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Abstract

Recent research developed under the ECB research task force on Monetary Policy, Macroprudential Policy and Financial Stability highlights the existence of trade-offs and spillovers that monetary policy and macroprudential authorities face when deciding on their policy interventions. Monetary policy measures are key to support the supply of credit to the economy, but they could also have unintended consequences on financial stability risks. Macroprudential policies are instead effective in limiting financial stability risks, but they could also reduce the length of economic expansions by preventing credit from flowing to productive economic activities. In addition, since monetary and macroprudential policies transmit to the broad economy via the financial system, they unavoidably affect each other's effectiveness. Taking these factors into account is key for the design and implementation of both policies.

JEL: E3, E44, G01, G21
Key words: risk taking, financial frictions, systemic risk, policy trade-offs

Non-technical summary

This paper presents the key analytical findings and policy implications that have emerged from ECB staff's research developed under the ECB Research Task Force (RTF) on Monetary Policy, Macroprudential Policy and Financial Stability. The purpose of this RTF was to foster cooperation within the ECB to produce new frameworks of analysis for key research and policy questions on the interaction of monetary policy, macroprudential policy and financial stability.

Over the course of 2017-2021 ECB staff engaged in producing state-of-the-art research based on conceptual and quantitative models and empirical analysis addressing the following questions:

1. Is macroprudential policy effective?
2. How does monetary policy affect incentives and financial stability risk?
3. How do monetary and macroprudential policies interact?
4. Is there scope for a prudential role for monetary policy?

The main findings can be summarised as follows:

- **Macroprudential measures face tradeoffs between systemic risk and economic growth.** By limiting the build-up of systemic risk, macroprudential policy makes recessions less severe and expansions last longer, with positive effects on long-term GDP growth. Macroprudential policy could, however, also reduce the length of the expansions by preventing credit from flowing to productive economic activities. Hence, being able to quantify the costs and benefits of macro-prudential instruments is vital for their correct calibration.
- **Monetary policy measures are also not immune to tradeoffs. While key to support the intermediation capacity of banks, these policy interventions may also lead to unintended consequences linked to bank vulnerabilities.** Accommodative monetary policy generally increases banks' risk-taking incentives. Evidence of this is stronger for unconventional monetary policy interventions, giving rise to concerns about risks to financial stability. In general, liquidity operations increase banks' interconnectedness while negative rates increase rrisk taking behaviour of banks. The design features of unconventional monetary policy instruments matter for mitigating possible unintended consequences associated with excessive risk accumulation.

- **Monetary and macroprudential policies entail significant spillovers.** The degree of accommodation of monetary policy is key to determine the short-term impact of macroprudential policy and, hence, the macroprudential policy space. At the same time, the soundness of the banking system affects the transmission of monetary policy, and the level of the natural real interest rate. The impact of monetary policy easing on bank lending and risk taking is larger when macroprudential policy is accommodative.
- **The existence of spillovers, however, does not per se imply a need for coordination.** In principle, if both policies work perfectly, each can address its own distortions of interest in an uncoordinated fashion (Tinbergen principle).
- **In the presence of limits to macroprudential policy, there may be a conceptual case for a prudential role of monetary policy**. The use of macroprudential tools has been rather limited (too little, too late). By tightening during the build-up phase ("leaning against the wind"), monetary policy contributes to reducing credit and, more specifically, leverage, thereby reducing the likelihood and/or severity of crises. By loosening ("cleaning") during the crisis phase, monetary policy contributes to speed up the recovery in the event of a crisis.
- **Yet, the use of monetary policy for prudential purposes may be challenging in practice.** Monetary policy may be too "blunt" to deal with financial stability and result in substantial net marginal costs. The lack of synchronization of countries' exposures to systemic risk also make any attempt to lean against the financial cycle using monetary policy quite problematic in the euro area.
- **A correct calibration of instruments aimed at straightening the resilience of the financial sector, could reduce the scope for interventions over the cycle.** State-contingent policy interventions might be challenging to implement due to the difficulty in identifying the different phases of the cycle. Macroprudential instruments aimed at straightening the resilience of the financial sector can also reduce the probability that risk becomes excessive and a crisis materializes, hence, limiting the scope for monetary and macroprudential cyclical interventions.

From a practical point of view, the results highlight that both monetary and macroprudential policies face important trade-offs between the supply of credit to the broader economy and financial stability risks. Hence, policy makers need to be aware of these tradeoffs when designing policy interventions that act through the financial system and can, hence, affect

each other effectiveness. In this respect, there are clear advantages of taking into account financial stability considerations for monetary policy decisions.[1] Another insight that emerges from the analysis is the crucial importance of reducing limits to the practical implementation of macroprudential policy and the need for strengthening the use of macroprudential measures aimed at reinforcing the resilience of the financial system at the country level. This would avoid the need for a prudential approach to monetary policy and the potential costs associated with leaning against the wind policies.

From an analytical point of view, substantial progress has been made to develop credible frameworks of analysis that aim at quantifying the costs and benefits of macroprudential and monetary policy interventions need to properly capture the trade-offs between financial stability risk and economic outcomes entailed in the two policies, including potential non-linearities in their interaction and heterogeneity in the effects (across countries and sectors of exposure). Still, measuring the excessiveness of risk-taking poses a clear challenge in this respect. The ability to assess in a timely manner whether risk taking becomes excessive and leads to the build-up of systemic risk requires the development of new state-of-the-art empirical and conceptual frameworks.

An important dimension of the interaction of monetary and macroprudential policies that has been left to future considerations concerns their redistribution channels. An exploration of the transmission of monetary and macroprudential policies across sectors (e.g. banks vs non-banks intermediaries) and individual agents (e.g. borrowers vs savers) would be useful to provide further insights on the costs and benefits of interventions targeted to specific sectors or groups of agents. In addition, focusing on the redistributive channel of transmission of the two policies would also deepen our understanding of their interlinkages and spillovers. Pursuing this path, would, however, require a considerable research effort in developing new frameworks of analysis useful to identify the most relevant dimension of heterogeneity for the transmission of policies, including distilling the aggregate implications of such redistributive effects.

[1] See ECB Monetary Policy Strategy Statement (2021). The research undertaken in the context of the RTF has been very influential in shaping the discussions and ultimately the conclusions of the monetary policy strategy review as regards the role of financial stability considerations for monetary policy. See also ECB Occasional Paper No. 272.

INTRODUCTION

The Global Financial Crisis (GFC) raised the awareness among both academics and policy makers of the critical importance of financial stability risks for economic and financial outcomes. It unequivocally revealed the need for a macroprudential approach to the regulation of the financial sector (e.g. Freixas, Laeven, and Peydro, 2015). Hence, the traditional (micro) focus on the soundness of individual financial institutions was to be coupled with a variety of new macroprudential instruments aimed at addressing systemic risk. At the same time, the GFC also revived the interest in understanding the role of monetary policy for financial stability outcomes (e.g. Kashyap and Siegert, 2019; Stein, 2012; Svensson, 2017) and its interaction with the new macroprudential framework (e.g. Angelini et al, 2014; Farhi and Werning, 2016). More than a decade after the onset of the crisis, financial stability considerations and potential risks to the financial system are an important topic of discussion at major central banks (e.g. Lagarde, 2020; Powel, 2020), as also reflected in the outcome of the recent monetary strategy review of the ECB.[2]

This article provides a review of the interlinkages between monetary policy, macroprudential policy and financial stability based on recent research. In particular, it focuses on key analytical findings and policy implications of state-of-the-art research conducted at the ECB to deepen our understanding of these interdependencies both from a theoretical and an empirical standpoint.[3] The discussion is organised around four main questions.

Is macroprudential policy effective? From a conceptual point of view the objective of macroprudential policy aims is to correct distortions that create a wedge between the social and the private value of risk which exposes the economy to an increase likelihood of a systemic financial event (see **Martin, Mendicino and Van der Ghote, 2021** for a review of the literature). Regardless of the nature of the distortions that economics agent fail to internalise, hence, exposing the economy to systemic risk, theoretical frameworks (e.g. Bianchi, 2011; Bianchi and Mendoza, 2018; Jeanne and Korinek, 2019; **Van der Ghote,**

[2] See ECB Monetary Policy Strategy Statement (2021).

[3] Over the 20127-2021 period, the ECB's Research Coordination Committee set up the Research Task Force (RTF) on Monetary Policy, Macroprudential Policy and Financial Stability with the purpose of fostering cooperation within the ECB to produce new frameworks of analysis for key research and policy questions on the interaction of monetary policy, macroprudential policy and financial stability. The task force has been chaired by Luc Laeven and coordinated by Angela Maddaloni and Caterina Mendicino. Additional information is available on the RTF web page.

2021) highlight a number of channels through which macroprudential policies may limit the buildup of financial stability risks.

A growing number of papers provides empirical evidence on the effectiveness of macroprudential policies in moderating credit and asset price cycles (Bruno et al. 2017; Cerruti et al, 2017) and reducing negative GDP tail risks (**Chavleishvili et al. 2021a**). For instance, **Ampudia et al. 2021** documents that capital and borrowers' measures increase the resilience of banks and borrowers and can curb excessive credit growth. Yet, the empirical assessment of the impact of macropudential policies do not put much emphasis on the potential costs of achieving these objectives and hence, on the *net benefits* of macroprudential interventions. Being able to balance the costs of macro-prudential policies with their benefits is vital for the correct calibration of macroprudential instruments.

Recent ECB research makes some progress along these dimensions. The results suggest that the implementation of macroprudential measures faces tradeoffs between systemic risk and economic growth. Credible frameworks of analysis that aim at quantifying the costs and benefits of macroprudential interventions, hence, need to properly capture these trade-offs. **Gadea, Laeven and Perez-Quiros (2020)** using time series of a panel of developed economies, shows that there is a growth-and-risk trade-off associated with the pace of credit growth. Hence, there exist an optimal level of credit that balances these positive and negative effects of credit on growth. Macroprudential policy by restraining credit growth in order to avoid a deep financial crisis-induced recession can negatively affect the cumulation of economic growth during the expansion. **Chavleishvili et al. (2021a)** develop a macro-financial stress test to monitor down side risk to the economy and a metric of macro-prudential stance which quantifies when interventions may be beneficial.[4] The framework accounts for the interactions and non-linear effects in the relationship between financial vulnerabilities, financial stress and real GDP growth.

Quantitative models are particularly useful to assess the cost and benefits of macroprudential policy and their overall effects on financial risk and social welfare (e.g. Bianchi, 2011, 2020; Clerc et al, 2015; Bianchi and Mendoza, 2018; **Mendicino et al, 2018**; Gertler et al. 2020; **Van der Ghote, 2021**).[5] The recent model developed by **Mendicino et al. (2020a)** quantifies

[4] See **Chavleishvili et al. (2021b)** for a review of the related literature and **Chavleishvili and Manganelli (2019)** for the development of the quantile vector autoregressive model for forecasting and stress testing.
[5] **Cozzi et al. (2020)** review a variety of macro-financial models developed at the ECB, and documents that in the long run, models that ignore bank default imply that output falls permanently due to higher capital requirements.

the optimal increase in capital requirements which trades-off the benefits arising from a lower frequency of bank insolvencies at the expenses of restricting the supply of bank credit in normal times. In the model, bank solvency problems arise endogenously from high default rates among bank borrowers and enable the model to reproduce important non-linearities observed in the data in terms of firm default, bank default and GDP growth. Episodes of simultaneously high borrower and bank defaults (twin defaults) impose very large deadweight losses on the society which exacerbates the welfare losses associated with bank insolvencies. Hence, capturing the frequency and severity of twin defaults is crucial for the assessment of the net benefits of higher bank capital requirements.

