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On the interaction between monetary and macroprudential policies

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ABSTRACT

The Global Financial Crisis fostered the design and adoption of macroprudential policies throughout the world. This raises important questions for monetary policy. What, if any, is the relationship between monetary and macroprudential policies? In particular, how does the effectiveness of macroprudential policies (or lack thereof) influence the conduct of monetary policy? This discussion paper builds on the insights of recent theoretical and empirical research to address these questions.

JEL: E3, E44, G01, G21.

Key Words: Financial Frictions, Capital Requirements, Systemic Risk.

NON-TECHNICAL SUMMARY

In recent decades, the adoption of macroprudential policies all over the world has fuelled an ongoing debate regarding the effects of these policies and their interactions with monetary policy. This discussion paper provides a research-based overview of this debate.

We begin by analysing the conceptual foundations for macroprudential policy in modern macroeconomic models. These models are built on the premise that economics agents do not internalize the effects of their leverage and risk-taking on the stability of financial system as a whole. This generates inefficiencies or distortions that give rise to *systemic risk*, which warrants a macroprudential policy approach to financial regulation. This role of macroprudential policy is supported both by empirical evidence, which suggests that it does contain symptoms of systemic risk such as credit growth, leverage and house prices, and by quantitative models, which indicate that can have a sizable effect on systemic risk.

In an integrated framework, there are spillovers between macroprudential and monetary policies because they both affect financial markets and economic activity. As long as macroprudential policy is managed effectively, however, the Tinbergen principle applies: macroprudential policy can focus on systemic risk whereas monetary policy can focus on keeping inflation stable on target. In practice, however, there are reasons to believe that the macroprudential framework may not yet be fully effective. In this case, there is a conceptual argument for monetary policy to play a macroprudential role. In most models, this role takes the form of tightening ex ante (i.e., during the build-up of financial imbalances) to reduce leverage, and loosening ex post (i.e., during financial crises) to speed up the recovery.

The practical implications of the argument are more elusive. Monetary policy may be a blunt macroprudential instrument because it affects the entire economy, so that any practical attempt to modify it along these may be counterproductive. In practice, moreover, the welfare costs from a lower stability of inflation may outweigh the gains (if any) from financial stability. All in all, the view that emerges is that there are trade-offs associated with the use of monetary policy to contain systemic risk. The literature still lacks a clear sense, however, of exactly how favourable (or unfavourable) these trade-offs are quantitatively.

I. INTRODUCTION

The Global Financial Crisis led to the widespread perception that new regulations were needed to ensure the stability of the financial system as a whole, which fostered the design and adoption of macroprudential policies all over the world (see for instance, Cerutti et al. (2017)). This raises important questions for monetary policy. What, if any, is the relationship between monetary policy and macroprudential policy? In particular, does the expansion of macroprudential policy have implications for the conduct of monetary policy? If so, what are these implications?

In this discussion paper, we build on recent research to address these questions. We begin by analysing the role of macroprudential policy in modern macroeconomic models. Most of these models are built on the premise that economics agents (such as households and financial intermediaries) are rational, but they are also small and thus fail to internalize the full effects of their actions. Because of this, they may through their individual choices expose the economy to excessive or "systemic" risk, for instance by taking on too much leverage. Through the lens of these models, macroprudential policy is a broad term that applies to interventions that seek to correct this excessive risk, for instance by limiting the leverage of economic agents.

Building on this conceptual justification for macroprudential policy, we then turn to its effectiveness in practice. Namely, how successful are macroprudential interventions, either on lenders (e.g. bank capital requirements) or borrowers (e.g. loan-to-value ratios) at constraining credit, leverage, and ultimately systemic risk? We provide a brief discussion of the recent empirical evidence in this regard. The key takeaway is that such interventions appear to be effective at constraining credit and leverage, although their ultimate benefits in terms of lower risk are harder to gauge empirically. This is why economists have relied on quantitative models to assess the net benefits of macroprudential policy, and generally found them to be of first-order importance in managing systemic risk.

In practice, however, macroprudential policy may be far from effective, because macroprudential policy frameworks are incomplete or altogether missing. In this case, a key

question is whether it is optimal to adjust monetary policy to deal not just with its traditional focus on nominal rigidities but also with the distortions that emanate from systemic risk and that cannot be appropriately addressed by macroprudential policy.

To address this question, we then introduce nominal rigidities into the framework, which monetary policy seeks to counteract in the traditional New-Keynesian fashion. Two main results emerge from this integrated framework. First, if macroprudential policy is managed effectively, each type of policy can to largely focus on addressing a different friction: while monetary policy corrects the distortions associated to nominal rigidities, macroprudential policy eliminates the costs associated to systemic risk. Second, if macroprudential policy is not managed effectively – for instance, because part of the financial system lies beyond the reach of regulation – there are potential gains from using monetary policy for macroprudential purposes. A simple way of illustrating the rationale for this last result is through a simple "envelope-theorem" type of argument: when monetary policy deviates locally from its focus on nominal rigidities, there are second-order losses on the price stability front but first-order gains on the systemic-risk front. On net, welfare increases.

Although these conceptual results follow from a general class of models, their practical implications are more elusive. Indeed, there are concerns that – in practice – monetary policy is too "blunt" a tool for macroprudential purposes, so that any attempts to use it along these lines may do more harm than good. We review the main arguments in this regard and provide a brief overview of the empirical evidence and quantitative exercises used to support them. Given the current state of knowledge, the view that emerges is that we do not yet have a clear understanding of what the effective trade-offs are of using monetary policy to contain systemic risk.

The discussion paper is organized as follows. Section II provides a framework to justify the role of macroprudential policy, as well as empirical and quantitative estimates of the gains of macroprudential intervention. Section III adds monetary policy to the mix and discusses the benefits and potential costs of using monetary policy for macroprudential purposes. Finally, Section IV provides a brief summary and concludes.

II. THE ROLE OF MACROPRUDENTIAL POLICY

II.1. THEORETICAL CONSIDERATIONS

We begin this discussion paper by analysing the conceptual role of macroprudential policy. At a very general level, its objective is to contain systemic risk or widespread financial instability. According to the ECB, systemic risk is "the risk that financial instability will become so widespread that it impairs the functioning of the financial system to such an extent that growth and welfare suffer materially".[1] Throughout the discussion paper, we use systemic risk and financial instability interchangeably, with the understanding that the latter is the instability that ensues when the former materializes.

To better characterize the role of macroprudential policy, it is useful to think of a stylized financial economy. This workhorse economy, which we rely on to organize ideas, is characterized by two features. First, it includes borrowers and lenders, so that financial markets play an important role in intermediating resources between both types of agents. The precise nature of these borrowers and lenders could vary depending on the application (e.g. impatient vs. patient households, banks vs. savers, etc..), but it is not important at this level of generality. Second, the economy exhibits fluctuations that are linked to the functioning of financial markets. In particular, we think of the economy as transitioning repeatedly between three stages or phases: build-up, crisis and normal times.

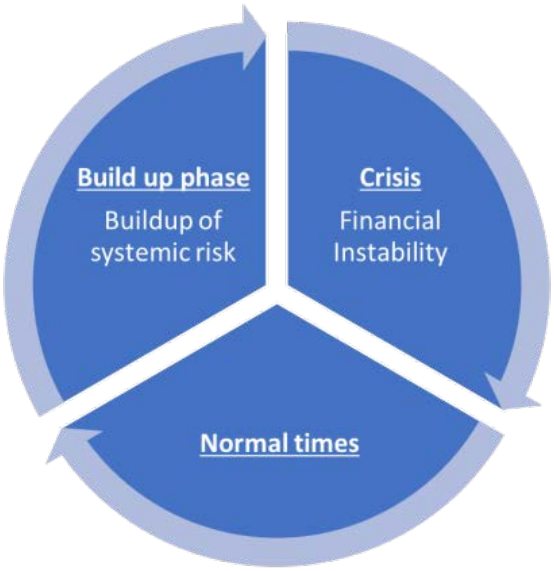
The build-up phase sows the seed of systemic risk. It is in this phase that agents make the decisions that shape the crisis to come, such as their leverage, the composition of their portfolios and, more generally, their exposure to different types of risk. The precise nature of the systemic risk that builds up depends on the application being considered. It can refer to contagion (e.g. from banks' exposure in the interbank market), to the accumulation of imbalances that eventually unravel (e.g. correlated risks or loosening of lending standards), or to agents' vulnerabilities to macroeconomic shocks (e.g. from high leverage ratios). We use "build-up" as a catch-all term to capture the phase in which economic agents make decisions

[1] ECB (2009), The concept of systemic risk. Special feature in the ECB Financial Stability Review, December.

that have implications for both the likelihood and the severity of crises. By its very nature, the build-up is an ex ante phase, i.e., it takes place before the crisis materializes. It is typically, but not necessarily, a time of high leverage, high asset prices, and highly liquid financial markets.[2]

The crisis phase is the stage at which systemic risk materializes. This could happen for different reasons, e.g. if the imbalances accumulated during the build-up phase suddenly unravel, or if there is a change in the environment that uncovers underlying vulnerabilities. The crisis could simply result from a large and unusual shock that has significant implications for the real economy. Whatever its trigger, it is an ex post phase, i.e., systemic risk materializes and financial stability ensues. It is typically a time of deleveraging, collapsing asset prices, and illiquid financial markets. Finally, we use "normal times" to denote the phase in which the economy is neither building up systemic risk nor undergoing a crisis. Figure 1 below provides a graphical illustration of these phases.

Figure 1: a stylized view of systemic risk



Like real-world economies, therefore, our workhorse economy is continuously transitioning between the build-up phase, the crisis phase, and normal times. These transitions generate

[2] For an in-depth discussion of the different types of systemic risk, see De Bandt, O. and P. Hartmann (2000) and De Bandt, O. , Hartmann, P. and J.L. Peydro (2012).

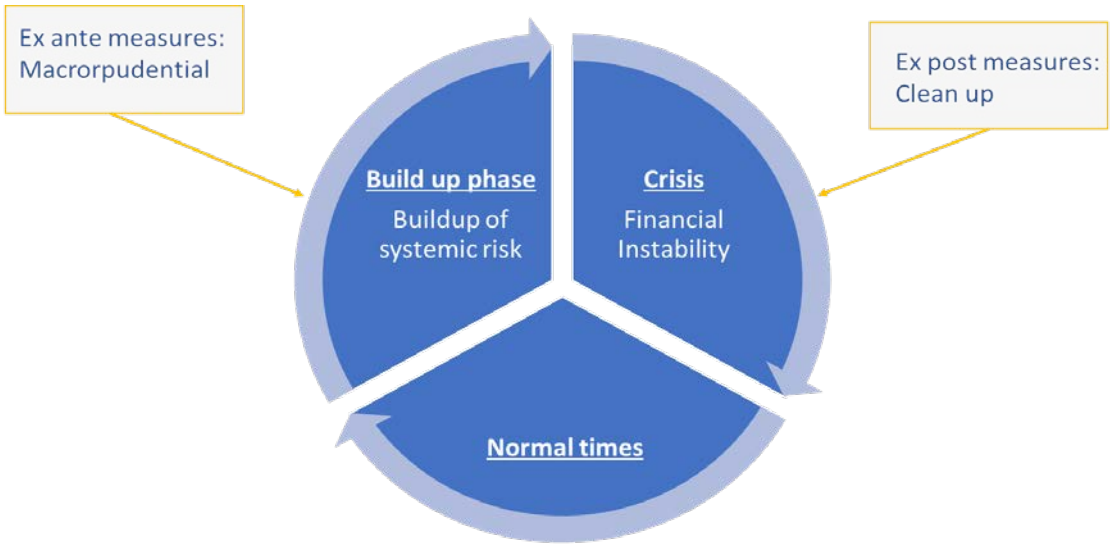
volatility, moreover, both in financial variables such as asset prices and leverage, and in real outcomes such as output and employment. And this volatility, especially when it is tied to financial crises, imposes large costs on the economy (see e.g. Laeven and Valencia 2013). Under standard measures of welfare, which broadly reflect some notion of the average level of consumption and of its volatility, crises are costly both because they reduce consumption and because they increase its volatility. But just because they are undesirable, crises do not imply that there is scope for policy to intervene. In other words, it may well be that the equilibrium of the financial economy is constrained optimal.

The academic literature has devoted substantial efforts to understanding the conditions under which the laissez-faire equilibrium of an economy like the one outlined above is constrained optimal or not. One central feature of any such economy is that the aggregate outcome depends on the individual choices of many agents. During the build-up phase, agents' individual actions (e.g., choice of leverage, portfolio composition, setting of lending standards, etc…) contribute to the economy's overall accumulation of risk. Simply put, the ex-ante choices of individuals determine the likelihood that the crisis occurs and its severity when it does. During the crisis, moreover, agents' individual actions (e.g. choice of deleveraging, liquidation of assets, etc…) shape the extent of the aggregate downturn suffered by the economy. In other words, the ex post choices of agents also determine the severity of the crisis and the likelihood of a swift recovery.

Even though aggregate outcomes depend on the actions of all individuals, each individual takes the evolution of the aggregate economy as given. This failure of individuals to internalize the effects of their actions can lead, under certain conditions, to suboptimal outcomes. A full review of these conditions would exceed the scope of this paper, but they all have something in common: namely, they distort the price system in a way that prevents agents from properly gauging the effects of their choices (see **Box 1** for a brief overview of the literature). As a consequence, agents' ex ante or ex post choices are distorted relative to what would be socially desirable. Ex post, for instance, crises may be self-fulfilling. In this case, agents decide to run on certain banks or liquidate certain financial assets because they expect a crisis, but it

is this very action that brings about the crisis in the first place. Ex ante, financial markets may be limited or incomplete, meaning for instance that agents can only borrow through non-contingent debt contracts. In this case, they may be in a dire economic condition should a crisis occur, thereby being forced to deleverage and liquidate assets or – alternatively – to cut down consumption in ways that are harmful to the economy as a whole. Also ex ante, the expectations of subsidies or bailouts (e.g. deposit insurance) may lead agents to take on too much risk, which may also raise the likelihood or severity of crises.

