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MONETARY POLICY, PRUDENTIAL POLICY AND BANK'S RISK-TAKING: A LITERATURE REVIEW

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Abstract

The pre-crisis low interest rates environment is raising concerns among researchers and policymakers about its impact on the triangle prudential policy - monetary policy - bank's risk-taking. While interest rates are set at low level for inflationary and economic growth reasons, they may lead banks to take more risk, jeopardizing the financial system and impeding the recovery. This paper provides a literature review, on the one hand, on the interaction of monetary and prudential policies through their impacts on bank's risk-taking, and on the other hand, on the issues of their coordination. Monetary policy appears to have ambiguous effects on banks' profitability, and then, on banks' risk-taking behaviour. Despite monetary and prudential policies pursue different objectives, they inevitably interact, raising challenges that face policymakers. Albeit it is argued that monetary policy alone is not sufficient to maintain macroeconomic and financial stability, and that it should be coordinated with prudential policy, the form of this coordination is not clear-cut.

Keywords: Monetary policy, prudential policy, financial stability, bank's risk-taking

1 Introduction

In the aftermath of the 2008 financial crisis, two major changes impacted banking systems. On the one hand, central banks of developed economies have implemented both conventional and unconventional monetary measures. They set interest rates at very low levels, sometimes even opted for negative interest rates and bought financial assets on a massive scale. On the other hand, regulatory authorities tightened the banking regulation (microprudential regulation) and implemented new tools as macroprudential policy. Their objectives were twofold: to stimulate economic growth; to

rescue and strengthen the banking system. Whereas the first objective seems to have been achieved, the second is still in question since period of low interest rates seems to have deleterious impacts on banks' behaviour and financial stability.¹

Therefore, we can wonder how banks react in such a conflicting environment featured by accommodative and restrictive policies. Will banks grant less credit? Or, while respecting the regulation, will they finance more risky projects for more profit? In this paper, we provide an overview of the literature on the prudential policy-monetary policy-banking risk triangle in order to identify the challenges face by policymakers. The aim of our paper is to provide researchers and policymakers with policy-relevant research questions that can help in designing and implementing macroprudential policy for a better coordination with monetary policy.

From a theoretical point of view, extended period of low interest rates may exacerbate banks risk-taking in order to increase profits (Rajan, 2005; Jimenez et al., 2014; Gambacorta, 2009; Altunbas et al., 2014). Risk-taking can be understood as an action or a decision of banks that induces higher asset volatility and depreciates bank soundness. The impact of low interest rates on risk-taking is twofold.

First, it modifies *ex-ante* banks' incentives to take risks (Borio and Zhu, 2012; Dell'Ariccia and Marquez, 2013). The mechanisms at work are simple and based on what Rajan (2005) describes as the "paradigm of the search for yield". The search for yield in a low interest rates environment increases demand for risky assets. The massive demand of these assets pushes up their price, thus reducing the risk premiums attached to them and sending a "fake" signal on their actual quality. This mechanism is self-sustaining since the general decline in returns, combined with the illusion of falling risk levels, increases the incentive to take risks. The financial system is thus becoming more fragile, as the assets held by financial agents (banks, pension funds, private investors) are generally riskier.

Second, it relaxes *ex-post* the funding constraints on agents, thereby increasing their overall debt levels (Bernanke and Blinder, 1988; Bernanke and Gertler, 1989). A low interest rates policy reduces the cost of capital and facilitates the substitution of equity for deposits, thus encouraging banks to grant loans. Such a policy also results in a significant assets valuation (e.g. real estate or financial bubbles) and an appreciation of the wealth of agents. Then, agents benefit from greater creditworthiness (due to a higher value of their collateral). The level of leverage (i.e. the ratio between asset and equity) increases, exacerbating the vulnerability of balance sheets to macroeconomic shocks. Ultimately, monetary policy can change the composition of private agents' and banks' balance sheets: on the assets side by increasing the weight of risky securities, on the liabilities side by increasing leverage, weakening the stability of the whole financial system.

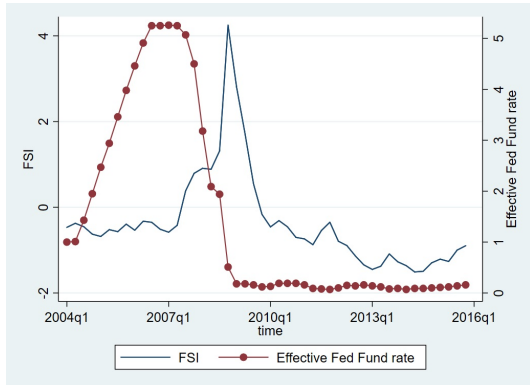
However, this prediction seems to be yet unfulfilled since the financial system appears stable. Two indexes are widely used to assess the stability of the financial system: the financial stress index (FSI) and the Composite Index of Systemic Stress (CISS) respectively used in the US and in the euro area.² As depicted in figures ?? and ??,

¹The financial stability can be defined as the robustness or the resilience of the financial system. The robustness of the system refers to the system's ability to resist negative shocks. The system is said to be resilient in relation to its capacity "*to adapt in response to both short-term shocks and long-term changes in economic, social, and ecological conditions while continuing to fulfil its functions in serving the real economy*" (Berry et al., 2015, p.10).

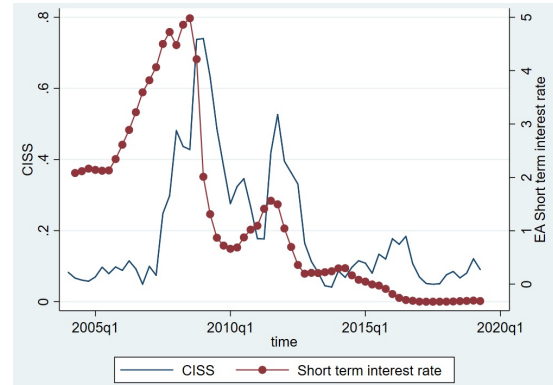
²The FSI measures the degree of financial stress in the markets and is constructed from 18 weekly data

while the monetary interest rates are low, from 2010, the financial systems appear solid.

(a) Interest rate and Financial stress index in the US



(b) Short term interest rate and CISS in the euro area



Source: Data for the graphs are collected on the FRED and on the ECB websites

Figure 1: Overview of interest rate and financial stress index in the US and euro area

It is then possible to imagine that prudential policies have efficiently played their role and counter the source of financial instability induced by excessive low interest rates. By increasing banks' equity, higher capital requirement under Basel III increases the shareholders' "*skin in the game*", making them to bear most of the cost associated to excessive risk-taking. Consequently, by mitigating banks' risk-taking incentives, prudential policy should offset the negative effects of an accommodative monetary policy (Gertler and Karadi, 2011).

Nevertheless, two problems appear immediately. The first one is that prudential policy can be constrained by the nature of monetary policy (Agur and Demertzis, 2012). For example, bank capital standards are less stringent in times of economic growth fostered by a low interest rates policy. The second one is that prudential policy can also affect the real economy and may conflict with monetary policy objectives. Thus, the increase in constraints on bank capital (microprudential approach), the introduction of maximum leverage or a counter-cyclical capital buffer (macroprudential approach) can limit the volume of credit, increase financing constraints and have an impact on the economic activity and on the level of inflation. Therefore, the interactions of these two policies raise the question of the coordination of the two policies for a satisfying outcome for the economic and financial spheres.

We make a literature review of theoretical studies on the conditions for the emergence of a monetary policy risk-taking channel and its links with prudential policy. The identification of such a channel is at the heart of the question of a possible trade-off between the different economic policy objectives and therefore their coordination. Many empirical studies have already identified the existence of such a channel and confirm the

series: seven interest rate series, six yield spreads and five other indicators. The CISS is an alternative tool to the FSI and includes 15 mostly market-based financial stress measures equally split into five categories, namely the financial intermediaries sector, money markets, equity markets, bond markets and foreign exchange markets.

negative effect of low interest rates on bank's risk-taking appetite.³ The lower the interest rates, the more the banks take risk. Nevertheless, it appears that there is not a consensus among theoretical works on this issue. On the one hand, monetary easing whets banks' risk appetite through various channels: the (bank's and the borrowers') balance sheet channel (Bernanke and Gertler, 1989; Rajan, 2005) and the liquidity channel (Diamond and Rajan, 2006). On the other hand, other studies show that monetary easing can be beneficial for banks and would limit their risk-taking. Lower interest rates reduce the bank's opportunity and refinancing costs and increase its franchise value (Smith, 2002; Agur and Demertzis, 2012; Korinek and Simsek, 2016). In this sense, banks are encouraged to reduce their risk following a decrease in interest rates. However, the effects of a low interest rate policy will be different depending on whether banks can adjust or not their capital level (Dell'Ariccia et al., 2014). De Nicolò et al (2010) highlight two opposing forces that play a role in the risk-taking channel: the search for yield effect and the risk transfer effect. While the first effect results in a greater risk taking following the fall in interest rates, the second effect produces the opposite result. The decrease in interest rates leads to a decrease in the cost of the bank's liabilities. Then, the bank, in order to capture the maximum gains from the success of its investments, is encouraged to invest in less risky assets and therefore to take less risk. In a nutshell, we can imagine that the impact of monetary policy on bank's risk is non-linear and depends on some factors that need to be identified.

In addition, the existing literature proves that, even if monetary and prudential policy should focus on its respective objective and be conducted by two separated institutions or not, they inevitably interfere and should be coordinated. Even if this point of view is now widely shared, there is no room for the positive effects of monetary policy easing or for negative effects of monetary policy contraction on the bank's risk-taking behaviour. Monetary policy easing in theoretical models is considered as a factor of bank's risk-taking and a threat to financial stability. The question of the impact of monetary policy on the financial stability and the expected cost of crisis resolution in presence of prudential policy is still left open.

We propose to organize this paper as follows. Section 2 presents the prudential instruments aimed at disciplining banks and ensuring the stability of the system. Section 3 discusses the potential effects of monetary policy on the bank's risk-taking behaviour. We examine how the two policies interact and discuss their coordination in section 4. Then, section 5 concludes.