How does monetary policy affect incentives and financial stability risk? The GFC also renewed interest in the relationship between bank risk taking and monetary policy e.g., Allen and Rogoff, 2011; Adrian and Shin, 2010; Dell'Ariccia et al., 2017; Diamond and Rajan, 2011; Di Maggio and Kacperczyk, 2017; Jimenez et al., 2014; Maddaloni and Peydro, 2011). With the implementation of new (unconventional) monetary policy instruments a growing number of papers analyse the implications of these policies for risk taking in financial markets (e.g., Chodorow-Reich, 2014; Koijen et al., 2021; Krishnamurthy and Vissing-Jorgensen, 2011; Krishnamurthy et al., 2017) and bank lending (e.g., Chakraborty et al., 2018; Di Maggio et al., 2020; Rodnyansky and Darmouni, 2017; Peydro et al., 2021).

In the euro area, there is some limited evidence of the importance of banks' balance sheet conditions and the risk-taking channel of monetary policy before the GFC (see **Albertazzi et al., 2020** for a review of the evidence). As the crisis materialised banks' financial conditions became crucial for the transmission of monetary policy. Among the new (unconventional) monetary policies introduced by the ECB, the positive and side effects of central bank liquidity provision and the policy of negative interest rates attracted substantial attention in the policy and academic debate.

In line with theoretical arguments (e.g., Bagehot, 1873; Diamond and Dybvig, 1983; Rochet and Vives, 2004; Freixas et al., 2010; Stein, 2012) central bank liquidity provisions have positive effects on lending (e.g. Cahn et al., 2018; van Bekkum et al., 2018, **Jasova, Mendicino and Supera, 2021**) and are associated with lower money market tensions

(**Corradin et al. 2020**).[6] However, these interventions also increased systemic risk at the margin.[7] A vast literature focused on the incentives provided by central bank liquidity provisions to hold government bonds (Acharya and Steffen, 2015; Battistini et al., 2014; Drechsler et al, 2016, Altavilla et al., 2017); **Jasova et al. (2022)** present evidence on the fact that during crisis times central bank liquidity interventions provide incentives for banks to disproportionally pledge with the central bank bonds issued by other banks (more than sovereign) and notably those issued by interconnected banks, in line with theories of interbank monitoring (e.g., Rochet and Tirole, 1996). Within domestic banks, the pledging of bonds issued by systemically important banks is the most pronounced, as well as, the direct cross-pledging of bank bonds, consistent with theories of bailout expectations in the event of a systemic crisis (e.g., Acharya and Yorulmazer, 2007; Farhi and Tirole, 2012). Hence, central bank liquidity operations contribute to higher bank interconnectedness and, at the margin, systemic risk.[8]

Central bank asset purchases are also not immune to unintended consequences as they induce scarcity effects in some money market segments (see Arrata, Nguyen, Rahmouni-Rousseau and Vari, 2019; **Brand, Ferrante and Hubert, 2019**; **Corradin and Maddaloni, 2020**). Evidence in **Corradin et al (2020)** is suggestive of the fact that ECB asset purchases worsened money market conditions in the euro area, while the Securities Lending Programme was not sufficiently active to counterbalance scarcity in some segments of the market. Central bank asset purchases induce scarcity effects by withdrawing government bond collateral from the financial system. Since government bond is the main type of collateral used in secured money markets, ECB asset purchases are associated with an increase in the dispersion of 1-day money market rates in the euro area.

In addition, **Karadi and Nakov (2021)** show that asset-purchase policy is effective in mitigating a credit crunch in response to financial shocks which impair banks' capital

[6] See also Garcia-de-Andoain, Heider, Hoerova and Manganelli (2016) for evidence of the positive effects of the ECB liquidity provision during the financial and sovereign debt crises on the supply of liquidity in the unsecured money markets, especially to banks located in stressed countries.

[7] Targeted longer-term refinancing operations have instead been successful in stimulating lending supply while containing side effects. In particular, the policy reduced the exposure of participating banks to domestic sovereign bonds but the policy stimulus actually only reached the targeted segments, such as lending to firms and to households, excluding housing loans (**Albertazzi, Altavilla, Boucinha and Di Maggio, 2018**).

8 Most of the existing literature analyzes systemic risk emerging from linkages via the interbank market (e.g., Abbassi et al.,2021; Acemoglu et al., 2015; Allen and Gale, 2000; Cabrales et al., 2017; Iyer and Peydro,2011) rather than from the cross-holding of bank-issued securities. In the euro area, the cross-holding of bank-issued securities has become more relevant than inter bank deposits in recent times (e.g. ECB, 2015). See also **Bekaert and Breckenfelder (2019)** for the evolution of the cross-holding of bank bonds over more recent years.

position. However, at the same time, by improving credit condition and competition between banks, asset purchases reduce bank profitability and slow down bank recapitalization. Therefore, optimal exit from balance sheet policies should be gradual.[9]

The implications of negative policy rates sparked a lively academic debate in recent years. Some argue that low or negative rates do not impact the economy differently from positive policy rates (e.g. Rogoff. 2017), while others, instead stress that these policies could be less accommodative or even contractionary (e.g. Brunnermeier and Koby, 2018; Eggertson et al. 2019). Euro area evidence shows that in response to negative interest rate policies high-deposit funding banks - i.e. those most exposed to the negative rates policies - increase risk taking by more and lend relatively less in the syndicated loan market than banks which are less dependent on deposit funding (**Heider, Saidi, Schepens, 2019**). In addition, they also invest more in riskier securities (**Bubeck, Maddaloni, Peydro, 2020**) and suffer a large negative impact of interest rate surprises on their stock prices (**Ampudia, Van den Heuvel, 2018**). However, the overall effect of negative policy rates are mitigated by the fact that banks are able to transfer negative rates on to corporate deposits, hence also providing incentives for corporations to reduce cash holding and increase investment (**Altavilla et al. 2020**). In addition, negative policy rates have acted as an empowerment to ECB's asset purchase program (**Demiralp, Eisenschmidt, Vlassopoulos 2019**).

Recent cross-country evidence by **Bittner et al. (2021)** estimate how banks' balance sheets and funding costs interact in the transmission of monetary policy rates to their credit supply Their results show that in response to the introduction of negative policy rates in 2014 the bank balance sheet channel (Kashyap and Stein, 2000; Jimenez et al., 20212) is at work in banking systems featuring higher deposit rates (such as Portugal), while it is not in banking systems featuring deposit rates already close to the zero (such as Germany). In the latter, bank's liabilities structure matters, as banks with a higher deposits-to-assets ratio lend more.

The forces behind inducing a differential effect of a policy rate cut on banks' lending decisions and risk-taking are explored in **Heider and Leonello (2021)**.[10] Building on a framework a' la Holmstrom and Tirole, (1997) they show that policy rate cuts may have two

[9] Subsidies on banks' equity issuance could speed up banks' recapitalization and therefore allow for a quicker optimal exit from asset-purchase policy.
[10] An important strand of the literature explores the transmission channels of low or negative rates using DSGE models (e.g. Rognlie 2016; Brunnermeier and Koby 2018; Sims and Wu 2019; Ulate 2021).

opposite effects on lending and risk-taking depending on the initial level of interest rates. On the one hand, lower rates reduce the premium asked by outside investors. This makes bank financing cheaper and so relaxes the bank's financing constraint, increases balance sheets capacity, pushing lending up and inducing banks to behave more prudently. On the other hand, by passing through to the loan rate, the reduction in the policy rate decreases the amount per loan that banks can promise to outside investors, thus constraining their ability to raise external funding and ultimately reducing lending and increasing risk-taking incentives. The strength of these two opposing effects depends on the initial level of interest rates because of the zero lower bound on retail deposit rates. When policy rates enter negative territory, outside investors in the form of depositors no longer reduce the premium because they can alternatively withdraw their deposits and store the cash. The lack of cheaper bank financing weakens the effectiveness of the policy rate cut. It may even be the case that the financing constraint tightens, and the rate cut becomes contractionary (reversal rate) and banks' risk-taking incentives rise.

The risk-taking channel of monetary policy, however, does not necessary conflicts with financial stability. Increased risk taking contributes to restore lending to the broad economy and thus improve economic conditions, which in turn may have a positive effect on banks' riskiness. While existing literature has mainly emphasized possible heterogeneity in the effects of negative rates, **Mendicino, Puglisi, and Supera (2021)** provide evidence on the transmission of policy rate shocks to aggregate economic and banking activity. Results show that policy rate shocks have quantitatively similar effects both in positive and negative territory. Policy rate cuts generally lead to a relaxation of banks' lending standards (e.g. Maddaloni and Peydro, 2011; Ciccarelli, Maddaloni and Peydro, 2015), suggesting an important role for the credit channel of monetary policy (e.g. Bernanke and Gertler, 1995; Bernanke, 2007) also in negative territory. Nevertheless, they do not increase systemic financial distress, as measured by aggregate SRISK (Brownlees and Engle 2017), or Moody's expected default frequencies (EDF) for banks. Substantial heterogeneity is, however, documented in the pass-through of negative policy rate shocks to lending rates. Banks with (ex-ante) lower levels of deposit rates are on average less responsive to policy rate shocks in negative territory compared with banks with (ex-ante) higher retail deposit rates. This result warrants some concerns regarding the possibility that a larger number of banks reaches the effective lower bound as we move further in negative territory, hence, reducing the effectiveness of policy rate cuts going forward.

Porcellacchia (2021) studies the effect of a policy rate cut on bank solvency and therefore on the likelihood of a bank crisis. The paper finds that there is a critical policy rate level, below which a trade-off exists between monetary easing and bank stability. Using banking data, the author proposes a methodology to quantify this tipping point, below which low rates may harm bank stability.

How do monetary and macroprudential policies interact? After showing that both monetary and macroprudential policies face important trade-offs between the supply of credit to the wide economy and financial stability risks, we turn to the exploration of the interdependencies between monetary policy and financial stability. A number of papers have established the existence of spillovers between monetary and macro-prudential policy (e.g. Benigno et al. 2012; Lambertini et al, 2012; Angelini et al., 2014; Collard et al., 2017; Harrison, Nelson and Ferrero, 2018; Martinez-Miera and Repullo, 2019; **Darracq-Paries, Kok and Rancoita, 2019;** Carrillo et al., 2021).[11]

Van der Ghote (2021) argues that (conventional) monetary policy and macro-prudential policy interventions can both help to safeguard financial stability. However, the paper shows that macroprudential policy does so much more effectively, which suggests that macroprudential policy should be the first line of defense against the build-up of systemic financial vulnerabilities.

Mendicino et al. (2020) instead highlight that the degree of accommodation of monetary policy is crucial to determine the short-term impact of macroprudential policy and, hence, the macroprudential policy space. Overall, the strength of monetary policy accommodation is key to determine the overall balance between the short-run costs and long-run benefits from capital requirement changes. In particular, more accommodative monetary policy, by mitigating the cost of the transition, enables a larger optimal increase in capital requirement.

At the same time, the soundness of the banking system affects the transmission of monetary policy, and the level of the natural real interest rate. **Van der Ghote (2020**) shows that in economies with sufficiently low interest rates, by containing systemic risk in financial markets macro-prudential policy also boosts the natural rate of return and hence helps

[11] **Cozzi et al. (2020)** explore the interaction of bank capital requirement with monetary policy using a variety of macro-financial models developed at the ECB for policy analysis.

mitigating the intensity of liquidity traps. This effect is particularly strong during turbulent financial times, hence revealing a novel complementarity between financial stability and macroeconomic stabilization.