Figure 2: ex ante and ex post policy interventions



Whatever their ultimate cause, we shall refer throughout to these suboptimal actions of agents (either ex ante or ex post) as the inefficiencies or distortions associated to systemic risk. It is the existence of these inefficiencies that warrant policy interventions. As illustrated in Figure 2, these interventions could be ex post, i.e., once the crisis occurs, or ex ante, i.e., during the build-up phase. The former can be thought of as "clean-up" measures taken to mitigate the severity of an ongoing crisis or to speed up the recovery in its aftermath, such as liquidity injections, asset support schemes, or bank recapitalizations. The latter can instead be thought of as "preventive" measures taken to reduce the likelihood that a crisis occurs and/or

its severity should it do so. This type of measures is broadly referred to as macroprudential policies.[3]

Macroprudential policy, therefore, is a general term that encompasses many different types of policies imposed during the build-up phase to address the inefficiencies arising from systemic risk. They take different forms, but perhaps the two most common ones are countercyclical capital buffers in the case of banks, which restrict lending, and loan-to-value or debt-to-income ratios in the case of households, which restrict borrowing.[4] Their objective is to contain credit during the build-up phase in order to reduce the likelihood and severity of crises. But how effective are they?

Box 1: brief review of the conceptual literature on macro-prudential policy[5]

Crockett (2000); Borio et al (2001); Borio (2003) and Kashyap and Stein (2004) are among the first observers who pointed out the flaws of a micro-prudential approach to financial regulation and recognized instead the importance of a macro-prudential approach. Relative to its micro counterpart, the distinctive feature of the macro approach is that it takes into account the general-equilibrium effects of the interactions among the institutions that compose the financial system on the stability of the system as a whole.

Before the global financial crisis of 2007-09, the macro-prudential approach focused primarily on regulating externalities related to strategic interactions (Allen and Saunders 2003, review; Dell'Ariccia and Marquez 2006; Gorton and He 2008) or interconnectedness (Allen and Gale, 2000, 2004 and 2007; Bebchuk and Goldstein 2011; Rajan and Diamond 2011) among financial institutions. However, the crisis revealed that most of the institutions in wholesale financial markets are interconnected to a large extent rather through their common asset positions and

[3] Macroprudential policies are ex ante in the sense that they are imposed during the build-up phase, but they also have an ex post component because they are relaxed during crises.
[4] Other important measures include regulations to maturity (e.g. limiting to short-term debt) or to specific exposures (e.g. currency risk).
[5] Prepared by Alejandro Van der Ghote.

market value of their positions (Kashyap et al 2008; Brunnermeier et al 2009; French et al 2010; Hanson et al 2011). Since then the core of the analysis switched to regulating the so-called fire-sale or credit-crunch externalities. Hart (1975), Stiglitz (1982) and Geanakoplos and Polemarchakis (1985) had initially pointed to this class of externalities in general equilibrium economies with incomplete financial markets, and subsequently Caballero and Krishnamurthy (2001), Gromb and Vayanos (2002) and Lorenzoni (2008) studied them in more detail.

Formally, such fire-sale externalities exist in environments in which a redistribution of assets among agents/institutions affects their relative prices and, consequently, also their spanning properties. In these environments, typically, institutions do not fully internalize the collective effects of their individual asset positions on the asset prices. This in general leads to Pareto suboptimal outcomes or outcomes that are not consistent with standard social welfare criteria. Taxes or quantity restrictions on assets or individual institutions that induce the appropriate redistribution (i.e., macro-prudential policy intervention) thus generally improve allocative efficiency over laissez faire.

In the aftermath of the crisis, downward pressures on real interest rates—and low interest rates in general—also underscored the importance of the so-called aggregate-demand externalities for the macro-prudential regulatory framework (Farhi and Werning 2016; Korinek and Simsek 2016). A chief problem with secularly low interest rates is that those rates may weaken the ability of monetary policy to stimulate the economy, especially during downturns, because the monetary policy rate may become constrained by the effective lower bound (ELB) on nominal rates. The externality arises only when agents (which here may also include households or nonfinancial firms) do not fully internalize the collective effect of their individual deleveraging decisions on aggregate savings, the level of the natural rate of interest (i.e., the equilibrium interest rate that is consistent with inflation on target and production at full capacity), and the likelihood and/or intensity of hitting the ELB with the policy rate. Taxes or quantity restrictions that curb leverage a priori can then improve social welfare over laissez faire through this channel as well.

At the present juncture, both pecuniary externalities in financial markets (which by now also encompass other externalities beyond fire sales—see Dávila and Korinek 2018 for a general classification) and the aggregate-demand externality are the main rationale for the macro-prudential approach (Farhi and Werning 2016; Stein 2019, keynote speech). Van der Ghote (2020a) finds theoretically a novel complementarity between both types of externalities that reinforces the overall benefits from the macro-prudential approach. Low expected natural rates in the euro area at least over the medium term (Blanchard 2020; Jorda et al 2020) suggests that this complementarity will continue to be important going forward.

II.2. BRIEF OVERVIEW OF THE EMPIRICAL EVIDENCE

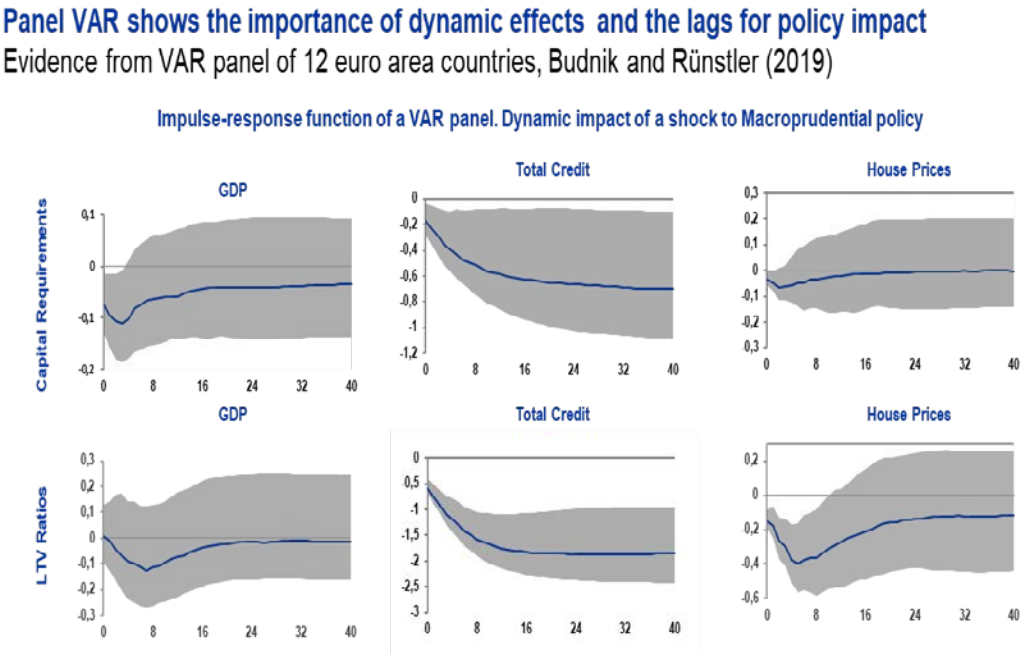
There is by now a growing body of empirical evidence on the effects of macroprudential policies (see **Box 2** for a review of the literature). Overall, this evidence suggests that macroprudential policies appear to be effective at containing typical symptoms of systemic risk, such as credit growth, leverage and house prices.[6] Figure 3, for instance, illustrates VAR evidence from the euro area on the effects of a tightening in capital requirements and loan-to-value ratios. As the figure shows, the evidence suggests that these measures have a significant effect on credit and, to a lesser extent, on house prices. In a similar vein, other studies have recently found that macroprudential policies appear to be effective in curbing house prices and credit, especially those policies that are borrower-based[7]. There appear to be notable transmission lags in these effects, however, with a delayed impact that reaches its peak only after three years (see e.g. Poghosyan (2019)).

Despite this evidence on the effect of macroprudential policies on credit and house prices, there is still debate regarding their impact on economic activity. Using aggregate data to track the effects of tightening loan-to-value ratios, for instance, Richter et al. (2019) argue that such tightening entails negligible costs in terms of foregone GDP. This finding is consistent with the euro-area evidence depicted in Figure 3. Focusing instead on capital requirements, Fraisse and

[6] For a survey of the evidence, see Galati and Moessner (2018).
[7] Budnik, Katarzyna Barbara, and Gerhard Rünstler. "Identifying SVARs from sparse narrative instruments: dynamic effects of US macroprudential policies." (2019).

Thesmar (2020) use bank-and firm-level data to document that their tightening has a negative effect not just on credit but also on investment and employment.

Figure 3: VAR evidence on the effects of macroprudential measures



Notes: Source Budnik and Rustler (2019).

But even if we acknowledge that macroprudential policies are effective at containing the symptoms of systemic risk, albeit at a cost, how beneficial are they ultimately? In other words, can we say anything about their effectiveness in reducing the likelihood of crises, or the severity of crises once they arise? This is a hard question to answer empirically because financial crises are infrequent, which makes it challenging to identify the causal effect of macroprudential measures on crises.

One way to address this question is to refer to the empirical link between credit growth and financial crises. If, as the evidence suggests, excessive credit growth is linked to crises that are followed by sluggish growth and if macroprudential policies are effective at constraining credit growth, then surely macroprudential policies must reduce the incidence of crises and

positively affect long-term growth (see Box 2 for a discussion of this approach). Recently, though, some research has tried to establish a tighter causal link between macroprudential polices and the incidence of crises by relying on micro data. Jiménez et al. (2017), for instance, analyse the effects of Spain's system of dynamic provisioning on bank lending. This system, which was introduced in 2000, required banks to build a buffer in "good" times, i.e. before losses on loans are recognized, which could then be used to cover losses in "bad" times, i.e., once losses on loans materialize. Using bank- and firm-level data, and exploiting bank heterogeneity, the authors document that dynamic provisioning smoothed the supply of credit in Spain, reducing it during in the run-up to the financial crisis of 2008 but expanding it during the crisis itself. Crucially, the expansion of credit during the crisis was found to have a positive impact on firm performance as measured both by employment and likelihood of survival.

This type of evidence is still scant, however, and there is substantial scope for further empirical work. One specific difficulty is that, to overcome identification challenges, some of the recent empirical work relies on firm- and bank-level data and use a diff-in-diff methodology to identify the effects of macroprudential policies. By its very nature, however, this work cannot say much about the aggregate magnitude of the effects of macroprudential polices. One alternative that is currently gaining traction among macroeconomists is to use this type of empirical estimates to partially calibrate general equilibrium models that can in turn be used to compute the aggregate effects of interest.[8] To the best of our knowledge, this methodology has not yet been applied to the study of macroprudential policy. Because of this, we turn instead to a more traditional set of quantitative exercises, which rely on general-equilibrium models but – to the extent that they are calibrated –do not try to match empirical estimates from microeconomic data.

[8] Recent examples of this approach in the macro-finance literature can be found in Catherine et al. (2018), Herreño (2020) and Martin et al. (2020).

Box 2: evidence on the effects of macroprudential policy[9]

The European Systemic Risk Board (2014) states that the ultimate objective of macroprudential policy is to contribute to the safeguarding of the stability of the financial system as a whole. This includes strengthening the resilience of the financial system and decreasing the build-up of vulnerabilities, thereby ensuring a sustainable contribution of the financial sector to economic growth.

This definition goes in line with other statements from different institutions. For example, according to the FSB-IMF-BIS (2011), the objective of macroprudential policy is to limit systemic or system-wide financial risk, thereby limiting the incidence of disruptions in the provision of key financial services that can have serious consequences for the real economy". The argument is that macroprudential policies should be implemented because they affect intermediate variables related to financial distress, and that financial distress has a direct impact on the volatility of GDP growth and the depth of recessions.

Looking carefully at these definitions, financial stability is emphasized due to the implications that it has for economic growth. Surprisingly, most of the papers in the empirical literature concentrate on the effects of macroprudential policies on financial stability, but only a few of them measure the effects on the ultimate goal, economic growth. Actually, following the meta-analysis of Araujo et al (2020), the papers in the literature that do include GDP growth in their analysis tend to find a negative and statistically significant negative effect of macroprudential policies on economic activity, in particular when referring to a tightening of such policies. This effect is so clear that some papers directly refer to the "Cost of macroprudential policies" (Richter et al 2018).

On the other hand, another strand of the literature concentrates on the fact that recessions associated with financial imbalances, particularly with credit booms, tend to be deeper and the associated recoveries tend to be sluggish(e.g. Jorda et al (2011) and Claessens et al (2011),

[9] Prepared by Gabriel Perez Quiroz.

among many others). These empirical findings have had a clear impact in defining the role of macroprudential policies because they imply that, by reducing financial distress, such policies should lead to milder recessions and should thus have a positive impact on long-term economic growth.

In a recent ECB discussion paper, Ampudia et al (2020) integrate these alternative views on the effects of macroprudential polices on GDP growth by analysing and measuring both the benefits and costs of their implementation. The paper presents the results of a range of cutting-edge models and analytical tools assessing how a variety of macroprudential policy instruments affect the stability of euro-area banks, households and aggregate credit, but also how some novel models are able to balance the short-term costs of prudential policies in terms of constraining aggregate credit growth with their long-term benefits.

In particular, the paper provides quantitative evidence that capital measures decrease bank default risk and smooth credit supply. These results are obtained by changing the capital ratio of the 3-layers-of-default model of Clerc et al (2015) and computing the probability of bank default and the evolution of total credit in response to an adverse financial shock. In addition, the paper uses microdata from the Household Finance and Consumer Survey for Italy and Spain to establish empirically that borrower-based measures strongly reduce mortgage default probabilities. Finally, using an integrated micro-macro model for different EU economies, based on Jorda et al (2020), the paper also shows that a tightening of loan-to-value or debt-to-income limits reduces the risk of default for both households and banks, and increases their resilience against adverse macroeconomic conditions.

