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MACROPRUDENTIAL POLICY IN A MONETARY UNION

DEHMEJ Salim[1] and GAMBACORTA Leonardo[2]

ABSTRACT

Using a simple New Keynesian model of a monetary union that incorporates financial frictions, we show that country-targeted macroprudential policy could complement a single monetary policy at the union level. In particular, macroprudential policy helps taming financial and economic imbalances in presence of countercyclical financial shocks and imperfect transmission of monetary policy to financial conditions in a monetary union. These results are even stronger when different economies are hit by asymmetric shocks that cancel out without provoking any monetary policy reaction. In addition, we show that when coordinated with monetary policy, country-targeted macroprudential policy (implemented by national or supranational authorities) has advantages over a federally implemented policy that reacts to average financial indicators.

Keywords : Monetary Union, Macroprudential Policy, New-Keynesian Model.
JEL codes : E12, E50, F45, G18.

RÉSUMÉ

En utilisant un modèle néo-keynésien simple, qui représente une union monétaire et intègre des frictions financières, cet article montre qu'une politique macroprudentielle ciblée par pays et agissant sur l'offre de prêts pourrait compléter la politique monétaire unique au niveau de l'union. Une telle politique macroprudentielle améliore le degré d'optimalité de l'union monétaire en atténuant les déséquilibres économiques et financiers entre les pays en présence de chocs financiers, des spreads de crédit contracycliques, ou d'une transmission incomplète de la politique monétaire aux conditions financières. Ces résultats sont d'autant plus vrais lorsque les pays représentant le cœur et la périphérie font face à des chocs asymétriques ne nécessitant aucune réaction de la politique monétaire.

Mots clés : Union Monétaire, Politique Macroprudentielle, Modèle New-Keynésien.
Classification-JEL: E12, E50, F45, G18.

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Résumé non technique

L’expérience de la zone euro au cours de la dernière décennie a montré qu’une politique monétaire unique ne favorise pas nécessairement la convergence des économies appartenant à une union monétaire. Comme l’illustre l’analyse des écarts entre le taux directeur de la politique monétaire unique et celui auquel aurait conduit l’application d’une règle de Taylor standard, que nous calculons à plusieurs niveaux : la zone, le « cœur », la « périphérie », il existe de fortes divergences économiques et financières entre les pays de la zone. Dit autrement, une politique monétaire dite « *one size fits all* » n’est pas appropriée car elle est simultanément accommodante pour certains pays, alors qu’elle est restrictive pour d’autres. De plus, une politique monétaire qui utiliserait une règle de Taylor élargie à la stabilité financière risquerait de renforcer davantage les divergences entre pays puisqu’elle engendre des conditions financières plus hétérogènes. Ceci est expliqué par le fait que la zone euro souffre de chocs asymétriques qui sont étroitement liés à l'hétérogénéité des cycles financiers et notamment immobiliers. En effet, les cycles économiques et financiers sont divergents à l'intérieur et surtout entre pays européens. L’objectif de ce travail est d’étudier si la politique macroprudentielle, quand elle est ajustable par pays, permettrait d’atténuer les déséquilibres économiques et financiers tout en permettant à la politique monétaire unique de continuer à œuvrer pour la stabilité monétaire de la zone euro.

En utilisant un modèle néo-keynésien simple, qui représente une union monétaire et intègre des frictions financières, cet article montre qu'une politique macroprudentielle ciblée par pays pourrait améliorer la stabilité financière et économique. Le modèle proposé se compose de quatre blocs représentant les trois équations classiques du modèle néo-keynésien – une équation de demande globale ‘IS’, une équation d'offre ‘Phillips’ et une règle de Taylor – en plus d'une équation de friction financière, dérivée d'un marché du crédit micro-fondé. Cette dernière équation s’inspire du modèle IS-LM-CC de Bernanke et al. (1988) qui distingue entre le taux de la Banque centrale et le taux de prêt pratiqué par les banques. La politique macroprudentielle agit dans ce modèle en influençant l’offre de prêts.

Les résultats obtenues montre que la politique macroprudentielle améliore le degré d’optimalité de l'union monétaire en réduisant les déséquilibres économiques entre le cœur et la périphérie, en présence de chocs financiers, des frictions financières telles que des spreads de crédit contracycliques qui amplifient le cycle financier (Minsky, 1975) ou une transmission imparfaite de la politique monétaire aux conditions financières. Ces résultats sont d’autant plus vrais lorsque les pays représentant le cœur et la périphérie font face à des chocs asymétriques ne nécessitant aucune réaction de la politique monétaire. Enfin, à moins que la structure économique des pays et les chocs soient complètement symétriques, une politique macroprudentielle déployée à l’échelle nationale, qui peut être guidée par une autorité nationale ou supranationale, est systématiquement plus efficace qu'une mise en œuvre fédérale, qui réagit à la situation moyenne des pays.

1 Introduction

The experience of the euro area over the last decade has shown that a single monetary policy does not necessarily promote convergence of economies belonging to a monetary union. For example, since 1999, the gap between the ECB's interest rate and the interest rate that would have resulted from the application of a Taylor rule in the core and peripheral countries was very large[1]. In fact, monetary policy was relatively loose in the periphery (see the left-hand panel of Figure 1), mainly between 2002 and 2007, which could have contributed to the building up of financial and economic imbalances (Altunbas et al., 2014)[2].

This calls for the use of macroprudential (henceforth MaP) policy as a complementary instrument to monetary policy. The global financial crisis has made it clear that financial stability has a macroprudential or systemic dimension that cannot be ignored. Treating the financial system as merely the sum of its parts leads one to overlook the system's tendency to swing from boom to bust.