Finally, **Darracq Pariès, Kok and Rottner (2020)** argues that the risk of hitting the 'reversal interest rate' depends on the capitalisation of the banking sector. This creates a new motive for macroprudential policy interventions. In particular, countercyclical capital buffers rules have the potential to reduce the probability of entering a reversal rate territory, hence allowing monetary policy to be more effective. This suggests an important complementarity between the two policies.

Empirical evidence on the interaction of policies is scant. The findings in **Altavilla, Laeven, and Peydro (2020)** points to strong complementarities between monetary policy and macroprudential policy. The impact of monetary policy easing on bank lending and risk taking is indeed larger when macroprudential policy is accommodative. This effect is particularly strong for less (ex-ante) capitalized banks. Further, a more accommodative policy mix spurs lending to high ex-ante productive firms. Results provide strong evidence that credit channels of monetary policy depend on the strength of the macroprudential environment, and thus that monetary policy needs to take the macroprudential environment into account.

Is there scope for a prudential role for monetary policy? The existence of spillovers does not *per se* imply a need for coordination. In principle, if both policies worked perfectly, each could address its own distortions of interest in an uncoordinated fashion (Tinbergen principle). By doing so, monetary policy effectively eliminates the distortions associated to nominal rigidities, while macroprudential policy eliminates the distortions associated to systemic risk (e.g. Angelini et al., 2014; Collard et al., 2017; Carrillo et al., 2021). This is the case in **Van der Ghote (2020)**: it is optimal for monetary policy to fully focus on price stability, if macroprudential policy can be optimally designed and implemented.

In the presence of limits to macroprudential policy, there may be a conceptual case for a prudential role of monetary policy (e.g. Farhi and Werning 2016, Caballero and Simsek 2019, Stein 2019). Limits to the implementation and effectiveness of macroprudential policy could be related to the presence of a large share of non-bank financial intermediaries (Plantin, 2015; Bengui and Bianchi, 2018; Ordonez, 2018; Begenau and Landvoigt, 2021) or political

economy considerations (e.g. Rola-Janicka, 2019). In addition, 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 not optimal from the perspective of the union as a whole (e.g. Fornaro and Romei 2019).

The use of monetary policy for prudential purposes may, however, be challenging in practice. Monetary policy may, however, be too "blunt" to deal with financial stability. The cost in terms of foregone output and/or price stability might outweigh the benefits of the reduced probability of financial crises (e.g. Svensson 2018, **Kockerels and Kok 2019**). In addition, the lack of synchronization of countries' exposures to systemic risk also make any attempt to lean against the financial cycle quite problematic in euro area.

State-contingent policy interventions might be generally difficult to implement in practice due to the difficulty in identifying the different phases of the cycle. Both monetary policy and the cyclical component of macroprudential tools, such as the countercyclical capital buffer, face this challenge. However, simpler forms of interventions, such as a tax on debt or capital requirements, can achieve a substantial share of the welfare gains (e.g. Bianchi, 2011; Clerc et al. 2015; **Mendicino et al. 2018**).

An appropriate calibration of instruments aimed at straightening the resilience of the financial sector, such as the capital requirements or loan to value ratios, could reduce the probability that risk becomes excessive and a crisis materializes (e.g. Freixas, Laeven Peydro, 2015; **Van der Ghote, 2021**). In addition, by reducing the amplitude of the financial cycle, these type of policy interventions could also reduce the scope for monetary and macroprudential cyclical interventions.

From a practical point of view, the results presented in this article highlight that both monetary and macroprudential policies face important trade-offs between the supply of credit to the wide economy and financial stability risks. Hence, policy makers need to be aware of these tradeoffs when designing policy interventions that act through the financial system. In this respect, there could be advantages of taking into account financial stability considerations for monetary policy decisions. Further, from the analysis it also emerges the crucial importance of reducing limits to the implementation of macroprudential policy and the need for strengthening the use of measures aimed at reinforcing the resilience of the

financial system at the country level. This would avoid the need for a prudential approach to monetary policy and the potential costs associated with leaning against the wind.

From an analytical point of view, substantial progress has been made to develop credible frameworks of analysis that aim at quantifying the costs and benefits of macroprudential and monetary policy interventions need to properly capture the trade-offs between financial stability risk and economic outcomes entailed in the two policies, including potential non-linearities in their interaction and heterogeneity in the effects (across countries and sectors of exposure). Still, measuring the excessiveness of risk taking poses a clear challenge in this respect. The ability to assess in a timely manner whether risk taking becomes excessive, hence, leading to the build-up of systemic risk, requires the development of new state-of-art empirical and conceptual frameworks.

An important dimension for the interaction of monetary and macroprudential policies that has been left to future considerations, concerns their redistributional channels. The research agenda of the RTF touched upon issues related to how monetary and macroprudential policy transmits across sectors (e.g. banks vs. non-banks intermediaries) and individual agents (e.g. borrowers vs. savers) only marginally, partly due to limited data availability. Further exploration of the redistributive effects of monetary and macroprudential policy would be useful to provide further insights on the costs and benefits of interventions targeted to specific sectors or groups of agents. In addition, focusing on the redistributive channel of transmission of the two policies would also deepen our understanding of their interlinkages and spillovers. Pursuing this path, would, however, requires a considerable research effort in developing new frameworks of analysis useful to identify the most relevant dimension of heterogeneity for the transmission of policies, including distilling the aggregate implications for such redistributive effects.

The remaining of the article is organised as follows. Section 1 focus on the impact of macroprudential policy, while Section 2 discusses the linkages between monetary policy and financial stability. Section 3 elaborate on the interaction between the two policies and Section 4 on the prudential role of monetary policy. Section 5 discusses additional considerations related to the distributional effects of monetary and macroprudential policies. Section 6 concludes.

1. IMPACT OF MACROPRUDENTIAL POLICY

Several research projects carried out under the RTF address the following question: *What is the macroeconomic impact of macroprudential policies?*

According to **Martin, Mendicino and Van der Ghote (2021)** the conceptual foundations for macroprudential policy lies on the premise that economics agents (such as households and financial intermediaries) fail to internalize the full effects of their actions and, hence, expose the economy to systemic risk. Macroprudential policy aims at correcting distortions that create a wedge between the social and the private value of risk which exposes the economy to the risk of experiencing a strong systemic financial event.

These distortions can be of different nature: whereas some of them originate directly in the regulatory or legal environment (e.g. deposit insurance, tax advantages of non-contingent debt, limited liability), or in the nature of financial relationships (e.g. asymmetric information) others originate in general equilibrium effects that are not internalized by agents (e.g. fire sales, aggregate demand externalities).[12] While much of the discussion before the GFC has been centered around the former two types of distortions, the crises has reinvigorated interest in the latter type as it has become apparent from the crisis that financial institutions in wholesale markets are primarily interrelated through similarity in financial asset positions.[13] In principle macroprudential instruments can be tailored to target each of these distortions separately.

Financial imbalances which endogenously build up make the financial system vulnerable to their sudden unraveling, with adverse effects not only on the financial sector but also on the wide economy.[14] Agents' individual actions contribute to the overall exacerbation of risk during the build-up phase (e.g. choices of leveraging, lending standard, etc.…) and to the

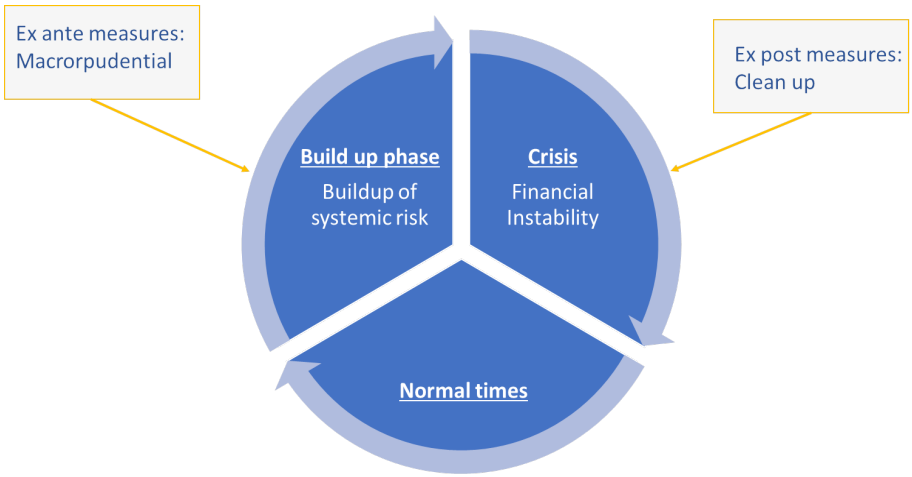
[12] **Carletti, Goldstein an Leonello (2019)** analyze the role of liquidity regulation and its interaction with capital requirements in a global-games model in which banks are exposed to both solvency and liquidity crises. In a similar framework, **Leonello, Mendicino, Panetti and Porcellacchia (2021)** study optimal policy and how it changes with the nature of financial crises. **Dell'Ariccia and Ratnovski (2019)** show how the risk of contagion amplifies bank risk-taking, and how, in these circumstances, a commitment by authorities to shield banks from systemic risk can therefore reduce bank risk-taking. In **Mendicino, Nikolov, Rubio-Ramirez , Suarez and Supera (2020)** 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. In **Van der Ghote (2021)**, instead, banks take on too much leverage because of the existence of pecuniary externalities in financial intermediation.

[13] See Box 1 in **Martin, Mendicino and Van der Ghote (2021)** for a review of the literature on the conceptual foundation for macroprudential policy.

[14] The risk of experiencing a strong systemic financial event can emerge endogenously or can be trigger by exogenous (idiosyncratic or aggregate) shocks. 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).

severity of the unravelling phase (e.g. choices of deleveraging, liquidation of assets, etc.…). Hence, agents' individual actions affect both the likelihood and the severity of financial crisis.

Figure 1: Stylized view of systemic risk



Source: Martin, Mendicino and Van der Ghote (2021)

The successions of periods of booms, in which financial imbalances build up, followed by periods of crisis, in which systemic risk materializes, and finally a normal time phase, represent the "financial cycle". Figure 1 provides a graphical illustration of these phases. We denote as "normal times" the phase in which the economy is neither building up systemic risk nor undergoing a crisis. Macroprudential policy acts counter-cyclically over the financial cycle. Hence, optimal macroprudential policies should be tightened when the systemic risk increases and loosened as the likelihood of a systemic crisis subdues. This general result hold regardless of whether the main rationale for macroprudential policy the existence of is pecuniary or of aggregate demand externalities.

In a recent paper, **Van der Ghote (2021)** considers an economy that endogenously fluctuates between booms and busts (such as the one in Figure 1). Banks in this framework do not consider the effects of their individual choices on the price of loan portfolios, giving rise to a pecuniary externality. It is optimal for macroprudential policy to limit bank leverage only at times of intermediate bank wealth, i.e. when banks have enough capital to sustain lending but not enough to withstand an adverse change in financial conditions, which corresponds to the build-up phase of systemic risk. The optimal policy reduces the likelihood and intensity of financial

crises, but it does so at the expense of curtailing financing to firms and hindering economic activity on impact when the intervention is active. The optimal policy reduces the frequency of financial crises by 25% relative to a scenario without macroprudential policy. The social welfare gain over that benchmark scenario amounts to 0.67% in terms of permanent consumption increase per annum.[15]

Building on this conceptual justification for macroprudential policy, a few papers turn to its effectiveness in practice. Recent empirical evidence shows that macroprudential policies are effective at containing symptoms of systemic risk, such as credit growth and house price booms. In particular, **Ampudia et al (2020)** provide evidence of the effectiveness of macroprudential policy in smoothing the credit cycle.[16] Capital and, especially, borrower-based measures are effective in curbing excessive credit growth.