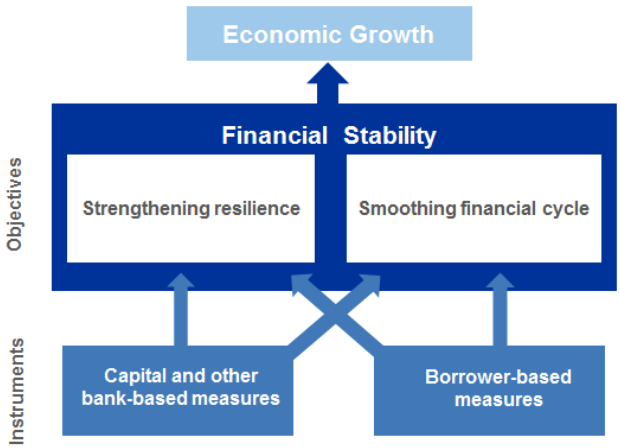
All the previous evidence implies that both, capital-based measures and borrower-based measures have a direct impact on strengthening resilience of banks and borrowers as it is shown in the left part of Chart B.1. Regarding the other dimension of financial stability, the control of financial vulnerabilities that is commonly expressed as smoothing financial cycle, it is usually defined in terms of the evolution of credit variables.

Credit is the most widely analysed variable when measuring financial vulnerabilities. The paper by Arujo et al (2020) or Gadea et al (2021) analyse the effect on credit of different

macroprudential policies using meta-analysis. Meta-analysis amounts to a quantitative survey of a literature reporting different estimates of the same parameter. These particular papers revise 6000 and 2000 estimates of parameters that relate macroprudential policy and its effect on credit. Both papers find that, according to estimates, macroprudential measures can curb aggregate credit growth as intended, with borrower-based instruments being found to be more impactful than bank capital measures.

In addition to the revision of these findings, Ampudia et al (2020) provides its own estimation of the impact of macroprudential policies on credit. This estimation uses a panel BVAR with the narrative sign restrictions of Antolin and Rubio (2018) as used in Budnik and Runstler (2020), showing the importance of the lag structure in the transmission of macroprudential shocks.

Chart B.1 Transmission mechanism of macroprudential policies to economic growth.



All this evidence refers to the right part of ChartB.1. By taking into account both parts of financial stability, Ampudia et al (2020) provide a thorough analysis of the direct effects of macroprudential policies. But the whole picture is not complete without the top of the chart. The final step is to address how financial stability finally affects economic growth.

In this regard, Ampudia et al (2020) follow the approach of Gadea et al (2020). Using a panel data of advanced economies, they separate the recession and expansion periods and relate

the characteristics of these periods (duration, deepness, amplitude) to the evolution of credit to GDP in the years previous to those periods. The authors find a positive non-linear relation between the increase in credit and the deepness of the recession. At the same time, for low levels of credit, they find a positive relation between the increase in credit during expansion periods and the duration of these periods. On the contrary, for high levels of credit, this relation is negative. Therefore, a reasonable increase in credit encourages the duration of expansions and therefore the long-term growth of the economy. But an excess of credit reduces the duration of expansion and increase the probability of causing more severe recessions. There is an optimal level of credit that balances these positive and negative effects of credit on growth.

To sum up, macroprudential policies do have a positive impact on long-term GDP growth by affecting financial stability, making recession less severe and expansions to last longer, but too much control could damage the length of the expansions by not allowing credit to finance productive economic activities.

II.3. A QUANTITATIVE EXPLORATION

To quantify the various effects of macroprudential policy, we rely on two models developed at the ECB. They both share a common feature: namely, the source of systemic risk is the behaviour of financial intermediaries. They differ in the specific channel that gives rise to systemic risk and in the type of macroprudential policy intervention, however. In the first model (Van der Ghote, 2020a) banks take on too much leverage because of the existence of pecuniary externalities in financial intermediation. These externalities imply that banks fail to internalize the collective effect of their individual leverage decisions on asset prices, interest-rate margins and – ultimately – on their aggregate capacity to extend financing to the real economy. We use this first framework to illustrate the social benefits of imposing state-contingent limits on banks' ability to leverage. In the second model (Mendicino et al. (2020a)), individual banks take on too much risk because of safety net guarantees, which imply that the

interest rate paid on deposits is independent of banks' leverage choice. This framework is designed to reproduce relevant features of the data, including the frequency and severity of episodes of abnormally high levels of bank insolvencies. This makes it useful to quantitatively assess the net effect of changes in the level of capital requirements on the euro area economy.

Van der Ghote (2020a) models an economy in which banks play a key role intermediating funds between households and firms. Firms require working capital funding in advance of production to conduct their day-to-day operations smoothly. Both banks and households can provide these funds, but banks are better at monitoring the expenses of firms. In an ideal world without frictions, therefore, banks alone would fully finance all of the economy's profitable firms. However, it is assumed that the world is far from ideal due to two (realistic) frictions. First, just like firms, banks may be tempted to divert funds for their own private benefit. In order to keep this temptation in check, households (i.e., bank creditors) may require banks to keep some "skin in the game" by investing a portion of their net worth in the loans that they make to firms. Second, banks largely fund themselves through non-contingent debt claims, so that they concentrate aggregate risk in their balance sheets even when they leverage to finance diversified loan portfolios.[10]

The two frictions combined imply that the aggregate net worth of banks as a share of total wealth is the economy's single relevant state variable. Also, these frictions shape a stochastic cycle that oscillates continuously between booms and busts.

In the cycle, banks are financially unconstrained only when their wealth share is sufficiently high. In such well-capitalized phases, banks can fully finance all of the economy's profitable firms, production is efficient, and neither economic activity or aggregate output are affected by disturbances to bank net worth or by changes in financial conditions. In contrast, when the

[10] See Holmström and Tirole (1997) and Tirole (2010) for a workhorse model of banking in which banks are good at monitoring firms and bank debt-holders use internal equity as a discipline device to induce banks monitor properly. Van der Ghote (2020a) builds on their model. Martinez-Miera and Repullo (2017, 2019) also build on their model to study issues concerning financial stability and macro-prudential policy intervention. Begenau et al (2005), Begenau and Stafford (2019) and Haddad and Sraer (2020) document empirically that banks tend to concentrate systematic risk in general, and interest-rate risk in particular, in their balance sheets. Di Tella and Kurlat (2021) argue theoretically that banks do so deliberately as part of their optimal dynamic hedging strategies.

wealth share of banks is sufficiently low, they are financially constrained and thus unable to finance all profitable firms, production is consequently inefficient, and aggregate output responds both to financial conditions and to disturbances in bank net worth. A decline in bank net worth at this stage (for instance, due to low returns on their loan portfolio) forces banks to liquidate part of their portfolio at discounted prices to households, which creates a two-way feedback between falls in the price of loan portfolios and losses in bank net worth. The loop amplifies the impact of disturbances in general and hence increases instability in the price of loan portfolios, bank net worth, aggregate financing to firms, and aggregate output.

The central features of this framework are broadly consistent with different stands of the literature. Conceptually, the key role played by bank net worth is common to the canonical works of Holmström and Tirole (1997), Gertler and Kiyotaki (2010), Gertler and Karadi (2011), He and Krishnamurthy (2013) and Brunnermeier and Sannikov (2014). Empirically, it is consistent with the findings of Baron et al. (2020), who construct a comprehensive dataset on bank equity returns for 46 countries over the period of 1870–2016 and show indeed that bank equity declines are strongly associated with substantial credit contractions and output losses even in the absence of narrative evidence of banking panics.[11] Finally, the cycle in Van der Ghote (2020a) is also consistent with the growth-at-risk (GaR) approach for forecasting conditional distributions of output growth rates (see Adrian et al 2018a, Adrian et al 2019a, Adrian et al 2019b and Adrian et al 2020 for details).

To analyse the effects of macroprudential policies, Van der Ghote (2020a) restricts attention to lender-based instruments that take the form of limits on leverage. These limits are the same for all banks and can be set contingent on the aggregate state of the economy (i.e., banks' share of wealth). They are binding only when they are below both the incentive-compatible limit that is imposed by bank creditors and the efficient quantity of leverage at which banks are able to fully finance all profitable firms. When set at their optimal level, these

[11] More generally, the model is consistent with the broad empirical evidence that documents how shocks to bank balance sheets are transmitted to lending and economic outcomes (Khwaja and Mian, 2008; Paravisini, 2008; Chodorow-Reich, 2014; Amiti and Weinstein, 2018; Huber, 2018).

macroprudential limits are shown to improve financial stability and thus raise social welfare over laissez faire.

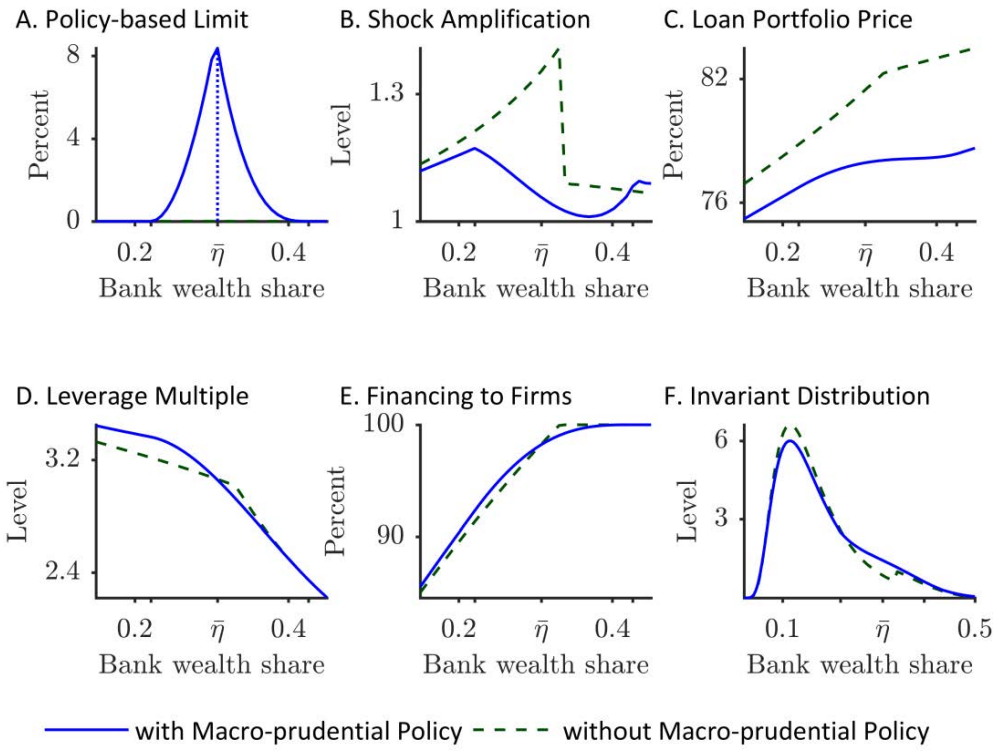
The conceptual reason for which macroprudential limits to leverage are beneficial is that they address a pecuniary externality. In particular, banks do not take into account the effects of their individual choices on the price of loan portfolios, and this has first-order effects on financial intermediation and welfare through three channels. The first channel is the sensitivity of the price of loan portfolios to disturbances to bank net worth. This channel manifests itself in the feedback loop mentioned above, and it creates a notion of excessive shock amplification. It is closest to the standard fire-sale externality that is common in the macro-finance literature (e.g. Gromb and Vayanos (2002) and Lorenzoni (2008)). A second channel operates instead through the level of the price of loan portfolios. In the well-capitalized phases, banks inefficiently bid up this price: by collectively reducing their leverage, banks could depress the price of loan portfolios and boost their rate of return, thereby improving their collective profitability throughout the cycle. This effect has recently been studied by Di Tella (2017, 2019), who also discusses its implications for optimal financial regulation. Lastly, there is a third channel that operates through the franchise value of banks (i.e., Tobin's Q). This channel arises because, given the forward-looking nature of the model, banks' leverage is limited by their franchise value. An improvement in banks' profitability throughout the cycle boosts their franchise value and allows them to increase their leverage precisely when financial conditions are tight and the incentive-compatible limit is binding, i.e., in the poorly-capitalized phases. The optimal macroprudential intervention curbs the pecuniary externality taking into account its effects through all three channels simultaneously.

The main takeaway of the analysis is that the optimal policy only restricts bank leverage when the wealth share of banks is at intermediate values. The reason is intuitive. When their wealth share is sufficiently high, banks as a whole are so wealthy that they can withstand large net worth losses without reducing the asset side of their balance sheets. Put simply, the probability that a crisis—i.e., a period of bank's asset liquidation, asset price dislocations, credit disruptions to the real economy, and excessive volatility—occurs in the near future is

negligible. At the other extreme, when their wealth share is sufficiently low, banks are severely financially constrained and the crisis has already arrived. Asset prices are already dislocated, and further limiting bank leverage with policy interventions only intensifies this dislocation and the disruptions in credit. It is when bank net worth is intermediate that macro-prudential policy can make a difference. In such cases, banks as a whole are sufficiently well-capitalized to have large aggregate effects but not to tolerate adverse disturbances without liquidating assets. Thus, the social benefits from mitigating amplification effects of disturbances in the financial sector outweigh the social costs of curtailing financing to firms on impact. In addition to these social gains, the improvement in the stability of the financial system increases bank profitability and boosts Tobin's Q throughout the cycle. This increased profitability enables banks to sustain higher leverage in general, which – in particular – mitigates the severity of crises and speeds up the economic recovery in their wake. All in all, the optimal policy keeps boom-bust cycles more stable around better-capitalized phases with higher bank wealth shares, thereby smoothing fluctuations in aggregate financing to firms and in aggregate output over the cycle.

Viewed through the lens of the stylized economy of Figure 2, periods of high bank wealth correspond to "normal times", in which economic activity is relatively unaffected by changes in financial conditions. Times of intermediate bank wealth are instead times where banks have enough capital to sustain lending but not enough to withstand an adverse change in financial conditions. It is at these times, which correspond to the build-up phase in our stylized economy, that banks build up risks and sow the seeds of future crises. It is therefore at these times that macroprudential policy must intervene to limit bank leverage. Times of low bank wealth correspond to the crisis phase in our stylized economy, which call for a relaxation of macroprudential policy to allow banks to raise leverage as much as possible.

Figure 4: the effects of macroprudential policy in a model (Van der Ghote 2020a)



Notes: The leverage multiple is the minimum of the incentive-compatible limit, the policy-based limit and the efficient quantity of leverage. Threshold state $\bar{\eta} \in (0,1)$ *is such that above the threshold, the incentive-compatible limit exceeds the efficient quantity, and below the threshold, the opposite happens. Source: Van der Ghote (2020a).*

Figure 4 provides a more thorough illustration of the effects of optimal macroprudential policy in the framework of Van der Ghote (2020a). The figure contrasts the equilibrium outcome under the optimal policy with that under laissez faire. In the six panels, the horizontal axis measures the aggregate net worth of banks as a share of the economy's total wealth, which as we mentioned is the state variable that summarizes the phase of the cycle.