There is indeed a growing literature that claims that monetary policy should factor in financial stability considerations. Monetary policy should "lean against the wind" (LATW, Borio and Lowe 2002; Gambacorta and Signoretti 2014) to prevent financial imbalance, rather than merely "clean up afterwards" (Bernanke and Gertler, 1999). Blinder (2010) notes the emergence of a new consensus on the responsibility of central banks to combat asset price bubbles, by using targeted regulatory tools, rather than interest rate, which is considered as a blunt tool (Svensson, 2016). In the meantime, many economists sthink that the central bank's interest rate could play a major role to ensure financial stability[3], in order to avoid leakages overseas and notably to shadow banking. In addition LATW is also a way to take into consideration the banks' risk-taking channel (Adrian and Shin, 2009; Borio and Zhu, 2012), especially when many asset types show signs of overpricing. However, MaP policy can revisit this debate in the case of a monetary union where financial shocks could be asymmetric and a (common) LATW policy could be not successful.

From the standpoint of the "optimum currency area" theory developed by Mun-

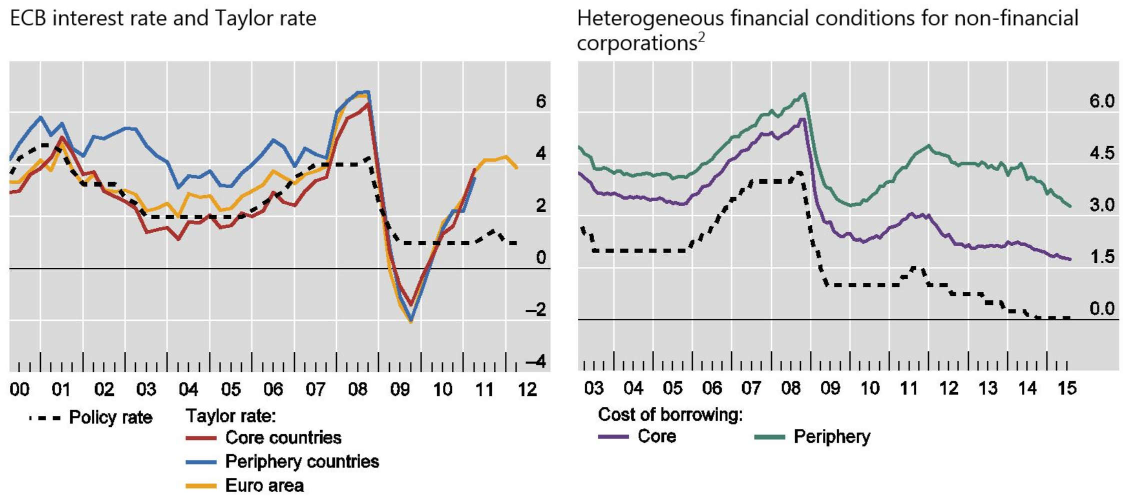
[1] We follow the standard distinction between core (Germany, the Netherlands, Finland, Austria, France) and periphery (Greece, Spain, Italy, Portugal, Ireland). See among others Quint and Rabanal (2014).

[2] Those divergent interest rates do not depend upon the fact that financial indicators are not taken into consideration by a standard Taylor rule. Interestingly, Couppey-Soubeyran and Dehmej (2016) illustrate, using a static counter-factual analysis, that augmenting the Taylor rule by a financial indicator (credit or housing) to ensure financial stability would have led to more divergent (Taylor) interest rates from the main interest rate and between countries.

[3] See Smets (2014), Carré et al. (2015) or Adrian and Liang (2016) for a survey.

dell (1962), MaP policy may be interpreted as an alternative adjustment tool that enhances the degree of optimality of a monetary union, specifically when economic cycles are out of sync. This is particularly the case of the Eurozone which suffers from low mobility of production factors, the absence of fiscal transfers between countries (Kenen, 1969), and heterogeneous real estate cycles (Krugman, 2012). Additionally, business and financial cycles are divergent among European countries (Stremmel, 2015). Figure 1 (right-hand panel) illustrates that the core and the periphery have divergent financial conditions, that have been amplified since 2010. It also shows also that the credit spread between the lending rate and the ECB interest rate has been increasing since 2010, particularly in the periphery.

Figure 1: Euro area financial conditions[1] (in per cent)



[1]Core countries includes Germany, the Netherlands, Finland, Austria and France; while the periphery countries are Greece, Spain, Italy, Portugal and Ireland. [2]The aggregated cost of borrowing for non-financial corporations is based on short-term loans.
Sources: ECB; authors' calculations.

Within the European Union, the European Systemic Risk Board (ESRB) is responsible for the MaP oversight of the financial system primarily by issuing warnings and recommendations[4]. The Single Supervisory Mechanism (SSM) designates the

[4]The ESRB was established in January 2011. At the national level, there are four institutional models for the allocation of macro-prudential powers: the government, the central bank, the financial authority and a committee with representatives from these three bodies (ESRB, 2014).

ECB as an important player of the MaP framework for the countries that participate in the banking union, mostly those of the Eurozone. According to Article 5(2) of the SSM Regulation (ESRB, 2014)[5], the ECB has the power to set tighter (not looser) regulatory requirements[6] than national authorities. The asymmetric nature of the ECB's powers reflects the potential inaction bias of national authorities. In fact, the costs of applying MaP tools are felt immediately (constraints on demand), while benefits are long-term (reduction in the probability, frequency and severity of financial crisis). Nevertheless, other MaP measures, mainly related to housing stock, such as loan to value (LTV) ratios and debt to income (DTI) ratios, remain under national competence and are not coordinated at the Union level.

The coexistence of four layers of MaP decision-making in the European Union (the ESRB, the European Banking Authority (EBA), the ECB and national authorities) makes the institutional architecture rather complex and calls for adequate coordination, information sharing, and communication.