2 Prudential policy and bank's risk-taking

Banks are considered as important agents for the economy. They fulfill specific roles as consumption Smoother (Diamond and Dybvig, 1983), information producer (Leland and Pyle, 1977; Campbell and Kracaw, 1980), monitor (Diamond, 1984) and liquidity provider (Acharya and Mora, 2015). However, banks are prone to some threats such as bank run and contagion (Diamond and Dybvig, 1983; Jacklin and Bhattacharya, 1988; Chari and Jagannathan, 1988; Schoenmaker, 1996) and excessive risk-taking (Altavilla et

³For a synthesis of the empirical studies, see Gambacorta (2009).

al., 2020).⁴ Let's add that the bank's excessive risk-taking can be amplified by many other factors such as the opacity and the long maturity of bank's assets, moral hazard, banking competition the deposit insurance and the wide dispersion of bank's funds providers, and translate into "gambling for resurrection" strategies (Diamond and Rajan, 2011).⁵

Therefore, some actions are required in view of maintaining the soundness of the banking system. In fact, due to information asymmetry and moral hazard, banks could behave such as to maximize their private profit at the expense of depositors and other creditors. The bank's risk-taking behaviour can translate into a search for yield (investing in riskier projects), granting loans to risky borrowers, reducing the monitoring effort, etc. Hence, the banking sector has proven to be the more prone to threats to stability than other sectors of the economy. As state by Gorton and Winton (2002) "*banks and panics are inherently intertwined*" (p. 64). It is then necessary to introduce and to develop prudential measures that aim at fostering individual bank's soundness, mitigating the occurrence and the magnitude of crises, and at protecting depositors.

In the following sub-sections, we present the development of prudential tools, their use and effectiveness.

2.1 The development of prudential tools

The preceding threats against the financial stability have led policymakers to implement and to reinforce prudential policy. The latter includes microprudential and macroprudential measures, and aims at preventing banks from taking more risk and at fostering financial stability. There are several prudential tools and each of them transmits to the real economy through different channels. To better understand the transmission channels of prudential tools it appears important to identify each of them.

2.1.1 The prudential tools

It is admitted that banks are prone to idiosyncratic risk but to systemic risk as well. As a result, the regulator in order to prevent threats to financial stability should disentangle idiosyncratic risk, which stems from specific problems in individual banks, from systemic risk.⁶

Mitigating this idiosyncratic risk, which is assumed to be exogenous, is the main objective of microprudential regulation. However, financial stability is not guaranteed by the only microprudential policy since solving individual bank moral hazard problem does not suffice to tackle systemic risk. The macroprudential policy complements the microprudential policy in that way since macroprudential tools target systemic risk, which is endogenous and has two dimensions: a time-varying dimension and a 'structural' dimension.⁷ In this sense, following Borio (2003), we can feature each side of the prudential

⁴Altavilla et al. (2020) distinguish between productive risk-taking and excessive risk-taking. They define the latter as the loan origination towards risky firms ("*firms with a large share of their loans and not improving over time*").

⁵However, Bandaranayake et al. (2020) find that competition in the banking sector has an economically negligible effect on financial stability.

⁶According to IMF (2009) systemic risk can be defined as "*a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and that has the potential to cause serious negative consequences for the real economy*".

⁷According to Galati and Moessner (2018) the time-varying dimension captures the procyclicality

policy as presented in Table ??.

Table 1: Macroprudential approach versus Microprudential approach

	Macroprudential approach	Microprudential approach
Proximate objective	Limit financial system-wide distress	Limit distress of individual institutions
Ultimate objective	Avoid output (GDP) losses	Consumer (investor/depositor) protection
Model of risk	(in part) endogenous	exogenous
Correlations and common exposures across institutions	Important	Irrelevant
Calibration of prudential controls	In terms of system-wide distress; Top-down	In terms of risks of individual institutions; Bottom-up

Source: Borio (2003)

However prudential tools can be separated in 3 main groups depending on whether they focus on capital, liquidity and credit.

Tools related to bank capitalization are the capital requirement ratio, the leverage ratio, the counter-cyclical capital buffer and the capital conservation buffer. The capital requirement, usually expressed as equity as a percentage of risk-weighted assets, is the first pillar of prudential regulation. It was introduced in Basel I and focuses on the quality of banks' capital to ensure the resilience of individual financial institutions (microprudential view of regulation).⁸ It was revisited by Basel II by increasing the sensitivity of the capital requirement to the risk of the bank's assets. But the Basel II capital requirement still has some limits.⁹ To deal with these shortcomings, Basel III introduces a leverage ratio which does not depend on the assets risk. The leverage ratio (which could be understood as the ratio of bank capital over total assets and measures the amount of protection provided to the bank by its equity) is an instrument of both micro- and macroprudential regulation since it allows managing the total credit volume in the economy while fostering the bank's soundness.

Moreover, macroprudential policies have a preventive role aimed at avoiding the excessive build-up of systemic risk over time, which in practice may also give these policies a macroeconomic stabilization dimension.¹⁰ This is the reason why the regulator introduces the "*The counter-cyclical capital requirement*" which addresses the procyclicality problem of the existing capital requirement and is composed of a counter-cyclical capital buffer and a capital conservation buffer. Albeit the constitution logic of counter-cyclical capital buffer and the capital conservation buffer are similar, the provision of the counter-cyclical capital buffer depends on the appreciation of the credit growth by the regulator.¹¹ This capital buffer is counter-cyclical since it allows banks to

of the financial system, while the 'structural' dimension focuses on the interconnectedness of individual financial institutions and markets, as well as their common exposure to economic risk factors.

⁸The Basel I agreements focuses on requiring banks to build regulatory capital of at least 8% of risk-weighted assets.

⁹See for instance Lannoo (2001) and Hakenes and Schnabel (2011).

¹⁰For example, it is likely that macroprudential policy will be eased during downturns and tightened during upturns. In this sense, macroprudential policy also embeds a counter-cyclical component.

¹¹In case of excessive credit growth, the regulator could require the provision of an additional capital

absorb negative shock while limiting the importance of a credit crunch, and at the top of the cycle it allows slowing the credit growth. The implementation of such additional capital provisioning belongs to the national regulator, knowing that the provision can be up to 2.5% of risk-weighted assets depending on the assessment of the regulator of the credit growth and the underlying systemic risk (Basel Committee, 2010). The capital conservation buffer is a capital provision (in addition to the minimum capital requirement) during a period of absence of stress in order to absorb probable future losses (Basel Committee, 2010). This means that a capital conservation buffer is automatically set up during good times to prevent regulatory capital from being affected during a crisis.

With Basel III, the regulator possesses another measure related to bank capital: the dividend restriction (or retains earnings). Retains earnings allow banks to easily build up conservation and countercyclical buffers. Moreover, retains earnings avoid banks to send a bad signal on the market since external refinancing could be interpreted as a financial distress by investors (Giese et al., 2013). Furthermore, this measure may increase the bank's incentive to monitor since it increases the bank's stake in the game. Other measures exist and consist of capital surcharges for "too big to fail" institutions, competition regulations, reserve requirements, limits on interbank exposures, restrictions on foreign currency lending.¹²

The prudential measure dealing with liquidity is the implementation of two liquidity ratios under Basel III: the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR). As financial intermediaries, banks finance long-term assets with short-term resources (mainly deposits and short-term borrowings). But this maturity mismatch could lead them to severe liquidity problems. These two liquidity ratios can be seen as a way to deal with maturity matching issues (Lim et al., 2011). Albeit liquidity remains a vague notion and is difficult to measure (Pollin, 2012), the liquidity requirements imply that banks possess liquid assets that can help them to meet their commitments if needed.¹³

To control for credit risk, the regulator introduces respectively cap on the debt-to-income ratio (*DTI*) and cap on the loan-to-value (*LTV*). *LTV* and *DTI* caps may reduce the borrower's probability of default, by imposing borrowing constraints. These two tools aim at both counteracting the credit boom and matching credit supply to the quality of credit demand. The *LTV* and *DTI* limit the bank's exposure to risk.

to curb the credit growth and to prevent systemic risk.

¹²According to Basel Committee (2014) "*The G-SIB surcharge (along with other components such as the countercyclical capital buffer as applicable) expands the 2.5% capital conservation buffer, which is subject to a three-year phase-in period.*"

¹³The *liquidity coverage ratio* (LCR) focuses on a short term time horizon. It is composed of two constraints related to *high quality liquid assets* (henceforth, *HQLA*), i.e. assets that can be transformed into cash to meet cash outflows for a 30-day period (Basel Committee, 2013), capital inflows and outflows. To be considered as *HQLA*, an asset must have low risk and volatility, be easier to assess, be less correlated to asset risk, etc. Moreover, the consultative document of Basel III stipulates that the LCR aims at favouring the short-term resilience of banks (regarding their liquidity risk), ensuring banks sufficient *HQLA* to stand a crisis over 30 days. According to Pollin (2012), a way for banks to comply with this constraint is to increase the maturity of the liability side.

The *net stable funding ratio* (NSFR) establishes the principle of balancing the bank's budget: long-term resources must cover long-term commitments. According to Pollin (2012), this ratio ensures the consistency between liabilities and the liquidity of assets. The Basel Committee (2014) sets the minimum NSFR requirement at 100%. The NSFR is the ratio of the amount of available stable funding to the amount of required stable funding.

They require banks to only partially finance projects. The DTI requires the bank to appreciate the capacity of a borrower to support the credit charges given its revenue, while the LTV requires banks to limit their exposure in case of a mortgage loan. It obliges banks to grant credit up to a fraction of the collateral. The higher the LTV the higher the counter-party credit risk.¹⁴

At this stage, it should be noted that macroprudential policy is the set of measures aiming to ensure the stability of the financial system as a whole. To achieve this, the regulator possesses many tools that can be combined or used in isolation. In other words, prudential tools often complement such that there is not a one-to-one matching between prudential tools and externality. These tools focus mainly on the systemic risk and address it not only in its cross-sectional (interconnection between banks) and time dimension (counter-cyclical measures) but also in the lender and the borrower dimensions.