Panel A plots the optimal macro-prudential policy, measured as the additional restriction on bank leverage beyond the one that would arise under laissez-faire. The measure is expressed in percentage terms. The panel shows that the optimal policy restricts leverage occasionally, only when the bank wealth share is at intermediate values. The panel also shows the degree

of the intervention varies over the cycle as well, with the restriction on leverage being more intense around the phases in which the incentive-compatible limit would have otherwise been occasionally binding. Panel B depicts the degree to which disturbances to bank net worth are amplified in equilibrium: loosely speaking, it captures the effect of disturbances to bank net worth on the price of loan portfolios. The panel shows that the optimal policy reduces amplification on impact and significantly relative to laissez faire. Coupled with panel A, it also shows that the degree of the intervention peaks precisely when shock amplification is highest under laissez-faire.

Panel C plots the price of the securitized loan portfolio. The optimal policy extends the region in which banks are financially constrained and households are the marginal investors. The policy thus depresses the price throughout, which boosts the rate of return on loan portfolio investments, the interest-rate margin and bank profitability throughout as well. Panel D plots the leverage multiple of banks while panel E depicts the aggregate quantity of credit that banks provide to firms. The two panels show that under the optimal policy, bank leverage and aggregate financing to firms are higher during crises relative to laissez faire. This comes at the expense of reducing both leverage and financing slightly during phases with intermediate values of bank wealth share.

Lastly, Panel F depicts the invariant distribution over the aggregate state, that is, the share of time the cycle spends at each phase on average over a sufficiently long horizon. The panel shows that the optimal policy reduces the frequency and intensity of crises, while keeping the cycle more stable around phases with higher bank wealth shares and output levels. Overall, macroprudential policy improves social welfare by a substantial amount, generating gains that are equivalent to a 0.67% permanent increase in annual consumption.

The findings outlined here extend beyond the specific model of Van der Ghote (2020a), and they coincide broadly with similar results in the literature. Schmitt-Grohé and Uribe (2016), Phelan (2016), Bianchi and Mendoza (2018), Jeanne and Korinek (2019), and Gertler et al (2020), among others, also characterize the optimal macroprudential policy in related settings. They also conclude that the optimal policy interventions should be tightened when

systemic risk is high and loosened as the leveraged agents become better capitalized and the likelihood of a systemic crisis subdues. By doing so, macroprudential policy enhances financial stability and improves social welfare over laissez faire. These general results hold regardless of whether the main rationale for macroprudential policy is the existence of pecuniary externalities, of the type discussed here, or of aggregate demand externalities, which arise when agents reduce their individual demands in order to deleverage without taking into account how – in the aggregate – this deleveraging leads to a decline in output and welfare. Although there are other sources of systemic risk as we mentioned earlier, these two types of externalities have been the ones most explored in the macroeconomic literature (e.g. Kashyap et al. (2008); Brunnermeier et al. (2009); Hanson et al. (2011); Farhi and Werning (2016); Stein (2019)).[12]

From a quantitative standpoint, however, the precise effect of optimal macroprudential policy on social welfare is still contested in the literature. Here, there are discrepancies among different studies due to their different assumptions regarding the structure of financial markets, the nature of frictions within those markets, the type of pecuniary externalities, the existence (or lack) of aggregate demand externalities, and even due to uncertainty concerning parameter values or functional specifications among similar theoretical frameworks. To the best of our knowledge, model-based estimates of the welfare gains of optimal macroprudential policy range from a modest 0.1% to a substantial 1.4% in terms of the annual consumption equivalent increase over laissez faire (e.g. Bianchi (2011), Carrillo et al. (2020)).[13]

[12] See the keynote speech delivered by Stein at the Fourth Annual ECB Macro-prudential Policy and Research Conference for an up-to-date survey on the subject. In related surveys, Bank of England (2009), De Nicolo et al (2012) and Claessens (2015) also emphasize the importance of externalities related to strategic complementarities (i.e., those that arise from the strategic interactions of banks or more general financial institutions) and interconnectedness (i.e., those caused by the propagation of shocks from systemically important institutions or through financial networks) for the macro-prudential approach. De Bandt and Hartmann (2000), Crockett (2000), Borio et al (2001), Borio (2003) and Kashyap and Stein (2004) are among the first observers who recognize the importance of such an approach for a proper safeguard of the stability of the financial system as a whole. See **Box 1** for details.

[13] In environments with sufficiently low interest rates—such as the ones that many expect in the euro are going forward (i.e., Blanchard 2020, Jorda et al 2020, among others)—recent research suggests that these gains from macroprudential policy may be larger insofar as it helps relax the effective lower bound (ELB) on nominal rates. In Van der Ghote (2020b), for instance, macroprudential policy that curbs the pecuniary externality and contains systemic risk in financial markets also reduces aggregate risk in credit and output. This reduction in risk boosts

One critique of these models is that the state-contingent policy that they characterize might be challenging to implement in practice due, for instance, to the difficulty in identifying the different phases of the cycle. However, the literature has shown that simpler forms of interventions, such as fixed tax on debt (e.g. Bianchi, 2011) can achieve a substantial share of the welfare gains. In Mendicino et al. (2020a), setting the level of capital requirements optimally is effective in reducing the likelihood of banking crises substantially.

Mendicino et al. (2020a) develop a structural general equilibrium model of bank default risk, in which bank solvency problems arise endogenously from high default rates among their borrowers, and embed it into an otherwise standard quantitative macroeconomic framework with costly state verification frictions.[14] The model captures well the behaviour of the euro area economy not only in normal times but also during periods of high bank insolvency, which are characterized by banks' equity declines and severe credit and output losses.[15] Thus, it is well suited for the quantitative assessment of the benefits and costs of higher capital requirements.

As in the previous paper, banks intermediate resources between households and productive firms. Due to specialisation, however, they are exposed to idiosyncratic default risk on the loans that they make, and this risk cannot be fully diversified. The key bank-related friction in the model is that bank depositors do not adequately price individual bank default risk at the margin. This leads banks to take on too much risk by exposing themselves excessively to losses on their loan portfolio. Individual banks do not internalize the effects of their choices on the equity returns of the whole banking sector and, hence, on the sector's future aggregate

risk-free real interest rates in general and the natural rate of return in particular (i.e., the equilibrium interest rate that is consistent with inflation on target and production at full capacity). A higher natural rate, in turn, relaxes the effective lower bound (ELB) on nominal rates, thereby enhancing the ability of monetary policy rate to stimulate the economy and weakening the aggregate demand externality.

[14] A distinguishing feature of the model is to account for the special structure of bank asset risk (seeNagel and Purnanandam, 2020). Hence, loans have limited upside potential because healthy borrowers merely repay the contractually agreed amount including interest. However, they carry significant downside risk due to the possibility of default.

[15] Mendicino et al. (2020a) abstracts from the complications associated with the modelling of panics, as in line with Baron, Verner and Xiong (2021) which shows that panics are an amplification mechanism, they are not necessary for banking crisis to have severe economic consequences.

lending capacity. Higher bank capital requirements limit bank risk-taking incentives and make banks more resilient to credit losses, thereby reducing the probability of bank solvency crises.[16]

Banks in the model fund their lending to firms both with equity (own funds) and with (insured) deposits. Equity financing is subject to frictions, however, which make it costly. Both banks and firms operate under limited liability and can default on their debt obligations. A non-performing portfolio of loans leads to a fall in bank equity and, in its most extreme case, to a bank default.

Crucially, banks are imperfectly diversified across borrowers due to the segmentation of credit markets in islands. Each bank operates in a segment of the credit market and cannot diversify island-specific shocks.[17] Thus, these shocks generate heterogeneity in banks' performance and default outcomes: in particular, a bank operating in a specific segment of the market fails if firms in that segment perform very poorly.

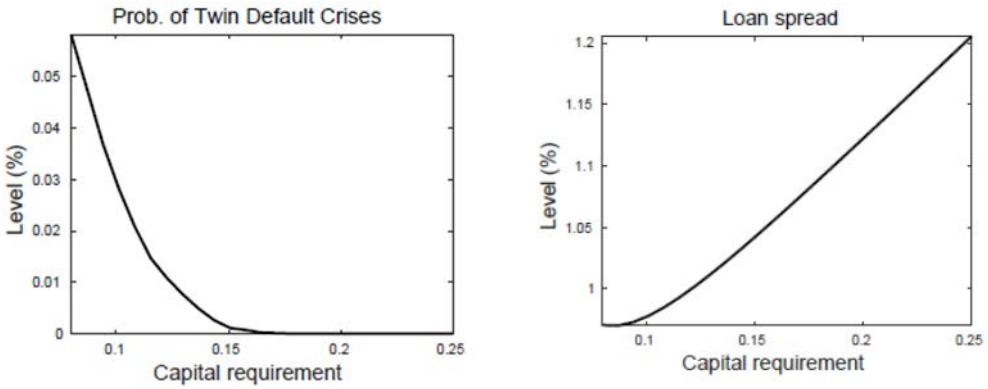
A tightening of capital requirements imposes a trade-off by reducing the probability of banking crises at the expense of restricting the supply of bank credit in normal times. Figure 5 illustrates this trade-off. On the one hand, higher capital requirements make banks less vulnerable to credit losses. When banks are less levered, non-diversifiable risk has a lower impact on bank equity thereby reducing the incidence of bank defaults. As a result, bank insolvency crises become less frequent and deadweight losses associated with the costs of asset repossession declines. This is depicted in the figure's left panel. On the other hand, higher capital requirements are also costly for the economy. Given that the availability of bank equity is limited, an increase in capital requirements raises the cost of bank funding and

[16] Mendicino et al. (2018) show that in this class of models, micro- and macroprudential considerations seem aligned in ensuring that bank default is close to zero. Having resilient banks minimizes the deadweight costs of bank defaults and shuts down bank-related amplification channels, thus stabilizing the reaction of the economy also in response to aggregate shocks. A quantification to the euro area points towards an important contribution of the macroprudential motives and gains of higher capital requirements.

[17] The assumption on the exposure of banks to non-diversifiable risk is consistent with the evidence in Galaasen et al. (2020). In addition, the economy is also subject to aggregate productivity shocks, as well as risk shocks, i.e. shocks to the dispersion of firm- and island-specific shocks.

translates into higher borrowing costs for firms, reduced bank credit, and lower investment. Hence, crisis prevention entails a reduction in credit and economic activity in normal times. This is depicted in the figure's right panel, which shows how the spread on firm credit rises with capital requirements.

Figure 5: the effects of capital requirements in a quantitative model



Notes: This figure shows the implications of different values of the capital requirement starting from the calibrated level of 8%. Source: Mendicino et al. (2020a)

Mendicino et al. (2020a) find that, taking these different effects into account, welfare is maximized by setting a 15 percent capital requirement on banks. Starting from a low initial level, an increase in the capital requirement raises welfare because the gains from reducing the likelihood of bank defaults outweigh the losses from imposing higher funding costs on banks. At the optimal capital requirement, the probability of bank default is less than 0.1 percent and further reductions in bank failures have a limited impact on welfare. Thus, once capital requirements are raised beyond 15 percent, the negative effect of higher borrowing costs for firms dominates and welfare falls. Importantly, suboptimally low capital

requirements are associated with substantially higher likelihood of banking crisis and significantly larger associated economic costs. [18]

Crucially, the frequency and severity of banking crises driven by borrower defaults is a key determinant of the optimal level of capital requirements prescribed by the model, and ignoring it biases the optimal level downward. As a result, the model implies higher optimal capital requirements than commonly used alternative formulations of bank default risk, which fail to reproduce these relevant features of the data. In Mendicino et al. (2020a) bank insolvencies are always accompanied by high levels of defaults among banks' borrowers. Hence, for the same level of bank insolvencies, the model predicts larger costs for the society, as in our model the economy experiences deadweight default losses and equity declines not only for banks but also for firms. This result underscores the importance of modelling bank default risk in a structural way. Failing to generate the right frequency and severity of twin defaults understates the costs associated with bank default and, hence, biases downwards the net benefits of higher capital requirements.

More than a decade after the global financial crisis, the optimal long-run level of bank capital requirements still remains an open question. Although there exist policy proposals that recommend increasing capital requirements to levels above 20% (e.g. Admati and Hellwig, 2013; The 2017 Minneapolis Plan), most quantitative macro-banking models find that such high level of capital requirements would be detrimental for welfare. Basically, they would shrink the size of the banking sector substantially and would thus entail excessive economic costs in terms of reduced bank lending, investment and output. The growing number of papers that assess the determinants of the optimal level of bank capital requirements, emphasizes banks' role in liquidity provision, systemic risk taking, imperfect competition and deadweight losses from bank defaults (e.g. Van Den Heuvel, 2008; Clerc et al. 2015; Corbae and D'Erasmo, 2018; Mendicino et al., 2018; Begenau, 2019). [19] Despite differences in the underlying

[18] In Gertler et al. (2020) optimal macroprudential policy implies a reduction in the probability of runs from 0.9% to 0.4% quarterly, whereas, in Bianchi (2011) it reduces the long run probability of crisis from 5.5 % to 0.4%.
[19] Few of these papers also study the importance of state-contingent instruments. Getting the level of capital requirements right is of foremost importance compared to the additional gains attributable to the optimal use

frictions, a common result in this strand of the literature is that the optimal level of capital requirements is few percentage points higher than the pre-crisis level.[20] Mendicino et al. (2020a) complement previous findings by showing that a substantially higher capital requirement is optimal in a framework that captures default risk in a structural manner, thereby properly accounting for the cost of credit losses associated with bank failures.

This concludes our discussion on the effects of macroprudential policy. But how does it interact with monetary policy? We turn to this question next.