Our contribution to the literature is threefold. First, our paper analyses how macroprudential policy could enhance the degree of optimality of a monetary union. Second, it identifies some key general principles for the conduct of a policy mix that combines a single monetary policy and a MaP policy. Third, despite its simplicity, the model can analyse simultaneously the effects of some financial frictions: countercyclical credit spreads, financial shock and imperfect transmission of monetary policy to financial conditions (pass-through).

Our study emphasises that a better policy mix promotes not only financial but also macroeconomic stability, particularly when core and periphery economies are hit by asymmetric shocks. A single monetary policy conducted at the Union level reacts only to average conditions, which mask differences in member countries (Constancio, 2015b). For example, the unintended accommodative (restrictive) effect of monetary policy for countries that record higher (lower) inflation may be counteracted by country-adjusted restrictive (loose) MaP measures, such as an increased (reduced) countercyclical capital buffers or lower (higher) LTV/DTI caps.

Our analysis also shows that unless economies and shocks are completely symmetric, a national implementation of MaP policy, adapted to the situation of each member state, is more appropriate than a federal implementation that reacts to the

[5]The ECB is required however to notify the national authorities (Article 5(4)) which can object to the measures, even though objections are not legally binding (ESRB, 2014). Furthermore, national authorities must notify the ECB of their intention to implement MaP tools (Article 5(1)) and the ECB can object to them.

[6]Those falling within the scope of the Capital Requirement Regulation (CRR) and Capital Requirement Directive 4 (CRD4) that implement the Basel III banking regulation.

average situation.

The reminder of the paper is organized as follows. Section 2 reviews literature. Section 3 presents the model. Section 4 discusses optimal policy mix under different scenarios. The last section concludes.

2 Literature review

Several papers have demonstrated the potential stabilising role of MaP policy. Some MaP tools may complement - and in some cases even replace - monetary policy (Cecchetti and Kohler, 2014), as they transit through similar channels (Beau et al., 2011). For example, N'Diaye (2009) stresses that increased regulatory capital requirements during economic upswings can act as a brake on the financial accelerator mechanism. As a result, MaP policy may contribute to economic stability and facilitate the task of the monetary authority. In the case of the Eurozone, many papers, using DSGE modelling framework, highlight the ability of MaP policy to moderate regional imbalances. For example, Angelini et al. (2012) stress that MaP policy may improve macroeconomic stability when economic fluctuations are caused by housing markets or financial shocks, especially when the central bank and the MaP authority cooperate closely. Brzoza-Brzezina et al. (2015) and Rubio (2014) show that countercyclical MaP tools can help deploying a more uniform monetary policy in the Eurozone, whereas Quint and Rabanal (2014) emphasise that the introduction of a national MaP policy reduces macroeconomic volatility and palliates partially the absence of autonomous monetary policies.

On the empirical side, since systemic risk has both structural and cyclical dimensions and appears in several guises (excessive credit and leverage, illiquidity and balance sheet mismatches, interconnectedness and moral hazard), ESRB (2014) suggests that using a toolkit may be more effective than using a single instrument. However, the effectiveness of MaP policy is still an open issue, especially when more than one tool is activated. MaP policy effectiveness should be analysed with respect to the specific goal that they are aimed to achieve, which is increasing the resilience of the financial system or, more ambitiously, taming financial booms and busts. Currently the evidence is mixed, with most of the work analyses the impact of macroprudential tools on bank lending rather than on the ultimate goal of containing systemic risk. For instance, recent evidence suggests that DTI and, probably to a lesser extent, LTV caps seem to be comparatively more effective than capital requirements as a tool for containing credit growth (Claessens et al., 2013; Kuttner and Shim, 2016). Indeed, the recent activation of the Basel III countercyclical capital buffer (to risk-weighted domestic residential mortgages) in Switzerland, while having some effects on mortgage pricing, seems to have had little impact on credit extension (Basten and Koch, 2015). As clarified by the Basel III framework, the main objective of the Basel III countercyclical capital buffer is to increase the resilience of the banking system. Tuning the cycle is rather a difficult task to achieve (Drehmann and Gambacorta, 2012). Some instruments may work better to achieve the narrow aim of increasing financial system resilience rather than the broader aim of constraining the cycle.

3 A simple new Keynesian model with credit intermediation

We use a reduced-form New Keynesian model[7], augmented by an additional equation that captures financial frictions (credit spreads, financial shock and imperfect transmission of monetary policy to financial conditions). The model is written as log-linear deviations from the steady state.

We use this framework to analyse the potential benefits of MaP policy in a monetary union by means of comparative statics. The model consists of four building blocks representing the three "New Keynesian" equations, in addition to a financial friction equation (FF) that introduce the credit market. The first three equations are an IS aggregate demand curve, a Phillips supply curve (PC), and a monetary policy "Taylor rule" (TR) representing the central bank's policy interest rate (Table 1 reports the list of symbols):

$$IS : y = -\beta(i_c - i) + \epsilon_d \tag{1}$$

$$PC : \pi = \pi^e + \lambda_y y + \epsilon_s \tag{2}$$

$$TR : i_n = i + \alpha_y y + \alpha_\pi(\pi - \pi^*) \tag{3}$$

The first equation is a simplified IS demand curve where economic agents borrow from banks to consume or invest. It links output gap y, defined as the percentage deviation of aggregate output from its potential level, to the difference between the

[7] The model adapts the static IS/LM-AS/AD model developed by Bofinger et al. (2006) or Mankiw (2016). It takes into account the critic of Romer (2000) about the need to replace the quantity instrument (LM) by interest rate as monetary policy main tool (IS-MP). Poutineau and Vermandel (2015) used this framework to study how MaP policy has an impact on the economy through its effects on credit rate and how it can increase welfare, taking into account different possible interaction between monetary and MaP policies.

real credit rate $(i_c - \pi^e)$ and real natural rate $(i - \pi^e)$[8]. The output gap y is also affected by a demand shock ϵ_d, which represents an exogenous shift in demand that arise from changes in consumption and/or investment.

