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**ARTICLE**

# Monetary policy or macroprudential policies: What can tame the cycles?

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**Abstract**

This survey systematizes the rapidly growing literature on the influence of monetary policy and macroprudential policy on the macroeconomy. It examines the impact of monetary policy on the financial cycle and asks how macroprudential instruments influence the efficiency of monetary policy. The questions of whether monetary policy should take account of the financial cycle and lean against the wind is also addressed. The literature review shows that monetary policy is not neutral for financial stability, but should not take into account the financial cycle because the costs probably outweigh the benefits.

**KEYWORDS**

asset bubbles, leaning against the wind, macroprudential policies, risk-taking channel

**JEL CLASSIFICATION**

G01, G21, E32, E32, F52

## 1 | INTRODUCTION

The global financial crisis (GFC) of 2007–2009 has led to a resurgence of the macroprudential approach to financial regulation, which aims to mitigate the risk of the financial system as a whole. Although the term is rather new, macroprudential policies have been in place since the end of WW2, especially in emerging economies with excessive capital inflows, mainly in the form of capital import controls (Kelber & Monnet, 2014; Kenç, 2016). They are also relevant for

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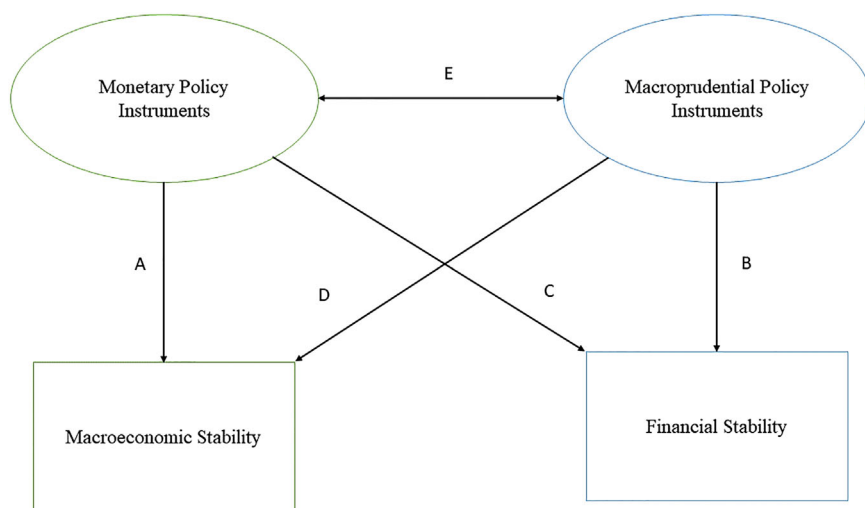


FIGURE 1 Interdependencies and research lines [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

advanced economies, with regulatory standards harmonized and national supervisory measures coordinated by the Bank for International Settlements (BIS). The BIS acts as a host for various other institutions, such as the Basel Committee on Banking Supervision, which formulates wide-ranging prudential standards and recommends standards of best practice in banking supervision (“Basel I” to “Basel IV”).

In order to prevent systemic crises in the future and to increase the resilience of the financial system, new supervisory bodies were created and existing regulatory frameworks were expanded. In many jurisdictions, financial supervisory bodies were given the mandate to ensure financial stability and were equipped with numerous new macroprudential tools. In some countries, this mandate went to specific supervisory bodies, but in a large number of cases (71% of 119 countries in 2000–13; Cerutti et al., 2017a) it remained with the central bank, which must ensure financial stability in addition to guaranteeing price stability.

As new tasks arise and additional instruments are made available, a bundle of interesting questions arise: how is the macroeconomic performance of these instruments? How do these instruments influence each other? To what extent should monetary policy and macroprudential policy coordinate in order to jointly safeguard financial stability and macroeconomic stability?

This survey reviews the growing literature on the interplay between monetary policy and macroprudential policy with a focus on developed economies. The work on emerging market economies, where macroprudential instruments are used together with capital controls to prevent currency crises, is omitted here (overview in Erten et al., 2021). The literature considered can be divided into five different strands (Figure 1). It usually deals with the direct effects of either monetary policy instruments for macroeconomic stability (string A) or of macroprudential instruments for financial stability (string B). These direct effects will not be considered here.

Rather, the analysis concentrates on the indirect effects of both policy instruments. In particular, we ask what effects monetary policy measures have for financial stability or the financial cycle (string C) and analyze the consequences of macroprudential instruments for the real cycle, that is, price level and output developments (string D). Both strings will be considered from a positive and a normative perspective. Finally, the question is addressed whether monetary policy

instruments and macroprudential instruments should be in one hand or distributed among different institutions (string E).

## 2 | CONCEPTS AND DEFINITIONS

Traditionally, the objective of monetary policy is to guarantee “macroeconomic stability,” which under flexible inflation targeting comprises two goals, price and real stabilities. Price stability is often defined as an inflation rate of around or below 2% p.a. in the medium term. Real stability is resource utilization around its long-run sustainable rate, often measured by potential output or minimum sustainable unemployment (Svensson, 2018). In contrast, there is no such clear-cut definition of “financial stability,” which is often understood by central banks as a state in which the financial system is able to withstand shocks and reduce financial imbalances so that it can fulfill its key economic functions. Moreover, there is no specific proxy to capture “financial instability.” Frequently, “abnormal” credit expansion is considered an important indicator of systemic risk (Bank of England, 2009) because it precedes financial crises (Borio & Drehmann, 2009) and is associated with sharp falls in the prices of financial assets and real estate. An often used measure is the credit-to-output ratio, whose deviation from the trend value is referred to as the “Basel gap” (Lang & Welz, 2017).

The major monetary policy instrument during normal times is the interest rate set by the central bank (“policy rate”), supported by communication in the form of forward guidance, that is, announcements of the future path of the policy rates. In crisis times, nonconventional instruments like asset purchases under “quantitative easing” (QE) are also used. In comparison, there is a whole bundle of micro- and macroprudential tools, which have been largely introduced since the outbreak of the GFC in 2007. Microprudential instruments are institution-specific. They aim to reduce the risks of individual financial institutions and provide direct protection for depositors and borrowers. Macroprudential instruments have institution-generic effects. They intended to reduce systemic risks within the entire financial sector and serve to reduce the macroeconomic costs of financial market instabilities (Borio, 2003; Galati & Moessner, 2013).

Despite these clear definitions, macroprudential instruments cannot always be clearly distinguished from microprudential instruments in individual cases, because these can specify both specific target values for individual banks and general target values for the entire banking sector. All prudential instruments intend to increase the resilience of the banks on a “going-concern basis” and focus either on the time series dimension or on the cross-sectional dimension of financial stability (Galati & Moessner, 2013, 2017). They can be further divided into three major categories (Shin, 2013); (Table 1)

- Capital-based measures intend to strengthen banks’ ability to absorb losses. They include “hard measures” that must be met anytime, and various “buffers” that can be used in periods of stress.
- Liquidity-based measures intend to counter risks from maturity mismatches.
- Borrower-based measures intend to address banks’ vulnerability to single clients.

Other measures include limits to large exposures to single counterparties and several disclosure requirements as well as margins and haircut requirements.