III. MONETARY POLICY AND FINANCIAL STABILITY

Up to now, we have discussed the role of macroprudential policy in the context of our workhorse economy, but we have remained silent on the role of monetary policy. To shed light on this role, we now add a monetary dimension to the economy. In particular, we introduce money as a unit of account and assume that there is a monetary authority or central bank that sets the short-term nominal interest rate. This will be, throughout most of the discussion paper, the monetary policy tool that we focus on. We also assume that, in the usual New-Keynesian tradition, the economy is characterized by the presence of nominal rigidities. This implies that, by setting the short-term nominal interest rate, monetary policy effectively sets the short-term real interest rate as well and it thereby affects aggregate demand and output.

In models of this type, the role of monetary policy is to undo the effects of nominal rigidities. In other words, the optimal monetary policy tries to approximate the behaviour of the economy as much as possible to what it would be if prices were fully flexible. This usually translates into a monetary policy objective of price and/or output stabilization (Woodford, 2003; Svensson, 1999) But how does the presence of systemic risk change this objective? In other words, what should monetary policy do in our workhorse economy?

of countercyclical buffers (e.g. Clerc et al. 2015) or to the time varying sensitivity of capital ratio to default risk (e.g. Mendicino et al. 2018).

[20] The majority of existing papers suggests gains from higher capital requirements; an exception is Elenev et al. (2021).

The answer to this question turns out to depend on the effectiveness of macroprudential policy. Insofar as macroprudential policy works well, monetary policy should to a first approximation stick to its traditional objective (e.g. Korinek and Simsek 2016, Caballero and Simsek 2019). By doing so, monetary policy effectively eliminates the distortions associated to nominal rigidities, while macroprudential policy eliminates the distortions associated to systemic risk as discussed in Section II. This is reminiscent of the traditional Tinbergen principle, which states that a policymaker that wishes to attain a certain number of goals needs to control an equal number of instruments. In this case, the goals are to eliminate the distortions imposed by nominal rigidities and by systemic risk, and the instruments are monetary and macroprudential policy, respectively.

Of course, macroprudential policy in the real world may be far from effective. In this case, it may be optimal to adjust monetary policy to deal not just with nominal rigidities but also with the distortions that emanate from systemic risk and that cannot be appropriately addressed by macroprudential policy. Moreover, monetary policy may itself contribute to systemic risk (Stein (2012)).

III.1. MONETARY POLICY WHEN MACROPRUDENTIAL POLICY IS EFFECTIVE

Suppose that we augment our workhorse economy to introduce money and monetary policy. In particular, we assume that money is a unit of account, so that all firms set their prices in nominal terms. There is a nominal rigidity, however, in the sense that firms are not free to adjust their prices: the simplest way of introducing this friction is by assuming that only a random subset of firms can adjust its prices in any given period (e.g. Calvo (1983)). We also introduce a central bank that is willing and able to exchange nominal bonds for money at any given point in time. By doing so, it can set the short-term nominal interest rate and, due to the presence of nominal rigidities, it can effectively set the short-term real interest rate as well.

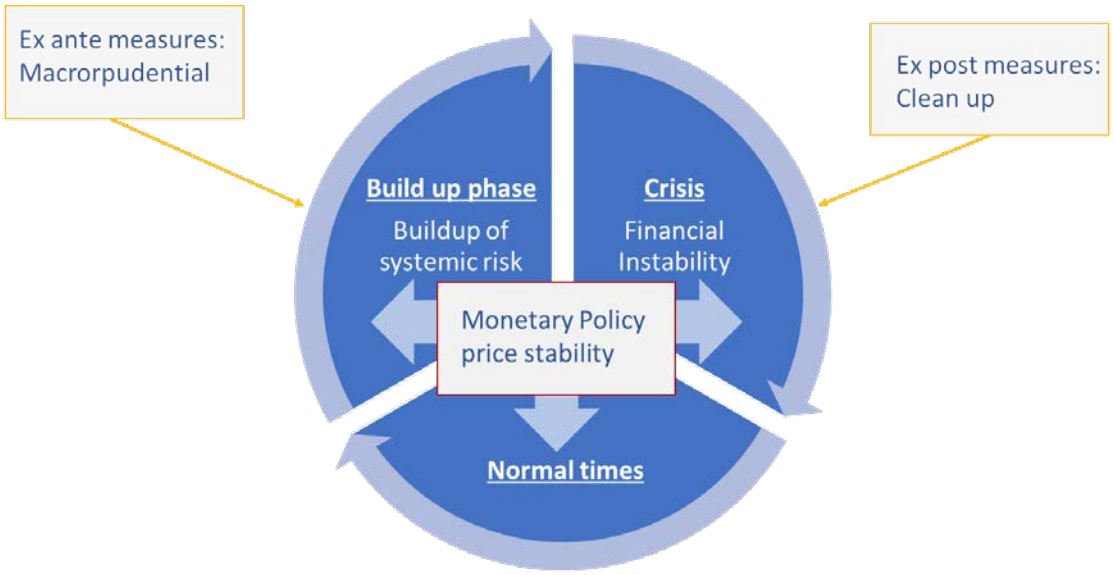
How should monetary policy be conducted in this world? Suppose first that macroprudential policy is set optimally, i.e., it effectively eliminates the distortions associated with financial

instability. In this case, the academic literature suggests that – to a first approximation – there is a sort of "separation principle", by which macroprudential policy should address the distortions associated to systemic risk while monetary policy should deal with the distortions associated to nominal rigidities.[21] In other words, if macroprudential policy is optimal, monetary policy need not be concerned with systemic risk or its implications (e.g. Van der Ghote (2020a), Caballero and Simsek (2019)). In the specific model of Van der Ghote (2020), for instance, this implies that – if macroprudential policy can be optimally designed and implemented (e.g. as in Figure 4) – it is optimal for monetary policy to fully stabilize prices. This result is sometimes summarized by saying that macroprudential policy is the "first line of defence" against the risk of financial instability. Insofar as this line of defence works properly, monetary policy can focus solely on price stability. Figure 6 below illustrates this separation of tasks for the particular model of Van der Ghote (2020a).

There are two important observations regarding this result before proceeding. The first applies specifically to a currency union such as the euro area. In such an environment, optimal macroprudential policy is typically country-specific, as the distortions generated by systemic risk are likely to differ across countries at each point in time. Thus, at any point in time, some countries may find themselves in the build-up phase while others experience a crisis or are undergoing recovery. This means that a one-size-fits-all macroprudential policy may be inappropriate, and there may be large gains from implementing this policy at the country level. **Box 3** provides a detailed discussion in this regard and explores the interaction between monetary policy and country-specific macroprudential policies in a currency union.

[21] Strictly speaking, since there is an interaction between monetary and macroprudential policies, there are in principle gains of coordinating both policies. Quantitatively, though, the gains from such coordination appear to be small (e.g. Angelini et al. (2014), Collard et. al (2017)). For further discussions on the interaction between monetary policy and macroprudential regulations see also, among others, Lambertini, Mendicino, Punzi (2013), Gelain, Lansing, Mendicino (2013), Leduc and Natal (2016); De Paoli and Paustian (2017), Kiley and Sim (2017), Gelain and Ilbas (2017), Carrillo et al. (2017) and Gersbach el al.(2018).

Figure 6: Monetary and macroprudential policy in the model of Van der Ghote (2020a)



The second observation is a qualification of the general result by which – insofar as macroprudential policy works well – monetary policy can focus exclusively on the distortions generated by nominal rigidities. This result does not imply that monetary policy should not respond at all to macroprudential policy or – more broadly – to financial conditions. The introduction or modification of macroprudential policy, for instance, is bound to generate transitional effects that may be optimal for monetary policy to address. One clear instance of this is the introduction or permanent tightening of capital requirements.

Most recent research on capital requirements agrees that, in the long run, the imposition of higher capital requirements improves bank resilience and is beneficial for the economy (e.g. Van Den Heuvel (2008), Begenau (2019), Martinez-Miera and Suarez (2014), Clerc et al. (2015), Mendicino et al. (2018), Elenev et al. (2020)). In the short run, however, an increase in capital requirements is likely to have a contractionary impact on credit supply and aggregate economic activity. This raises a crucial question: what are the costs of this transition, and how do they depend on monetary policy?

Mendicino et al. (2020b) argue that, in fact, the size of the short-term costs of increasing capital requirements depends crucially on the degree of monetary policy accommodation. Thus, monetary policy it is a key factor in determining the overall balance between the transitional costs and the long-run benefits of raising capital requirements. In particular, the optimal increase in capital requirement is larger when accommodative monetary policy cushions the cost of the transition.

Table 1. Transitional costs of higher capital requirements under alternative monetary policy scenarios

Taylor-Rule	Strict Inflation Targeting	Ramsey Optimal	ELB
24.85%	22.48%	16.82%	39.09%

Note: The numbers report the percentage of the long-run gains eaten up of the transitional costs. This is computed by comparing welfare over the whole transition path with welfare at the new steady state with (1.38pp) higher capital requirements. The implementation horizon is assumed to be 8 quarters. The Effective Lower Bound (ELB) is assumed to be 5 bps below the baseline policy interest rate. Source: Mendicino et al. (2020b)

To illustrate this point, Table 1 reproduces the transitional costs of imposing higher capital requirements in a quantitative model calibrated to reproduce salient features of the euro area economy. Starting from the calibrated level of 8%, the welfare maximizing level of higher bank capital requirement is computed by also taking into account the effects of the transition to this higher level. The table illustrates how the transitional costs depend on the stance of monetary policy. Under a standard Taylor rule, the transitional costs offset 25% of the welfare gains from the long-run increase in capital requirements. If monetary policy is constrained in its ability to be accommodative, for example because of an effective lower bound ("ELB"), the transitional costs reduce the long-run welfare gains by up to 40%.

Strict inflation targeting completely offsets the distortions associated to nominal rigidities and mitigates some of the aggregate demand effects under the baseline Taylor rule. However, this is not enough to avoid the transitional costs of capital requirements, which contract credit and

thus investment and output. These costs are transitory because they last only until bankers accumulate enough net worth so as to reach the level of bank equity financing associated with the new steady state. Although strict inflation targeting reduces the transitional costs in terms of welfare relative to the Taylor rule regime, it does so only modestly. For the increase in capital requirements that maximizes long-run welfare, the short-run costs amount to approximately 22% of the long-run gains.

When monetary policy is instead conducted optimally in response to the increase in bank capital requirements, it reduces the real interest rate beyond what prescribed by the Taylor rule and further than what is needed to stabilize inflation. Output declines much less over the transition path albeit at the cost of an increase in inflation. This reduces the transitional costs to 17% of the long-term welfare gains without completely eliminating the trade-off between the short and long-run effects of capital requirements. Intuitively, monetary policy cannot directly offset the short-term tightening in the supply of credit but can soften the economy's adjustment to it.

These results suggest that, even in the case in which macroprudential policy is designed optimally, monetary and macroprudential policy cannot be considered in isolation. In particular, in an economy that experiences the implementation or activation of macroprudential measures, it is beneficial to allow monetary policy to deviate from a strict inflation targeting objective. In fact, under a flexible and symmetric inflation targeting the monetary authority is able to temporary keep inflation above the target. This turns out to be beneficial for the economy.

The findings of Mendicino et al. (2020b) contribute to the debate on the interaction between monetary policy and macroprudential regulations when the constraint of an ELB on monetary policy is explicitly taken into account (e.g. Ferrero et al., 2018; Chen et al., 2020).[22]

[22]Ferrero et al. (2018) shows that, during boom-bust episodes in housing markets macroprudential policy can help avoid zero lower bound episodes by alleviating debt leveraging. More recently, Chen et al. (2020) quantify the short and long run effects of borrower-based measures aimed at curbing household debt. Consistently with the findings of Mendicino et al. (2020b) they argue that while the long-run benefits are similar across different

Box 3: Macroprudential and monetary policy interactions in a monetary union[23]

In a monetary union where monetary policy is focused on area-wide developments, macroprudential policies gain more importance in order to counteract possible adverse effects on financial stability of the "one-size-fits-all" monetary policy. As the single monetary policy mandate is to deliver price stability over the medium term for the euro area as a whole, it would typically look through financial stability risks building up in specific market segments, jurisdictions or individual countries. Such risks could, however, have implications for financial stability at the area-wide level. Hence, in a monetary union setting such as the euro area, nationally-oriented macroprudential policies have a role to play in ensuring financial stability for all jurisdictions and supporting monetary policy conduct through the cycle. In fact, the argument for proactive macroprudential policies may even be stronger in a monetary union than elsewhere due to their targeted nature and the fact that they can be adjusted to reflect the heterogeneous economic and financial developments across countries within the monetary union.[24]

Macroprudential policy in the euro area is primarily conducted by designated national macroprudential authorities with a central coordinating and horizontal role for the ECB.[25] The predominantly decentralised organisation of macroprudential policymaking in the euro area inter alia reflects the still incomplete integration of national banking sectors and heterogeneous financial cycles across euro area countries. It also reflects that

types of borrower-based measures, the short-run costs of can differ substantially, especially at the zero lower bound.

[23] Prepared by Matthieu Darracq Pariès, Christoffer Kok and Elena Rancoita.

[24] See e.g. Constâncio, V., "Financial stability risks, monetary policy and the need for macroprudential policy", speech at the Warwick Economics Summit, February 2015.

[25] This is especially the case since the establishment of the Single Supervisory Mechanism which granted the ECB some macroprudential powers. According to the SSM Regulation, the power to initiate and implement macro-prudential measures will primarily remain with the national authorities, subject to a notification and coordination mechanism vis-à-vis the ECB; see Article 5 of Council Regulation (EU) No 1024/2013. See Constâncio et al. (2019) for a description of macroprudential policy conduct at the ECB and Cassola et al. (2019) for details on the institutional organisation within the ECB.

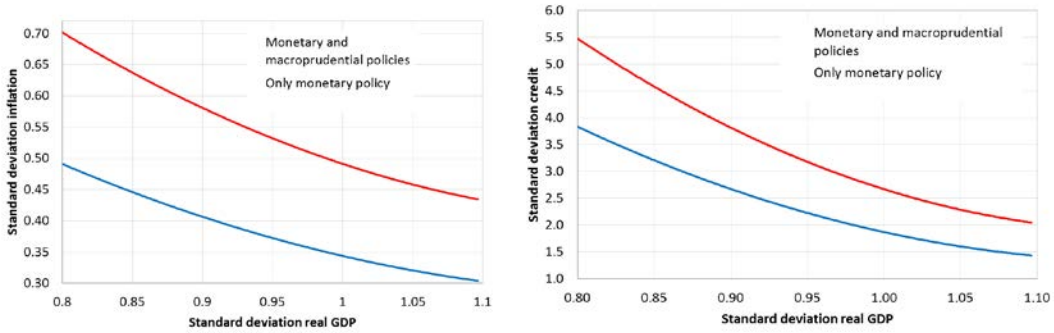
macroprudential policies are well suited to take into account national factors, such as the build-up of financial imbalances and the financial system's degree of resilience.