The second equation represents the Phillips supply curve (PC) linking inflation rate to its expected future value, the output gap and a supply shock ϵ_s which represents an unexpected change to production. The third equation is the Taylor rule, which describes how the central bank sets the policy rate by taking into account the nominal natural rate, and responding to inflation and output gaps.

The last equation introduces financial frictions (FF) and determines the lending rate which reacts to the policy rate, output gap, financial shocks and to MaP policy:

$$FF : i_c = \gamma_n i_n - \gamma_y y + \gamma_{MaP} MaP + \epsilon_f \tag{4}$$

As in the IS-LM-CC model developed by Bernanke and Blinder (1988), we distinguish between two interest rates: i_n the policy interest rate and i_c the credit rate. The novelty with respect to the usual modelling is that: a) it is the credit rate that enter the IS equation rather than the policy rate; and b) the credit rate is determined by a forth equation that equalize the demand and supply of credit. The credit rate represents the cost of borrowing (financial conditions) and includes the credit spread or risk premium beyond the policy rate. It is the differential between the real credit rate and the real natural rate (Wickselian rate that equalizes saving and investment and keeps the economy on a stable path) that matters for the output gap. Financial conditions are looser if $(i_c < i)$ and restrictive if $(i_c > i)$. The FF equation captures many financial frictions: counter-cyclical credit spreads[9] (γ_y), transmission of monetary policy to financial conditions[10] (γ_n) and financial shocks (ϵ_f) such as a decrease in the value of collateral or in lender's capital.

Following Minsky's financial instability hypothesis (1975) where credit risk is usually underestimated (overestimated) during boom (bust) periods, we hypothesize that the credit rate and - by extension - the credit spread $(i_c - i_n)$ are countercyclical (negative relation between i_c and y). This is also what we observe from the literature on the risk-taking channel (Gambacorta, 2009). For example, as output increases, the value of collateral is likely to rise and the expected probability of default to decrease, which leads banks to supply more credit and vice versa. This mechanism is similar to the "external finance premium" concept developed by Bernanke and

[8] Expected inflation cancel out in the IS equation.

[9] Credit spread is considered as barometer of financial instability (Curdia and Woodford (2010))

[10] The transmission is sometimes imperfect (pass-through different from one). Constancio (2015a) highlights that ECB's interest rate cuts (95 basis points) from June 2012 to 2014 was transmitted partially to the effective borrowing costs faced by firms (30 basis points).

Gertler (1989), in which asymmetric information represents a financial friction that amplifies financial and economic cycles (financial accelerator mechanism).

It is worth noting that in absence of financial frictions (if $\gamma_n = 1$, $\gamma_y = 0$ and $\epsilon_f = 0$), we obtain a conventional "three equation" New Keynesian model where $IS : y = -\beta(i_n - i) + \epsilon_d$ (see Mankiw (2016)).

We derive the FF equation by equalizing the supply and demand of credit, for which we try to introduce some micro-foundations (Cecchetti and Li, 2008). Loan supply depends positively on equity $K = \nu_y y$ (which is linked to the output gap through retaining earnings) and deposits D[11]. Deposits $D = \eta_y y - \eta_n i_n$ are positively correlated with the output gap (increase in savings via the income effect) and negatively correlated with the policy rate[12] (opportunity cost for investing in remunerated securities;Bernanke and Blinder, 1988). Loan supply also depends positively on the mark up, which is the difference between the lending rate and the cost of funding, or the opportunity cost of investing in risk-free assets $(i_c - i_n)$[13]. Lastly, macroprudential policy denoted MaP is aimed to tighten (ease) the supply of credit during an upswing (downswing) through banks' balance sheets (CGFS, 2012). MaP policy could operate on loan supply using different tools such countercyclical capital requirements, leverage restrictions, general or dynamic provisioning, the establishment of liquidity requirements[14]. Here, for simplicity, we consider only one tool but we could interpret it also as a weighted average of tools that impact on loans' supply.

The credit supply is represented by the following equation:

$$L^s = K + D + \omega_{cs}(i_c - i_n) - \omega_{Map} MaP \tag{5}$$

We replace K and D by their respective equations and simplify as follows:

$$L^s = \nu_y y + \eta_y y - (\eta_n + \omega_{cs}) i_n + \omega_{cs} i_c - \omega_{Map} MaP$$

The demand for loans reacts positively to the output gap as agents have a greater willingness to borrow if the expected future income is higher (an increase in the

[11] We can also introduce reserve requirements since banks (supply of credit) could be constrained by reserve requirements τ. In this case we replace deposits by available Deposits $(1 - \tau)D$. We ignore the reserve requirement ratio ($\tau = 0$) in order to simplify the model and because it represents only 1% in the Eurozone (ECB Monthly Bulletin, 2/2012).

[12] For simplicity, we suppose that deposits are not remunerated and that savers do not hoard money.

[13] We can think either about real or nominal margins since inflation cancel out $(i_c - i_n = (i_c - \pi^e) - (i_n - \pi^e))$.