However, for the prudential policy to be effective, the transmission channel of its tools should be known and controlled. In the following development, we will give an overview of different channels through which prudential policy could transmit to real economy.

2.1.2 The transmission channel of prudential tools to the economy

The macroprudential tools essentially aim at limiting the rise of endogenous risk. In this subsection, we examine how a prudential shock (loosening or strengthening constraints) helps to ensure the resilience and the stability of the financial system.

While many studies have examined the transmission channels of monetary policy, very few have focused on those of prudential policy.

The regulator may use the anticipation channel to drive the financial agent's behaviour. This channel (the anticipation channel) is an important channel through which macroprudential instruments operate (New Zealand Central Bank report, 2013; henceforth (NZCB, 2013)). Based on Lucas's rational expectations theory that individuals make decisions based on available information, since they are able to anticipate the consequences of economic policies, it is therefore possible for the regulator to obtain from financial actors the desired behaviour. Through the policy signal which it sends, the regulator may align the behaviour of financial agents (mechanism qualified of "moral suasion"). Thus, the regulator by disclosing the information on the evaluation of systemic risk, manages to persuade financial institutions to modify their behaviour and to act in the desired direction. The credibility of macroprudential tools, however, remains the bedrock of effective moral suasion. The deployment of macroprudential tools provides a stronger signal than the mere declarations of the regulator (actions are better than words).

The different channels identified in this report are based on three tools dealing respectively with the regulatory capital, the liquidity and the asset market (asset prices).¹⁵

The strengthening of the regulatory capital composition requirements, by increasing the share of common stocks and reserves, leads banks to increase their long-term resources

¹⁴The *loan-to-value ratio* is the ratio of the mortgage amount to the appraised value of the property.

¹⁵It is worth noting that the transmission channels of prudential tools are different depending on whether they are aimed at lenders (e.g. capital requirements, dynamic provisioning, etc.) or borrowers (LTV, DTI, etc.). They also differ depending on whether the measure is global or sectoral (for more details see NZCB (2013)).

and deposits, but to shrink their assets volume (known as “credit crunch”). As a result, the capital buffer increases. The reaction of banks leads to a re-evaluation of the credit, with a negative impact on both the demand and supply of credit. Hence, the regulatory capital requirement, by affecting agents’ expectations, mitigates risk and reinforces the resilience of the financial system. In fact, following the reinforcement of the capital constraint, households anticipate a rise in the credit cost. Then, credit growth slows down. The drop in credit demand implies a fall in the supply of credit, and thus ensures a better resilience to the system.

The same transmission mechanism could also be found when the countercyclical capital requirement is tightened. The only difference is that this measure results in a better ability of banks to absorb losses. The resilience of the system is therefore ensured if banks choose to improve their capacity to absorb losses either by increasing their capital or by lowering their credit activity.

By increasing the core funding ratio, countercyclical capital buffer (or for a specific sector) requirements help to smooth financial cycle. Banks could issue equity or retain earnings. Compared to the strengthening of the countercyclical capital buffer, the increase of a sectoral countercyclical capital buffer appears more effective since the ability of banks to raise external funds reduce considerably. Banks do not have to fund a sector declared as risky by the regulator, and thus, they do not have to raise funds.

If the increase in the preceding requirements (core funding ratio and counter-cyclical buffer) spreads in the banking circuit (change in banking behaviour) and in the credit market, the implementation of a threshold on the Loan-To-Value ratio (LTV) directly impacts the agents’ expectations, as well as the credit market. Households modify their credit demand with respect to the perceived signal on the LTV ratio. If it turns out that the next LTV cap would reduce their debt capacity, then households will increase their demand for credit. The tightening of the restrictions on the LTV ratio leads to a fall in the demand for credit, and thus a fall in asset price (because households buy less). Moreover, the increase in the LTV ratio leads to the reinforcement of the collateral requirements (value of collateral required higher than before), and therefore a decrease in the loss (for the banks) in case of default (Loss Given Default) (NZCB, 2013).

In addition, macroprudential policy can spread in the economic and financial sphere through other channels such as the allocation channel and the signal channel (Giese et al., 2013) .

The allocation channel can be considered as the channel of capital. Indeed, it consists for the regulator to address financial agents’ constraints and motivations through the regulatory capital requirement. On the one hand, in the event of a credit boom, the rise in the counter-cyclical buffer limits the credit bubble and strengthens the resilience of the financial system. On the other hand, during a recession, the decline in the counter-cyclical buffer can help supporting credit supply, safeguard market confidence, and foster growth. This channel is close to the channel of anticipation as previously discussed.

The signal channel reflects the role that has information provided by macroprudential authorities. The regulator enables better decision-making by financial agents, through the disclosure of signals on the costs and profits of alternative actions. Banks that are considered poorly capitalized should use the information contained in clear and objective standards to recapitalize. Indeed, the presentation of clear standards allows banks to assess their capitalization and take the necessary measures to comply with the requirements.

In sum, prudential tool transmit to the economy through different channels.

However, the facility with which they transmit to the economy will determine their use and effectiveness.

2.2 The use and effectiveness of prudential tools on the economy

We have shown in the preceding development that prudential tools are diverse and transmit to real economy through different channels. Therefore, it appears that their effectiveness in ensuring financial stability also differs. While most studies describe macroprudential policies, Cerutti et al. (2017) focus on which policies are actually used across a large set of countries. These authors also analyse which policies are most effective in reducing procyclicality in financial markets and associated systemic risks. They find that macroprudential policies are used more frequently in emerging economies, with foreign exchange-related policies. Borrower-oriented macroprudential tools (such as caps on loan to value (LTV) and debt to income (DTI) ratios) are used relatively more in advanced countries. In regards to the effectiveness of macroprudential policies, Cerutti et al. (2017) find that limits on LTVs and DTIs, and financial institutions-based policies (such as limits on leverage and dynamic provisioning) appear to be especially effective in alleviating growth rates in credit and house prices.

If the prudential tools are largely used, their effectiveness is not yet well understood for at least three reasons. First, in a theoretical point of view, there is a lack of a consensus about the modelling framework of the nexus between financial and macroeconomic spheres. Second, it is difficult to accurately assess the effectiveness of prudential measures insofar as they are jointly used with other policies. Third, the fairly recent implementation of macroprudential tools (in the aftermath of the 2008 financial crisis) makes it hard to accurately assess their effectiveness. Besides, for example in the European Union, the effectiveness of macroprudential policy is hard to assess since, as noted by Nettekoven (2020), the same macroprudential measure is sometimes used for different macroprudential objectives by member states, or different macroprudential measures are used for the same macroprudential objective. However, it is widely recognized that macroprudential policies are effective in ensuring stability at some extent. For instance, Lim et al. (2011) show that the procyclicality of credit and leverage is reduced by prudential tools such as LTV and DTI limits, reserve requirements and ceiling on credit growth. Capital inflows in emerging markets is reduced by the use of reserve requirements when there are floating exchange rates (IMF, 2013c). IMF (2013c) also evidences that macroprudential tools negatively impact house price appreciation rates and credit growth. Moreover, macroprudential policy limits the risk that a bust occurs and the shock that could hit the real economy due to financial turmoil (Dell’Ariccia et al., 2012). Studying the effects of macroprudential tools on diverse economies since 2000, Zhang and Zoli (2016) find that these tools are effective to varying degrees, with most effect for LTV caps and measures aiming at limiting the credit growth, capital flows and house price growth (see also Cerutti et al. (2015) and Oh (2013)). The LTV caps allow the regulator to reach two simultaneous goals: reduce bubble frequency and strengthen the financial stability by limiting the credit boom during good times. Furthermore, dynamic provisioning appears effective in smoothing downturns and ensuring credit availability during recession. Bruno et al. (2017) evidence that macroprudential policies are more successful when they complement monetary policy by reinforcing monetary tightening than when they act in opposite directions.

However, prudential regulation presents some limits since some agents remain

unregulated. As enlightened by Levy-Garboua and Maarek (2014), the preventive side of macroprudential policy is inefficient since some activities are out of its scope, such as shadow banking. These financial agents are important as they can impact the financial system by spreading the risk to the banking system. Other sectors such as insurance and pension funds also escape. As Dirks et al. (2014) say, these two financial actors have important balance sheets and could be sources of instability for the financial system. That is, they deserve more attention for the regulator.

In addition, numerous studies show that more stringent regulations could lead to a rise in the cost of capital and to a credit crunch (Jeanne and Korinek, 2013; 2014; Pollin, 2012; Levy-Garboua and Maarek, 2014; European Central Bank, 2013 (henceforth, ECB (2013))). As these authors show, a strict capital requirement drives poorly capitalized banks to search for funding in financial markets. However, according to the pecking order theory developed by Mayer and Majluf (1984), market funding remains the last resort for any organization. This type of funding sends a bad signal to the market, and leads to mistrust of investors and to higher risk premium. This translates into an increase in the bank's funding costs. To avoid such a cost, banks are more inclined to reduce their assets. This inevitably leads to credit rationing. In a study, the ECB (2013) highlights the risk of a vicious circle in which a restrictive regulation plunges corporate and the economy. Restrictive capital requirement leads to a credit crunch, higher funding costs and disinvestment. There is a slow down of economic growth. Firms face more difficulties, leading to an increase in the risk perception. The increasing risk perception leads to an increase in the funding costs, deepening the credit crunch.

But the impact of the regulations differs according to the types of asset, customers and financial institution. In fact, Pollin (2012) show that the effects of macroprudential regulation will differ according to the maturity and risk of each asset, the characteristics of the investments, the sensitivity of the borrowers to the interest rates, the type of the borrower (household or corporate) and the quality of the financial institution (well capitalized or not).

Furthermore, micro and macro approaches of prudential regulation can be complementary, but conflicting as well (BIS, 2018). The complementarity between the two approaches of banking supervision stems from the fact that macroprudential measures are often blunter than microprudential ones. Counter-cyclical macroprudential measures are softened uniformly across all banks during downturns, leading to undesirable results. For instance, unhealthy banks may be kept alive due to such policy easing and discourage lending on the interbank market. Microprudential policies can alleviate such undesired effects. Moreover, macroprudential policy may fail in ensuring a sound financial system because of collective moral hazard (see Fahri and Tirole, 2012). For instance, if financial institutions anticipate that requirements will be softened in the downturn, they will have ex-ante incentives to collectively take more risk. According to individual bank risk, microprudential requirements on banks can be tightened, then banks would be discouraged from taking more risk in isolation. In this sense, microprudential policy can mitigate collective risk.

