulate debt will result in tighter macroprudential policy. Whether there will be net tightening depends on the relative size of both distortions, their relative cost, and the relative effectiveness of macroprudential policy.[40] We will assume that, on balance, macroprudential policy is tightened in the first-best solution.

[39] See Bianchi and Mendoza (2010) and Jeanne and Korinek (2012) for models in which pecuniary externalities due to fire sales give a rationale for ex ante prudential policy.

[40] In a more complete model, the costs of debt overhang need, of course, to be related to lower output. However, this way, we maintain the linear-quadratic structure.

How can this first-best solution be implemented in an environment where the authorities cannot commit? As discussed above, when there is a debt overhang it is very likely that monetary policy will be the last one moving. It is therefore reasonable to assume that the macroprudential decision makers set policy taking the monetary policy reaction function as given (a Stackelberg equilibrium with the macroprudential authorities moving first). If the monetary authority has price stability as its sole objective, then the first best can be replicated. The monetary authority will set inflation equal to zero. The macroprudential authority will realize this and will therefore have no incentive to relax macroprudential policy in order to have a higher output and let the monetary authorities do part of the work. Macroprudential policy will be set as in equation (4). This will be independent on whether the macroprudential policy authorities care about inflation or not.

The first best will not be achieved if the monetary authority also cares about financial stability. If the monetary authority has a loss function with both price stability and financial stability (i.e., the first and third term of equation (1)), the monetary authority's reaction function will be given by

$$\pi = b(\hat{\theta} - \theta^*) - b(\pi - \pi^e) + b\delta. \tag{6}$$

Inflation will be higher, the higher the debt overhang and the easier macroprudential policy. Knowing this, the macroprudential authority will have an incentive to make use of the fact that the monetary authority will accommodate a part of the debt overhang. The financial stability objective gives rise to an inflation bias.

To see this, assume the macroprudential authority minimizes losses from output and leverage deviations taking the monetary policy reaction into account. Under rational expectations, this yields the following reaction function:

$$\delta = \frac{a(\beta(1+b)+\alpha b)}{b+\alpha\beta(\beta(1+b)+\alpha b)}(y^* - \hat{y}) - \frac{b}{b+\alpha\beta(\beta(1+b)+\alpha b)}(\hat{\theta} - \theta^*). \tag{7}$$

Comparing equation (7) with (4), it is easy to show that the reaction coefficient to the output gap is greater in (7), whereas the reaction

coefficient in absolute terms to the leverage gap is smaller. In other words, because the macroprudential authority knows the monetary authority will have an incentive to inflate part of the debt overhang away, it will choose an easier macroprudential policy stance favoring output and allowing for a larger debt accumulation. The end result is a somewhat higher output, but also higher debt accumulation and an inflation bias. The inflation bias is larger than the one that would result from the time-inconsistency problem that would result from the fact that, ex post, a monetary authority that cannot commit will always have an incentive to inflate part of the debt away.

Both the reputational and time-inconsistency risks can be mitigated by clearly separating the objectives, instruments, communication, and accountability of the macroprudential and monetary policy domains (even if they are performed by the same institution), while maintaining the benefits from information sharing. In particular, in order to avoid the time-inconsistency problem and also to ensure clear accountability, it is important that price stability remains the monetary authorities' primary objective. A lexicographic ordering with the price stability objective coming before the financial stability objective will avoid an inflationary bias that may arise from the central bank's involvement in financial stability, while ensuring that financial stability concerns are still taken into account. Such a credible mandate of the monetary authorities will also give the right incentives for the macroprudential policymakers to lean against the buildup of leverage and growing imbalances and not rely on inflation to solve their problems.

5. Conclusions

The financial crisis has accelerated the introduction of a new policy domain called macroprudential policy aimed at maintaining financial stability. The implications for the monetary policy framework are, however, more debated, with some arguing for minimal changes to the price-stability-oriented frameworks that existed before the crisis and others arguing for a radical rethink putting financial stability on equal footing with price stability and merging the macroprudential and monetary policy objectives. After reviewing the various arguments and the empirical evidence in this paper, I find myself

in the middle ground. The costs of financial instability and systemic financial crises are very large: just cleaning up is no longer an option. While the new macroprudential policy framework should be the main tool for maintaining financial stability, it is still very much under construction and its effectiveness in avoiding systemic crises largely unproven. At the same time, there is evidence that the standard monetary policy stance intimately interacts with important drivers of financial imbalances such as credit, liquidity, and risk taking. And various non-standard monetary policy instruments used in the recent crisis (such as reserve requirements, collateral rules, and asset purchases) are difficult to distinguish from macroprudential tools both in their intermediate objectives (addressing financial market malfunctioning) and in their transmission channels. All these arguments argue for making financial stability an explicit objective of monetary policy, to be used when macroprudential policies fail as an instrument of last resort. But doing so entails important risks. First, as policymakers are unlikely to fully prevent financial crises, there is a risk that the reputation of the central bank is damaged, which may affect its overall independence and credibility. Second, when both objectives are equally ranked, it may give rise to time-inconsistency problems, as monetary policy ex post has an incentive to inflate away some of the debt overhang associated with financial crises. More generally, a concern for financial stability may lead to so-called financial dominance. To mitigate these risks, it is important that price stability remains the primary objective of monetary policy and a lexicographic ordering with financial stability is maintained. This will allow the central bank to lean against the wind (if necessary), while maintaining its primary focus on price stability in the medium term.

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