[14] Loan to value ratios and debt to income ratios are usually considered as macroprudential tools that constraint borrowers (Blanchard et al., 2013). However, they also have an effect on banks' lending, since they limit the amount that a bank can lend against a specific collateral. For a review see, amongst others, Cerutti et al. (2017).

project's probability of success) but reacts negatively to the real credit rate (the cost of borrowing):

$$L^d = \mu_y y - \mu_c(i_c - \pi^e) \tag{6}$$

In order to simplify the model, we follow Cecchetti and Kohler (2014) by assuming that monetary policy is credible ($\pi^e = \pi^*$) and that agents have rational expectations, so expected inflation can be normalized to zero ($\pi^e = \pi^* = 0$)[15]. By imposing a clearing condition for the loan market ($L^s = L^d$) we can obtain the lending rate or cost of borrowing i_c:

$$FF' : i_c = \gamma_n i_n - \gamma_y y + \gamma_{Map} MaP,$$

where $\gamma_n = \frac{\eta_n+\omega_{cs}}{\mu_c+\omega_{cs}}$,$\gamma_y = \frac{(\nu_y+\eta_y)-\mu_y}{\mu_c+\omega_{cs}}$ and $\gamma_{MaP} = \frac{\omega_{MaP}}{\mu_c+\omega_{cs}}$.

Equation FF is slightly different from FF' since we introduce an exogenous financial shock[16] ϵ_f to the credit rate i_c.

Figure 2 describes how credit market clears. L^s and L^d curves indicate, respectively, the supply and demand of credit. Credit institutions do not accept any interest rate that is below the policy rate, that is their refinancing cost. For example, during a period characterised by an excessive credit supply, a restrictive macroprudential policy MaP^+ shifts the L^s line to the left, which means a reduction in the supply of credit. This raises the equilibrium cost of borrowing, which could moderate imbalances.

We assume that the lending rate is countercyclical and that $\gamma_y = \frac{(\nu_y+\eta_y)-\mu_y}{\mu_c+\omega_{cs}} > 0$. The main hypothesis here is that credit demand's elasticity to output μ_y[17] is lower to the sum of elasticities of equity and deposits (credit supply) to output $(\nu_y + \eta_y)$.This hypothesis simplifies the analysis, but it is not essential. We will show below that MaP policy is still useful even if theoretically credit spread is procyclical since it compensates any reaction of lending rate to output.

[15] As a result the following equations are simplified $PC : \pi = \lambda_y y + \epsilon_s$; $TR : i_n = i + \alpha_y y + \alpha_\pi \pi$ and $L^d = \mu_y y - \mu_c i_c$

[16] In a recent paper Peersman and Wagner (2015) argue that financial shocks are an important source of macroeconomic fluctuations, accounting for at least 30% of the United States output's variation. They identify three types of financial shocks: a risk-taking shock, a securitisation shock and a lending shock.

[17] Calza et al. (2006) find that the elasticity of credit demand to real GDP for the euro area is 1.48.

Table 1: List of symbols

Variable	Description	Parameter	Responsiveness of
y	output gap	β	output gap to credit minus natural rates
i_c	loan interest rate	λ_y	inflation to output gap
i	natural interest rate	α_y	policy rate to output gap
i_n	policy interest rate	α_π	policy rate to inflation
π	inflation	γ_n	credit rate to policy rate
MaP	macroprudential policy	γ_y	credit rate to output gap
L^s	supply of loans	γ_{MaP}	credit rate to MaP policy
L^d	demand of loans	ω_{cs}	supply of loans to credit spread
K	bank's capital	ω_{MaP}	supply of loans to MaP policy
D	deposits	ν_y	bank's capital to output gap
ϵ_d	demand shock	η_y	deposits to output gap
ϵ_s	supply shock	η_n	deposits to policy rate
ϵ_f	financial shock	μ_y	demand for loans to output gap
τ	reserve requirement	μ_c	demand for loans to credit rate

Figure 2: Supply and demand for credit

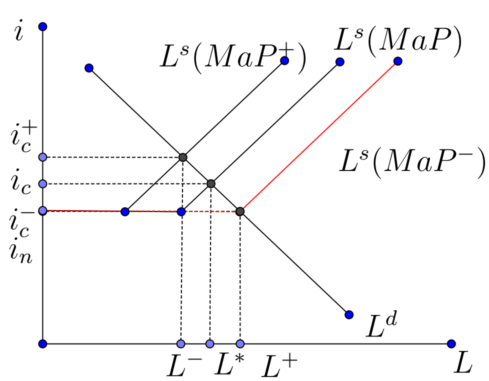
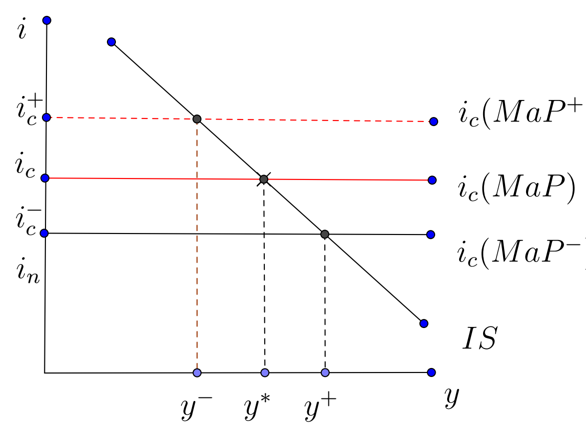


Figure 3: Credit spread vs output gap



In what follows, our model will help us explaining how a monetary union could benefit from a country-specific MaP policy in the case of asymmetric shocks (e.g ϵ_f), imperfect pass-through and countercyclical credit spreads that cannot be fully neutralised using a single monetary policy or a federal MaP that reacts to average conditions. Figure 3 illustrates how MaP policy influences output through its effect on financial conditions. Following a tightening of MaP measures (shift of the credit rate to $i_c(MaP^+)$), output declines because agents reduce consumption and investment.