The macroprudential goals may conflict with microprudential ones. We can imagine that, in a boom, as individual banks seem to be sound, bank supervisors may consider regulatory requirements tightening unnecessary, while procyclicality and aggregate risk-taking concerns may lead macroprudential authorities to tighten prudential instruments. Conversely, in a downturn, seeking to mitigate the impact on the economy, the macroprudential authorities could wish to release buffers, while bank supervisors

may prefer that institutions preserve as much capital as possible so as to better absorb their losses (BIS, 2018).

However, it is worth noting that prudential policy is not the only one that affects bank's risk-taking behaviour. Monetary policy is another one and we discuss its effects on the bank risk in the following section.

3 Monetary policy, bank's profit and risk-taking

The correlation between interest rates and bank's profit are mostly admitted to be positive. Higher interest rates may induce higher bank's revenues. This mindset focus mainly on the asset side of the bank's balance sheet. It ignores the fact that banks have also costly funding, and that the higher the interest rates the higher the bank funding costs. Therefore, interest rates may have ambiguous effects on the banks' profit generally assessed by the net interest margins (difference between bank's interest income and interest expense expressed as a percentage of average earning assets).

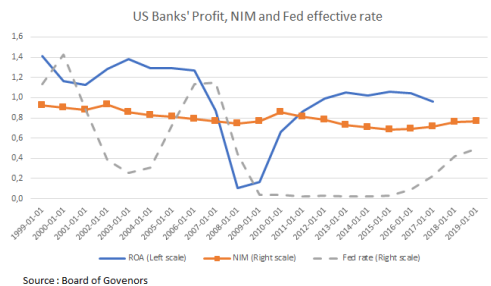
In the same vein, monetary policy, by impacting bank's profit, may drive bank's risk-taking behaviour. Most studies have focus on this issue and can be gathered under the so-called *"risk-taking channel of monetary policy"*.

In this section, we will review the literature on the impact of interest rates on respectively bank's profit and bank's risk-taking.

3.1 The impact of monetary policy on bank's profit

As we have already stated, it is believed, rightly or wrongly, that market rates and bank's profit are positively correlated. In this sense, banks are thought to be more profitable during monetary contraction, and to face margin and profit losses during monetary loosening. However, as depicted in Figure ??, the bank's profit appears to be negatively correlated to interest rates.

(a) Fed effective rate and banks' profit and NIM in the U.S



(b) short-term interest rates and banks' profit and NIM in the euro area

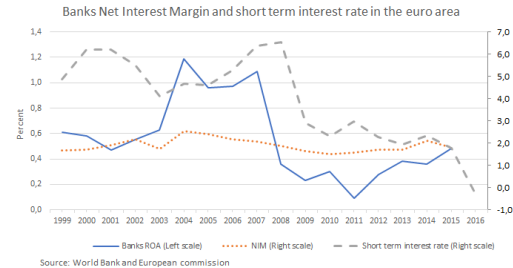


Figure 2: Interest rate and banks' profit and NIM

Sub-figures ?? and ?? depict the short-term interest rates and bank's profit and net interest margin (NIM) in the U.S and the euro area. Albeit, interest rates and banks' NIM curves are mostly downward trending, they are not synchronous most of the time. Looking at sub-figures ??, it is clear that large declines in the Fed effective interest rates appear during recessions (the 2001 dot-com bubble and the 2008 financial crisis) and coincide, surprisingly, with increase in banks' NIM. But after the crisis, as interest rates

continued to fall, then banks' margins decrease as a result. However, from 2015, Fed effective interest rates and bank's margins start to move in the same direction. The same analysis can be made on the movements of interest rates and banks' NIM in euro area (sub-figures ??). The negative correlation between market rates and banks' NIM is more pronounced in the euro area. Nevertheless, we observe that they start to move in the same direction from 2014.

Questioning the relation between interest rates and bank's NIM, Ennis et al. (2016) find no support to the premise that higher rates will produce wider net interest margins. The "maturity mismatch" appear to be the key factor explaining the impact of interest rates on bank's net interest margin. The policy rate may have a greater impact on bank's liabilities (short maturity) than on its assets (longer maturity). While the rates on long-term loans may remain stable, increase in market rates may increase bank's funding costs, leading to a decrease in the NIM. Another element that may determine the impact of interest rates on banks' net interest margin is the bank's market power. If banks have the possibility to control interest spread, then it will be possible to have a positive correlation between market rate and NIM. This may be facilitated by the price insensitivity of depositors. Furthermore, the zero lower bound (ZLB) on nominal interest rates may support a positive relation between interest rates and bank's NIM. Approaching the ZLB, the interest spread narrows considerably since banks cannot charge negative interest rates on deposits. In such environment, rising market rate may induce increasing NIM.

Nevertheless, the monetary environment may determine the impact of interest rates on bank's NIM and profitability. For instance, Claessens et al. (2017) find that interest rates asymmetrically impact bank's NIM and profitability, according to the monetary environment. Globally, decreasing interest rates narrow bank's NIM since interest incomes fall more than interest expenses. This may suggest that banks reprice their assets more actively than their liabilities. However, there is no significant impact of interest rates on bank's profitability (measured by the ROA). More precisely, the adverse effect on NIM is more pronounced in a low interest rates environment. As stated above, near the ZLB, banks hardly reduce their funding rates while still passing on more of the low interest rates to borrowers. There is also a difference in the banks' react according to their size. Small banks appear to be more affected in low interest rates environment than large banks, maybe because they mainly rely on deposit funding (Claessens et al., 2017). Furthermore, the longer the interest rates remain low the more negatively impacted are the bank's NIM and profitability. As outlined by Claessens et al. (2017), these results could be explained by the fact that banks have assets which reprice over 1 or 2 years. So, lower interest rates take time to translate into lower NIMs. This may explain the unusual period depicted in sub-figure ?? from 2010 to 2015, where NIMs have continued to fall while the fed effective rate has been relatively stable at historically low level. Moreover, banks may only partly offset in the short and medium term the negative effect of NIM on profit by generating non-interest revenue or diminishing their interest expenses.

Borio et al. (2017), investigating how monetary policy affects bank profitability, find a positive and non-linear relation between market rate and bank's profit and NIM. Their analysis, on over 70% of worldwide bank assets as reported in the *Banker Magazine* from 1995 to 2012, establishes that NIM is positively linked to the level of the short-term rate and the yield curve slope, and that this relation is concave. This means that changes in short-term rate have a larger impact when it is close to zero. In the same vein, they establish a positive link between interest rates and banks' profit, meaning that the positive

effect on NIM may be stronger enough to offset the negative effect on non-interest income and provisions. Moreover, the effect of interest rates on banks' profit is stronger in a low interest rates environment. In a nutshell, we can conclude that monetary policy has non-linear effects on banks' interest revenues and profits.

Time horizon appears to be a factor explaining the effect of monetary policy on bank's profit. Aydemir and Ovenc (2016) find that short-term rates and the slope of the yield curve significantly affect Turkish banks' profits both in the short and the long run. These effects differ based on the time horizon. In the short run, short-term interest rates and the slope of the yield curve negatively impact banks' profits. However, these impacts turn out to be positive in the long run.

Since monetary policy impacts banks revenues and profit, we are well founded to think that it may also drive banks' risk-taking behaviour. In the next subsection, we develop the main idea and findings in the existing literature on this question.

3.2 The bank's risk-taking channel of monetary policy

The risk-taking channel (henceforth RTC) of monetary policy refers to "*the notion that interest rates policy affects the quality and not just the quantity of bank credit*" (Dell'Ariccia et al., 2016). Said differently this channel refers to any change in perception and tolerance of risk by agents (Borio and Zhu, 2012). Monetary policy mainly transmits to the financial system through three main channels: the bank's and the borrower's balance sheet channels and the liquidity channel. The magnitude of the first two channels are exacerbated by the "financial amplification" mechanism: the deterioration of credit conditions amplifies any negative shock to the economy (Bernanke and Gertler, 1989; Bernanke et al., 1996)

In order to better understand the relationship between monetary policy and bank's risk-taking, we present successively theoretical developments and some empirical works carried out so far.

3.2.1 Theoretical evidences of the risk-taking channel

Some theoretical studies try to explain how monetary policy impacts bank's risk-taking through the borrower's and bank's balance sheets and the bank liquidity.

The borrower's balance sheet channel

Monetary policy affects borrowers net wealth and induces risk-taking. Importantly, monetary policy modifies the financial position of the borrowers in two direct ways. On the one hand, the rise in interest rates leads to an increase in interest charges on outstanding loans, reducing the net cash flow of borrowers and their solvency. On the other hand, the rise in interest rates leads to lower asset prices and a deterioration in the asset's value. This is followed by a tightening of financial constraints (due to the loss of collateral value) and deleveraging.¹⁶ In this sense, a monetary easing increases the borrower's creditworthiness

¹⁶This mechanism refers to what Bernanke and Gertler (1989) describe as debt-deflation. Following an unexpected fall in prices, access to credit for borrowers would fade or suddenly harden. This would negatively modify the supply and demand for credit and would exacerbate the fall in prices, the mechanism

and then allows “bad borrowers” to enter the credit market (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997). As interest rates decrease, assets price increases and borrowers become richer. For the same amount of assets used as collateral, borrowers access a larger amount of financing. As the overall borrower’s solvability (“fictitiously”) improves, the supply of credit increases and financing costs reduce (Bernanke and Gertler, 1989).

Moreover, monetary policy changes agents’ preferences between holding liquidity or investing (Gilchrist and Leavhy, 2002). The decrease in monetary rates reduces the profitability of holding liquidity and leads households to withdraw and increase their consumption and investment. In turn, the rise in demand for assets induces inflation (bubble formation) while the assets valuation leads to a misperception (underestimation) of probability of default (Borio and Zhu, 2012). This implies an increase of investment in risky assets that would not be financed without this inflation.