However, macroprudential policy can also impact the economic cycle. Since recessions associated with financial imbalances tend to be deeper and the associated recoveries tend to be sluggish, then by reducing systemic risk such policies could lead to milder recessions and, hence, have a positive impact on long-term growth.

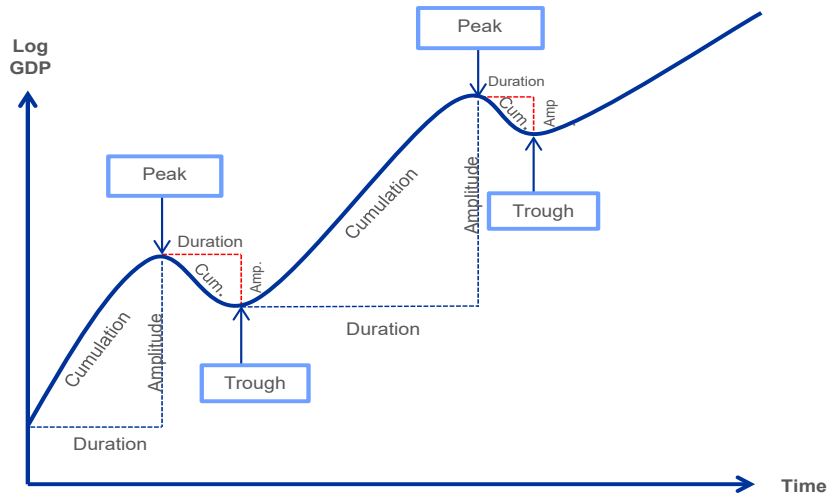
By focusing on the effects of macroprudential policy on the relationship between GDP growth and financial crises, **Gadea, Laeven and Perez Quiros (2020)** provide a thorough assessment of the overall economic gains of macroprudential policies. While macroprudential policy is effective in increasing resilience across banks and households, and in smoothing the credit cycle, it also affects the economic cycle. Both capital- and borrower-based measures entail tradeoffs between financial risk and economic growth.

Let's consider an economy subject to recurrent expansions and recessions which follow one other, as depicted in the Figure 2. In line with the empirical evidence, let's also assume that expansions are longer, on average, than recessions. This means that economies are in expansion most of the time. Hence, to assessing the overall impact of credit dynamics on the real economy one also need to understand the role of credit also in expansions. By exploring the impact of credit over both expansions and recessions, **Gadea, Laeven and Perez Quiros (2020)** show

[15] The computer codes replicating the quantitative results in the paper are available here https://www.openicpsr.org/openicpsr/project/118645/version/V1/view.
[16] The paper presents the results of a range of cutting-edge models and new analytical tools assessing i) how a variety of macroprudential policy instruments affect the stability of euro-area banks, households and aggregate credit; ii) the balance between the short-term costs of prudential policies in terms of constraining aggregate credit growth and their long-term benefits in terms of economic growth.

that credit affects both expansions (mainly their duration) and recessions (mainly their amplitude) and there is a growth-and-risk trade-off associated with the pace of credit growth.[17]

Figure 2 Business Cycle Scheme



Source: Gadea, Laeven and Perez Quiros (2020)

The analysis uses a panel data of advanced economies, which separates 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 before those periods. A positive non-linear relation between the increase in credit and the deepness of the recession emerges. For low levels of credit, the relation between the increase in credit during expansion periods and the duration of these periods result to be positive. On the contrary, for high levels of credit, this relation is negative. While rapid credit growth tends to be followed by deeper recessions, more credit implies longer expansions which have a direct positive impact on economic growth. 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. Overall, there is an optimal level of credit which maximizes the length of expansions with relatively small recession losses.

[17] The amplitude and duration define the size of the cumulation which represents the total gain in wealth associated with the period. The benefits and cost of the business cycle are given by the difference between the cumulation of GDP during the expansion and the recession.

Macroprudential policy should manage the balance between longer expansions and deeper recessions. By limiting symptoms of systemic risk, macroprudential policy makes recession less severe and expansions last longer, with positive effects on long-term GDP growth. But, macroprudential policy could also damage the length of the expansions by not allowing credit to finance productive economic activities. Hence, being able to balance the short-term costs of macro-prudential policies with their long-term benefits, is vital for the correct calibration of macroprudential instruments.

Chavleishvili et al. (2021 a) develop a quantile vector autoregressive model that allows macro-prudential authorities to optimally balance the inter-temporal trade-off between expected growth and downside risks to the economy. The baseline model includes a measure of financial stress and of the financial cycle alongside GDP growth, which can interact to different extents at different quantiles giving raise to substantial asymmetries and tail interactions.

Quantitative models are particularly useful to assess the cost and benefits of macroprudential policy and their overall net effects on financial risk and social welfare. In the model developed by **Mendicino et al. (2020a)** higher capital requirements imposes a trade-off by reducing the probability of banking crises at the expense of restricting the supply of bank credit, and reducing economic activity, in normal times.[18] Figure 3 illustrate this trade-off.

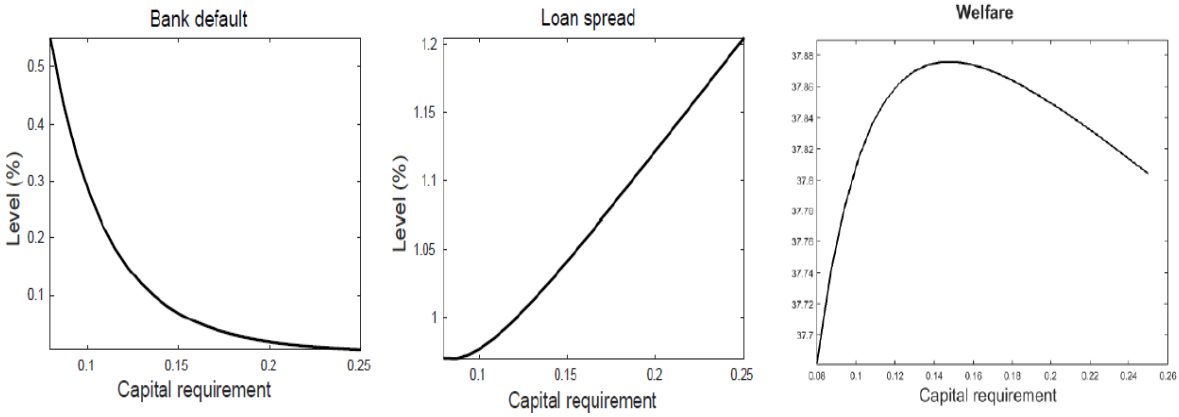
Higher capital requirements make banks less vulnerable to credit losses, thereby reducing the incidence of bank defaults.[19] However, given that the availability of bank equity is limited, an increase in capital requirements raises the cost of bank funding and translates into higher borrowing costs for firms, reduced bank credit, and lower investment.[20]

Household welfare is a summary measure of the net benefits of higher capital requirements. Starting from low levels of CR, the positive effects on bank defaults dominate and welfare increases. When the probability of bank default is already low, further reductions in bank

[18] **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.
[19] **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.
[20] **Fang , Justra, Martinez Peria, Persbitero and Ratnovski (2020)** document that the effects of higher capital requirement on credit are smaller during times of higher economic growth.

failures (due to even higher capital requirements) have a limited beneficial impact for the society and the negative effect of elevated borrowing costs dominates and welfare declines.

Figure 3 Effects of capital requirements in a quantitative model



Source: Mendicino et al. (2020a)

Setting the level of capital requirements optimally is effective in reducing the likelihood of banking crises substantially.[21] At this level, the gains from the reduction in the probability of bank defaults outweigh the losses from the negative effect of elevated borrowing costs for firms.[22] At the optimal capital requirement, the probability of bank default is less than 0.1 per cent.[23] Further reductions in bank failures have a limited beneficial impact for the society and the negative effect of elevated borrowing costs for firms dominates. [24]

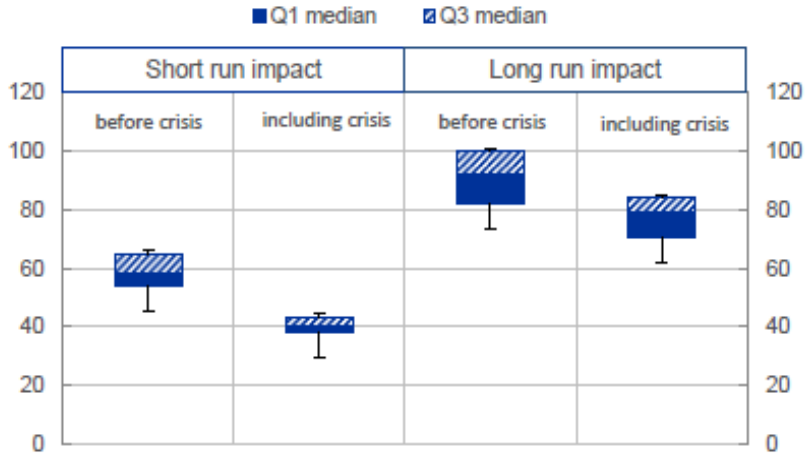
2. (UNCONVENTIONAL) MONETARY POLICY AND FINANCIAL STABILITY

The second part of the RTF agenda addresses the following question: *what are the financial stability implications of unconventional monetary policy?*

[21] In the model bank insolvencies are driven by borrowers' defaults. This means that bank insolvencies involve very large deadweight losses and severe contractions in economic activity. Hence, the optimal level of capital requirements is higher than in alternative models which understate the costs associated with bank default and, hence, biases downwards the net benefits of higher capital requirements.
[22] Getting the level of capital requirements right is of foremost importance compared to the additional gains attributable to the optimal use 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)**.
[23] According to the model, a capital requirement of approximately 15% is optimal for the euro area economy. A data-driven approach in **Dagher, Dell'Ariccia, Laeven, Ratnovski, and Tong (2020)** also arrives to an optimal level of capital of around 15%.
[24] Using a variety of macro-financial models developed at the ECB, **Cozzi et al. (2020)** documents that in the long run, models that ignore bank default imply that output falls permanently due to higher capital requirements.

Albertazzi et al. (2020) review monetary policy spillovers to bank stability focusing on the large body of empirical work drawing on extensive granular datasets available at the ECB for policy analysis. Before the 2007-2009 financial crisis most of the empirical work in the euro area found weak evidence that banks' balance sheet conditions (bank lending channel) played a significant role in the transmission of monetary policy in the euro area. There is evidence on the contribution of relatively lose monetary policy to risk-taking by banks in the pre-crisis period, but there is no consensus on the importance of this factor on the build-up of risks.

Figure 4. Short-run and long-run pass through of interest rates



Source: Albertazzi et al (2020)

As the crisis materialized banks drastically restricted the loan supply and tightened lending standards and the pass-through of (declining) policy rates to borrowers was considerably reduced (see Figure 4). In the post-crisis period smaller and weakly capitalized banks, as well as banks more dependent on unstable sources of funding restricted loan supply more aggressively. Hence, banks conditions became crucial for the transmission of monetary policy.