4 Monetary and macroprudential policy mix

In this section we analyse the optimal policy mix in a monetary union composed of two countries (core and periphery, with subscript c for the former and p for the later) in the presence of asymmetric and symmetric shocks. We first consider a single monetary policy set by the ECB and then interest rates that are decided by the national central banks (henceforth NCBs) and account for different situations of the core and the peripheryseparately. In particular, we consider the cases where authorities: a) do not react to financial instability; b) react only with the interest rate or c) react with interest rate and federal or country-targeted MaP policy.

The nominal rate is set by a central bank (ECB) that minimises a quadratic loss function (LF) for the monetary union, without taking into consideration financial stability:

$$LF^{ECB} = \frac{1}{2}y^2 + \frac{\theta}{2}\pi^2, \tag{7}$$

where θ denotes the central bank's relative weight on inflation stabilization. Without loss of generality, but to simplify the algebra, we assume that the central bank weights both objectives equally ($\theta = 1$). For simplicity, we also assume, in a first step, that the transmission of monetary policy to the credit market is complete ($\gamma_n = 1$)[18]. Since the ECB reacts to the average variables of the core and the periphery, we rewrite our model as follows:

$$IS : y = \frac{y^c+y^p}{2} = -\beta\frac{(i_c^c+i_c^p)}{2} + \beta i + \epsilon_d$$

$$PC : \pi = \frac{\pi^c+\pi^p}{2} = \lambda_y\frac{(y^c+y^p)}{2} + \epsilon_s$$

$$TR : i_n = i + \alpha_y y + \alpha_\pi \pi$$

$$FF' : i_c = \frac{i_c^c+i_c^p}{2} = i_n - \gamma_y\frac{(y^c+y^p)}{2} + \gamma_{MaP}MaP + \frac{(\epsilon_f^c+\epsilon_f^p)}{2}$$

[18] $\gamma_n = 1$ if $\eta_n = \mu_c$. We relax this assumption in section 4.3.

MaP policy could be implemented at a federal or national level. We focus in what follows mainly on the policy mix in the presence of a financial shock. However, demand shocks have also an (indirect) effect on the credit rate and hence on the credit spread through the output gap.

4.1 Asymmetric shock

In the first policy experiment, we assume that the periphery and the core are hit by a fully asymmetric financial shock (respectively $\epsilon_f^p = -\epsilon_f^c$), where the periphery for example suffers a positive financial shock (financial stress), while the core experiences a negative one (favourable financial conditions).

4.1.1 Comparison of the ECB's interest rate with theoretical national interest rates

The ECB ignores financial shocks since they are fully asymmetric $\frac{(\epsilon_f^c+\epsilon_f^p)}{2} = 0$. The interest rate is therefore fixed by minimizing Lagrange subject to the Phillips curve (PC): $L = \frac{1}{2}y^2 + \frac{1}{2}\pi^2 + \chi(\lambda_y y + \epsilon_s - \pi)$. After solving for the optimal interest rate (see the annex for details) the expression for i_n is:

$$i_n^{ECB*} = i - \frac{\lambda_y(\beta\gamma_y - 1)}{\beta(1+\lambda_y^2)}\epsilon_s + \frac{1}{\beta}\epsilon_d$$

The policy rate reacts to the natural rate, but also to shocks (supply and demand). To verify whether the ECB's interest rate corresponds to both economies, we compare it with theoretical rates that are consistent with each region need separately.

When calculated in a similar manner, the theoretical NCBs' rates are:

$$i_n^{NCB^p*} = i - \frac{\lambda_y(\beta\gamma_y-1)}{\beta(1+\lambda_y^2)}\epsilon_s + \frac{1}{\beta}\epsilon_d - \epsilon_f^p \text{ and } i_n^{NCB^c*} = i - \frac{\lambda_y(\beta\gamma_y-1)}{\beta(1+\lambda_y^2)}\epsilon_s + \frac{1}{\beta}\epsilon_d + \epsilon_f^c$$

NCBs counterfactual policy rates are different from the ECB rate because they consider the financial shock. In fact, the ECB's monetary stance is simultaneously tighter for the periphery ($i_n^{ECB*} > i_n^{NCB^p*}$) and looser for the core ($i_n^{ECB*} < i_n^{NCB^c*}$). MaP policy would improve economic conditions of the monetary union by compensating for differentmonetary stances and by insuring homogeneous financial conditions.

4.1.2 Policy mix with a single monetary policy and macroprudential policy

Following Cecchetti and Kohler (2014), we introduce a credit spread in the loss function.

Country targeted Macroprudential policy

The loss functions of national MaP authorities are:

$$LF^c_{MaP} = \frac{1}{2}(i^c_c - i^{ECB*}_n)^2 \text{ and } LF^p_{MaP} = \frac{1}{2}(i^p_c - i^{ECB*}_n)^2$$

In each country, the MaP authority minimises any deviation of the credit spread from its optimal level $i^{c,p}_c - i^{ECB*}_n = 0$ using the financial frictions equation, taking the policy rate as given.

$$FF'_{NCB} : i^c_c - i^{ECB*}_n = -\gamma_y y^c + \gamma_{MaP} MaP^c - \epsilon_f \text{ and}$$
$$i^p_c - i^{ECB*}_n = -\gamma_y y^p + \gamma_{MaP} MaP^p + \epsilon_f$$

In each country, the MaP policy rule contains the financial shock and reacts to the counter-cyclical impact of the output gap on the credit spread. This helps to minimise the MaP authority's loss function and ensure economic convergence between the core and the periphery.