For the purpose of illustrating the benefits of national macroprudential policies in a monetary union, a dynamic stochastic general equilibrium (DSGE) model with various macro-financial linkages and consisting of two countries subject to a single monetary policy is employed.[26] The model is a two-country DSGE model, where the home country represents one country of the euro area and the foreign country represents the aggregation of the other euro area member states. In the model, the two countries are interconnected via trade and banking sector linkages. On the trade side, residential goods are treated as durable goods and are non-tradable, while non-residential goods can be traded across countries. For what concerns cross-border credit linkages it is assumed that households and firms can borrow abroad (as well as at home).

Macroprudential policies that complement monetary policy by targeting national financial imbalances can deliver welfare benefits in terms of smaller business cycle fluctuations. Combining a euro area-wide monetary policy and national macroprudential policies can achieve greater stability in GDP, credit and inflation than could be achieved if the single monetary policy were the only policy tool available for macro-financial stabilisation. To illustrate this trade-off, Chart B.2 compares standard deviations of GDP, inflation and credit growth across euro area countries when both policies are applied and when the single monetary policy operates alone. Deviations are lower in the combined approach (blue line), which benefits households and firms, as a more stable macro-financial environment allows them to better plan their investment and savings decisions.

[26] See Darracq Pariès, M., Kok, C. and Rancoita, E. (2019).

Chart B.2. Efficiency policy frontiers between three policy target variables (inflation, credit, real GDP) Supporting monetary policy with macroprudential policy enhances macroeconomic stabilisation



Note: left panel: standard deviation of real GDP and inflation; right panel: standard deviation of real GDP and credit. Source: Darracq Pariès, Kok and Rancoita (2019).

The chart depicts efficiency policy frontiers (EFCs) representing the boundary where it is not possible to attain lower variance in one policy objective variable (i.e. macro stabilisation measured by real GDP) without increasing one of the others (i.e. credit growth or inflation). The simulation represents a monetary union in which countries are faced with asymmetric shocks, which underlines the benefits of macroprudential policies that target national imbalances. Similar but somewhat less pronounced results are found for a monetary union in which countries are subject to symmetric shocks.

III.2. THE LIMITS OF MACROPRUDENTIAL POLICY

Section II established that, at least in quantitative models, the potential welfare gains from macroprudential policy are sizable. Moreover, insofar as macroprudential policy is conducted optimally, we have argued that monetary policy can for the most part focus on addressing the distortions generated by nominal rigidities. There are many reasons for which macroprudential policy may be far from optimal in practice, however.

A first reason is that policy makers may be reluctant to apply macroprudential measures. This reluctance, which gives rise to what is commonly referred to as inaction bias, stems from a central feature of this type of measures: namely, their costs are visible and felt immediately, while their benefits accrue over time and are difficult to quantify. This problem can be compounded by political economy considerations, since macroprudential measures have clear and visible redistributional effects. Loan-to-value or debt-to-income ratios, for instance, may hamper the ability of poor or disadvantaged households to access credit. In a similar vein, a rise in capital requirements may raise the cost of credit for small or young firms. Of course, it is possible that these households or firms ultimately benefit from their restricted access to credit, insofar as these restrictions reduce their exposure to crises as well as the severity of the latter. Ex ante, however, agents are likely to perceive mainly the costs of these restrictions, making them politically unpopular.[27]

Once macroprudential policies are applied suboptimally, for instance for political economy considerations, their benefits can decline quickly. To illustrate this, Table 2 depicts the costs of implementing a suboptimal macroprudential policy within the model of Van der Ghote (2020a). Sub-optimality in the table results from imposing ad-hoc caps on the percentage difference between the policy- and the market-based limit on leverage. These caps can be rationalized as the result of political pressures that restrain macro-prudential policy interventions. The lower the cap, the less intense is the intervention.

Under the optimal policy, the percentage difference between policy- and market-based limits on leverage attains maximum values of around 6% (Figure 4A). Table 1 shows that, relative to the optimal policy, caps of around 4-6% have small effects on the frequency of crises and welfare gains over laissez-faire. These effects become noticeable, however, around caps of around 2-4%. Finally, low caps of around 0-2% deliver values close to those under laissez-faire. These results suggest that the losses of limiting macro-prudential policy are non-linear, i.e., they are small at first but become sizeable once the distance between actual and optimal policy increases.

[27] See Rola-Janicka (2019) for an analysis of the political economy of prudential regulation.

Table 2. Effects of limiting macro-prudential policy

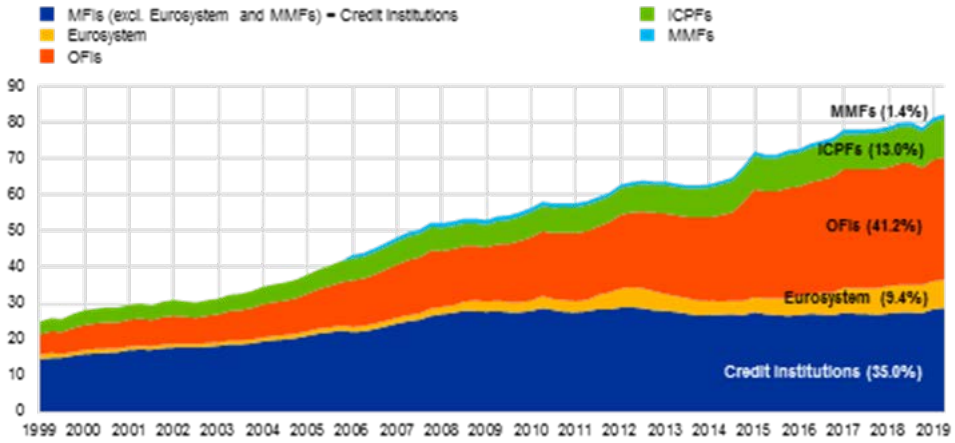
	Cap on Macro-prudential Policy Intervention					
	0.00%	2.00%	4.00%	6.00%	8.00%	10.00%
Frequency of Crisis	6.00%	6.00%	5.00%	3.00%	2.50%	2.00%
Social Welfare Gains	0.00%	0.09%	0.22%	0.48%	0.60%	0.67%

Note: Source Van der Ghote (2020a).

A second reason that may hamper the effectiveness of macroprudential policy is that not all financial intermediaries lie within its reach. In particular, most lender-based macroprudential measures are aimed at banks. But a substantial share of the financial system is in the hands of non-bank intermediaries, and thus lies beyond the scope of such measures.

Figure 7 illustrates this for the euro area, by plotting the evolution of financial-sector assets by the type of institution that manages them: credit institutions (i.e., banks), other financial institutions (i.e., all financial institutions that are not classified as banks, insurance companies, pension funds, public financial institutions, central banks, or financial auxiliaries), insurance corporations and pension funds, and money market funds. The figure shows that the share of assets managed by other financial institutions has increased substantially in recent years, from 45% in 2009 to 59% in the third quarter of 2019: in absolute terms, the value of these assets increased from €24 trillion to €48. The direct implication for macroprudential policy is that approximately 60% of the financial system's assets lies outside of its reach. Moreover, this share is endogenous, and it would probably be even higher if a tightening of macroprudential policy provided even greater incentives for assets to migrate away from banks to other financial institutions.

Figure 7: euro area financial sector assets

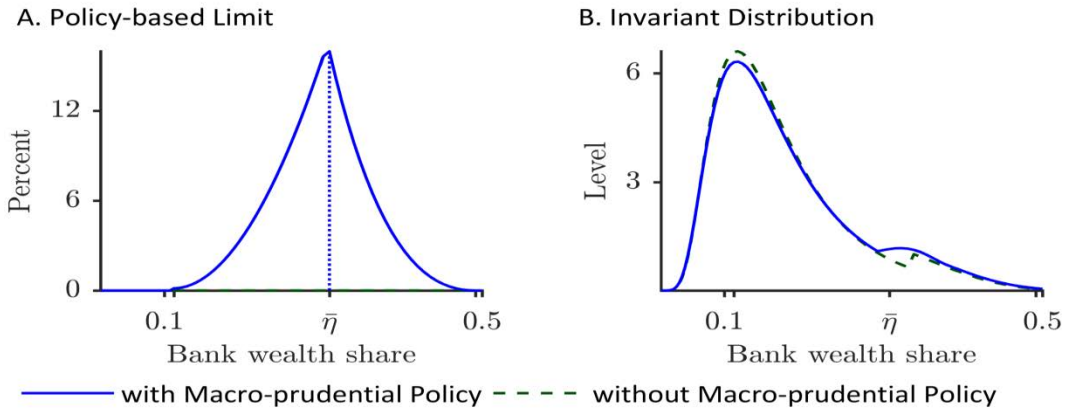


Note: Source ECB.

To illustrate how the presence of non-bank financial intermediaries or "shadow banks" can limit the effects of macroprudential policy, we use a modified version of Van der Ghote (2020a). Relative to the baseline model, the novel assumption is that macroprudential policy affects only a subset of banks, while the rest are assumed to be shadow banks that lie outside the reach of regulation. Figure 8 shows the optimal macroprudential policy (Panel A) and the economy's invariant distribution (Panel B) when the share of shadow banks is calibrated to 40% of all intermediaries. The key takeaway is that the effectiveness of macroprudential policy falls very steeply once shadow banks are introduced in this manner. As Panel B shows, the policy now has barely any effect on the economy's invariant probability density, i.e., on the distribution over states of nature. The reason is that, given their ability to bypass leverage constraints, shadow banks end up intermediating a disproportionate share of the economy's resources. In other words, it is not just that a subset of the economy's banks can bypass macroprudential regulation, but also that their existence encourages regulatory arbitrage that

raises their size relative to "traditional" banks.[28] Because of this, macroprudential policy has very little bite.

Figure 8: Effect of macroprudential policy in the presence of shadow banks



Note: Source Van der Ghote (2020a).

Of course, this migration of activity to the shadow banking system is extreme in our example because traditional and shadow banks are assumed to be perfect substitutes. In reality, there are many reasons for which it may be hard for intermediation to migrate from one to the other. Notably, while traditional banks fund themselves mainly through deposits, shadow banks do so mainly through repurchase agreements (repo) or commercial paper, and while traditional banks typically hold portfolios of loans to individual households or firms up to maturity, shadow banks usually invest in structured products such as asset-backed commercial paper (ABCP), asset-backed securities (ABS), or collateralized debt obligations (CDOs) (Pozsar 2008; Adrian and Shin 2009; Adrian et al 2012). The results from the extended model are nonetheless in line with the literature (Adrian and Ashcraft 2012, review; Plantin 2015; Begenau and Landvoigt 2018; Bengui and Bianchi 2018; Ordonez 2018), which in general assumes imperfect substitutability for the products and/or services that the two types of

[28] While direct empirical evidence in this regard is still scarce, Cizel et al. (2016) find that macroprudential actions are associated with a slowdown of bank credit to non-financial borrowers but an increase of lending by non-bank financial intermediaries.

banks provide. Those papers also find that in the presence of shadow banks, the optimal macro-prudential policy is tighter but its improvement on the stability of the banking sector as a whole (i.e., both traditional and shadow) is smaller.

Finally, there is an additional reason for which macroprudential policy may be suboptimal or limited, one that applies specifically to currency unions such as the euro area. Namely, it is set at the country level. We have mentioned that this is in principle beneficial, since it enables policy to be tailored to the circumstances of each country. But it also entails costs, because agents may be able to circumvent the restrictions imposed by these policies by moving part of their activities abroad. [29] Moreover, national governments may fail to internalize the cross-border spillovers effects of their macroprudential policies. The benefits of such policies adopted in any one country, for instance, may partly accrue to other countries that also gain from the reduced likelihood and/or severity of crises. Moreover, national governments may be reluctant to put their own banks at a disadvantage with respect to their international competitors by tightening macroprudential regulation. In either case, macroprudential policy may be suboptimally lax. Likewise, the costs of such policies adopted in any one country may also partly accrue to other countries that also suffer from the ensuing reduction in economic activity. If these costs are not fully internalized by individual governments, macroprudential policy may be too tight.[30] Regardless of which force dominates, macroprudential policy is likely to be suboptimal when it is implemented at the national level.

All of these reasons are likely to limit the effectiveness of macroprudential policy in practice, thus implying that the inefficiencies associated to systemic risk are unlikely to be fully corrected. What does this imply for the conduct of monetary policy? Should it somehow correct for the limits of macroprudential policy? We turn to this question next.

[29] There is indeed some evidence of cross-country leakages through regulatory arbitrage. For instance, Reinhardt and Sowerbutts (2015) show that leakages are biggest for changes in capital requirements, which induce some shift in borrowing from domestic to foreign banks, while no such effect is found for a tightening in lending standards

[30] Fornaro (2019) shows how, in the context of a currency union in which monetary policy is constrained by the zero lower bound, the set of macroprudential policies adopted by each individual country may end up being excessively costly from the perspective of the union as a whole, leading to depressed levels of aggregate demand and output.

III.3. A MACROPRUDENTIAL ROLE FOR MONETARY POLICY

Let us return to our workhorse economy, and suppose that macroprudential policy is suboptimal: namely, for any of the reasons outlined above, it fails to completely eliminate the inefficiencies associated to systemic risk. What should monetary policy do? Should it stick to its traditional role, i.e., to addressing the distortions associated to nominal rigidities, or should it also be adjusted to partially tackle systemic risk as well? In other words, is there a macroprudential role for monetary policy?