While the use of monetary policy instruments is well-documented, there is less information on the use of prudential instruments. Two studies evaluate their significance. Boar et al. (2017) use data taken from Lim et al. (2011, 2013), Kuttner and Shim (2016), and Cerutti et al. (2017b) for

**TABLE 1** Taxonomie of macroprudential instruments

Categories	Policy tool	Description/Purpose
Capital-based measures	Countercyclical capital buffer (CCyB)	Capital built up in good economic times, which can be used to maintain lending in times of crisis
	Systemic risk buffer (SRB)	Increases the resilience of large, strongly networked, and internationally active banks by providing them with additional capital
	Capital conservation buffer (CCoB)	Improves banks' general loss-absorbing capacity and avoids breaches of minimum capital requirements when losses occur
	Leverage ratios (LEV)	Ratio of regulatory core capital relative to total exposure; individual positions (unlike capital requirements) being included unweighted in the ratio
Liquidity-based measures	Minimum reserve requirements	Minimum amount of reserves a credit institution is required to hold with a central bank
	Caps on liquidity coverage ratio (LCR)	Minimum level of highly liquid assets which ensures that banks can meet their net payment obligations over a period of 30 days
	Caps on net stable funding ratio (NSFR)	Ratio of available stable funding relative to required stable funding; addresses longer-term liquidity risks
Borrower-based measures	Caps on loan-to-value (LTV) ratio	Ratio of the amount borrowed to the market value of the underlying collateral; mostly applied to real estate loans
	Caps on loan- (debt-) to-income (LTI/DTI) ratio	Ratio of the amount borrowed (total debt) to the total annual income of a borrower; limits the extension of credit beyond a multiple of borrowers' annual income
	Caps on debt-service-to-income (DSTI) ratio	Ratio of debt service payments relative to total disposable income

Source: European Central Bank (website), Shin (2013, p. 51), Cerutti et al. (2017b, p. 20).

a sample of 64 countries (including 29 industrial countries and 35 emerging market economies) between 1990 and 2014. They identify 1149 macroprudential policy measures, most of which were taken after the outbreak of the GFC. Several measures served to safeguard liquidity in the form of minimum reserve rate changes (49%), which dominate mainly in emerging market economies; only far behind them are instruments on the asset side (22%) and solvency protection measures (19%). The majority of the measures taken (62%) were restrictive; the majority of measures also served to avoid procyclicality.

Budnik and Kleibl (2018) use data from surveys of experts from supervisory authorities in 28 Member States of the European Union between 1995 and 2014. They identify a total number of about 1700 macroprudential instrument applications. Instruments include measures that were either genuinely macroprudential or essentially microprudential, but were likely to have an impact on the entire banking system. All operations in which these instruments were introduced, recalibrated or suspended are recorded. By far, the most frequently reported measures concern large exposure limits, followed by minimum capital requirements, liquidity requirements and restrictions on credit standards. The majority of actions taken were regarded as a tightening of prudential requirements, especially in the case of limits on large exposures, minimum capital requirements and liquidity requirements.

### 3 | MONETARY POLICY AND THE “FINANCIAL CYCLE”

The literature on the influence of monetary policy instruments on financial stability covers both positive and normative aspects. The positive branch asks how monetary impulses influence financial stability and how strong this influence is. The normative branch asks whether monetary policy should take into account possible dangers of monetary impulses on financial market stability in its decisions.

The vast majority of the models presented here assumes that the central bank pursues a flexible inflation target, which is why monetary policy is represented by a modified (Taylor, 1993) rule for the key interest rate. According to this policy rule, the monetary authority sets the nominal interest rate in response to deviations of inflation from its target and to some measure of real economic activity, such as the output gap. The literature often uses DSGE models that allow the macroeconomic effects of different shocks to be compared among alternative policy regimes. Such models have a solid microfoundation and are not subject to the Lucas (1976) critique, because their behavior patterns are independent of government policy. They can therefore be used to compare alternative monetary policy measures or to analyze their interaction with macroprudential policy.

#### 3.1 | Positive analysis: How important are monetary instruments for financial stability?

##### 3.1.1 | Characterizing the financial cycle

An important finding from the “Great Moderation” period between 1990 and 2007 was that financial crises can occur even after a period of stable production and low and stable inflation rates. Since then, financial crises have not been regarded as an expression of the real cycle, but as the culmination of another dynamic, called the “financial cycle” (Claessens et al., 2011). This cycle includes the co-movement of a number of financial sector variables, such as credit volumes or equity, bond, and real estate prices. From this point of view, variation in bank leverage (proxied by credit growth) has proved to be relevant for asset price changes (Schularick & Taylor, 2012), as historical data show that many financial crises have been preceded by mortgage credit and housing booms (Jordà et al., 2014).

Credit growth expansions are more likely to be triggered by credit supply shocks than by credit demand shocks (Mian et al., 2017, for a panel of 30 advanced countries from 1960 to 2012). Rising household debt ultimately leads to a slowdown in GDP growth. This negative relationship only

holds for household debt and not for nonfinancial corporate debt, which has weak additional predictive power for GDP growth. The relationship is stronger when an economy is close to the zero nominal interest rate boundary (*ibid.*). Looking at flow variables instead of stocks shows that the negative impulse response of output does not come from new household debt, which has a positive effect, but from the lagged effects of debt service, which makes GDP growth significantly negative with a horizon of 5–7 years (Drehmann et al., 2018).

Some studies use a turning point analysis to extract cycles and find a close link between macroeconomic and financial cycles (Claessens et al., 2012). Other studies focus on frequency-based filters, in some cases complemented by turning point analysis (Hiebert et al., 2014). They find that house price and credit cycles last much longer than real cycles (Drehmann et al., 2012; Rünstler & Vlekke, 2017); moreover, financial cycles differ between member states of the euro area (Hiebert et al., 2018; Schüler et al., 2020) or between the USA and major European countries (Rünstler & Vlekke, 2017). This suggests that real and financial cycles are “distinct phenomena” (Drehmann et al., 2012), which may justify pursuing a macroprudential stabilization policy that differs from monetary (and fiscal) policy (Rünstler, 2016).

The financial cycle has the following longitudinal and cross-sectional characteristics: it lasts 10–20 years; its length and amplitude have increased in the past and peaks are often accompanied by banking crises or considerable financial stress (Drehmann et al., 2012) for seven countries from 1960 to 2011; (Borio et al., 2018). The growth of lending and the price development of individual asset classes are increasingly synchronized worldwide, with the correlation of stock prices in particular increasing; in this respect, a global financial cycle exists (Jordà et al., 2019 for a sample of 17 advanced economies over a period of 150 years). The increasing synchronization of the development of existing stock prices results from a growing correlation of risk premiums (“risk appetite”), whereby US monetary policy has become an important driver of global risk appetite (*ibid.*).

### 3.1.2 | Risk-taking channel of monetary policy: A threat to financial stability?

The relationship between monetary policy and financial stability (string C in Figure 1) is the subject of the literature on the “risk-taking channel,” which examines the influence of low interest rates on risk perception or risk tolerance of lenders (Borio & Zhu, 2012). This literature supplements a comprehensive literature on the influence of liability restrictions and deposit insurance on the risk appetite of commercial banks, which, however, leaves open the role of interest rate changes initiated by monetary policy. The literature on the risk-taking channel fills in this gap and shows that monetary policy is not irrelevant for financial stability.

There are several ways how an expansionary monetary policy increases risk-taking (Gambacorta, 2009): low interest rates initiate a “search for yield” among asset managers, which is associated with higher risk taking (Rajan, 2006). The impetus results from the specification of an unchanged target value for the return, which can only be achieved at low market interest rates if higher risks are taken. The rigid target value follows for psychological reasons, such as money illusion and the lack of recognition that nominal interest rates decrease with falling inflation rates, or from institutional or contractual inertia, for example, when insurance companies have to earn a guaranteed interest rate that has been contractually guaranteed or is legally stipulated.

Some models consider the risk-taking effects of changes in interest rates in conjunction with macroprudential instruments. Angeloni and Faia (2013) examine the interaction of monetary policy and macroprudential policy in the context of a DSGE model with banks and examine the

influence of an expansive monetary policy on bank risk and on output and inflation. Monetary policy follows a modified *Taylor* rule that includes reactions of the policy rate to financial market conditions. Macroprudential policy variables are minimum capital ratios in three variants (constant, procyclical, and anti-cyclical ratios). Banks finance themselves through equity and deposits and grant loans to finance risky projects. They act as “relationship lenders” (Diamond & Rajan, 2000) and generate higher liquidation proceeds from the projects than their financiers; banks are, however, exposed to the possibility of a run that begins as soon as depositors fear that their deposits will not be repaid. Bank risk is measured by the probability of a bank run. Without minimum capital requirements, an expansionary monetary policy leads to an increase in bank leverage and in bank risk; a minimum capital ratio reduces the risk of a bank run.