A number of papers explores the positive and side effects of central bank liquidity operations. In a recent paper, **Jasova, Mendicino and Supera (2021)** argue that by extending the maturity of available funds to three years, the 2011 very long-term operations suddenly reduced uncertainty regarding the availability of central bank liquidity over an extended period. While the lengthening of the maturity of central bank liquidity by itself is not sufficient to stimulate lending, the reduction in central bank liquidity policy uncertainty improved lending outcomes, with economically relevant firm-level investment and employment effects.

Central bank liquidity operations, however, also entail adverse financial stability spillovers.[25] In particular, there is a broad consensus in the academic literature on the fact liquidity interventions increased incentive for banks to invest in government debt. In a recent paper, **Jasova, Laeven, Mendicino, Peydro and Supera (2021)** present evidence on the fact that central bank liquidity interventions during crisis times incentive banks to disproportionally pledge in central bank operations bonds issued by other banks and are associated with an increase in bank interconnectedness and hence, at the margin, contribute to increase systemic risk in the banking sector.[26]

Large scale central bank liquidity interventions also raised concerns about the central bank taking excessive risk with potential repercussion on its credibility. **Caballero et al. (2019)** show that over the 2010-2012 period the credit risk implied by the long term refinancing operations was negatively related to the one implied by the (potential) purchase of stressed assets (Security Markets Programme and Outright Monetary Transactions). Hence, additional lending or asset exposures can increase overall financial risk to the central bank's balance sheet less than proportionally in bad times.

Targeted longer-term refinancing operations have instead been successful in stimulating lending supply while containing side effects. In particular, the policy reduced the exposure of participating banks to domestic sovereign bonds but the policy stimulus actually only reached the targeted segments, such as lending to firms and to households, excluding housing loans. See **Albertazzi, Altavilla, Boucinha and Di Maggio (2018**).

Corradin et al. (2020) argue that while liquidity provision is associated with lower money market tensions, asset purchases induce scarcity effects in some money market segments and, hence worsen money market conditions.[27] Figure 5 shows the dispersion of one-day money market rates. Before 2015, the dispersion was low, suggesting that higher central bank liquidity provisions support money market functioning and are thus associated with lower money market tensions. During 2015-2016, the dispersion increased and excess liquidity levels were high,

[25] **Corradin and Sundaresan (2018)** show that central bank's provision of liquidity introduces a trade-off for banks between lower holding of cash and higher investment in new loans, as well as, lower asset liquidation and lower expected cost of closure.
[26] **Bekaert and Breckenfelder (2019)** document that euro area banks hold bonds issued by other banks, with particularly high concentration in periphery countries.
[27] Asset purchases imply a reduces supply of collateral for a given stock of assets. **Corradin and Maddaloni (2020)** document that the Securities Market Program purchases increased specialness - the scarcity premium of procuring a bond in the repo market – for Italian government bonds.

suggesting that central bank asset purchases induce scarcity effects by withdrawing government bond collateral from the financial system which is the main type of collateral used in secured money markets. In this respect, the December 2016 Securities Lending Programme by increasing collateral availability improved market functioning.[28] The scope of the program was initially to lend specific bonds temporarily to market operators in order to reduce the cost of acquiring good quality collateral. In a second moment, the Eurosystem also introduced the cash-collateral option which allowed accepting cash - not only bonds - in return for lending bonds. Overall, the Securities Lending Programme is associated to a reduction in the dispersion of 1-day money market rates in the euro area.

Figure 5. 1-day dispersion in money market rates in the euro area

Source: Corradin et al. (2020)

In addition, the paper also shows that Basel III regulation also impacts the functioning of the money market.[29] In particular, the leverage ratio requirement led to reduced borrowing, higher rates and increased dispersion in money markets at quarter-ends, i.e., at the time when leverage ratios are reported to the regulators.[30]

These finding are important because tighter money market conditions result in an impairment of the lending capacity of banks, with sizable economic effects (e.g. **De Fiore, Hoerova and**

[28] **Aggarwal, Bai, and Laeven (2020)** examine the role of the securities lending market in collateral transformation and show that the reuse of safe bonds through the Securities Lending Programme reduced demand for borrowing these bonds in the private lending market.

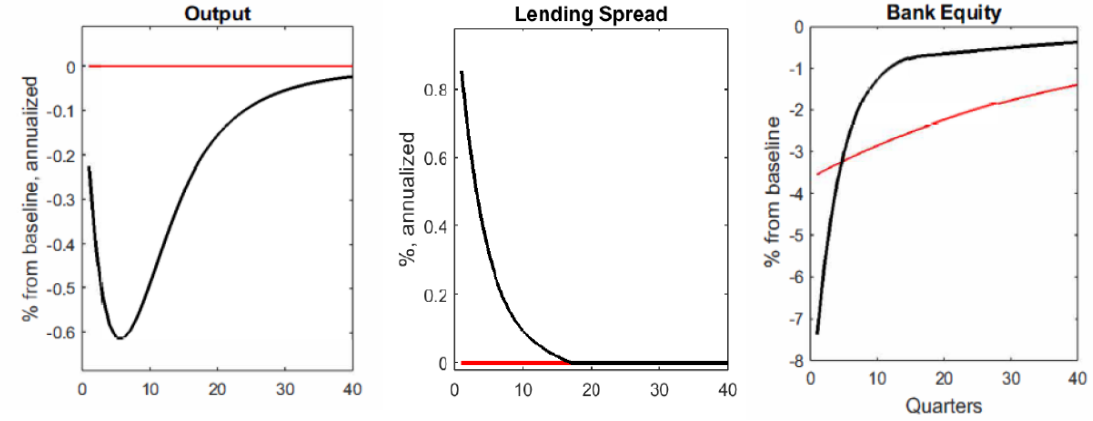
[29] **Hoerova, Mendicino, Nikolov, Schepens and Van den Heuvel (2018)** examine costs and benefits of liquidity regulation. They provide empirical evidence on the benefits – stemming from smaller reliance on central bank liquidity in crisis times – as well as quantitative evaluation of the costs based on two state-of-the-art macro models with financial frictions.

[30] Liquidity regulation, as introduced in Basel III with the minimum liquidity coverage ratio, is another pillar of macroprudential policy. The general purpose of this regulation is to forestall financial panics fuelled by excessive maturity mismatch on bank balance sheets. **Porcellacchia (2021)** focuses on the costs of liquidity regulation in terms of financial disintermediation. It finds that the central banks can mitigate such costs by keeping a large balance sheet.

Uhlig, 2019).[31] Such negative effects can be mitigated if the central bank expands its balance sheet through bond purchases or through liquidity-providing refinancing operations, as both policies satisfy banks' increased demand for liquid assets and mitigate de-leveraging pressures.[32] Well-functioning secured markets naturally cushion the macroeconomic impact; hence, central bank balance sheet expansion is needed, if secured markets do not function smoothly.

Central bank asset purchases are also not immune from unintended consequences on bank vulnerability. Figure 6 displays the response of the economy to a financial shock under no asset purchases (black solid line) and under optimal asset purchases (red line) as reported in **Karadi and Nakov (2020)**.

Figure 6. Central bank asset purchases and financial shocks



Source: Karadi and Nakov (2020)

In the presence of binding financial constraints, asset purchases are effective in offsetting the negative impact of a financial shock. Output and lending spreads are perfectly stabilized, as well as inflation (not shown in the picture). In addition, this policy also mitigates the initial drop in bank equity caused by the financial shock. However, by avoiding an increase in lending

[31]Money market rates determine funding costs of banks. If funding costs increase for some banks, their profitability decreases, which may affect their ability to lend to the real economy and affect the transmission of monetary policy. **Altavilla, Carboni, Lenza, and Uhlig (2019)** document that the cross-sectional dispersion in unsecured interbank money market rates significantly raises lending rates banks charge to firms, with a peak effect during the Global Financial Crisis and the euro area sovereign debt crisis.

[32] **D'Avernas, Vandeweyer, Darracq Paries (2020)** show that the central bank can efficiently mitigate liquidity stress by increasing the supply of money to banks or accepting broader collateral. In the presence of non-bank financial intermediaries, these types of policy interventions have more limited effect on asset prices as they are only targeted to the traditional banking sector. Interventions directly aimed at purchasing large quantities of illiquid assets are instead necessary to prevent asset prices for falling far below fundamentals and, hence, also liquidity risk from growing in the non-bank sector.

spreads, central bank asset purchases reduce bank profitability and slow down the recapitalization of the banking sector.

Albertazzi, Becker and Boucinha (2021) find substantial heterogeneity in the impact of the search for yield mechanism entailed in the ECB asset purchase program. An intended channel of this type of interventions is the portfolio rebalancing channel whereby, by reducing yields on safe long-term securities, asset purchase programs induce investors to shift their investments towards assets with higher expected returns, thus taking on more risk. While in more vulnerable countries this mechanism incentivized banks to rebalance their portfolio towards riskier securities, in other countries the rebalancing was observed mostly in terms of bank loans.

The research agenda also explores the financial stability spillovers of policies designed to provide additional accommodation when the policy rate reaches the zero lower bound, such as negative interest rates.

A number of RTF papers assess the impact of negative rates in the euro area on banks' behaviour and the aggregate economy. Low rates generally have an impact on the risk taking behaviour of banks. [33] In the case of negative rates, this effect is stronger for banks with lower deposit rates or that rely more on deposit funding. Euro area banks have been reluctant to pass on negative rates to their retail depositors (households). Hence, high-deposit banks increase risk taking and reduce lending in the syndicated loan market relative to low-deposit banks (**Heider, Saidi, Schepens, 2019**). In addition, high-deposit banks also search for yield by investing in riskier securities (**Bubeck, Maddaloni, Peydro, 2020**). These banks also suffer a large negative impact of interest rate surprised in negative territory on their stock prices (**Ampudia, Van den Heuvel, 2018**). Yet, the overall effect of negative rates is mitigated by the fact that banks can transfer negative rates on to corporate deposits, hence also providing incentives to corporations to reduce cash holding and increase investment (**Altavilla et al., 2020**). Negative policy rates have also acted as an empowerment to ECB's asset purchase program (**Demiralp, Eisenschmidt, Vlassopoulos, 2019**).

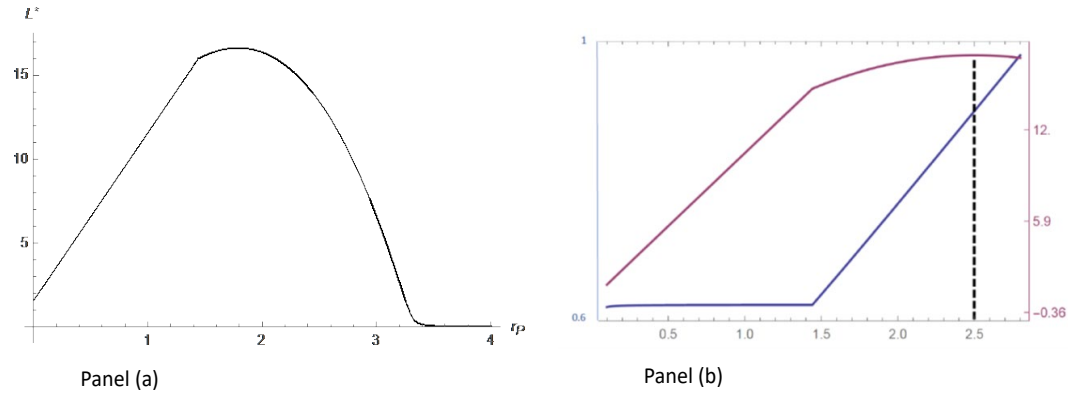
Recent, cross-country evidence by **Bittner et al. (2021)** highlight the importance of the level of the deposit rate and banks' liability structure for the transmission of negative rates via banks' supply of credit to firms. Banking systems featuring higher deposit rates are affected similarly

[33] **Nucera**, **Lucas, Schaumburg and Schwaab (2018)** show that as long-term interest rates decrease banks on average increase their size, hold more sizable derivative books and more asset in trading portfolio and in come cases also increase leverage and decrease deposit finding.

by policy rate cuts in negative territory as they would typically be in positive territory, with weakly capitalized banks expanding lending. In contrast, the role of bank capitalization for the pass-through of monetary policy is muted in banking systems featuring lower deposit rates and hence, limited in their pass-through of the interest rate cut to deposits. In such an environment, banks that heavily rely on deposit funding lend more to riskier borrowers. In both cases, higher bank-lending translates into higher firm-level investment.