If monetary policy changes the wealth of borrowers, it can also impact the wealth of lenders, namely banks.

The bank’s balance sheet channel

Monetary policy affects banks’ balance sheets via two sub-channels: the credit channel and the bank capital channel, driven by an assets substitution, the pro-cyclicality of the bank leverage and the search for yields (Bernanke et al., 1996; De Nicolo et al., 2010; Adrian and Shin, 2009; Rajan, 2005).

Assets substitution implies that following a decline in the monetary interest rates, the return of risk-free assets decline and banks substitute risky assets to risk-free assets until the returns of the two types of assets equalize (De Nicolo et al., 2010).¹⁷ This asset substitution effect is reinforced by “search for yield” which acts on the liabilities side of the banks’ balance sheet. Rajan (2005) explains that the fall in the interest rates makes it difficult for the bank to meet its obligations to its creditors.¹⁸ Facing the decline in profitability, banks would rather invest in highly risky (highly profitable) assets in order to maximize profitability and ensure depositors’ remuneration. Besides the substitution and search for yield effects which imply change in the quality of originated loans, there is also a volume effect. As monetary easing improves bank’s equity, banks’ ratios over-perform the regulatory ratios, leading banks to take additional risk while still complying with the regulation (Adrian and Shin, 2009; Agur and Demertzis, 2012). This effect is amplified by limited liability. Following monetary easing, banks would invest in riskier projects, letting the creditors bear the risk in case of a failure. This analysis is consistent with the risk-shifting effect (see De Nicolo et al., 2010).

It is worth noting that bank capitalization is also a factor that determines the effects of monetary policy on bank’s risk. If the capital structure is set exogenously, a fall in interest rates leads highly capitalized banks to take more risk, while the opposite effect occurs for high-levered banks (Dell’Ariccia et al., 2014).

Finally, there is a “Greenspan put” effect involving the effects of monetary policy on the risk taking of agents via expectations. If agents anticipate a decline in interest rates

repeating itself in a loop.

¹⁷The hypothesis of bank’s limited liability, bank’s neutrality or non-aversion to risk are important for this effect to reveal.

¹⁸The decrease in the monetary rate drives the decrease of the lending rate, while the deposit rate remains almost constant.

in the event of difficulties in the future, then they will take more risk today. This means that a high interest rates would be associated with greater risk taking (De Nicolo et al., 2010).

If monetary policy impact bank's lending activity, it may also affect the bank's liquidity.

The liquidity channel

Liquidity can be defined as the ability of the bank to meet its current commitments without affecting daily operations or financial conditions.

The liquidity channel is identified by Diamond and Rajan (2006) as a rather close version of the bank lending channel. In their activity, banks do not only do maturity conversion, but they also do liquidity conversion. They use liquid deposits to finance illiquid assets. Banks are therefore subject to a risk of illiquidity if savers decide to simultaneously withdraw their funds. That could be the case if the demand for money by economic agents (for transaction purposes) is greater than the supply of money. Thus, monetary policy is an important element that affects the capacity of banks to finance the economy and exposes them to illiquidity risk. An expansionist monetary policy aims to satisfy a demand for money and to maintain satisfying liquidity conditions on the markets. Relying on liquidity conditions, banks tend to finance long-term projects, while their liabilities (the deposits) have a short-term horizon. Therefore, this has a negative effect on the soundness of the financial system since banks may become insolvent in case of a massive withdrawal of deposits. In other words, monetary easing increase the risk that banks face insolvency problems in the event of monetary contraction.

The preceding transmission mechanisms of monetary policy (balance sheet and the liquidity channels) are described for conventional monetary policy. Therefore, it is then necessary to understand how monetary policy affects bank's risk-taking behaviour during unconventional periods.

The monetary RTC under unconventional monetary policy

Unconventional monetary policy may change how interest rates affect bank's risk.¹⁹ The RTC, developing through risk perception and risk tolerance (see Adrian and Shin, 2009; Borio and Zhu, 2012) and the "*search-for-yield*" effect (Rajan, 2005) may be amplified in the negative interest rates environment. On the one hand, negative interest rates may impact the interest rates channel.²⁰ The negative interest rates environment triggers some heterogeneity in the banking system as it prevents mostly deposit-funded banks from fully adjusting their funding costs. In fact, when the zero lower bound (ZLB) is crossed, interest rates on deposits cannot be further adjusted, inducing a change in the standard transmission mechanism. The resulting contraction of profit margins may

¹⁹Monetary policy is considered as unconventional when exceptional measures are introduced in response to the inability to the standard nominal interest rates to play its role. Unconventional measures deal with negative interest rates, credit easing (purchasing private assets), forward guidance (public communication about the future monetary policy stance), helicopter money (permanent increase in the money supply) and negative interest rates (nominal interest rates below zero).

²⁰According to the standard interest rates channel, a change in the policy rate is transmitted to deposit and loan rates through the banking system.

impair the standard interest rates channel because banks that mostly rely on deposits, for profitability reasons, might start raising interest rates charged on loans instead of lowering them in response to a policy easing to protect their profit margins (Demiralp et al., 2019).

On the other hand, while some authors consider that the bank lending channel is ineffective or is broken down in negative interest rate territory (see Borio and Gambacorta, 2017; Eggertsson et al., 2017), this channel is strengthened instead for two main reasons (Demiralp et al., 2019). First, negative interest policy is assimilated to a charge on reserves that may incentivize banks to extend more loans in an effort to reduce their reserve holdings. Second, due to the ZLB on deposit rates, there is a decrease in the opportunity cost of holding retail deposits and an increase in the demand for deposits. Then, banks may issue more loans in response to this increased deposit funding.

After reviewing some of the theoretical supports to the monetary risk-taking channel, it is interesting to have an overview of the empirical studies assessing this channel.

3.2.2 Empirical studies on the monetary risk-taking channel

While the theoretical works on the risk-taking channel have been elaborated decades before, it is only recently that empirical studies on the subject emerge. They deal with the balance sheet channel, the ex-ante and ex-post bank's risk. The ex-ante bank's risk refers to the risk taken when granting loans, i.e. the credit quality at the loan origination. We refer to ex-post risk, the risk that materializes after the loan origination, i.e. the risk (and/or the change in the risk level) of outstanding loans.

Empirical studies on the balance sheet channel of monetary policy

In order to understand how the bank lending channel of monetary policy work, Kashyap and Stein (2000) test if the impact of monetary policy on lending behaviour differ among banks in regard to the liquidity. They find that small banks are more sensitive to monetary shocks, especially banks with low liquidity. In addition, banks whose debtors are highly sensitive to monetary shocks hold very little liquid assets.

In the same vein, Den Haan et al. (2007) examine the behaviour of banks loan portfolio components (business loans, mortgages, and household loans) in the event of monetary and non-monetary shocks (productivity shocks). Using VAR models, they show that, following a monetary contraction, mortgages and household loans decline considerably, while the response of credit to enterprises is positive. Moreover, taking the balance sheet channel into account, a monetary contraction would have a stronger effect on the consumers balance sheets, encouraging banks to reduce credit to households in favour of corporate credit. Also, the rigidity of rates on loans granted to households would reduce bank margins following the rise in monetary rates. The monetary contraction is also reflected in a decline in profits and thus in the amount of banks' equity. To comply with the regulatory constraints and to compensate for profit losses, banks would reallocate their funds to assets with shorter maturity (and thus reduction of mortgages) and a flexible rate (reduction in loans to households).

Other empirical studies exist and evidence an impact of monetary policy on the bank's balance sheet. For instance, Lown and Morgan (2006) find that credit conditions harden following a monetary contraction. But this relationship is not statistically significant. Maddaloni et al. (2008) establish a positive relationship between monetary expansion and credit conditions easing. This relationship is reinforced by a prolonged period of

monetary easing. The easing of credit conditions by the bank implies an easier access to bank credit for risky borrowers and a weakening of the bank stability.

If monetary policy affects the bank's portfolio composition, this may result from a change in the ex-ante period of the bank's decision-making, i.e. before and at the loan origination. The following section deals with this aspect.

The link between monetary policy and the ex-ante bank's risk

De Nicolo et al. (2010) analyse quarterly US bank data from 1997 to 2008 to assess the impact of monetary shocks on banks' ex-ante risk-taking.²¹ There is highlighted a negative relationship between Fed real rates and bank risk-taking. A decrease of interest rates leads to an increase in the ex-ante risk of bank's assets. But this impact of monetary policy on asset risk is less pronounced for less-capitalized banks. Equivalent results are obtained by De Nicolo et al. (2010) when capturing bank's risk through the ratio of risk-weighted assets to total assets. They find a negative relationship between the Fed real rate and the ratio of risk-weighted assets to total assets. A decline in interest rates results in an increase in bank risk, but less for less-capitalized banks.

While the impact of changes in short-term interest rates on the credit volume has been mainly assessed in most studies, Jimenez et al. (2014) study the impacts of change in short-term interest rates on banks' appetite for credit risk.²² They find that low interest rates lead to an increase in credit supply and a high probability of allocating more credit to risky borrowers, and this effect is larger for poorly capitalized banks. However, in the short-term, decrease in interest rates reduces bank portfolio risk. This means that the interest rates cut, reducing the borrowers interest expenses, reduces their probability of default (as well as that of the bank). However, the long run, low interest rates lead banks to take more risk (driven by the search for yield logic).

In general, monetary policy easing is considered as a key factor leading banks to take more ex-ante risk. However, its impact appears to be dependent on banks' characteristics such as the bank's capitalization. Moreover, monetary policy may also have effects on the bank's ex-post risk, i.e. on the risk of outstanding loans.