Dell’Arricia et al. (2014) consider a model economy with banks that can reduce the risk of their loan portfolio by means of costly monitoring. Banks are protected by limited liability and their monitoring effort is private information. Banks finance themselves through equity and deposits. Two scenarios are considered: in the first scenario, banks can freely choose their capital structure and adjust it to changes in the risk-free interest rate fixed by monetary policy. In this case, interest rate cuts increase leverage; banks reduce their monitoring effort and increase their risk taking. In the second scenario, the banks’ capital structure is predetermined, and the reactions to an interest rate cut depend on their capital resources. Banks with a high capital base reduce their monitoring costs and become riskier, while banks with a low capital base behave the other way round.

In a series of contributions, Adrian and Shin (2010a, 2010b, 2014) show how monetary policy influences the risk appetite of investment banks by setting short-term interest rates. They consider risk-neutral banks with assets having a longer maturity than liabilities. A bank maximizes expected wealth, but faces a value-at-risk constraint; it holds a capital cushion large enough to keep the default probability below some benchmark level. Falling short-term interest rates induces the bank to grant more loans and to increase leverage; risk premia on long-term asset increase and their interest rates fall. If the fall in long-term rates is substantial and the duration mismatch between assets and liabilities is large, the bank’s net value increases, which allows the banking sector to take higher risks.

The above hypotheses are reflected in a number of empirical studies presenting evidence for a risk-taking channel in the United States and in the euro area. Empirically, low short-term interest rates are associated with

- an increase in the willingness of banks to accept risk, especially for small and weakly capitalized banks (Delis & Kouretas, 2011), for the euro area; Altunbas et al. (2014), for the EU and for the United States; Jimenez et al. (2014), for Spain; Buch et al. (2014); Dell’Arricia et al. (2014), and Ioannidou et al. (2015), all for the United States);
- lower lending standards (Delis & Kouretas, 2011), for Greece; Maddaloni and Peydró (2011), for the euro area and for the United States; Neuenkirch and Nöckel (2018), for the euro area);
- a decrease in banks’ net interest margins, lower bank profits and a reduced ability to raise bank capital; the negative effects are larger the lower the interest rate level is and the longer the interest rate cut lasts (Claessens et al., 2018 for a sample of banks from 47 countries between 2005 and 2013).

Some recent papers ask whether bank risk-taking has changed after interest rates became negative. Bounougou (2020) uses a sample of nearly 10,000 banks from 59 countries and present evidence that banks took less risks in the years following the introduction of negative interest rates. In particular, small and well-capitalized banks were successful in mitigating the effects of negative



interest rates on risk-taking. Using different risk measures and applying a matching procedure for a sample of banks from the euro area, Nucera et al. (2017) find that banks predominantly relying on deposit funding are perceived as more risky when interest rates became negative. In contrast, banks with sufficiently diversified income streams are perceived to be less (systemically) risky.

Malovaná and Frait (2017) use data from the Czech Republic and five member states of the euro area (Germany, France, Italy, Belgium, and Austria) and compare the effects of monetary and macroprudential policy instruments on the macroeconomy and the credit cycle. They also address the problem that the short-term policy rate is no good measure of the monetary policy stance anymore since the policy rates reached their lower bounds and unconventional measures were implemented. To solve that problem, they do not estimate a shadow rate (Wu & Xia, 2016), but use a synthetic index of overall euro area monetary conditions (MCI) (Babecka-Kucharcukova et al., 2016). They find that monetary tightening has a negative impact on the credit-to-GDP ratio and a positive impact on bank leverage. This supports the view that accommodative monetary policy contributes to a build-up of financial vulnerabilities, that is, it boosts the credit cycle.

### 3.1.3 | Asset price bubbles

A bubble is a situation where the price of an asset deviates from its fundamental value in an asymmetric and explosive way, until a large price correction occurs (Jordà et al., 2015). Conceptually, asset prices consist of a fundamental component and a bubble component. The fundamental component of the asset price is the future payments discounted at the gross risk-free interest rate; the bubble component generates no future payout (Miao, 2014). If the asset has a finite maturity date  $T < \infty$ , its market price is zero for all periods  $t \geq T$ ; for all previous periods  $t < T$ , the asset price is given only by the fundamental component, which follows from a no-arbitrage condition. In this case, the bubble component is zero. However, if the asset has an infinite maturity, that is,  $T \rightarrow \infty$  holds, the equilibrium price expression has several solutions. One solution is again described by the fundamental component, but another solution is given by the sum of the fundamental component and a nonzero bubble component. This bubble component increases over time with a growth factor equal to the risk-free interest rate factor.

Despite the conceptual differences between the fundamental component and the bubble component, it is not easy to identify the latter empirically. The literature attempts this in particular for stock and real estate prices. The indicators often used are strong deviations in the level of prices from a reference value (Borio & Lowe, 2002) or large changes in growth rates of asset prices (Bordo & Jeanne, 2002) or combinations of both (Jordà et al., 2015). Not all bubbles are identical and are equally dangerous. For a sample of 17 advanced countries in the period from 1870 to 2013, Jordà et al. (2013, 2015) find evidence that bubble periods in real estate prices last longer than on stock markets, where price fluctuations are stronger. They calculate a total of 166 recessions (78 before WW2), of which 42 were associated with a financial crisis (“financial crisis recessions”), and 81 bubble periods (47 pure equity bubbles; 12 pure housing bubbles), in which asset prices rose until major price corrections of more than 15% occurred. Before WW2, every second financial crisis recession, but only every sixth normal recession, was associated with a bubble; after WW2, 21 out of 23 financial crisis recessions and 31 out of 65 normal recessions were associated with the bursting of a bubble (Table 2). Asset price bubbles fueled by bank credit growth result in a higher probability for a financial crisis recession. They are in particular dangerous because they result in deeper and more protracted recessions and the damages caused by the busting of credit-boom bubbles are considerable, with the worst outcome when the bubble is in housing prices.

TABLE 2 Relative frequency of asset price bubbles by type of recession

	Full sample	Pre-WW2	Post-WW2
<b>Financial crisis recessions</b>	46	23	23
No bubble	15	13	2
Equity bubble	13	6	7
Housing bubble	5	2	3
Both bubbles	13	2	11
<b>Normal recessions</b>	120	55	65
No bubble	70	46	24
Equity bubble	34	4	30
Housing bubble	7	3	4
Both bubbles	9	2	7

Source: Jordà et al. (2015).

Several papers analyze the link between monetary policy and asset price bubbles. They ask whether (i) monetary policy can have an impact on asset price bubbles and (ii) a tighter monetary policy, in the form of higher short-term nominal interest rates, may help to disinflate asset prices. The last question is traditionally answered in the affirmative, that is, an interest rate hike is regarded as the appropriate answer to a bubble (Filardo, 2004). This is challenged in Galí (2014), who argues that monetary policy has no influence on whether a bubble develops or not, but it can influence its development over time. A rise in interest rates triggered by monetary policy increases the volatility of asset prices and their bubble components. As mentioned above, the expected change in the bubble component equals the market gross interest rate and increases with rising interest rates. Thus, a restrictive monetary policy reinforces the bubble—even if asset prices fall because the decline in the fundamental component more than compensates for the expected increase in the bubble component.

The empirical evidence is mixed. Precrisis studies typically find that monetary shocks negatively affect stock prices (e.g., Bernanke & Kuttner, 2005; Rigobon & Sack, 2004). Fischbacher et al. (2013) use a controlled laboratory experiment setting and test which monetary instruments are best to reduce bubbles. They find only a small effect of interest rate policies but a large impact of announcing the possibility of reserve requirements. Whether such reserve requirements are actually imposed is not important. Galí and Gambetti (2015) find protracted episodes in which stock prices end up increasing persistently in response to an exogenous tightening of monetary policy. Blot et al. (2017) find that the effects of monetary policy are asymmetric so the responses to restrictive and expansionary shocks must be differentiated. Restrictive monetary policy is not able to deflate asset price bubbles whereas expansionary policies do fuel stock market bubbles.