According to **Heider and Leonello (2021)** policy rate cuts have two opposite effects on lending and risk-taking whose strength depends on the initial level of interest rates. On the one hand, a policy rate cut reduces the required return for outside investors. This makes bank financing cheaper and so relaxes the bank's financing constraint pushing lending up and inducing banks to behave more prudently. On the other hand, by passing through to the loan rate, the reduction in the policy rate decreases the amount per loan that banks can promise to outside investors, thus constraining their ability to raise external funding and ultimately reducing lending and increasing risk-taking incentives.

Figure 7. Relationship between policy rates, lending and risk taking



Panel (a) Panel (b)

Source: Heider and Leonello (2021)

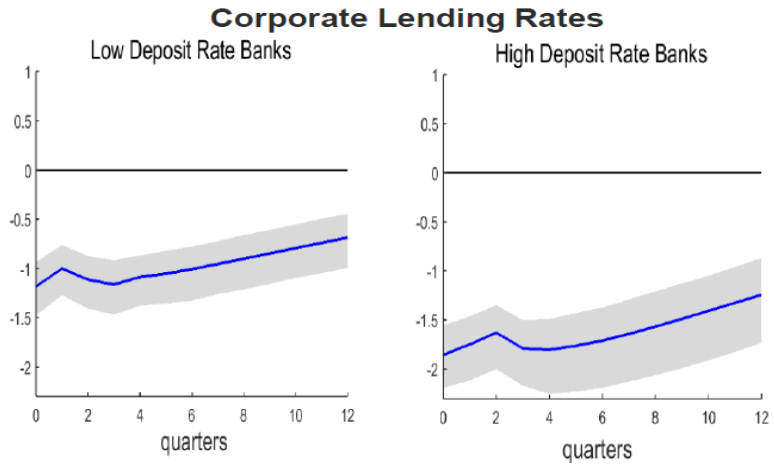
The strength of these two opposing effects depends on the initial level of interest rates. In normal times, when policy rates are away from their lower bound, the pass-through to (short-term) deposit rates is stronger than that to (long-term) loan rates. Hence, the external financing constraint relaxes, and monetary policy is accommodative. When policy rates enter negative territory, the transmission to deposit rates is impaired because there is a zero-lower bound on retail deposit rates. A rate cut then still transmits to lower loan rates but less so to lower deposit rates. As a result, the external financing constraint relaxes less, and the effectiveness of the

policy rate cut weakens. It may even be the case that the financing constraint tightens, and the rate cut becomes contractionary (reversal rate) and banks' risk-taking incentives rise.

The interplay between these two opposing effects gives rise to a non-monotonic relationship between a policy rate change and lending, as illustrated in Figure 7 panel (a). In normal times, lending increases following a policy rate cut, while the opposite is true in a low interest rate environment. The level of the policy rate at which lending is maximal identifies the reversal rate. Figure 7 panel (b) shows how the contractionary effect of monetary policy below the reversal rate is also associated to an increase in bank risk-taking. This is captured by the blue line in the figure, which represents bank screening effort.

Recent evidence by **Mendicino, Puglisi, Supera (2022)** shows that negative policy rate shocks in the euro area are associated with a positive impact on banking and economic activity without giving raise to financial stability concerns. These results suggest that the "reversal rate" – an interest rate level below which the contraction in banks profitability leads banks to reduce lending to the broader economy – has not been reached yet. However, results suggest that going forward, there could be a reduction in the pass-through of the monetary policy stimulus through negative policy rates. The empirical findings show substantial heterogeneity in the pass-through to lending rates of policy rate shocks in negative territory. Figure 8 shows the pass-through to borrowers of policy rate cuts in negative territory for banks with ex-ante low (RHS) and high (LHS) deposit rates. The pass-through to borrowers is indeed lower for banks with (ex-ante) lower rates on deposits.

Figure 8. Monetary policy pass-though in negative territory



Source: Mendicino, Puglisi, Supera (2021)

Porcellacchia (2021) studies the impact of low interest rates on bank solvency, and therefore on bank creditors' incentive to roll over their debt. There are two competing effects: while on the one hand low rates are a boon for banks holding long-term assets, on the other hand they compress these banks' interest margins. The paper shows that at a sufficiently low interest rate the latter effect dominates, threatening bank insolvency and a roll-over crisis. Using banking data, the author proposes a methodology to quantify this tipping point, below which low rates may harm bank stability.

To sum up, monetary policy has a material impact on bank risk taking and, in some circumstances, also on the stability of the banking sector. In particular, unconventional monetary policy measures may lead to unintended consequences linked to bank vulnerabilities, but they are overall crucial to support the capacity of the financial system to intermediate. The design of unconventional monetary instruments matters for their effectiveness and their unintended consequences. Making measures more targeted can indeed limit the buildup of risk.

3. MONETARY POLICY AND MACROPRUDENTIAL POLICY INTERACTION

The broad question addressed in the third part of the agenda is: *How do monetary and macroprudential policies interact?*

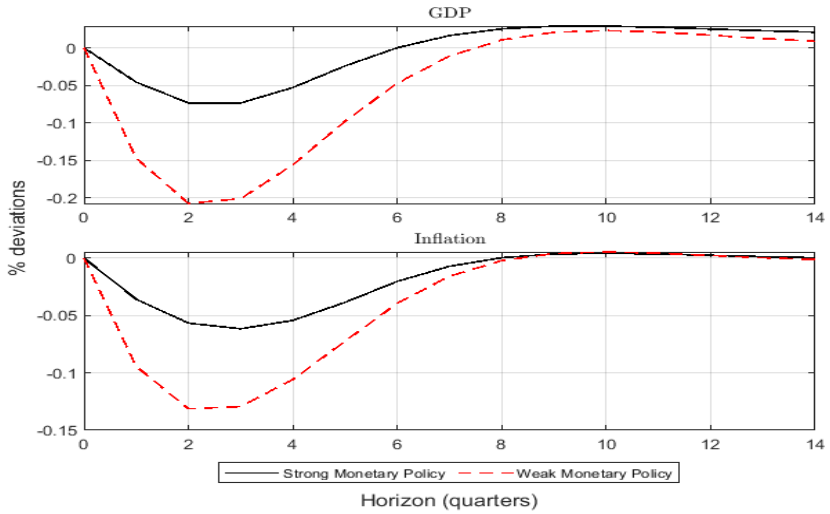
Current conventional wisdom on monetary policy contends that its role is to attain some form of price stability while maintaining output close to its long-run sustainable (or "natural") level. The instruments under the direct control of the monetary authority operate directly on financial markets. In this regard, both monetary and macroprudential policies operate through the same channels of transmission, with potentially large interactions between the two policies.

The RTF research agenda explores the impact of monetary policy on the effectiveness and optimality of macro-prudential policy. There is broad consensus that in the long run, the imposition of higher capital requirements improves bank resilience and is beneficial for the economy. **Mendicino et al. (2020b)** show that in the short run, however, an increase in capital requirements is likely to have a contractionary impact on credit supply and aggregate economic

activity. Hence the macroprudential authority needs to carefully balance the short-run costs and long-run benefits of changes in capital requirements.

The degree of monetary policy accommodation can affect the size of the short-term cost of

Figure 9. Effects of a 1pp increase in capital buffers over time



Source: Mendicino et al. (2020b)

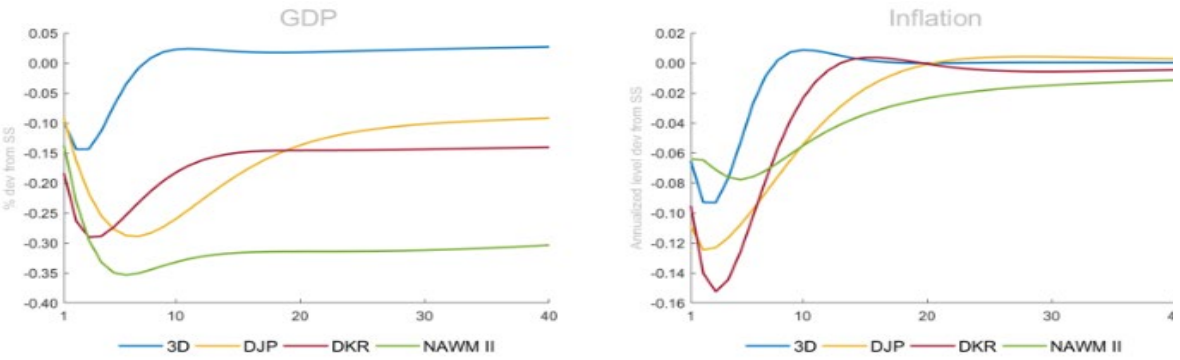
increasing capital requirements and hence affect the optimal increase in capital requirements. See Figure 9. The macroprudential authority can afford a larger increase in capital requirements, under a more accommodative monetary policy (black solid line). In contrast, when monetary policy is constrained in its ability to be accommodative (red dashed line), for example because of an effective lower bound, the short-term are the largest and hence leave macroprudential authorities with limited space to increase bank capital requirements.

In a recent paper **Cozzi et al. (2020)** explore the interaction of bank capital requirement with monetary policy using a variety of macro-financial models developed at the ECB for policy analysis. In response to an increase in bank capital requirements, GDP falls modestly. The impact on (annualized) inflation is also modest and recovers in 8-10 quarters due to a flat Philipps curve (see Figure 10). [34] The more strongly monetary policy leans against the negative effects of a capital requirements increase on aggregate demand, the smaller the impact on output and inflation in the short- and medium-run. Hence, larger countries experience a smaller

[34] **Darracq-Paries, Kok-Sorensen and Rodriguez-Palenzuela (2011)** model (known as DKR), the **Darracq-Paries, Jacquinot and Papadopoulou (2016)** model (known as DJP), the **Mendicino**, **Nikolov, Suarez and Supera (2018a)** model (hereafter known as 3D because it models the defaults of banks, firms and households) and the NAWM II model of **Coenen, Karadi, Schmidt and Warne (2018)**.

decline in economic activity following a capital requirement increase in a monetary union, as their weight on the union output and inflation is larger (**Darracq-Paries, Kok and Rancoita, 2019**).