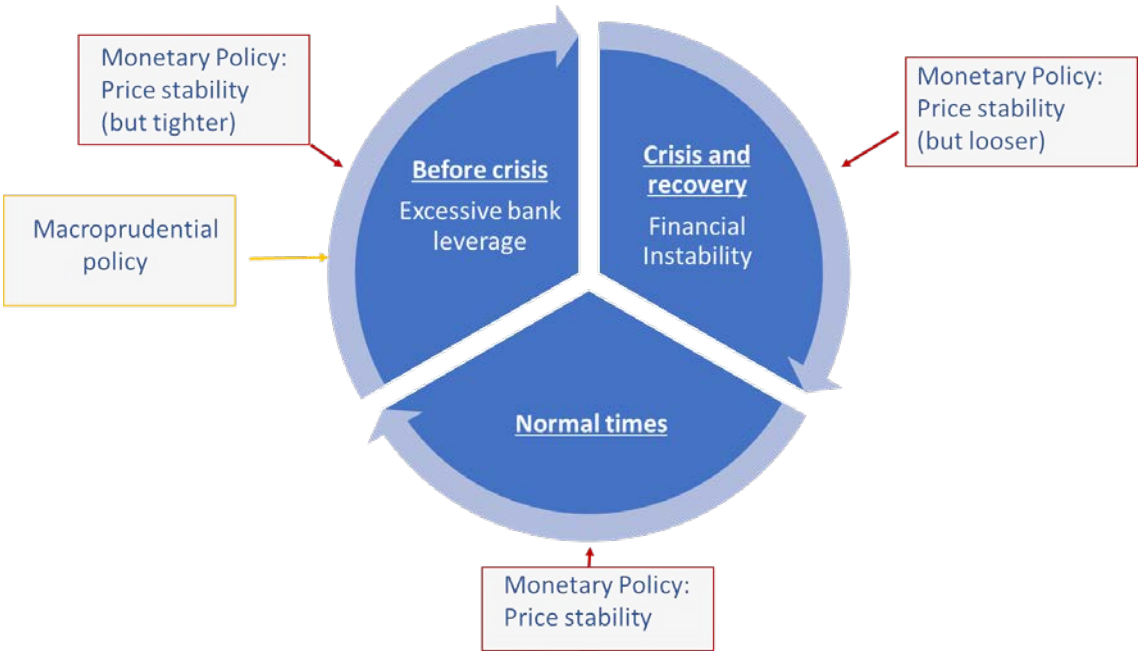
Conceptually, the answer to this question is affirmative (e.g. Farhi and Werning 2016, Caballero and Simsek 2019, Stein 2019). In the absence of a fully effective macroprudential policy, monetary policy should in principle contribute to containing systemic risk, i.e., it should not focus solely on addressing nominal rigidities. To illustrate the essence of the argument behind this statement, consider our workhorse economy and define a "benchmark" monetary policy as one that seeks to eliminate only the distortions associated to nominal rigidities (e.g. Stein (2012)). To a first approximation, this policy is welfare-maximizing if macroprudential policy optimally addresses the distortions associated to systemic risk. But if macroprudential policy fails to do this, then it must be optimal to adjust monetary policy somewhat to deal with systemic risk. The reason is that any such deviation from the benchmark policy will generate first-order gains on the systemic risk front while entailing only second-order losses on the nominal rigidity front.[31]

Of course, this presupposes that monetary policy can affect the economy's level of systemic risk. But this is true in most models, where systemic risk – as we have discussed – is related to borrowing and leverage, and monetary policy controls the short-term interest rate (e.g. Dell'Ariccia, Laeven and Marquez (2014) and Martinez-Miera and Repullo (2017)).[32] In such case, the results that emerges is that monetary policy must deal with systemic risk by tightening relative to the benchmark ex ante, i.e., during the build-up phase, and loosening

[31] A potential added advantage of monetary policy that is outside the scope of these models is that it affects all agents in the financial system, while macroprudential policy tends to be more targeted (e.g., Stein (2014)).
[32] There is ample evidence of a risk-taking channel of monetary policy, whereby lower rates increase systemic risk by boosting financial leverage (e.g., Jimenez et al. (2014) and Dell'Ariccia, Laeven and Suarez (2017)).

relative to the benchmark ex post, i.e., during the crisis phase. By tightening ex ante, monetary policy contributes to reducing credit and, more specifically, leverage during the build-up phase, thereby reducing the likelihood and/or severity of crises (see Figure 9). By loosening ex post, monetary policy contributes to speeding up the recovery in the event of a crisis.

Figure 9: A macroprudential role for monetary policy



We can explore this logic further within the quantitative model of Van der Ghote (2020a), under the extreme assumption that there is no macroprudential policy at all. Figure 10 illustrates the optimal monetary policy in such a scenario. In the figure, the vertical axis depicts expected inflation. The horizontal axis instead depicts bank capitalization or net worth, which is the economy's state variable in this model. Under the optimal macroprudential policy, recall that it is optimal for monetary policy to attain full price stabilization thus setting expected inflation equal to zero in all states. When macroprudential policy is instead absent, Figure 8 shows that it is no longer optimal for monetary policy to stabilize inflation fully. Instead, monetary policy targets a negative inflation rate when bank net worth is relatively high and a positive inflation rate when bank net worth is relatively low. In other words, as we mentioned

above, monetary policy "tightens" when the net worth of banks is relatively high – which we can think of as the ex-ante stage, in which the crisis has not yet occurred – but it "loosens" once the net worth of banks is low enough – which we can think of as the ex post stage, when the crisis has occurred. Through these interventions, monetary policy reduces leverage in the former case and raises it in the latter.

These general results are robust and extend beyond the specific model used here.[33] Namely, monetary policy can and should play a meaningful macro-prudential role when the effectiveness of macro-prudential policy is limited. This stabilizing role of monetary policy has of course been discussed before, in particular in the context of the recurrent debate on "leaning-against-the-wind". The novelty of the new generation of models like the ones reviewed here is that they provide a solid theoretical justification for this role, based on explicit microeconomic frictions.

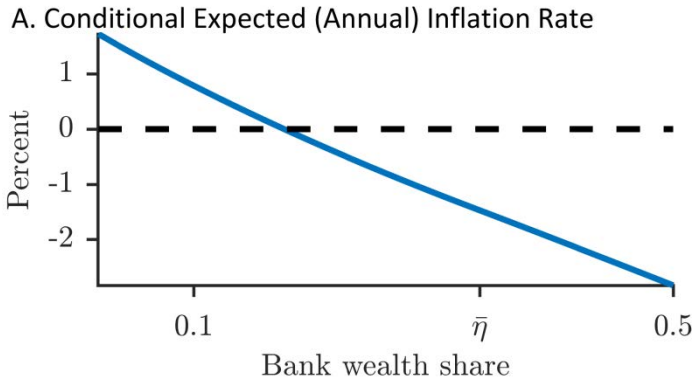
But even if we take these qualitative results at face value, what do they imply for the conduct of monetary policy in practice? How much should monetary policy deviate from price stabilization? And when should it do so?

These are open questions at the moment, and the answers are bound to depend on the specific model, source of systemic risk, and limits to macroprudential policy considered. In the model of Van der Ghote (2020a), for instance, we have just argued that it is optimal for monetary policy to play a macroprudential role. Quantitatively, though, this role turns out not to be very sizeable. On its own, monetary policy can at best achieve about one third of the welfare gains that would be attained by the optimal macroprudential policy. The reason is intuitive: in order to perform its macroprudential role, monetary policy must deviate from inflation stabilization as Figure 10 shows. But these deviations are costly in the presence of nominal rigidities, and these costs are convex in the particular case in which nominal rigidities take the form of Calvo pricing. Thus, the costs of deviating from price stability for

[33] Caballero and Simsek (2020), for instance, formally derive a very similar result in a context with aggregate demand externalities.

macroprudential purposes are non-linear, escalating quickly and thus limiting the desired extent of these deviations.

Figure 10: Optimal monetary policy in the absence of macroprudential regulation



Note: Source Van der Ghote (2020a).

This result is common to other papers in the literature, such as Kannan et al. (2012), Angeloni and Faia (2013), Angelini et al. (2014), and Carillo et al. (2020), all of which find small quantitative gains from using monetary policy for safeguarding both price and financial stability in the absence of macro-prudential policies. For instance, Carillo et al. (2020) find that an augmented Taylor rule that targets both inflation and a pertinent measure of credit spreads improves social welfare over the standard Taylor rule by 1.2% in the annual consumption equivalent measure. This improvement is less than one half of the 2.6% gain obtained from a dual regime rule that includes also a financial policy rule besides the standard Taylor rule. The quantitative gains found in the studies are small in general regardless of the degrees of freedom on the policy instrument (i.e., notably, predetermined rules with a small number of free coefficients versus Ramsey optimal policies).

To conclude, we have established that monetary policy can in principle play a macroprudential role, but there are costs of doing so. The view that, on net, this role of monetary policy is beneficial relies on a type of "envelope-theorem" argument: local deviations from the benchmark monetary policy generate second-order losses in terms of price stability but first-

order gains in terms of financial stability. But there is an alternative view that questions the practical implications of this result. According to this view, monetary policy is an inadequate or "blunt" tool to deal with systemic risk in practice, and any attempt to do so is likely to be detrimental for social welfare. We review some of its arguments next.

III.4. IS MONETARY POLICY AN ADEQUATE MACROPRUDENTIAL TOOL IN PRACTICE?

One important argument against the use of monetary policy in a prudential role like the one outlined above is that it may give rise to moral hazard. In particular, the argument goes, the expectation that monetary policy will be accommodative in the event of a crisis may exacerbate the build-up of systemic risk ex ante. Although this argument sounds compelling, its relevance depends crucially on the specific friction that gives rise to systemic risk in the first place. In the case of pecuniary or aggregate demand externalities, for instance, which are the most prominent in the macroeconomics literature, the expectation of ex post interventions may in fact reduce the build-up of systemic risk ex ante. The reason is that, in both cases, the inefficiencies associated to systemic risk arise precisely because there are externalities that exacerbate the severity of the crisis once it comes: prices and demand are too low in the case of pecuniary and aggregate demand externalities, respectively. By reducing the extent of these externalities, a loose monetary policy ex post can actually reduce the inefficiencies associated to systemic risk, and thus the need for prudential policy ex ante.[34] Moral hazard concerns may be justified if systemic risk originates in other frictions, though. In models of maturity mismatch, for instance, where the threat of roll-over crises serves as a disciplining device, ex post intervention may indeed strengthen the incentives to engage in risk-taking ex ante.[35]

A second major argument against using monetary policy for macroprudential purposes is that the instruments of monetary policy may be too "blunt" for the task at hand. Monetary policy typically controls the short-term interest rate, which may be a poor substitute for

[34] See e.g. Korinek and Simsek (2016), Bornstein and Lorenzoni (2018). The key observation here is that ex post interventions must be systemic and broad-based.
[35] See e.g. Diamond and Rajan (2012) and Farhi and Tirole (2012).

macroprudential regulation. In some models, for instance, an increase in the policy rate designed to "lean" against the build-up of financial imbalances may actually backfire and induce agents to increase their leverage, or may exacerbate asset price booms.[36] More crucially, optimal macroprudential regulation is typically targeted to specific types of assets or economic agents, whereas changes in the interest rate affect the entire economy. There are two main examples of this.

First, some forms of systemic risk are not directly related to credit or leverage. Some common examples of this are agents' excessive reliance on short-term debt, or their exposure to currency risk. In such cases, optimal macroprudential policy does not take the form of capital ratios or leverage restrictions but rather of outright regulation of agents' exposure to different types of assets or risks: the examples outlined above, for instance, may call for limits on short-term debt or currency mismatches. The short-term interest rate may be a poor substitute for such regulation.

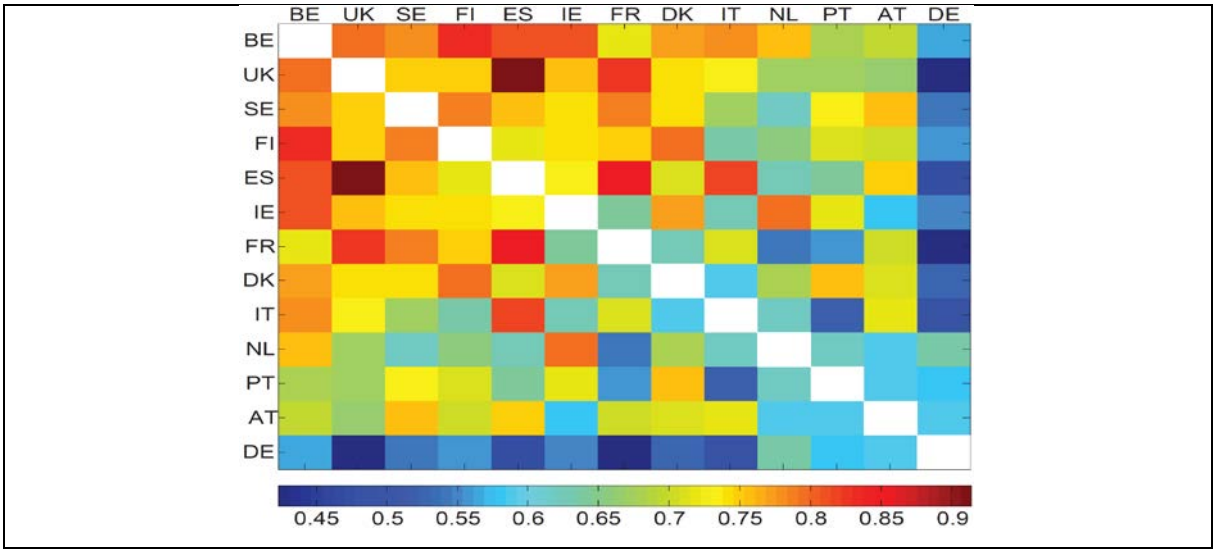
Second, even if systemic risk is related to credit or leverage, macroprudential regulation is typically targeted to a specific type of agents. In the quantitative models that we have discussed thus far, the distortions originate in the decisions of financial intermediaries, and the optimal macroprudential response is thus to regulate them through capital requirements. In alternative models, however, the distortions originate in the borrowing decisions of households, and the optimal macroprudential response is to regulate them through borrower-based measures like loan-to-value ratios (Korinek and Simsek (2016)). Yet a third alternative is that systemic risk originates in a specific sector of the economy, such as the housing sector, in which case it is optimal to specifically target macroprudential interventions to this sector.