Recent studies analyze the asset price effects of unconventional monetary policies, especially asset purchase programmes as part of QE. Such programmes have been implemented by the US Fed (after 2008), the Bank of England (after 2009), or the Eurosystem (after 2015), among others (Dell'Arricia et al., 2018). The studies ask about the channels through which government bond purchases are transmitted to other asset markets, how strong the effect on asset prices is, and what the impact of QE is once the effective lower bound is reached. Most studies conduct event studies to determine the price effects before and after the announcement of QE programmes. They find a strong lowering effect on medium- and long-term government bond yields, with QE acting through the portfolio channel (Gagnon et al., 2011; Joyce et al., 2011) and in particular through

the signal channel (Altavilla et al., 2016; Bauer & Rudebusch, 2014). Looking at the prices of other forms of assets, Joyce et al. (2011) find rather muted reactions to the BoE's early QE programmes, suggesting market segmentation. For the United States, Swanson (2021) finds significant and persistent influences of QE on stock prices and corporate bond prices comparable to the effects of conventional monetary policy. Significant expansionary effects on stock prices can also be identified for the Euro area (Krishnamurthy et al., 2018).

### 3.2 | Normative analysis: Should monetary policy “lean against the wind?”

Since central banks switched to inflation targeting in the 1990s, the majority view in the profession has been characterized by the “Jackson Hole consensus” (Issing, 2009), according to which monetary policy should neither actively prevent financial imbalances nor respond to financial market instabilities in the form of asset price bubbles or credit expansion. This position persisted in modified form even after the outbreak of the GFC, even though central banks were to be enabled by means of their micro- and macroprudential instruments to preemptively prevent the emergence of financial market instabilities (Jansson, 2014).

This “modified Jackson Hole consensus” (Smets, 2014), however, was challenged by proposals that central banks could set their policy rate in reaction to financial indicators, which have empirically been found to be a predictor of financial crisis, such as excess credit growth (Schularick & Taylor, 2012). This would entail a higher interest rate than is necessary for typical inflation targeting. Metaphorically speaking, monetary policy would increase the stability of the house before the winds unfold into a storm and is accordingly called “leaning against the wind” (LATW).

In particular, authors from the BIS strongly argue in favor of a LATW policy and advocate an interest rate that is higher than without the incorporation of a financial stability target (Bank for International Settlements, 2016; Filardo & Rungcharoenkitkul, 2016). Critics object that LATW policy does more harm than good because the marginal costs far exceed the benefits. For them, LATW reflects a strong dislike of low interest rates and underestimates the positive effect of low interest rates on employment (Svensson, 2017a, 2017b).

The models used to evaluate the costs and benefits of LATW differ in the variables that serve as a proxy for the financial imbalance (or the “wind”) and in the responses by the central bank to the imbalances (or the “degree of leaning”). Moreover, they apply different objective functions in order to evaluate the welfare effects of a LATW policy.

#### 3.2.1 | Basic cost–benefit approach

The simple cost–benefit analysis (Svensson, 2017a) looks at an economy, which is likely to experience a financial crisis in a subsequent period with given probability. The financial crisis has costs in the form of higher unemployment, that is, the unemployment rate deviates from its natural value. A LATW policy means an exogenous increase of the interest rate set by the central bank, which pursues an inflation target. The central bank does not follow a *Taylor* rule but sets the interest rate in order to minimize an intertemporal loss function, subject to a *Phillips* curve. The periodic loss function is quadratic in the gap between the inflation rate and the inflation target and on the gap between the actual unemployment rate and the long-run sustainable unemployment rate.

Minimizing the expected loss results in the (marginal) benefits and (marginal) costs of an LATW policy. The benefits result from a decrease in the entry probability for the crisis and from a lesser expected magnitude of the crisis in terms of higher unemployment. The costs result from the expected increase in the deviation of unemployment in noncrisis times. Costs have a crisis and a noncrisis component. The crisis component is the expected unemployment increase multiplied by the probability of a crisis. The noncrisis component is the expected noncrisis unemployment deviation.

Svensson (2017a) uses Swedish data to simulate the marginal costs and marginal benefits of an interest rate change. He tilts the model towards LATW by assuming that LATW leaves unemployment in noncrisis times unchanged and sets the expected noncrisis unemployment deviation equal to zero. The result of this simulation is that the cumulative marginal costs of an interest rate hike rise continuously over time and clearly exceed the marginal benefits, so that an LATW policy can be assessed as disadvantageous.

In addition to the effects included in the cost–benefit calculation, LATW policy also has some other undesirable effects because it reduces the effectiveness of monetary policy at the zero lower bound (ZLB). The higher interest rate raises the unemployment gap and reduces inflation expectations, which reduces the nominal interest rate despite the LATW policy. This also reduces the central bank’s scope for lowering interest rates when the zero interest rate threshold is reached (Svensson, 2017b, 2018).

The results of other studies for different countries point in the above direction. They show that an LATW policy is at most welfare-enhancing for very small interest rate hikes of a maximum of six basis points (Aikman et al., 2018; Ajello et al., 2019; Pescatori & Laséen, 2016); for significant interest rate hikes of 25 or more basis points, the costs are clearly higher than the benefits, so that an LATW policy is disadvantageous (see Aikman et al., 2018, for the UK; Ajello et al., 2019, for the United States; Gorea et al., 2016, for Canada; Saunders & Tulip, 2019, for Australia).

Svensson’s results have been subjected to a series of robustness checks. Adrian and Liang (2018) illustrate the sensitivity of the expected cost and benefit estimates to alternative assumptions for important model parameters, such as the size of the unemployment increase in a crisis state, the probability of a crisis, and the elasticity of the crisis probability with respect to a change in the policy rate. They find that, “under alternative assumptions for the probability of a crisis and its sensitivity to a rise in the monetary policy rate, even a very small benefit in term of a smaller rise in unemployment from LATW policy would suggest that LATW policy has net benefits.” However, even the outcome of a net benefit did not allow the clear conclusion that monetary policy should respond to the financial cycle and pursue a LATW policy, because macroprudential instruments might be more appropriate to control financial market risks.

Another point of criticism is that the cost–benefit approach does not take sufficient account of systemic risk and the persistence of financial cycles and thus neglects the long-term effects of a financial crisis (Bank for International Settlements, 2016). An important parameter is the probability for the onset of a crisis, which in Svensson (2017a) is influenced solely by the interest rates and has no dynamics. This contradicts the experience that systemic risks build up over time, making future employment and output losses more likely. Thus, timely monetary countermeasures in the form of an LATW policy have an additional advantage that could change the cost–benefit analysis in favor of an LATW policy (Filardo & Rungcharoenkitkul, 2016).

Some studies react to this critics by modifying the framework used in Svensson (2017a) to take into account the financial cycle. In Kockerols and Kok (2019), this is accomplished by making the probability of the start of a crisis dependent on an indicator of the financial cycle. They recalibrate the Svensson model for the euro area and find that LATW still implies substantial net marginal

cost and that macroprudential policy is the preferred tool over monetary policy to lean against the build-up of financial cycles.

### 3.2.2 | LATW in DSGE models

Different authors broaden the perspective and analyze LATW within a DSGE model whereby monetary policy is represented by an augmented *Taylor* rule for the interest rate. They use the welfare of a representative household to evaluate the benefits and costs of LATW. Gourio et al. (2018) model financial imbalances using a ratio consisting of the nominal level of debt to the efficient level of debt that prevails in the economy without distortions. The debt ratio influences the probability of a financial crisis, whereby a ratio larger than 1 characterizes the situation of a financial bubble. The central bank sets interest rates according to alternative *Taylor* rules, where the interest rate also reacts to changes in the debt ratio.

Gourio et al. (2018) simulate the adjustment paths of output, inflation, and crisis probability to different shocks (financial, technology, and demand shocks) for alternative monetary policy rules. A financial shock is an increase in an inefficient credit due to a bubble; a technology shock is a change in productivity; a demand shock is a disruption in the demand for money. A benchmark scenario is compared with alternative scenarios for model parameters. As a result, the benchmark scenario shows a decline in output that more than compensates for the reduced probability of crisis, so that the costs of a LATW policy also exceed the benefits. However, this changes in the alternative scenarios, which assume different values for the extent of the financial crisis, the size of the financial shocks, the sensitivity of the crisis probability to credit surpluses, and the degree of risk aversion of private households. In these scenarios, “LATW” would be beneficial.