Figure 10. Impact of increase in capital requirements on GDP and inflation



Source: Cozzi et al. (2020)

Several papers also explore how macroprudential policy affects the monetary policy transmission mechanism. **Cozzi et al. (2020)** show that bank leverage and default risk are key for the transmission of monetary policy shocks to the real economy. Banks' net worth is more sensitive to shocks when leverage is high and assets are risky. It follows that higher capital requirements and a less risky and leveraged financial system make the economy less responsive to conventional and unconventional monetary policy.[35] A stronger banking system dampens the transmission of monetary policy, but it also reduces macroeconomic and financial instability and the occasions in which the natural real interest rate needs to fall to very low levels.[36]

A protracted period of monetary policy easing after a financial crisis can be accompanied over time, or even trigger, by a new build-up of excessive systemic risk. **Van der Ghote (2021)** shows that under such an accommodative monetary policy, macroprudential policy needs to further tighten during the build-up to keep the likelihood of systemic financial distress in check, relative to a scenario with a less ex-post expansionary monetary policy.

The optimal exit from balance sheet policies needs to be very gradual (see **Karadi and Nakov (2021)**. Subsidies on banks' equity issuance could speed up banks' recapitalization and might

[35]Simulations based on **Gertler and Karadi (2011), Darracq-Paries et al. (2019)** and **Mazelis (2016).**
[36] **Van der Ghote (2018)** shows that if macroprudential policy is effective at dampening the financial cycle, thus making crises less severe and frequent, it also reduces the occasions when it is optimal to use monetary policy for financial stability purposes.

permit quicker optimal exit from asset-purchase policy. Hence, also suggesting an interesting form of interaction between central bank asset purchases and macroprudential policy.

In a recent paper, **Altavilla, Laeven, Peydro (2020)** study how the interaction between monetary and macroprudential policy affects bank lending behaviour and uncover complementarity among the two policies. They find that the effects of a monetary policy easing on bank lending and risk taking are larger when macroprudential policy is accommodative and this effect is particularly strong for less (ex-ante) capitalized banks. Importantly, a more accommodative policy mix spurs lending to high ex-ante productive firms.

The results reviewed in this section suggest that monetary and macroprudential policy cannot be considered in isolation. The fact that macroprudential policy is effective in addressing financial stability considerations, doesn't mean that monetary policy should not respond at all to macroprudential policy or – more broadly – to financial conditions. The degree of accommodation of monetary policy indeed matters to determine the short-term impact of macroprudential policy and, hence, the macroprudential policy space. At the same time, there is evidence of the complementarity of policies in response to a monetary policy easing. Monetary and macroprudential policies transmission channels entail significant spillovers. Hence, monetary and macroprudential authorities need to consider the existence of trade-offs and spillovers when deciding on their policy interventions.

4. PRUDENTIAL ROLE FOR MONETARY POLICY

The fourth part of the RTF agenda addresses the following question: *Should monetary policy have a prudential role?*

Several papers have established the existence of spillovers between monetary and macro-prudential policy. However, the existence of such spillovers does not *per se* imply a need for coordination. In principle, if both policies worked perfectly, each could address its own distortions of interest in an uncoordinated fashion (Tinbergen principle). By doing so, monetary policy effectively eliminates the distortions associated to nominal rigidities, while macroprudential policy eliminates the distortions associated to systemic risk. This is the case in **Van der Ghote (2021):** it is optimal for monetary policy to fully focus on price stability, if macroprudential policy can be optimally designed and implemented. This result thus suggests

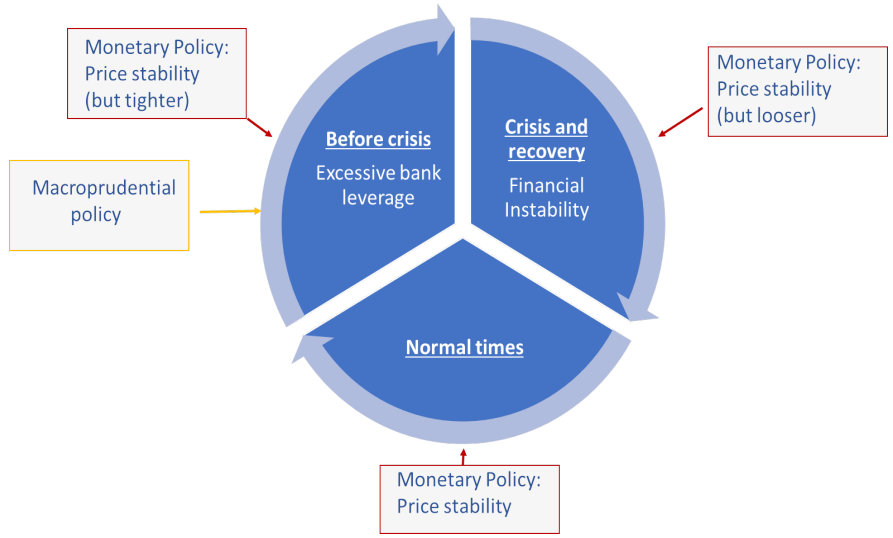
that macroprudential policy should be the first line of defense against the build-up of systemic financial vulnerabilities.

The RTF research agenda also explores the needs for a prudential role of monetary policy in the presence of limits to the implementation and effectiveness of macroprudential policy. This could be related to political economy considerations that arise since a macroprudential tightening could be politically unpopular, since part of the population will mainly perceive the short-term costs of the restrictions. A second reason for limited effectiveness of macroprudential interventions could be related to the fact that it targets only a certain type of financial institutions, i.e. banks. Hence, in countries with a large market share of non-bank financial intermediaries, tightening of macroprudential policy provided even greater incentives for assets to migrate away from banks to other financial institutions.

Last, in a monetary union, such as the euro area, macro-prudential policies are primarily designed and implemented by the national authorities, although the ECB has the power to activate more stringent measures for certain macroprudential instruments. Hence, national authorities my fail to internalize the cross-border spillovers and leakages effects of macroprudential policy and hence impose suboptimal interventions. Macro-prudential policy may be too lax, also for instance, because individual countries want their financial intermediaries to gain a "competitive edge" relative to those of their neighbors. Or, countries may collectively choose to adopt a lax macro-prudential framework because they expect the ECB to step in and "clean up" in the event of a large financial crisis.

In line with recent literature, **Martin, Mendicino and Van der Ghote (2021)** argue that if the effectiveness of macroprudential policy is limited, monetary policy needs, in principle, to deal not only with its traditional focus on nominal rigidities but also with systemic risk. This can be achieved by tightening ("leaning against the wind") during the build-up phase, and by loosening ("cleaning") during the crisis phase. By tightening ex ante, monetary policy contributes to reducing credit and, more specifically, leverage, thereby reducing the likelihood and/or severity of crises. By loosening ex post, monetary policy contributes to speeding up the recovery in the event of a crisis (see Figure 11).

Figure 11: Stylized view of systemic risk



Source: Martin, Mendicino and Van der Ghote (2021)

However, monetary policy may be too "blunt" to deal with financial stability. **Kockerels and Kok (2019)** show that using the policy interest rate to lean against the wind is associated with substantial net marginal costs in the euro area. Raising the policy rate ex ante reduces economic activity and raises unemployment before a crisis materializes, also resulting into a more severe downturn once the crisis occurs. This cost dominates the benefits of the reduced probability of financial crises.

Broadly speaking, state-contingent policy interventions, might be challenging to implement in practice due to, for instance, the difficulty in identifying the different phases of the cycle. While this represents a challenge both for monetary policy and the cyclical component of macroprudential tools, the literature has shown that simpler forms of interventions (e.g. a tax on debt or changes in the level of capital requirements), can achieve a substantial share of the welfare gains. An appropriate calibration of the level component of macroprudential instruments ensures that, in normal times, agents internalize the full effects that their individual actions have on exposing the economy to systemic risk. Hence, in boom periods, the economy features much lower amplification coming from risk taking/leverage. This reduces the probability that risk becomes excessive and a crisis materializes. Changes in the level of capital requirements or loan to value ratios, by reducing the amplitude of the financial cycle, could potentially sizably reduce the scope for monetary and macroprudential cyclical interventions. The correct calibration of the level component of macroprudential instruments, such as minimum capital requirements, delivers first order gains compared to the use of

instruments that vary over the cycle (see e.g. Clerc et al. 2015, **Mendicino et al. 2018**) as level instruments reduce the amplitude of the financial cycles. Finally, the lack of synchronization of the financial cycle in euro area countries provides a strong argument in favour of country-specific macroprudential policies as opposite to a generalized monetary policy tightening.

5. ADDITIONAL CONSIDERATIONS

An important dimension for the interaction of monetary and macroprudential concerns their redistributional channels. The research agenda of the RTF touched upon issues related to how monetary and macroprudential policy transmits across sectors (e.g. banks vs non-banks intermediaries) and individual agents (e.g. borrowers vs savers) only marginally, partly on the basis of a limited data availability.

Recent work estimates how monetary policy affects income, wealth, and consumption of individual households in the euro area. **Jasova, Mendicino, Panetti, Peydro, Supera (2021)** provide new evidence on the redistributive effects of monetary policy on worker labor market outcomes across both workers and firms via the credit channel. The analysis exploits a unique panel of administrative matched employee-employer and credit registry data in Portugal since the creation of the Eurozone in 1999. Results show that softer monetary policy conditions reduce labor income differentials (wages, hours, and employment) across firms with different financial constraints and across workers of different productivity.

Softer monetary policy conditions increase wages more in small and young firms especially if highly levered. Consistent with the *back-loaded wage mechanism*, monetary policy relaxes financial constraints and allows firms to increase the wage profile for their workers. In addition, consistent with the *capital-skill complementarity mechanism* following a monetary policy softening, small and young firms can increase both their physical and human capital by more. The credit channel of monetary policy plays an important role for the transmission of the heterogeneous effects of monetary policy to labor market outcomes, both in terms of the firm balance-sheet and the bank lending channel. The effects of the credit channel are particularly strong during crisis times.

Focusing on the impact of quantitative easing (QE) on income and wealth in the euro area, **Lenza and Slacalek (2018)** first estimate the aggregate effects of a QE shock, identified by

means of external instruments, in a multi-country VAR model with unemployment, wages, interest rates, house prices and stock prices. The paper then distributes the aggregate effects across households using a reduced-form simulation on micro data, which captures the portfolio composition, the income composition, and the earnings heterogeneity channels of transmission. The earnings heterogeneity channel is important: QE compresses the income distribution since many households with lower incomes become employed. In contrast, monetary policy has only negligible effects on the Gini coefficient for wealth: while high-wealth households benefit from higher stock prices, middle-wealth households benefit from higher house prices.

Slacalek, Tristani and Violante (2020) study the effects of monetary policy on household consumption expenditures. They analyze several transmission mechanisms operating through direct, partial equilibrium channels—intertemporal substitution and net interest rate exposure—and indirect, general equilibrium channels—net nominal exposure, as well as wealth, collateral, and labor income channels. The strength of these forces varies across households depending on their marginal propensities to consume, their balance sheet composition, the sensitivity of their own earnings to fluctuations in aggregate labor income, and the responsiveness of aggregate earnings, asset prices and inflation to monetary policy shocks. The paper quantifies all these channels in the euro area by combining micro data from the HFCS and the EU-LFS with structural VARs estimated on aggregate time series. The authors find that the indirect labor income channel and the housing wealth effect are strong drivers of the aggregate consumption response to monetary policy and explain the cross-country heterogeneity in these responses.