The value of MaP that minimises the loss function (FOC: $i^{c,p}_c - i^{ECB*}_n = 0$) is:

$$MaP^{c*} = \frac{\gamma_y}{\gamma_{MaP}} y^c + \frac{1}{\gamma_{MaP}} \epsilon_f \text{ and } MaP^{p*} = \frac{\gamma_y}{\gamma_{MaP}} y^p - \frac{1}{\gamma_{MaP}} \epsilon_f$$

In order to avoid imbalances, MaP policy is respectively tighter in the core and looser in the periphery. We may notice that MaP reacts not only to the financial shock but also to the demand shock through the output gap. By plugging MaP^{c*} and MaP^{f*} in the FF equations we obtain: $FF'_{NCB} : i^c_c = i^p_c = i^{ECB*}_n$. Thanks to country-targeted MaP policy, we reach the same output gap as in the absence of financial frictions:

$$y^c = -\beta(i^c_c - i) + \epsilon_d \text{ and } y^p = -\beta(i^p_c - i) + \epsilon_d$$

$$y^c = -\beta(i^{ECB*}_n - i) + \epsilon_d \text{ and } y^p = -\beta(i^{ECB*}_n - i) + \epsilon_d$$

Federal Macroprudential policy

The value of MaP that minimises the loss function ($LF^F_{MaP} = \frac{1}{2}(\frac{i^c_c + i^p_c}{2} - i^{ECB*}_n)^2 = \frac{1}{2}(-\gamma_y \frac{(y^c + y^p)}{2} + \gamma_{MaP} MaP)^2$) is:

$$MaP^{F*} = \frac{\gamma_y}{\gamma_{MaP}} \frac{y^c + y^p}{2}$$

We note that an implementation of MaP policy at a federal level ($LF^F_{MaP} = \frac{1}{2}(\frac{i^c_c + i^p_c}{2} - i^{ECB*}_n)^2 = \frac{1}{2}(-\gamma_y \frac{(y^c + y^p)}{2} + \gamma_{MaP} MaP)^2$) ignores the financial shock. In this case, economic imbalances emerge since output gaps of core and periphery deviate in opposite direction:

$$y^c = -\beta(i_n^{ECB*} - \epsilon_f - i) + \epsilon_d \text{ and } y^p = -\beta(i_n^{ECB*} + \epsilon_f - i) + \epsilon_d$$

In order to avoid the building up of imbalances in the euro area, the MaP authority (ie the ECB with/or national MaP authorities[19]) should fine-tune with country-targeted MaP policy to compensate the tight or loose stance of the single monetary policy.

4.2 Symmetric shock

In the previous section we have analysed the extreme case in which countries are hit by a full asymmetric shock. What does it happen in the more general case where the two countries are hit by the same shock? To this end, we assume that core and periphery are hit by a fully symmetric financial shock ϵ_f. The only change from the previous section is the presence of the financial shock in the ECB's financial friction's equation FF':

$$FF' : i_c = \frac{i_c^c + i_c^p}{2} = i_n - \gamma_y \frac{(y^c + y^p)}{2} + \epsilon_f$$

After solving for the optimal interest rate (see the annex for details), the resulting expression is: $i_n^{ECB*} = i - \frac{\lambda_y(\beta\gamma_y - 1)}{\beta(1+\lambda_y^2)}\epsilon_s + \frac{1}{\beta}\epsilon_d - \epsilon_f$, which is different from the previous ECB's rate in the presence of an asymmetric shock since it takes into account ϵ_f.

In this case, the financial shock can be neutralised through: a) the single interest rate, b) MaP policy, or even c) a combination of monetary and MaP policies[20]. However, the impact of such policies on the economy is not similar in practice. For example, a monetary authority that reacts only to a financial shock has to modify its nominal interest rate aggressively, which may have destabilising effects on inflation and output[21] (Svensson, 2016).

In this set-up, the MaP policy for the core, the periphery and the Union are:

$$MaP^{c*} = \frac{\gamma_y}{\gamma_{MaP}} y^c + \frac{1}{\gamma_{MaP}} \epsilon_f \text{ and } MaP^{p*} = \frac{\gamma_y}{\gamma_{MaP}} y^p + \frac{1}{\gamma_{MaP}} \epsilon_f.$$

[19] Schoenmaker (2013) distinguish between: a) a decentralised model, in which the ECB would set the macro-prudential framework and the NCAs would apply the tools in their respective countries or b) a centralised model, where the ECB would set and directly apply the macroprudential tools in cooperation with the NCAs.

[20] On this aspect, see the theoretical paper by Paoli and Paustian (2017) on the coordination of monetary and macroprudential policies. Cecchetti and Kohler (2014) distinguish between three possibilities: no coordination; full coordination; and partial or leader-follower coordination.

[21] Several simulations have indeed shown that an augmented Taylor rule alone does not constitute a welcome alternative, since it would be necessary in certain situations to raise the interest rate to very high levels to offset asset price inflation (BoE, 2009).

$$MaP^{F*} = \frac{\gamma_y}{\gamma_{MaP}} \frac{y^c + y^p}{2} + \frac{1}{\gamma_{MaP}} \epsilon_f$$

We can notice that federal and country-targeted MaP policies give similar outcomes only when both countries and shocks are fully similar. Otherwise, country-targeted MaP policies are more appropriate since a federal policy reacts to averages.