The previous models all assume that households refinance their debt each period, so that the total stock of debt responds to macroeconomic shocks and to changes in interest rates. In contrast, some papers distinguish between existing debt and new debt and assume that households service their debt only gradually, over a longer period of time (Alpanda & Zubairy, 2017; Bauer & Granziera, 2017; Gelain et al., 2018). As a consequence, the adjustment dynamics of household or corporate debt to shocks and policy changes (the “wind”) becomes highly persistent, with the dynamics depending on the assumed amortisation rate. In such a situation, the response coefficient of the interest rate change in the *Taylor* rule to changes in the debt-to-income ratio should be negative in order to stabilize the economy. The central bank should thus not engage in LATW, that is, lowering rather than raising interest rates relative to GDP as private debt rises.

### 3.2.3 | LATW in practice

Two countries have temporarily pursued an LATW policy, namely Sweden between 2010 and 2012 and—less pronounced—Norway at about the same time. During this period, Sweden temporarily increased its policy rate and responded to the development of the debt-to-income ratio of private households as an indicator of financial instability. Norway has also kept the policy rate somewhat higher than implied by medium-term outlook for inflation and output and the interest rate responded to house price developments and household indebtedness relative to disposable income (Olsen, 2015). In both countries, unemployment rate increased after 2012, which could be a lagged response to the LATW experiment. Moreover, households’ debt ratio kept raising

during the LATW phase, and, at least in the case of Sweden, there are signs that LATW policy has contributed to this (Svensson, 2013, 2014, 2018).

## 4 | MACROPRUDENTIAL POLICY INSTRUMENTS AND THE “REAL CYCLE”

We now change our perspective and ask what influence macroprudential instruments have on monetary policy targets, such as inflation and output. The literature asks two questions: how do macroprudential instruments influence the central bank's ability to reach its target? How should macroprudential and monetary policy work together to achieve price stability? Although the authorities, for example, in the European Union now have a large number of macroprudential instruments at their disposal, the literature analyzes the consequences of minimum capital requirements in particular, sometimes supplemented by a LTV ratio. Part of this literature deals both with the effects of macroprudential instruments on macroeconomic stability (string *D*) and with the question of what the optimal interaction between the two sets of instruments might look like (string *E*) and will therefore not be taken up again later.

### 4.1 | Does macroprudential policy has an effect on the traditional objectives of monetary policy?

#### 4.1.1 | Theoretical approaches

The theoretical literature usually focuses on the consequences of single macro-prudential instruments for the propagation of monetary policy shocks. Initially, financial intermediaries were largely neglected in DSGE models (Muellbauer, 2016). Financial frictions were modeled almost exclusively on the demand side of the credit market, either for households (Iacoviello, 2005; Kiyotaki & Moore, 1997) or for nonfinancial firms (Bernanke & Gertler, 1989).

Since the financial crisis, several papers explicitly introduce a banking sector into DSGE settings, but largely without considering the impact of macroprudential requirements (Curdia & Woodford, 2010; overview in Brunnermeier et al., 2013). Two different approaches are applied: the first approach uses the “industrial organization approach to banking” and considers a banking sector that has market power in the credit and deposit markets and sets different interest rates for households and firms (Gerali et al., 2010). Banks accumulate capital from retained earnings and are subject to adjustment costs in interest rates, so that changes in the key interest rate are not fully passed on to lending and deposit rates. Under these conditions, two major results emerge: (i) the banking sector weakens the output response to a monetary policy shock; (ii) a credit crunch triggered by an unexpected and prolonged destruction of bank capital has a significant negative impact on the real economy.

The second approach looks at banking from an “agency perspective” to motivate why the state of bank balance sheets affects credit flows. Gertler and Karadi (2011) and Gertler and Karadi (2013) assume a moral hazard problem only between the bank and its depositors; the banker can choose to divert funds from the assets it holds and transfer the proceeds (in form of bonuses or dividends) to his own household. The cost for him is that depositors can force the intermediary into bankruptcy and recover the remaining fraction of assets. In these models, there is friction on the

supply side of credit (not on the demand side) and the balance sheets of the bank and the borrower are indistinguishable.

Chen (2001), Meh and Moran (2010), or Silvo (2019) use a model framework originated by Holmstrom and Tirole (1997), in which there is a dual information asymmetry between firms and the bank, and the bank and its external creditors. The bank monitors the firms and mitigates the first information asymmetry; however, the bank's monitoring is not publicly visible and the bank must provide a credible incentive to actually perform its monitoring by investing a portion of its own net assets in the firm.

In both agency approaches, the bank's capital position determines its ability to attract credit-worthy funds and lend to enterprises. This "bank capital channel" becomes an important transmission link that amplifies the impact of technology shocks on output, investment, and inflation. An economy with more bank capital is more able to absorb shocks than an economy with less bank capital. However, financial shocks, such as a significant decline in bank capital, pose an independent threat to macroeconomic stability.

Building on this work, several contributions analyze the impact of macroprudential instruments on the propagation of aggregate shocks and on the transmission of monetary policy. There are two strands of literature that can be distinguished on the basis of Figure 1. The first strand examines the functioning of string *D* and analyzes the role of macroprudential policy in the propagation of shocks to output and inflation. Most contributions use New Keynesian standard models, but modify them with respect to the role of households and financial markets, thus creating a role for macroprudential policies. The second strand asks about the influence of macroprudential instruments on monetary policy transmission (on string *A*) and on the ability of monetary policy to lower interest rates.

The contributions to the first strand mostly consider capital requirements or loan-to-value (LTV) ratios as macroprudential instruments and assume that monetary policy follows a simple or an extended *Taylor* rule. Monetary policy sets the risk-free interest rate, which is often identical to the deposit rate. The bank lending rate is usually modeled as a mark-up on the risk-free interest rate, with the amount of the mark-up depending on the debt ratio of borrowers and on the macroprudential instrument. Monetary policy changes both the deposit and lending rates, whereas macroprudential policy changes only the bank lending rate. Apart from these similarities, the contributions differ in which borrower-lender relationships are considered, what aggregate shocks are analyzed and in how monetary policy and macroprudential policy interact.

A prototype of a model with financial frictions on interbank markets is Dib (2010), which distinguishes between two types of banks, savings and lending banks. Savings banks raise deposit from households, invest into government bonds and lend on interbank markets. Lending banks borrow on the interbank market, receive liquidity injections from the central bank, and raise equity from households to satisfy capital requirements. They lend to firms and buy government bonds as well. The financial risk consists of the incentive for lending banks to engage in a strategic default. Minimum capital requirements are intended to prevent this risk. The lending rate is modeled as a mark-up over the risk-free policy rate where the mark-up depends on the marginal costs of interbank borrowing and the marginal cost of raising bank capital.

The economy is subject to supply and demand shocks, financial shocks, and monetary policy shocks. Dib (2010) calibrates the model with US data from the period 1980 to 2008 and runs two simulations, one for a baseline scenario with banking sector and frictions on the credit demand side and one for a comparison scenario with demand frictions only. The impulse response of the most important macro variables shows that capital requirements reduce the real impact of aggregated shocks and thus always have a stabilizing effect on the real cycle.

In this respect, these results differ from those in another study, which shows that the effects of macroprudential measures depend on the type of macroeconomic shocks. Kannan et al. (2012) consider an economy with two types of households, borrowers and savers, who cannot lend to borrowers directly. There are financial intermediaries which take deposits from savers and lend to borrowers. The bank lending rate depends on the borrowers' net worth and is also influenced by the central bank, which has two policy instruments available; it can influence the bank lending rate by setting a higher risk-free policy/deposit rate or by imposing additional capital requirements. A larger capital requirement increases the wedge between the policy rate and the bank lending rate. The risk-free interest rate is in the baseline scenario set according to the *Taylor* rule. In the alternative scenarios, the policy rate also reacts to credit growth, and the macroprudential instrument is also used.