Another important dimension to consider when analysing how monetary policy and macroprudential policy interact and affect financial stability is the role of non-bank financial intermediation. Non-bank financial intermediation can in turn be analysed looking at two interrelated sides. On the one hand, market-based financing has risen steadily in the euro area over the last decades, with corporate bonds increasing their importance as a means of financing. At the same time, several non-bank financial intermediaries became more important as part of the euro area financial sector, since the assets managed by non-banks have increased significantly.[37]

[37] See also ECB Occasional Paper No. 270.

The occurrence of the Covid-19 crisis and the related stress in the financial markets which affected in particular the non-banking sector acted as a catalyst to incentivise more research work in this area. In this context **Breckenfelder, Grimm and Hoerova (2021)** analyse how central bank interventions affect financial stability of the investment fund sector. They show that mutual funds faced unprecedented investor outflows as the COVID-19 shock hit and assess the effectiveness of central bank asset purchases and additional liquidity provision to banks in alleviating the crisis. Analyzing asset purchases, they find that funds with higher shares of assets eligible for central bank purchases in their portfolio before the COVID-19 crisis saw their performance improve by 3.7% and outflows decrease by 66% relative to otherwise similar funds. These results suggest that central bank asset purchases were effective in stopping fire-sale dynamics and staving off runs on non-bank financial intermediaries, even though funds did not have direct access to the lender of last resort facility of the central bank.

Another important aspect to consider when assessing how monetary and macroprudential policies affect the stability of the non-banking sector are the linkages between banks and non-banks. The above paper analyses whether additional central bank liquidity provision to the banking sector during the Covid-19 crisis supported bank repo lending to funds. They find that banks more exposed to the March 2020 liquidity crisis that took up central bank liquidity increased their repo transactions with funds by 3% to 4% compared to other banks. This finding suggests that central bank liquidity provision supported bank repo lending to funds, by alleviating bank liquidity constraints.

Related to this, **Bagattini, Fecht and Maddaloni (2021)** show that banks generally support affiliated funds hit by liquidity shocks (including the Covid19 shock), by buying their shares to counteract investors outflows. This support seems to contain liquidity crises: bank-affiliated funds experience fewer volatile flows even though they maintain lower cash buffers and have a lower flows-performance sensitivity. However, the provided liquidity support strongly depends on the parent banks' stability: in particular, poorly capitalized banks purchase significantly fewer fund shares of their affiliated distressed funds.

The paper also shows that during the COVID-19 crisis funds whose shares were in the portfolio of riskier and more affected parent banks not only did not receive liquidity support but bore the brunt of the banks' deleveraging effort. Moreover, funds more exposed to the UK after the Brexit referendum as well as funds more exposed to Italy during the Italian political turmoil in May 2018 experienced larger outflows if they were 1) unaffiliated, 2) affiliated to a riskier

bank, or 3) affiliated to an Italian or UK parent bank. These results identify novel channels of contagion between banks and non-banks and stress the importance of supporting the resilience of the banking sector. Indeed, results show that stable banks are better suited to stabilize their funds in crisis times through direct liquidity support – but they also highlight that shocks to parent banks spill over and impair the stability of their affiliated funds.

6. CONCLUSIONS

This paper provides a summary of the main findings of recent research carried out in the context of the ECB Research Task Force on Monetary Policy, Macroprudential Policy and Financial Stability, and draws a number of related policy implications.

Is macroprudential policy effective? Macroprudential policies are effective in moderating credit and asset price cycles but they entail explicit tradeoffs between systemic risk and economic growth that need to be quantified with appropriate frameworks of analysis. How does monetary policy affect incentives and financial stability risk? Monetary policy interventions may induce unintended consequences on financial stability linked to bank vulnerabilities. Targeting features of unconventional monetary policy instruments are key to mitigate these consequences and limit excessive risk accumulation.

How do monetary and macroprudential policies interact? Monetary and macroprudential policies involve significant spillovers since they both transmit to the broad economy via the financial system. In principle, if both policies work perfectly, there is no need for explicit coordination. However, in the presence of limits to macroprudential policy, there is a conceptual case for a prudential role of monetary policy, but this may be challenging in practice.

Overall, above mentioned trade-offs and spillovers highlights clear advantages of taking into account financial stability considerations for monetary policy decisions as well as of reduce limits to the implementation of macroprudential policy. Increasing the effectiveness of macroprudential policies would also lessen the need for a micro-prudential approach to monetary policy and reduce the potential costs associated with leaning against the wind.

In the last few years important progress has been made in developing better frameworks of analysis to quantify the tradeoffs faced by monetary and macroprudential policies, the extent of their interactions and the room for possible coordination. Still, the assessment of "excessive" risks accumulating in the system and the correct calibration of the instruments needed to increase resilience of the financial system remain challenging.

Some important dimensions related to the linkages between monetary and macroprudential policies have not been investigated in detail by the work of the research task force. In particular, more analysis is needed to evaluate the transmission of monetary and macroprudential policies through all the components of the financial sectors – like non-bank financial intermediaries. Similarly, the evaluation of the differential impact of these policies for borrowers and savers would shed more light on the tradeoffs faced by monetary and macroprudential policies.

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ANNEX

RTF Governance

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RTF Annual Conferences
ECB-RFS Macro-Finance Conference, 22-23 March 2021
ECB macroprudential policy and research conference, 16-17 December 2019
Research workshop on monetary policy and financial stability, 18-19 December 2018

RTF Policy Papers

Technical Papers

Macroprudential policy measures: macroeconomic impact and interaction with monetary policy, ECB WP 2376
Gabriele Cozzi, Matthieu Darracq Pariès, Peter Karadi, Jenny Körner, Christoffer Kok, Falk Mazelis, Kalin Nikolov, Elena Rancoita, Alejandro Van der Ghote, Julien Weber

This paper examines the interactions of macroprudential and monetary policies. We find, using a range of macroeconomic models used at the European Central Bank, that in the long run, a 1% bank capital requirement increase has a small impact on GDP. In the short run, GDP declines by 0.15-0.35%. Under a stronger monetary policy reaction, the impact falls to 0.05-0.25%. The paper also examines how capital requirements and the conduct of macroprudential policy affect the monetary transmission mechanism. Higher bank leverage increases the economy's vulnerability to shocks but also monetary policy's ability to offset them. Macroprudential policy diminishes the frequency and severity of financial crises thus eliminating the need for extremely low interest rates. Countercyclical capital measures reduce the neutral real interest rate in normal times.

Monetary policy and bank stability: the analytical toolbox reviewed, ECB WP 2377
Ugo Albertazzi, Francesca Barbiero, David Marques-Ibanez, Alexander Popov, Costanza Rodriguez D'Acri, Thomas Vlassopoulos

The response of major central banks to the global financial crisis has revived the debate around the interactions between monetary policy (MP) and bank stability. This technical paper sheds light, quantitatively, on the different mechanisms underlying the relationship between MP and

bank stability. It does so by reviewing microeconometric studies from the academic literature as well as those conducted internally at the ECB. The paper proceeds chronologically, using the recent crisis as a touchstone. First, it provides a brief overview of the main theoretical channels linking bank stability and the transmission of MP. It then analyses the evidence from the pre-crisis period in the light of the structural trends leading up to the crisis. As the crisis erupted, unconventional monetary policy (UMP) measures were deployed, and the paper suggests that these were essential to buttress bank stability and halt a systemic crisis. At the same time, these measures involved trade-offs, and the adverse spillovers on banks' intermediation capacity and risk-taking require close monitoring. The paper ends by offering a critical review of the methodologies employed and suggestions for the areas where analytical efforts should be focused in the future

The risk management approach to macro-prudential policy, ECB WP 2565
Sulkhan Chavleishvili, Robert F. Engle, Stephan Fahr, Manfred Kremer, Simone Manganelli, Bernd Schwaab

Macro-prudential authorities need to assess medium-term downside risks to the real economy, caused by severe financial shocks. Before activating policy measures, they also need to consider their short-term negative impact. This gives rise to a risk management problem, an inter-temporal trade-off between expected growth and downside risk. Predictive distributions are estimated with structural quantile vector autoregressive models that relate economic growth to measures of financial stress and the financial cycle. An empirical study with euro area and U.S. data shows how to construct indicators of macro-prudential policy stance and to assess when interventions may be beneficial.

Discussion Papers

Money markets, central bank balance sheet and regulation, ECB WP 2483
Stefano Corradin, Jens Eisenschmidt, Marie Hoerova, Tobias Linzert, Glenn Schepens, Jean-David Sigaux

This paper analyses money market developments since 2005 and examines factors that have affected money market functioning. We consider several metrics of activity in both secured and unsecured euro area money markets, and study interactions with new Basel III regulations and with central bank policies (liquidity provision, asset purchases and the Securities Lending Programme). Using aggregate data, we document that, prior to 2015, heightened financial market volatility coincided with worsening money market conditions, while higher central bank liquidity provision was associated with reduced money market stress. After 2015, the evidence is consistent with central bank asset purchases inducing scarcity effects in some money market segments, and with active securities lending supporting money market functioning. Using transactions-level money market data combined with supervisory data, we further document that the leverage ratio regulation impacts money markets at quarter-ends due to "window-dressing" effects, reducing money market volumes and rates. We also consider the macroeconomic impact of changing money market conditions, finding that the impact depends on whether frictions originate in secured or unsecured markets and on central bank policies in place.

On the interaction between monetary and macroprudential policies, ECB WP 2527
Alberto Martin, Caterina Mendicino, Alejandro Van der Ghote

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.

A risk management perspective on macroprudential policy, ECB WP 2556
Sulkhan Chavleishvili, Stephan Fahr, Manfred Kremer, Simone Manganelli, Bernd Schwaab

Macroprudential policymakers assess medium-term downside risks to the real economy arising from financial imbalances and implement policies aimed at managing those risks. In doing so, they face an inherent intertemporal trade-off between the expected growth and downside risks. This paper reviews the literature on Growth-at-Risk, embeds it in the wider literature on macroprudential policy, and proposes an empirical risk management framework that combines insights from the two literatures, by forecasting the entire real GDP growth distribution with a structural quantile vector autoregressive model. It accounts for direct and indirect interactions between financial vulnerabilities, financial stress and real GDP growth and allows for potential non-linear amplification effects. The framework provides policymakers with a macro-financial stress test to monitor downside risks to the economy and a macroprudential stance metric to quantify when interventions may be beneficial.

Monetary policy in a low interest rate environment: reversal rate and risk-taking, ECB WP 2593
Florian Heider, Agnese Leonello

This paper develops a simple analytical framework to study the impact of central bank policy-rate changes on banks' credit supply and risk-taking incentives. Unobservable ex post bank monitoring of loans creates an external-financing c constraint, which determines bank leverage. Unobservable, costly ex-ante screening of borrowers determines the level of bank risk-taking. More risk-taking tightens the external-financing constraint. The policy rate affects the external-financing constraint because it affects both the return on outside investors' alternative investments and loan rates. In a low rate environment, a policy-rate cut reduces bank funding costs less because of a zero lower bound (ZLB) on retail deposit rates. Bank risk-taking is a necessary but not sufficient for a policy-rate cut to become contractionary ("reversal"). Reversal can occur even though banks' net-interest margins increase. Credit market competition plays an important role for the interplay of monetary policy and financing s stability. When banks have market power, a policy-rate cut can increase lending and still lead to risk-taking. We use our analytical framework to discuss the literature on how monetary policy affects the credit supply of banks, with special emphasis on low and negative rates.

For a complete list of ECB working papers published as part of the RTF, see RTF web page.

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The views expressed here are those of the authors and not those of the ECB or the Eurosystem.

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