One important variant of this argument for a currency union like the euro area is that countries' exposures to systemic risk are likely to be heterogeneous over time. There is strong empirical evidence that this is indeed the case in the euro area. Figure 11 illustrates this by depicting euro area "concordance" in financial conditions, defined as the average share of

[36] See, for instance, Caballero and Simsek (2016) for an example of the former, and Gali (2016) for a discussion of the latter in the context of rational bubbles.

time by which country-specific financial conditions are in the same phase (e.g. expansion) than that of other euro area countries. As the figure shows, this is quite low, ranging from 0.53 for Germany to 0.75 for Belgium. The key takeaway of the figure is that, at any point in time, the optimal stance of macroprudential policy is likely to be very different across euro area countries.

Figure 11: concordance of financial conditions



Source: Schueler et al. (2015). Concordance is obtained on the maximum common sample, i.e., 1988Q1-2013Q4, using a turning point algorithm on the aggregated filtered financial cycles.

The key message of all these examples is the same: namely, optimal macroprudential policy should be a targeted intervention that seeks to correct the behaviour of a specific subset of economic agents, sectors, or – in the case of a currency union – countries. Monetary policy, through its control on the short-term interest rate, is blunt by definition, i.e., it affects all economic agents and sectors in all countries within a currency area.

These arguments do not necessarily invalidate the "envelope-theorem" reasoning outlined in the previous section, i.e., it may still locally optimal for monetary policy to play a macroprudential role. But it does call in to question the practical relevance of this reasoning, in the sense that any practical attempt to significantly alter monetary policy for

macroprudential purposes is likely to be ineffective and potentially counterproductive. To put it bluntly, monetary policy will get very little "bang for its buck" if it tries to play a macroprudential role.

A first strand of support for this view comes from empirical evidence, by directly measuring the relative effectiveness of monetary policy in dealing with credit, leverage, and/or asset prices. VAR evidence, for instance, suggests that macroprudential policy is significantly more effective than monetary policy at dealing with the symptoms of systemic risk. In particular, relative to monetary policy, macroprudential policy appears to be effective at curbing credit and asset price growth while imposing limited costs in terms of foregone output (e.g. Richter et al. (2019)).

Albeit suggestive, this type of evidence is subject to important caveats.[37] Thus, a second strand of support for the view that monetary policy is too blunt as a macroprudential tool builds on quantitative models. Svensson (2018), for instance, uses a stylized framework to quantify the costs and benefits of "leaning against the wind". His framework acknowledges that raising the policy rate ex ante, i.e., before a crisis materializes, has benefits in terms of both the likelihood of crises and their severity in terms of rising unemployment. But such an increase in the policy rate is also costly, both ex ante – because it reduces economic activity and raises unemployment before a crisis materializes – and ex post – because once a crisis materializes, it finds the economy in worse shape to begin with. All things considered, Svensson (2018) concludes that the use of monetary policy to "lean against the wind" is detrimental for welfare under reasonable parameter values.

Of course, like all calculations of this type, Svensson's results depend heavily on a number of assumptions. In particular, his framework been criticized for underplaying the costs of crises by failing to properly account for systemic risk and the financial cycle. Specifically, it is widely recognized that the recovery from financial crises tends to be slow and their effects can be especially long-lasting (e.g. Adrian and Liang (2016), BIS (2016), Filardo and Rungcharoenkitkul

[37] As always, this type of exercise is subject to concerns regarding the endogeneity and anticipation of the policy measures under study.

(2016), Gourio et al. (2017)). At the time of writing this discussion paper, this is an ongoing debate that has not yet been settled. Recent applications of Svensson's methodology to the euro area, augmenting it to take into account the financial cycle, appear to confirm his main findings (e.g. Kockerels and Kok (2019)). **Box 4** provides a more detailed discussion of these findings. But the final verdict is still out there.

Box 4: Can macroprudential policy alleviate the burden on monetary policy to "lean against the wind"?[38]

This box focuses on the long-running debate on whether, and if so to what extent, monetary policy should "lean against the wind" by addressing financial imbalances in addition to its inflation objectives. In other words, whether central banks should lean against the financial cycle by tightening monetary policy more than a pure inflation targeting rule would prescribe in order to curtail asset prices and credit growth in economic upswings, and vice versa in downturns.

The debate on whether to use monetary policy to address risks to financial stability, or to "lean against the wind", has been going on in policy and academic circles for at least two decades in two distinct stages. During the first stage, which lasted approximately until the Global Financial Crisis (GFC), the prevailing view was that monetary policy should respond to fluctuations in asset prices only to the extent that they affect forecasts of inflation or the output gap (see e.g. Bernanke and Gertler (1999, 2001) and Kohn (2006, 2008)). In the second stage, after the GFC, the focus turned towards credit-fuelled price bubbles and how to tackle such imbalances in the most effective manner. The severe consequences of credit-fuelled asset price bubbles called for the development of new policy instruments tailored to containing systemic risk, i.e. macroprudential policy.

[38] Prepared by Christoffer Kok.

To assess the cost and benefits of "leaning against the wind" (LAW) in the euro area the analysis presented here is based on the theoretical framework brought forward by Svensson (2017). The cost-benefit framework includes an inflation-targeting central bank. The cost of LAW is measured by the increase in unemployment following a monetary policy tightening, and benefits are related to a lower probability and severity of financial crises.

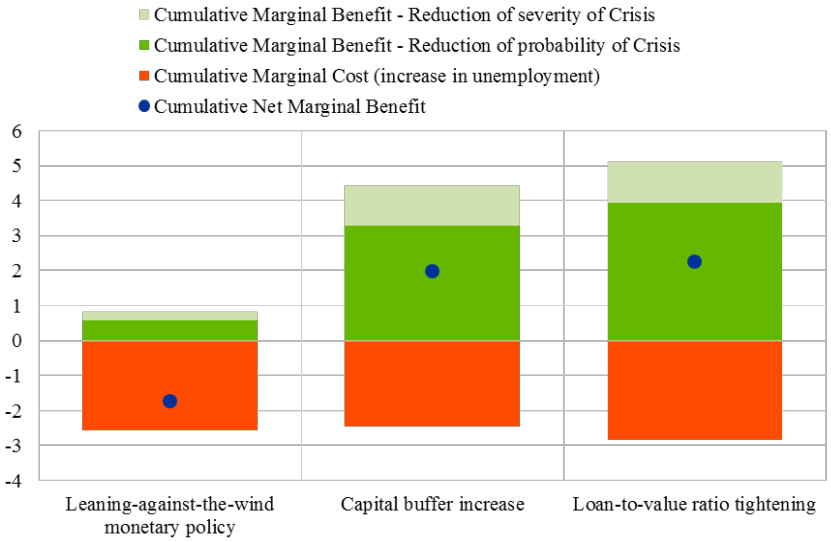
Svensson (2017) argues that LAW not only has a cost in terms of a weaker economy if no crisis occurs but also substantial costs in terms of higher unemployment going into the crisis due to the policy. The empirical analysis of Svensson concludes that the marginal costs of LAW far exceed the benefits. In other words, the cost of higher unemployment as a result of the monetary policy tightening far outweighs the benefits of the reduced probability and severity of financial crises. Svensson's conclusions have been criticised by the Bank for International Settlements (BIS) and others for not properly accounting for systemic risks and the persistence of the financial cycle, which risks ignoring the long-lasting effects on the real economy that financial crises may have (see e.g. Adrian and Liang (2016), BIS (2016), Filardo and Rungcharoenkitkul (2016), Gourio et al. (2017)). Accounting for these elements, it is argued, would create a case for a more active use of monetary policy to lean against the financial cycle. To shed further light on this question we have recalibrated Svensson's model for the euro area.

To shed further light on this question, Svensson's model was calibrated for the euro area, and extended to account for the influence of the financial cycle.[39] The empirical results are based on a monetary policy shock in an estimated DSGE model for the euro area.[40] The financial cycle is accounted for by making the probability of a crisis start dependent on a financial cycle indicator.[41] Chart B.3 summarises the main findings. The chart shows that the recalibration comes to the same conclusion for the euro area as Svensson does for Sweden; namely, that

[39] For more details see Kockerels and Kok (2019).
[40] For this purpose, the estimated DSGE model of Darracq Pariès et al. (2011) is employed.
[41] For this purpose, the model incorporates the systemic risk indicator recently developed by the ECB; see Lang et al. (2019).

LAW is associated with substantial net marginal costs (though slightly lower than the original Svensson result; see left-hand-side bar).

Chart B.3. Net marginal costs of "leaning against the wind" monetary policy vs macroprudential policy



Note: Cumulative impact after 40 quarters; in percentage points of the loss function). The monetary policy measure is a 1 pp. increase of the policy rate over 4 quarters. The macroprudential measure considered here is a 1 pp. increase of the capital buffer requirement and an LTV tightening of 1 pp. A 1 pp change in the policy rate, the capital buffer and the LTV cap, respectively, is not necessarily comparable; however, in this simulation the impact on unemployment is broadly similar across the three policy measures. Source: Kockerels and Kok (2019).

Macroprudential policy can tilt the cost-benefit balance and hence alleviate the burden of monetary policy to lean against the wind. Next, the framework is extended to also include macroprudential policy measures. Specifically, a permanent 1 pp increase in bank capital requirements and a permanent 1 pp tightening in LTV requirements are considered. It is observed (second and third bar from left in Chart B.3) that these measures are more effective in reducing the probability and severity of financial crises (marginal benefits) and that the negative impact on unemployment is lower (marginal costs), than a monetary policy that tries to address financial stability risks. Overall, the marginal benefits of macroprudential policy

outweigh the marginal costs. These findings would suggest a meaningful role for macroprudential policies in complementing monetary policy and helping alleviate the burden on monetary policy to lean against financial stability risks.

While illustrative of the potential benefit of complementing monetary policy with targeted macroprudential measures, the findings are obviously driven by the specific features of the Svensson framework. Furthermore, it has to be kept in mind that macroprudential policy and monetary policy are to a large extent interdependent. These interdependencies imply the potential for a trade-off between the two policy functions as the transmission of macroprudential instruments is likely to affect the monetary policy transmission mechanism. These considerations do not contradict the findings but, they underline the need to ensure an appropriate institutional framework with effective coordination mechanisms across the different policy functions, with clear delineations of responsibility. Ultimately, whether financial stability considerations should be directly incorporated in the monetary policy decisions depends on the effectiveness of macroprudential policies (see Smets (2014)).

IV. WHERE DO WE STAND?

We have provided a general overview of the current state of the debate on the interaction between monetary and macroprudential policies. Three main conclusions emerge from this overview:

(i) If macroprudential policy can be used to deal with systemic risk effectively, monetary policy can concentrate on eliminating the distortions associated to nominal rigidities.

(ii) If macroprudential policy is limited and cannot fully address the distortions associated to systemic risk, there is a conceptual case for monetary policy to play a macroprudential role. In most models, this takes the form of tightening ex ante (i.e., when financial imbalances are building up) to reduce credit and leverage, and loosening ex post (i.e., once a financial crisis materializes) to speed up the economic recovery.

(iii) The practical implications of this last result, however, are not entirely clear. There is a perception that monetary policy may be a blunt macroprudential instrument, in the sense that any practical attempt to significantly alter monetary policy along these lines is likely to be ineffective and potentially counterproductive.

In addition, in the specific case of a monetary union, there is a strong argument for macroprudential policy to be country-specific, as the distortions generated by systemic risk are likely to differ across countries at each point in time.

All in all, the view that emerges is that there are trade-offs associated with the use of monetary policy to contain systemic risk. The literature still lacks a clear sense, however, of exactly how favourable (or unfavourable) these trade-offs are. An unequivocal recommendation could be made in extreme situations. For instance, if inflation is slightly below target but financial imbalances appear to be large and/or accumulating (e.g. high and growing leverage of financial intermediaries), it makes sense for the monetary authority to keep an eye out on financial stability instead of focusing solely on inflation. The subtler dilemma for policy makers arises in interior situations, when inflation is perhaps far from its intended level and financial imbalances are also large. Should they give up partly on inflation in order to reduce systemic

risk? If so, what is the "sacrifice ratio" involved, i.e., how much should the monetary authority give up of the former in order to improve significantly on the latter? We do not have concrete answers to these questions.

Ultimately, part of the problem is that we still lack a complete understanding of macroprudential policy. To appreciate this, it is useful to contrast the state of macroprudential policy with the widespread consensus that has emerged around monetary policy over the last few decades. Although some aspects of this consensus are currently being called into question, most economists would agree on a general narrative pertaining the objectives, policy instruments, trade-offs and dynamic inconsistency problems of monetary policy. Namely, the main goal of monetary policy is to attain price stability, which is relatively easy to measure, by managing the short-term interest rate. In attaining this goal, the monetary authority faces a trade-off between price stability and output – as captured by the Philipps curve – and it is important for it to be independent in order to avoid politically-induced inflationary biases.

There is no comparable consensus narrative for macroprudential policy. Its objective is to reduce systemic risk or financial instability, but how exactly should this be measured? Should policy focus on the likelihood of crises, their severity, or both? Or should it instead try to smooth the financial cycle, measured as a combination of credit, leverage and asset price measures? What are the main policy instruments? Is it the leverage of households, corporations, or financial intermediaries that should be most closely regulated? And what are the trade-offs associated to such regulation, i.e., how much average growth – if any – needs to be sacrificed in order to attain an acceptable level of financial stability? Finally, what are the main political economy problems that it raises? Is the main danger one of inaction? Or is it instead that macroprudential policy may be used as a form of financial repression, to coax the financial system into financing public deficits? Table 3 below summarizes these issues.

If such first-order questions regarding the implementation of macroprudential policy are still open, it is only natural that the practical use of monetary policy for macroprudential purposes should be clouded by uncertainty as well. While – much progress has been made by recent

research and policy experience, reducing this uncertainty remains an exciting agenda going forward.

Table 3: Conventional narrative of monetary policy vs. macroprudential policy

	Monetary Policy	**Macroprudential Policy**
Objective	Price Stability (Inflation)	Financial Stability (Probability/Depth of crises? Financial cycle?)
Trade-offs	Inflation vs. Output (Phillips curve)	Output vs. Financial stability?
Instrument	Short-term interest rate	Capital requirements, Loan-to-value ratio, Debt-to-income ratio, etc..
Political economy considerations	Inflationary bias	Financial repression, Redistribution, etc…

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