There are two shocks, a financial shock and a productivity shock. In the event of a financial shock, banks relax their lending standards and reduce the markup of lending rates over the risk-free rate. House prices and house investments rise, the financial accelerator sets in and the volatility of output, inflation and asset prices increases. The macroprudential instrument directly counteracts the easing of credit conditions and helps stabilizing the real cycle. This is different in the case of a positive productivity shock, which increases output and leads to a boom in the housing market, but results in a fall in CPI inflation. This downward pressure is further reinforced by the use of the macroprudential instrument, which suppresses private sector borrowing. The result is that the output gap and inflation are more volatile, not less.

The nature of macroeconomic shocks is also central to Angelini et al. (2014) who consider time-varying, risk-weighted minimum capital requirements. There are two types of households, patient ones who save and impatient ones who borrow against the value of their house stock. Houses are traded between the household types. Banks hold capital (which can be increased only through retained earnings), raise deposits from patient households and grant loans to firms and impatient households. Banks have to fulfill a capital requirement imposed by the regulator.

There are two regulators, a central bank, which sets the risk-free interest rate and a macroprudential authority, which sets the capital requirements. There are two spreads, one between the risk-free rate and the deposit rate and another one between the deposit rate and the lending rate. The monetary policy rate influences both the deposit and the lending rates, while capital requirements have an impact only on the lending rate. There are three scenarios, one in which only the central bank acts, and two scenarios in which a macroprudential authority exists alongside the central bank and either both authorities cooperate with each other or act uncoordinatedly.

Angelini et al. (2014) consider two types of shocks, a change in the firms' production technology (supply shock) and a reduction in bank capital (financial shock). With supply shocks only, minimum capital requirements have little impact on output volatility and on inflation when used in a coordinated manner and are even disadvantageous when used uncoordinatedly. However, this changes with financial shocks, where minimum capital requirements have a stabilizing effect on the real economic cycle. These results suggest that macroprudential instruments are not suitable as substitutes for monetary policy, but should only be used in a complementary manner when financial shocks occur.

Bailliu et al. (2015) compare the performances of different policy regimes in reaction to exogenous shocks using Canadian data. They consider entrepreneurs who finance themselves through equity and debt, whereby debt financing is more expensive than equity financing due to a costly audit. As in Kannan et al. (2012), the macroprudential instrument increases this debt financing premium. Four policy regimes are compared, namely a simple *Taylor* rule as a benchmark scenario and an extended *Taylor* rule in which monetary policy reacts to credit cycles; the two



remaining regimes combine the two monetary policy rules with the macroprudential instrument. The performances of the four regimes are compared with respect to the expected lifetime utility of private households, which is used as the welfare criterion. Welfare is highest in regimes where policy makers respond to financial imbalances using both the monetary policy and macroprudential policy tool.

Finally, Beau et al. (2012) use a DSGE model that takes into account financial frictions, heterogeneous agents, and housing construction and is estimated for the period 1985–2010 for the euro area. The aim is to find out to what extent monetary policy and macroprudential measures support, are neutral or hinder each other. The result is that, in most circumstances, macroprudential policy has either a limited or a stabilizing effect on inflation.

This first strand of the literature has been complemented by a more recent strand, which analyzes the difficulties faced by central banks to implement interest rate cuts and to “go negative.” While many observers focus on the behavior of money users, who increase their cash holdings, Brunnermeier and Koby (2019) refer to the effects of negative interest rates on banks profits. At the heart of the hypothesis is an interest rate named the “reversal interest rate” (*RIR*), below which banks restrict their lending in order to safeguard their profitability. The *RIR* may well be positive and change over time. The higher it is, the less favorable are the opportunities for monetary policy to stimulate the economy by cutting interest rates.

A simplified commercial bank balance sheet clarifies the intuition. At the beginning of the period, the bank under review holds fixed-interest securities and loans on the assets side; it finances itself by spending deposits and holds equity. If the market interest rate falls as a result of expansive monetary policy, this has two opposing effects on the bank’s net asset value at the end of the period: on the one hand, the market value of the fixed-interest securities increases, thus increasing the bank’s asset value. On the other hand, the bank’s net interest income, that is, the difference between interest income and interest expenses from lending and deposit business, decreases. As a result, the bank’s net assets decrease, provided that it pays out dividends that remain constant.

If interest rates fall sufficiently sharply, the second effect more than compensates for the first effect and the Bank’s net assets decrease. Under strict equity capital regulations, this forces the bank to restrict its lending if it is unable to raise new equity capital. The market interest rate at which this occurs depends on various factors, such as the bank’s initial fixed-income securities holdings, the bank’s equity capital stock, or its dividend policy. In particular the height of the *RIR* depends on the strictness of regulatory capital requirements, because with stricter bank regulation, the bank is more likely to have to restrict its lending for regulatory reasons.

#### 4.1.2 | Empirical approaches

Until recently, there was barely any empirical literature, which asks for the effects of single macroprudential policy instruments on core objectives of monetary policy, such as output and inflation. Some studies take a historical perspective and analyze the impact of quantitative instruments used between 1945 and 1970 by some Western European Central Banks (ECBs) to manage monetary and credit aggregates. These quantitative instruments could be seen comparable to today’s macroprudential instruments and were used to control inflation and to direct credit into preferred sectors of the economy (Kelber & Monnet, 2014; Monnet, 2014).

Historical analyses must be treated with caution, however, because macroprudential tools, mandates of central banks, and macroeconomic conditions have changed dramatically. More

recent empirical studies estimate the impact of contemporary macroprudential policies using recently collected cross-country databases. They often model macroprudential instruments as an index variable and can be divided into three groups, again using Figure 1.

Contributions from the first group examine in isolation the effects of macroprudential instruments on the real cycle (string D). Boar et al. (2017) use data from a panel of 64 countries and investigate the influence of several macroprudential instruments on the level and the volatility of GDP growth over a 5-year period. The more frequently a country uses macroprudential instruments, the higher is the growth rate of its per capita GDP and the less volatile is its GDP growth. The effectiveness of macroprudential instruments depends on the level of openness and the financial development of the economy. The non-systematic part of macroprudential interventions – that is, ad hoc interventions – appears to hamper growth.

The second group of studies compares the macroeconomic effects of monetary policy instruments and macroprudential policy measures on the real cycle (strings A and D). Kim and Mehrotra (2018) use data for four inflation-targeting economies in Asia-Pacific region, which were the largest users of prudential tools during the past (Shim et al., 2013). Monetary policy measures are reserve requirements, but also credit growth limits, and liquidity requirements. Macroprudential policy measures are policy measures on housing markets, such as maximum LTV ratio, maximum debt-service-to-income ratio, risk weights on housing loans, and loan-loss provisioning on housing loans. Kim and Mehrotra (2019) expand the panel to 29 advanced and emerging economies. The key finding is that the impacts of contractionary monetary and macroprudential policy shocks on key macro variables (real GDP, price level, and credit) are similar. The transmission channels differ and there is some interaction between monetary and macroprudential policies, which is loosened over time in response to a contractionary monetary policy.

Finally, the third strand analyzes the effects of macroprudential instruments on both the financial and the real cycles (strings B and D). It provides empirical evidence on how the use of macroprudential instruments has spillover effects on output and inflation. Richter et al. (2019) consider changes in maximum LTV ratios for a sample of 56 countries between 1990 and 2012. They do not employ dummy variables to measure macroprudential policies, but use instead a numerical variable quantifying the quarterly changes in the maximum LTV ratios. The results show that changes in LTV ratios have substantial effects on activity in credit markets and house prices (as intended), but only modest and imprecisely estimated spillover effects on output and inflation. In particular, a 10 percentage points reduction in the LTV ratio lowers output by 1.1% over 4 years and has only small effect on the price level, which is close to zero. This output response would be equivalent to a monetary policy rate increase of only 26 basis points. It implies that policy makers can implement macroprudential policies without risking major impacts on their core monetary policy objectives.

These results do not point all in the same direction, but there is strong evidence for the existence of string D and thus for an influence of macroprudential instruments on macroeconomic stability. If macroprudential instruments influence not only the financial cycle but also the macroeconomic cycle, the question arises whether macroprudential policy should take this into account in its decisions. Should macroprudential policy react actively to macroeconomic cycles or behave passively and merely ensure that banks always have sufficient liquid reserves and equity capital to be prepared for crises?