The link between monetary policy and the ex-post bank's risk

In order to study the relationship between short-term interest rates and banking risk, Altunbas et al. (2014) opt for an ex-post risk measure, namely the Expected Default Frequency (EDF).²³ A strong point in Altunbas et al. (2014) is that they assess the monetary policy stance through the deviation of the real policy rate (money-market rate minus CPI inflation) from the "natural interest rates" (NRGAP). They find that accommodative monetary policy has a positive effect on bank risk. In order words, low interest rates environment deteriorates the bank's soundness. This effect is amplified in

²¹The risk variable is captured by two proxies: The credit quality (associated with borrowers' ex-ante risk) measured by the average internal risk ratings assigned to loans by the bank (risk rate) and the average relative credit spreads (difference between the lending rate and the effective Fed rate).

²²Thanks to within borrower comparison models and duration analyses, they investigate whether short-term interest rates prior to loan origination influence credit risk-taking by banks.

²³The Expected Default Frequency (EDF) is the probability of the bankruptcy of a bank over a given period. Data on the EDF are provided by Moody's KMV.

the case of an extended period of low interest rates. In this sense, not only the deviation of interest rates from a benchmark matters but also the length of the period of persistence of this deviation (Altunbas et al., 2014). This result comforts Gambacorta (2009) who evidences a positive relationship between the number of consecutive quarters of low rates (i.e. monetary interest rates below the rate implied by the Taylor rule) and the weakening of banks soundness (increase in EDF).

Monetary policy may have impacts not only on the quantity of new loans but also on their price. Ioannidou et al. (2007), study the impact of monetary policy on Bolivian bank's risk-taking, find that a monetary easing leads banks to grant new loans to riskier agents. Risk pricing is an important aspect of the bank's risk-taking behaviour. Since it is established that banks are likely to take more risk when monetary conditions are softened, we can wonder whether it is the borrowers or the banks themselves that are at the origin of this risk-taking. The underlying idea when focusing on risk pricing is that if banks are not the source of risk-taking, then they correctly measure the risk and adjust their lending conditions. Unfortunately, the increase in risk stems from the credit offer (banks) and not from the credit demand (borrowers). Ioannidou et al. (2007) observe that interest rates charged on the borrowers increase less than the borrowers risk. Banks do not properly calculate the price of the risk and/or do not integrate it into the lending rates.

Is monetary easing so harmful?

The preceding development describes monetary easing as threat to banks soundness. However, if low interest rates may depress bank margins, they can also have beneficial effects. Low interest rates trigger low refinancing costs, and, then appear as a support to bank's profit. In addition, low interest rates reduce the bank's opportunity cost (cost of hoarding liquidity) and, therefore, its risk incentive (Smith, 2002). Moreover, higher interest rates may also induce more risk-taking (Gan, 2004; Merrouche and Nier, 2010). Higher interest rates may reduce the bank's franchise value and trigger risk-taking (Gan, 2004). In addition, higher interest rates may flatten the yield curve and lead banks to take more risk in order to maintain profits (Merrouche and Nier, 2010). While numerous studies link monetary softening to a credit boom and financial fragility, Agénor and Da Silva (2012) find that the same results still hold in the event of higher interest rates. According to Agénor and Da Silva (2012), in a middle-economy, an increase in the monetary interest rates to alleviate inflationary pressure, translates into capital inflows and a credit boom.

Furthermore, it could happen that rates no longer play the role assigned to them. Brunnermeier and Koby (2019) establish the existence of a reversal interest rates.²⁴ In other words, following the Brunnermeier and Koby's reasoning, we can expect that monetary easing lead banks to reduce their risk since their capital constraints become more binding.

Therefore, we can wonder if monetary policy linearly impacts bank's risk-taking along the monetary cycle. Based on the lack of consensus on the effects of monetary policy on bank's risk-taking behaviour, Ngambou Djatche (2019) analyses non-linearity in the

²⁴Brunnermeier and Koby (2019, p.1) define the reversal interest rates as “the rate at which accommodative monetary policy “reverses” its intended effect and becomes contractionary for lending. It occurs when recapitalization gains from the duration mismatch are offset by decreases in net interest margins, lowering banks net worth and tightening its capital constraint”.

RTC. Through a non-dynamic threshold model, he evidences a negative threshold in the deviation of interest rates from the Taylor rule rate from which the effects of interest rates on bank risk reverses. Precisely, Ngambou Djatche (2019) find that when monetary policy is already too loose (interest rates below the Taylor rule) the RTC is at work. However, for small deviations below the Taylor rule or for deviations above it, the RTC fades out and banks' soundness increase with decreasing interest rates.

In a nutshell, from what precedes, we can assert that the relationship between monetary policy and bank's risk-taking remains ambiguous. In fact, banks do not suffer only from profit losses due to the fall in interest rates, but they also benefit from the reduction in refinancing costs at the same time (De Nicolo et al., 2010; Santos, 2014; Dell'Ariccia et al., 2014; Lamers et al., 2019; Ngambou Djatche, 2019). In this sense, the behaviour of banks will depend on the gain and loss they undergo due to changes in interest rates. This is in line with Bruno and Ngambou Djatche (2020) who find that monetary easing, as well as monetary contraction, may lead banks to take more risk according to some effects related to the risk sensitivity of its intermediation margin and risk sensitivity of the prudential tool. Further analysis is needed in order to better assess the impact of monetary on bank's risk and non-linear approaches seem to be one of the most appropriate.

At the end of this section, we can say that prudential policy impacts not only the bank's risk-taking behaviour but also macroeconomic variables and monetary policy drives the bank's risk-taking. It is therefore inevitable that monetary policy and prudential policy interact in both the financial and economic spheres. This raises the problem of their coordination. This point will be discussed in the following section.

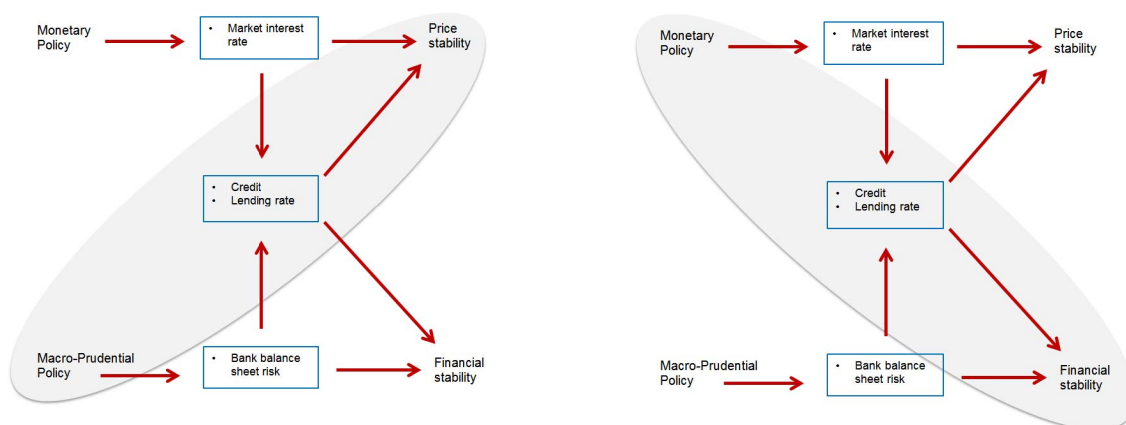
4 Prudential policy, monetary policy and risk-taking

As we have already said, even if prudential regulation and monetary policy seem independent since they have distinct objectives and tools, they very often interact. On the one hand, De Boissieu (2011) argues that central banks fulfilled their role as lender of last resort during the 2008 crisis by injecting liquidity in the economy supports the banking system and prevent the global financial system from collapsing.²⁵ However, Borio and Zhu (2012) argue that too accommodative monetary policy (low interest rates) improves investor wealth and could lead to a spike in borrowing. In this sense, the quantitative easing may result in that financial agents hold risky assets. On the other hand, a severe prudential policy could have a negative impact on monetary policymakers' actions. Imposing restrictions such as capital requirements could lead to a credit crunch and could slow economic growth (Galati and Moessner, 2013; ECB, 2013). Prudential policy can therefore offset the expected effect of a monetary policy. It is obvious that prudential policy interacts with monetary policy. Figures ?? gives a bird's eye on how one policy impact the other policy's objective.

It is therefore common to find the question about the substitutability or complementarity of macroprudential policy and monetary policy (Cartapanis, 2011;

²⁵De Boissieu C. (2011), Introduction au rapport du CAE, p.7, in BETBEZE J-P., BORDES C., COUPPEY-SOUBEYRAN J. et PLIHON D. (2011), « Banques centrales et stabilité financière », rapport du Conseil d'Analyse Economique, 2011, 344 p.

(a) Impact of (macro-) prudential policy on price stability (b) Impact of monetary policy on financial stability



Source: New Zealand Central Bank Report (2014)

Figure 3: Overlapping effects of monetary and prudential policy

Portes, 2014; Antipa and Matheron, 2014). The interactions between the two policies open the debate on three main points: the use of monetary policy for financial stability purposes, the number of institutions in charge of these policies (the two policies under a single institution's control or separated institutions), and how to coordinate them. We will tackle successively the three points in this section.

4.1 On the use of monetary policy for financial stability purposes

There is no consensus among researchers and policy makers about the use of monetary policy for financial stability purposes. Two main streams oppose: the “leaning against the wind” (LAW) and the “cleaning up afterwards” (CUA). According to the LAW, monetary policy, while responding to the real cycle, must also always respond to the financial cycle. This point of view is rejected by the CUA which allows monetary policy to respond to the financial cycle only in the event of a crisis. Leveuge (2018) largely discusses on this topic and gives an interesting panel of pros and cons of the LAW. As highlighted by Leveuge (2018), the CUA is undesirable since it induces a moral hazard problem. Financial agents, expecting a monetary intervention in the event of a crisis, may take more risk ex-ante leading to more instability. For this main reason, the LAW appears to be the appropriate view.