## 4.2 | Macroprudential policy: Safeguarding macroeconomic developments?

The Basel requirements currently stipulate that macroprudential instruments are used countercyclically and that capital requirements increase as credit risks increase. The “Basel gap” is used as proxy for the aggregate probability of bank default. The question of how beneficial this is is not answered here. Rather, we address the question of whether macroprudential instruments should be adjusted when inflation or output gaps arise, even if the credit cycle does not generate a need for adjustment.

Various papers analyze the role of macroprudential instruments in a monetary union, where the use of monetary policy instruments is decided centrally at supranational level, while the member states decide decentrally on the use of macroprudential instruments. Quint and Rabanal (2014) consider a model with two countries (a core and a periphery) with a common monetary policy. There are two sectors (nondurables and durables, which can be thought of as housing), and two types of agents (savers and borrowers) such that there is a credit market in each country and across countries in the monetary union. Monetary policy sets the policy rate by following the *Taylor* rule; macroprudential policy instruments change the spread to the lending rate for a given policy rate (as in Kannan et al., 2012). It is found that in a variety of scenarios and calibrations, the introduction of a macroprudential rule would help in reducing macroeconomic volatility and hence in improving welfare.

Rubio (2014) also looks at macroprudential policy in a monetary union of two countries whose real estate markets differ structurally in several dimensions. Monetary policy follows a *Taylor* rule; macroprudential policy also sets rule-linked ceilings for the LTV ratio in response to country-specific output and house price developments. The welfare-optimal LTV ratio is usually active and varies with both output and house prices.

Some papers contain counterfactual experiments and ask how macroeconomic development in countries on the European periphery (Ireland, Greece, Portugal, and Spain) would have been relative to the euro area average if macroprudential policies had been different from those actually pursued. Martin and Philippon (2017) carry out several such experiments and ask how unemployment would have developed in the peripheral countries if (i) these countries had limited the increase in private debt, (ii) these countries had pursued a more restrictive fiscal policy, (iii) the Eurosystem had already pursued a more expansionary monetary policy in 2006. The result would have been a more stable employment performance, with macroprudential intervention having significantly reduced the scale of the recession. This is especially the case in Ireland and Spain, but less in the other two countries, where the large build-up of public debt pushed interest rate spreads upward. Bielecki et al. (2019) show that a macroprudential policy prescribing region-specific LTV ratios would have contributed to output stabilization in the countries on the periphery of the euro area.

Rubio and Yao (2019) analyze the interaction between monetary policy and macroprudential policy after reaching ZLB. Monetary policy sets the policy rate according to the *Taylor* rule, while macroprudential policy sets LTV ratios and adjusts them to deviations in lending and output from their steady-state values. Two scenarios are considered, one in which the real interest rate is 4% and another in which it falls permanently to 2%, so that monetary policy comes into contact with the ZLB more frequently and for longer. In the first scenario, the “Tinbergen (1952) separation principle” applies, that is, the two policies should act independently of each other, with monetary policy focusing solely on macroeconomic stability and macroprudential policy focusing

exclusively on financial stability. In the second scenario, however, both policies are intertwined, and the macroprudential instrument should be used more for demand management and respond more strongly to output variations, which increases both financial and macroeconomic stabilities.

## 5 | COORDINATING MONETARY POLICY AND MACROPRUDENTIAL POLICIES

### 5.1 | Coordination or separation of policies?

A specific issue is that of the institutional arrangements for relations between the central bank and the macroprudential supervisor, the extreme scenarios being to merge the two policy areas or to transfer them to different authorities. For the first scenario, the Bank of England or the ECB stand out as examples. The United States and Sweden form examples for the second scenario (Kohn, 2015; Svensson, 2018). Synergy effects speak in favor of merging both functions at the central bank. In addition, central banks, as the bodies responsible for macroprudential banking supervision, take systemic risk more into account than other supervisory authorities, while these other authorities focus more on investor protection and the supervision of individual commercial banks. On the other hand, there are fears that the transfer of supervisory functions to the central banks would be counteracted by conflicts of interest with monetary policy, which could affect both the quality of banking supervision and the quality of monetary policy (Di Nioa & Di Giorgio, 1999; Ioannidou, 2005).

Closely related to the institutional division of policy areas is the question of whether and to what extent monetary policy and macroprudential policy need to be coordinated or should be conducted separately. The latter is supported by the *Tinbergen* principle, according to which each policy area should focus exclusively on the objective that it can best achieve. Accordingly, monetary policy should be geared towards maintaining price stability and macroprudential policy towards financial stability. However, this is only true as long as the objectives of both instruments are independent of each other and do not interact with each other; a separation is rather detrimental if violations of financial stability also affect price stability – for example, because rising real estate prices lead to higher rents and higher wage demands (Røisland, 2017). Conversely, low interest rates lead to increased risk-taking and endanger financial stability (Beau et al., 2012). Monetary and macroprudential policies should then be coordinated.

De Paoli and Paustian (2017) consider a macroprudential authority and a monetary policy authority, which either cooperate or work in a noncooperative fashion. They also consider the case in which policymakers can commit to a policy rule and the case in which they act under discretion. Under cooperation, one institution sets both the monetary policy and the macroprudential tool in order to fulfill a common goal while in noncooperative equilibria both institutions have separate goals. Under commitment, the authorities have the ability to deliver on past promises no matter what the current situation is today. In the discretionary setting, current policymakers perceive future policymakers to set their instrument according to an exogenously given Markov feedback rule. De Paoli and Paustian (2017) find that there are gains from cooperation, both under commitment and under discretion, and these gains depend on the nature of the shocks. Welfare gains are larger if one authority can lead the decision-making process. Leadership always improves welfare, but the effects are larger when the macroprudential authority moves first.

How cooperation is done depends on whether monetary policy and macroprudential instruments are strategic substitutes or strategic complements. In the first case, the increased use of

one instrument requires a reduced use of the other; in the second case, they have to be varied in the same direction. Which case applies depends on the costs of using the instruments and on how uncertain the effects are. Both instruments are substitutes, provided that the costs are low and the effects are not very uncertain, so that both instruments should be used in different directions. If the costs are high and the effects are uncertain, the instruments should be applied in the same direction (Røisland, 2017). Accordingly, both instruments change from strategic substitutes to strategic complements when the costs of using the macroprudential instrument increase or its impact becomes more uncertain. If in the extreme there are nonsignificant costs and uncertainty related to in particular macroprudential tools, it suggests that monetary policy should complement macroprudential policy and “lean against the wind” (*ibid*).

## 5.2 | Welfare-optimal policy rules

Most normative analyses assume a strict coordination of both policies within the same institution and ask what combination of rules for monetary policy and for macroprudential policy is optimal from a welfare perspective. To answer this question, several authors use DSGE models to compare the effects of macroeconomic disturbances on output volatility, inflation, and financial market risk in different scenarios, a benchmark scenario, and various alternative scenarios. The benchmark scenario comprises a traditional *Taylor* rule for monetary policy instrument without the use of additional macroprudential instruments. The contributions to the literature differ in the alternative scenarios for monetary policy, the macroprudential instruments considered, the financial risk measures used, and in the selection of the criteria used to compare the alternative rules (see Table 3).

Angeloni and Faia (2013) consider two groups of alternative scenarios that differ in the response coefficients of the policy interest rate to the inflation gap, which is low (1.5) or high (2.0). In addition, each group comprises some variants of the *Taylor* rule, which additionally provide for interest rate smoothing or reactions alternatively to asset prices or to bank leverage. The macroprudential instrument comprises constant, procyclical, or countercyclical capital requirements. Productivity and government demand shocks and monetary shocks are analyzed. Four criteria are cited to compare policy rules, namely household welfare and the volatility of inflation, output, and banking risk, respectively.

In the policy scenarios without the use of capital requirements, a *Taylor* rule that reacts aggressively to the inflation gap performs best for all criteria. Whether an additional interest rate smoothing and a reaction to asset prices or bank leverage is advantageous depends on the criteria selected. Among the alternative minimum capital requirements, countercyclical rules perform best; in this case, in addition, an aggressive response to inflation is beneficial for all criteria except output volatility. A response to asset prices or bank leverage changes the results somewhat, suggesting that countercyclical capital requirements and “LATW” are more likely substitutes. Among the policy options compared, the best policy is a combination out of mild countercyclical capital requirements together with a monetary policy, which reacts rather aggressively to inflation and systematically to financial market conditions.

Christensen et al. (2011) and Silvo (2019) also compare the welfare analysis of different monetary and regulatory policy regimes. They both use a DSGE model (Chen, 2001; Meh & Moran, 2010) that builds on the double moral hazard problem of Holmstrom and Tirole (1997); they differ mainly on the mechanism linking banks’ monitoring intensity and entrepreneurs’ moral hazard. Both papers use a conventional and an extended *Taylor* rule and consider constant and

TABLE 3 Welfare-optimal policy assignments: model features

Authors	Monetary policy instrument	Macro-prudential instrument	Financial risk measure	Criteria for regimes comparison
Christensen et al. (2011)	Standard Taylor rule (TR)	Time-invariant capital requir., Counter-cyclical capital requir.	Prob. for banking sector default	Expected household utility
Darracq et al. (2011)	Augmented (changes in housing prices)	Capital requir.	Bank leverage volatility	Ad hoc loss function
Angelini et al. (2014)	Standard TR	Time-varying capital requir.	Volatility loan-to-output ratio	Ad hoc loss function
Angeloni and Faia (2013)	Standard, augmented (asset prices, interest rate smoothing, bank leverage)	Capital requirements - constant, - procyclical, - countercyclical	Prob. of bank run	Household welfare, Volatility of - inflation, - output, - bank risk
Collard et al. (2017)	Counter-cyclical monetary policy	Procyclical capital requir.	Choice of risky projects	Expected household utility
Silvo (2019)	Standard TR, augmented TR (price of capital good)	Capital requirements - constant - countercyclical	Volatility loans to output ratio	Household utility, consumption equivalent relative to benchmark policy

Source: Own compilation; see also Loisel (2014).

countercyclical capital ratio regimes. They measure the welfare performance of different policy combinations in terms of expected household utility. The result is that a strongly countercyclical regulatory policy improves welfare compared to time-invariant regulation when the economy is exposed to shocks emanating from the banking sector. However, when the economy is exposed to productivity shocks, countercyclical capital regulation can counteract monetary policy. In this case, the welfare gain from the application of countercyclical capital regulation depends substantially on the aggressiveness of the monetary authority in responding to inflation and the size of the banking sector's risk externality arising from increasing bank lending.

Darracq et al. (2011) use a DSGE model with financial rigidities, which is calibrated to data from the euro area. Their model distinguishes between patient and impatient households (as in Angelini et al., 2014) and considers different types of banks (as in Dib, 2010), namely retail deposit-taking banks, wholesale banks, which face capital requirements and lending banks. Deposit-taking banks act under monopolistic competition and face nominal rigidities. Finally, there is a

financing premium, which is affected by capital requirements (as in Kannan et al., 2012). Darracq et al. (2011) focus on the joint determination of rules for monetary policy rule and macroprudential policy so as to minimize an ad hoc intertemporal quadratic loss function. The loss function mirrors the costs of volatility in inflation, changes in output, in the nominal interest rate, and in bank leverage. Monetary policy is represented by a *Taylor* rule augmented with asset prices and credit variables. Macroprudential policy is assumed to follow a capital requirement rule. The optimal monetary rule features a strong reaction of the policy rate to inflation and to changes in output and has a role for housing prices. The optimal macroprudential role features a positive reaction of capital requirements to output

In contrast to the work mentioned before, Collard et al. (2017) present arguments in favor of the “modified Jackson Hole Consensus” and argue that from a normative perspective, a separation of monetary and macroprudential policy is appropriate. In their benchmark model, it is optimal to apply *Tinbergen’s* separation principle and assign the goal of financial stability to macroprudential policy and the goal of macro stability to monetary policy. This result follows from the welfare criterion used, which is the expected utility of a representative household. It also results from the assumption that the risk taking of banks follows from the limitation in liability and from the existence of deposit insurance. Depending on the type of shocks considered, the two policies move in different directions over the cycle: optimal macroprudential policy is pro-cyclical and optimal monetary policy is countercyclical.

### 5.3 | Monetary policy and macroprudential policies: Rules versus discretion?

All DSGE models used so far for policy analysis assume that both monetary and macroprudential policies are bound by rules. Laureys and Meeks (2018) criticize this approach and point to a “poor performance of standard policy rules.” Following Angelini et al. (2014), they consider a central bank that pursues both monetary and macroprudential policies, that is, sets the short-term nominal interest rate and sets minimum capital ratios. The central bank aims to stabilize the inflation rate and output growth; in addition, it wants to prevent an abnormal expansion of lending vis-à-vis nominal output and avoid too high instrument variability. To this end, the central bank follows a “simple” *Taylor* rule (in which the interest rate reacts only to inflation and output gaps) and provides banks with countercyclical minimum equity values in the form of a feedback rule. In the case of rule-binding, the central bank decides once and for all on the coefficients of the two rules.

This policy scenario is compared with a situation in which the central bank decides on the optimal use of instruments on a discretionary basis, that is, in each period again. The result is that the “central bank would achieve a smaller loss by following a strategy of discretion rather than by committing to an optimized simple rule.” As an alternative, they use an extended rule containing an LATW component, in which the interest rate also reacts to the abnormal expansion of lending, and determine a value for the target function of the central bank, which corresponds to that for discretion.

### 5.4 | Concluding remarks

Since the outbreak of the financial crisis at the latest, central bank policy has not only been monetary policy, but also financial supervision. This can be seen in, for example, the new headquarters

of the ECB in Frankfurt, which consists of two towers, each housing the departments responsible for monetary policy and banking supervision. This raises a number of operational and strategic questions, the answers to which are the subject of this review in the literature. The main results are as follows:

- Monetary policy is not neutral in terms of financial stability, as interest rate cuts influence the risk taking behavior of market participants. There is some evidence in favor of a risk-taking channel, indicating that low interest rates increase the risk appetite of banks, especially small and weakly capitalized banks. Less clearly answered is the question of whether monetary policy promotes the emergence of bubbles in asset markets and what influence rising interest rates have on bubble development.
- It is not advantageous for the economy as a whole to influence the financial cycle by means of monetary policy and to conduct a policy of “LATW,” since the costs considerably exceed the benefits – even under parameter constellations that appear favorable for a LATW. The balance is shifting further at the expense of LATW policy because it is unclear whether interest rate increases will increase rather than reduce financial market instability.
- The influence of macroprudential instruments on the effectiveness of monetary policy in terms of stabilizing inflation and output remains unclear. However, various studies suggest that in monetary unions, the use of macroprudential instruments can usefully complement monetary policy in addressing macroeconomic stability, because macroprudential policy can be applied on a country-specific basis.
- It makes sense for monetary and macroprudential policies to coordinate and align their actions. Although such coordination can also take place between legally independent institutions, a merger within one institution could be beneficial.

Although our knowledge of the functioning and interaction of monetary and macroprudential policies has improved since the outbreak of the financial crisis, there are still gaps. With the exception of a few assumptions, the literature presented here analyzes the effects of monetary and macroprudential policy in a world of positive interest rates and only sporadically addresses the question of what might change if interest rates remain negative. Negative market interest rates could, however, become a permanent phenomenon if assumptions that natural interest rates in developed countries are falling prove to be true, for which there is some empirical evidence (Jordà et al., 2019).

The impact analysis of macroprudential measures has so far concentrated on a few instruments, mainly minimum capital requirements and upper limits for LTV ratios. It largely neglects various other recently introduced instruments, such as liquidity requirements or the possibility of a resolution of banks that are classified as “failing or likely to fail” (FLTF) and for which a bail-in procedure is conceivable. Particularly, in the case of a bail-in, the costs of a bank resolution are transferred to many stakeholders of the bank concerned, so that considerable macroeconomic effects can be expected.

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