Monetary policy as a driver of bank's risk-taking behaviour has led some researchers and the BIS to support the use monetary policy for financial purposes (see for instance Borio and Lowe, 2002; Stein, 2014). An important point that favours the LAW is that monetary policy affects all participants in the financial system, contrary to prudential policy that let some actor unregulated (such as the “shadow-banking”). The real difficulties in implementing a LAW approach of monetary policy remain on the nature of the financial variable to be included and their weight in the monetary rule. Many authors have proposed different augmented Taylor rules, introducing a stock price (Niscotò, 2012), housing prices (Gelain et al., 2013), credit growth (Quint and Rabanal, 2014; Verona et al., 2017) a credit or term spread (Curdia and Woodford, 2016; Carlstrom et al., 2017). Even if DGSE models evidence that augmented Taylor rule

(compared to standard rules) increases the social welfare, this result mainly depends on the choice of the financial variable and the shock (real or financial) that hit the economy.

There is a need for more analysis to determine financial variables and their weight in an augmented Taylor rule. In this vein, Verona et al. (2017) propose three main features for such a variable. The financial variable must be easy to measure, related to economic activity and be controlled by the central bank. For these authors, credit complies with the three criteria. However, the nature of the exact measure of the credit remains undetermined. For instance, Quint and Rabanal (2014) show that an augmented Taylor rule improves the welfare when using the nominal credit growth. However, there is no welfare improvement if monetary policy reacts to the credit-to-gdp growth. Although the overall welfare increase when monetary policy respond to nominal credit growth, borrowers are worse off. In this sense, LAW does not have the same implication for every financial agent (savers or borrowers). While credit spreads appear as a brilliant candidate for this purpose, Leveuge (2018) emphasizes the risk of circularity that may face central banks.²⁶

Cecchetti (2009) presents monetary policy as a substitute to prudential policy. The more we use monetary policy with a goal of stabilization, the less we need to resort to macroprudential policy. Interest rates can influence not only the economic sphere but also the financial sphere as well. In this sense, interest rates would help fighting against bubbles (asset and credit bubble), and would limit the agents' risk-taking behaviours. Therefore, monetary policy would have an objective of financial stability, the same objective of the macroprudential policy. LAW can be effective in both reducing the probability of crises and dampening the financial cycle (see for instance Filardo and Rungcharoenkitkul (2016)).

However, the Tinbergen principle requires a clear separation between monetary policy and prudential policy.²⁷ Prudential and monetary policy are very different according to their tools and objectives. Interest rate changes, responding to inflationary pressure, should not affect prudential decisions (Antipa and Matheron, 2014). Conversely, depending on the evolution of systemic risk, prudential measures can be implemented or phased out without affecting monetary authorities' decisions when setting interest rates. Moreover, the "clean" view supports the idea that monetary policy should not be used for financial stability purposes. Monetary policy should address the credit boom only if it impacts inflation pressures.²⁸ Monetary instrument is blunt if used for financial stability.

Another argument that supports this point of view is that economic growth can be a source of instability in the financial system (Portes, 2014). The announcement of the stabilization of the macroeconomic sphere could trigger overconfidence of economic agents, and would incentivize the latter to take more risk, thus aggravating the vulnerability of the financial system to shock. Moreover, if monetary respond to bank leverage, a restrictive monetary policy would jeopardize the economy if inflation is low because it would trigger

²⁶The circularity risk is related to the fact that the central bank would target a financial variable (forward-looking) that would itself be sensitive to the anticipated guidelines of monetary policy.

²⁷According to this principle, a tool must be used for a precise objective and must not be coupled with another one for more efficiency.

²⁸According to this point of view, monetary policy would serve only to "clean up" after a crash. It is useless to use monetary policy for financial stability reasons since it has limited spillover effects on credit and risk-taking.

deflation. Monetary policy is inferior to macroprudential policy in ensuring financial stability (Gertler and Karadi, 2011; Portes, 2014; Svensson, 2014).

Moreover, LAW is undesirable since costs outweigh benefits (Svensson, 2017). Comparing normal and crisis situations with and without LAW, Svensson (2017) finds that LAW weakens the economy from the first instance (normal time) and amplifies the severity of the crisis. This supports the arguments of IMF (2015) which are against LAW and is consistent with Brandao-Marques et al. (2020) who find that tightening monetary policy induces net losses and call for caution in the use of monetary policy to “lean against the wind”.

Sometimes real and financial cycles are non synchronized, leading to a conflict of objectives, as shown in Table ?? . In such cases, there is a cost in terms of inflation for the central bank to have a financial stability objective Leveuge (2018). However, in institutional context, the monetary authorities give priority to the objective of price stability, leading to financial instability.

Table 2: Monetary policy stance according to real and financial cycles

		Financial cycle	
		Upside	Downside
Real cycle	Upside	Tightening	Conflict of objectives
	Downside	Conflict of objectives	Loosening

Source: Leveuge (2018)

Even though LAW is costly, it can be necessary. The extent to which monetary policy should lean against the wind depends on the size of the housing subsidy and on the size of the output shortfall (Adam and Woodford, 2018) or on uncertainty about the relationship between the crisis probability and aggregate credit conditions, or the severity of the crisis, or the extent to which changes in the policy rate affect today’s inflation and output (Ajello et al., 2019).

It is obvious that monetary policy as well as prudential policy impact bank’s soundness and financial stability. Therefore, the question of the number of institutions in charge of monetary and prudential policies remains. We tackle this issue in the following subsection.

4.2 The question of the authority in charge of the two policies

The institutional set-up for reaching price stability, on the one hand, and financial stability, on the other hand, leads to opposing positions among academics and politicians. On the one side, there is a point of view that asserts that central banks are able to conduct monetary and prudential policies. On the other side, some concerns are expressed as a counter-argument to the first point of view. Friedrich et al. (2019) provide an overview of institutional set-up in some countries where prudential regulation is conducted solely by the central bank (New Zealand, England), jointly by the central bank and a supervisory authority (Switzerland, USA, Norway, European union), or solely by a supervisory authority (Australia, Canada, Japan, Swenden).

The arguments in favour of the designation of central banks as institutions in charge of monetary and prudential policy rely on their expertise on macroeconomic issues

(Blanchard et al., 2010). In fact, central banks are ideally qualified to monitor macroeconomic developments and, in several countries, they already regulate banks. This is the case, for example, in the European Union, where the ECB is the sole institution in charge of both policies.

Moreover, albeit the coordination between agencies involved in the resolution and the banking supervision appears as a solution to the dissociation of the central bank from the supervision in theory, this distinction causes some difficulties. It was the case with the coordination of the actions of various agencies involved (the Bank of England, the Financial Service Authority and the UK Treasury) in the rescue of the Northern Rock in 2007. The low process of rescuing causes important damages to the UK banking system, and to banking sectors around the world. Hence, the difficulties in deploying post-crisis monitoring measures with many agencies involved highlight the need for the conduct of monetary and prudential policies by the same institution. Coordinating the actions of two separate agencies in the crisis resolution phase has proven to be very difficult.

Furthermore, the key role of central banks as lenders of last resort requires central banks to be involved in banking regulation. Central banks should know more about ailing banks before rescue them. We can imagine that it is socially optimal to provide central banks (lenders of last resort) with supervision objectives for the authorities to first realize the importance of a solvency issue before engaging large bailout. This point of view is driven by the Bagehot's guidance which advocates that resolution measures should be directed towards illiquid institutions and not towards insolvent ones.²⁹ The overall idea can be summarized in the following statement of Kashyap (2010): *"As the lender of last resort, you are never sure who is going to come through the door and ask for a date. When you meet your date on a Friday night and your date is AIG, the question at hand is whether you'd like to know something about them before you have to pay \$85 billion to buy them dinner. If we mandate that the Fed is not involved in supervision then we make hasty, uninformed decisions inevitable when it is called upon as a lender of last resort."*

Similarly, centralizing macroprudential responsibilities within the central bank would allow better consideration of the potential implications of monetary policy decisions on leverage and risk-taking. In fact, the main underlying idea is that since prudential policy (at least in its macro side) inevitably overlaps with the monetary policy's objectives, macroprudential policy could be carried out by the central bank. And the macroprudential policy can be coordinated with the microprudential policy held by a banking supervisor.

In contrast, if we follow the modified Jackson Hole consensus view, there is no need for prudential and monetary policies to be brought under one roof since there is sufficient information sharing among the monetary and banking supervision authorities.

Moreover, setting central banks as the single authority in charge of monetary and prudential policy may entail risk of misjudgements (Cartapanis, 2011). The behaviour of central banks would shift in favour of inflation to the detriment of the stability of the financial system. A separation of the two policies is therefore a *sine qua non* condition for achieving both objectives: financial stability, on the one hand, and price stability and growth, on the other hand. Furthermore, Levieuge (2018), questioning the ability of monetary policy in ensuring financial stability, find that central banks often face a trade-off between price stability and financial stability. This trade-off stems from the fact that the real and financial cycles are often out of phase. As a result, central banks' behaviour is

²⁹The Bagehot's guidance prescribes a set of principles for successful lender-of-last-resort operations. These principles were described in Walter Bagehot's *Lombard Street*, published in 1873.

biased towards price stability at the expense of financial stability. An incorrect assessment of the financial context would lead to an inappropriate action of the central bank, at the risk of undermining its credibility, especially since its action also affects its main objective of price stability.

The concerns about the involvement of central banks in financial stability are important. We do have reason to believe that the central bank's involvement in financial stability may undermine the credibility of its pursuit of price stability at least for two reasons. On the one side, it requires a stronger involvement in distributional policies (Brunnermeier and Sannikov, 2014)³⁰ and in quasi-fiscal operations (Pill, 2013).³¹ The independence of the central bank may be undermined and it may be put under political pressures. Moreover, delegating the objective of financial stability to the central bank may create time-inconsistency problems to monetary policy. For example, in order to ensure long-term price stability, the central bank may be obliged to provide more liquidity than appropriate if inherent problems of over-indebtedness resulting from a financial crisis are not resolved.

Cecchetti (2016, p.3) calls for a clear separation between institutions in charge of each policy and argues that: *“Each policy authority continues to have a distinct job. Monetary policy tools are ill-suited to manage financial stability risks, so central bankers should retain their focus on price stability. Prudential policymakers have the tools that are particularly ill-suited for stabilization. They should retain their focus on financial stability, except in the most extreme circumstances”*.

In a nutshell, the optimal institutional set-up may prevent central banks from biased decisions and ensure them a clear independence. Even if many institutional set-ups may exist, the fact that financial stability and price stability are largely overlapping makes it difficult to separate both objectives and the instruments to achieve those objectives. In this sense, there is a need for coordination of monetary and prudential policies.

4.3 Combination of monetary and prudential policy

If monetary policy and prudential have different objectives, the last financial crisis changes the mindset that they should be set separately. Indeed, the coordination of the two policies seems to be desired and would be the optimal strategy. Partial equilibrium models as well as DGSE models prove the optimal outcome of coordinating prudential policy and monetary policy (Angelini et al., 2014; Quint and Rabanal, 2014; Brzoza-Brzezina et al., 2015; Van der Ghote, 2018; Cozzi et al., 2020; Jeanne and Korinek, 2020). For a panel of theoretical studies on this point, see Lubis et al. (2019).

As several studies show, the coordination of the two policies leads to an optimal solution in the search for stability of both the financial system and the economic sphere.

Based on econometric studies establishing the negative relationship between interest rates and risk taking of financial agents (described as a macroprudential paradigm: the

³⁰Monetary policy can work if it redistributes wealth in such a way that dampens the amplification effects. For instance, lowering short-term interest rates can increase the value of long-term bonds, thus stabilizing banks' balance sheets. Purchasing specific assets held by a sector with impaired balance sheets softens amplification for that sector.

³¹Central banks have access to fiscal resources (seigniorage) that might be used to deal with solvency issues.

higher the interest rates, the lower the risk taking of private agents), Cartapanis (2011) notes that a joint conduct of macroprudential and monetary policy is therefore necessary to ensure the effectiveness of the tools of each of them. In the same vein, Antipa and Matheron (2014) find that macroprudential policy is complementary to monetary policy. For these authors, macroprudential policy would support the real economy because it would limit disinvestment (and thereby the decline in production) in times of crisis.

Far from being complementary, monetary and prudential policies are substitute: the more we use monetary policy with a goal of stabilization, the less we need to resort to macroprudential policy Cecchetti (2009). It would therefore be useless to resort to macroprudential policy for the same purpose. Conversely, the increased use of macroprudential policy rules out any need for monetary policy, as stability is already assured.

According to ECB (2013), macroprudential policy allows aligning agents' incentives in counter-cyclical way, to deal with the specificity of each country and to reduce the risk-taking induced by a loose monetary policy as well. While monetary policy would encourage private agents to take risks, macroprudential policy by introducing constraints (on capital and credit) would help to resolve imbalances induced by such a monetary policy. It is therefore important that monetary and prudential policy be coordinated.

Furthermore, monetary policy is often used as resolution measure in the event of a crisis. Then, there is a common intuition that ex-post greater liquidity provision makes macroprudential policy more necessary to compensate for ex-ante moral hazard (incentives to take more risk). Albeit this mindset appears to be partially wrong, Jeanne and Korinek (2020) observe that it holds if the provision of liquidity is targeted and the instrument of macroprudential regulation is a Pigouvian tax on bank leverage. Moreover, if liquidity provision is hard, the financial constraints will be binding, making macroprudential regulation desirable. There is a need for coordination of the two policies that act at specific periods, macroprudential policy "leaning against the wind" (ex ante) and monetary policy "mopping up after the crash" (ex post).

Macroprudential policy and monetary policy prove complementary in that price stability and system stability reinforce mutually (ECB, 2013; Lubis et al., 2019). Financial stability as a factor facilitating the Central Bank's pursuit of its mission (price stability). But price stability alone does not ensure financial stability. It must be combined with a macroprudential policy (ECB, 2013). Moreover, while macroprudential policy aims at smoothing out economic fluctuations, it must be complemented by other policies (such as monetary policy) to boost the economy in a downward phase. This is consistent with Kawata et al. (2013) who show that separated policies are not at all desirable and coordination between monetary and prudential policy is a necessity for economic growth and financial stability.

The coordination of monetary and macroprudential policy can be summarized through a game theory. An interesting work that well depicts the loss of each policy is that of Agur (2019). The coordination of the two policies can be assimilated to a prisoner's dilemma where each policy tends to minimize its coordination cost (see Table ??). Monetary policy seeks to minimize the output gap while macroprudential policy to minimize the financial gap.

Given Table ??, the two policies should act in opposite direction to get greater payoff. When monetary policy is loosened, macroprudential policy must be tightened for a better outcome for both policies. But, as stated by Agur (2019), since the game has two Nash equilibria, the authorities disagree which of these is better. The presence of a coordination

Table 3: Loss function minimization and multiple equilibria in discrete play

	Loose Macprudential	Tight Macprudential
Loose Monetary policy	High, High	Low, Medium
Tight Monetary policy	Medium, Low	High, High

Source: Agur (2019)

problem is immediate, as is the conflict of preferences, since monetary authority prefers the top-right equilibrium, and regulator the bottom-left (i.e., the equilibria with the lowest losses in the respective authorities' loss functions). In this sense, when the two policies act separately (without coordination) there are risks to fall in sub-optimal equilibrium with worse outcomes for both policies.

The coordination of monetary and prudential policies remains a difficult exercise. Agur and Demertzis (2019) show that a change in the monetary policy rate ambiguously affects the regulator's entire trade-off driven by two countervailing effects: the profit effect and the leverage effect. According to the profit effect, a higher rate increases the bank's funding costs, hence, reduces its profitability. The leverage effect induces bank's risk to drop following monetary contraction since a higher policy rate makes debt more expensive. Due to the leverage effect, following higher interest rates, banks opt to deleverage, and to invest in projects with lower default risk. The regulator allows interest rates changes to partly "pass through" to bank soundness by not neutralizing the bank risk channel of monetary policy.

Although the existing literature on the banking regulation examines the interaction between monetary and prudential policies, monetary easing is merely addressed as a threat to financial stability. Moreover, the combination of micro- and macro-prudential tools in the same framework has deserved only little attention. In this vein, Bruno and Ngambou Djatche (2020) examine how monetary policy and microprudential policy affect risk-taking by banks and how the combination with macroprudential policy may be satisfying in terms of risk-taking and a crisis cost. They show that the 'nature' of microprudential regulation will determine the risk-taking behaviour of banks following a restrictive or expansionary monetary policy. As a result, following changes in monetary policy, the combination of the microprudential tool with a macroprudential tool such as a leverage ratio may lead to different outcomes in terms of risk-taking and expected cost of bank failure. An accurate appreciation of prudential tools appears to be crucial for a better coordination of monetary and prudential policies.

While monetary and prudential policies tend to raise coordination issues at the national level, the problem is not similar at an international level. This is a specific case for monetary unions where a "one-size-fits-all" monetary policy that entails asymmetric effects on different economies (larger versus smaller economies) in terms of output gap and inflation. In this context, prudential policy may complement monetary policy. Quint and Rabanal (2014) and Brzoza-Brzezina et al. (2015) find on this point that (decentralized) macroprudential policy compensates for the loss of independent monetary policy in the periphery by substantially lowering the amplitude of credit and output fluctuations. Furthermore, monetary policy has a cross-border effect (currency dimension) on foreign banking system and requires home authorities to take it into

account for a better coordination. This cross-border interaction has been studied by Takát and Temesvary (2019) who study the interaction between the monetary policy of major international currency issuers (USD, EUR and JPY) and macroprudential policies enacted in source (home) lending banking systems. For example, US monetary policy tightening would reduce UK-headquartered banks' USD-denominated lending to France. Therefore, a macroprudential tightening in UK may entail more expensive domestic lending, driving UK banks' lending outward. Takát and Temesvary (2019) find that tighter macroprudential policy in a home country mitigates the impact on lending of monetary policy of a currency issuer. For instance, macroprudential tightening in the UK mitigates the negative impact of US monetary tightening on USD-denominated cross-border bank lending outflows from UK banks.

In a nutshell, the form of the coordination between monetary policy and prudential policy is not clear-cut. Some points are relevant in complementing the existing literature. On the one hand, as state by Jeanne and Korinek (2020), the distributive implications of the combination of monetary and prudential policies may be questioned. On the other hand, some questions are worth asking. In particular, is a unique calibration of the microprudential tool well suited to address the bank's risk-taking driven by a change in monetary policy? Which combination of monetary and prudential measures are socially desirable? In other words, should the supervisor always respond to monetary easing by tightening its standards?

5 Conclusion

In this paper we review the existing literature on the interaction between monetary and prudential policies and their impacts on bank's risk-taking. It appears that the financial stability results from the attitude of financial institutions towards risk. Monetary and macroprudential policies inevitably interact. Sometimes they complement each other and sometimes they conflict. And the way each is conducted define the way the transmission of each policy to the economy. Moreover, accommodative monetary policy is assumed to be a driver of banks' risk-taking behaviour and is sometimes the root cause of threats to financial stability.

However, the impact of monetary policy on bank's risk-taking appears to be ambiguous. On the one side, monetary policy easing implies profit losses that may wet bank's risk appetite. On the other side, low interest rates induce lower refinancing costs that can refrain the bank risk-taking incentives. Although the effect of monetary policy on bank's risk has been largely analysed, the potential positive effects of accommodative monetary policy on banks' risk has been neglected. In order to complement the existing literature, there is a need to deepen empirical analysis of the risk-taking channel using a non-linear approach.

Nevertheless, in order to mitigate bank's risk-taking behaviour and prevent crisis, policymakers have set prudential tools. But prudential and monetary policies may oppose. On the one hand, binding prudential constraints could fade the expected beneficial effect of monetary tools. On the other hand, a too loose monetary policy could lead banks to take more risk, refraining the effectiveness of prudential tools. Albeit the coordination of the two policies is obvious, the question of how to coordinate them appears crucial. Whether monetary and prudential authorities should be separated or not, monetary and prudential policy coordination is the guarantee of macroeconomic and financial stability. While the coordination of both policies has been largely analysed, there are still rooms

for improvement. Further work is needed. Modelling non-linear coordination of the two policies or the distributive implications of the combination of monetary and prudential policies can be appropriated. Moreover, the inclusion of fiscal policy in the analysis as suggested by Cecchetti (2016) appears to be an area of improvement.

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