4.3 Heterogeneous transmission of monetary policy to financial conditions

In this section, we analyse if the federal implementation of MaP could be appropriate when the transmission of monetary policy to financial conditions is not the same in the two countries. To do that, we modify the financial friction equation (FF') by introducing heterogeneous transmission of monetary policy (Gambacorta, 2003). This distinction in the pass-through (denoted γ_n) could be justified for example by different bank lending conditions such as differences in prevalent mortgage contracts, for example fixed vs variable interest rates[22]. The monetary transmission is more direct when the lending rate applied to mortgage contract is variable because banks adjust their rates as the cost of funding (policy rate) is modified. Suppose, for example, that the pass-through is not complete in the core $\gamma_n^c = \frac{1}{2} < \gamma_n^p = 1$ and to simplify the analysis that the credit rate does not react to y ($\gamma_y = 0$). The FF' equations are :

$$i_c^c = \frac{1}{2} i_n^{ECB*} + \gamma_{MaP} MaP^c + \epsilon_f$$

$$i_c^p = i_n^{ECB*} + \gamma_{MaP} MaP^p + \epsilon_f$$

For a given policy rate, all things being equal, the spread between the rate credit and the policy rate is wider for the core ($i_c^c - \frac{1}{2} i_n^{ECB*} > i_c^p - i_n^{ECB*}$). This calls for more aggressive MaP policy in the core, compared to the situation where the transmission was complete, to minimise the loss function $LF_{MaP}^c = \frac{1}{2}(i_c^c - \frac{1}{2} i_n^{ECB*})^2 > LF_{MaP}^p = \frac{1}{2}(i_c^p - i_n^{ECB*})^2$.

Suppose for example that following a period of financial stress (ε_f), the central bank eases it's policy by ($-\epsilon_f$) to neutralise the impact of the financial shock on the cost of borrowing. In the presence of imperfect transmission in the core, financial conditions will be eased by only $\frac{1}{2}\epsilon_f$. So, MaP constraints should be released further to complement the action of the central bank.

[22] See Rubio (2014) for a DSGE model that study the coordination of monetary and MaP policies in a monetary union with different mortgage market structure.

$$i_c^c - \frac{1}{2}(i_n^{ECB*} - \epsilon_f) = \gamma_{MaP} MaP^c + \epsilon_f \iff i_c^c - \frac{1}{2} i_n^{ECB*} = \gamma_{MaP} MaP^c + \frac{1}{2}\epsilon_f = 0$$

$$if\ MaP^c = -\frac{1}{2\gamma_{MaP}}\epsilon_f$$

In this case, MaP policy is complementary to monetary policy since it could helps to ensure a better transmission of the monetary stance to financial conditions. As mentioned before, since MaP policy should be differentiated through countries $MaP^{F*} \neq MaP^{c*}$ to stabilize the economy, any federal implementation is not a first best policy.

5 Conclusion

In this paper we show that a monetary union could benefit from adopting a policy mix that combines a single monetary policy and a macroprudential policy adjusted to the economic and financial situation of each member state. Since macroprudential policy shares many transmission channels with monetary policy, it may compensate some limits of the common monetary policy by responding to asymmetric financial shocks and moderating macroeconomic imbalances related to endogenous and countercyclical credit spreads. This policy mix becomes even more useful when economies belonging to the monetary union are hit by asymmetric shocks or out of sync economic cycles: some countries require a tight policy stance, others a loose stance. In case of symmetric financial shock a monetary authority could react alone, but has to modify the policy interest rate aggressively, which may potentially have other destabilising effects. In this case a policy mix that also use macroprudential tools would promote not only macroeconomic, but also financial stability.

Annex. Solution for the central bank's optimal interest rate

Interest rate is set by minimizing the quadratic loss function LF^{ECB} subject to the Phillips curve (PC) equation. The central bank minimises the Lagrange: $L = \frac{1}{2}y^2 + \frac{1}{2}\pi^2 + \chi(\lambda_y y + \epsilon_s - \pi)$. First order conditions (FOCs) are:

$$\frac{\partial L}{y} = 0 \Leftrightarrow y + \chi\lambda_y = 0$$

$$\frac{\partial L}{\pi} = 0 \Leftrightarrow \pi = \chi$$

By solving the FOCs we obtain an optimal value of the output gap $y^{op} = \frac{(y^c+y^p)}{2}^{op} = -\lambda_y \pi$. We can replace the latter equation in the PC equation and then back into the (reduced form) output gap. We can derive in this way the optimal value of the output gap :

$$y = \frac{y^c + y^p}{2} = -\frac{\lambda_y}{(1+\lambda_y^2)}\epsilon_s$$

By plugging this formula into the PC equation and solving for inflation, we obtain :

$$\pi = \frac{1}{(1+\lambda_y^2)}\epsilon_s$$

$$LF^{ECB} = \frac{1}{2}(-\frac{\lambda_y}{(1+\lambda_y^2)}\epsilon_s)^2 + \frac{1}{2}(\frac{1}{(1+\lambda_y^2)}\epsilon_s)^2$$

In order to find the optimal interest rate, we insert y into FF' $i_c = \frac{i_c^c+i_c^p}{2} = \gamma_n i_n + \frac{\gamma_y\lambda_y}{(1+\lambda_y^2)}\epsilon_s + \frac{(\epsilon_f^c+\epsilon_f^p)}{2}$ and then combine y and i_c in the IS equation $y = \frac{y^c+y^p}{2} = -\beta\frac{(i_c^c+i_c^p)}{2} + \beta i + \epsilon_d$. We can then solve the resulting expression for i

$$i_{ECB}^* = \frac{1}{\gamma_n}i - \frac{\lambda_y(\beta\gamma_y - 1)}{\beta\gamma_n(1+\lambda_y^2)}\epsilon_s + \frac{1}{\beta\gamma_n}\epsilon_d - \frac{1}{\gamma_n}\epsilon_f$$

For the special case analysed in section 4.1, where the pass through is complete $\gamma_n = 1$ and the financial shock is asymmetric $\frac{(\epsilon_f^c+\epsilon_f^p)}{2} = 0$, we have :

$$i_{ECB}^* = i - \frac{\lambda_y(\beta\gamma_y - 1)}{\beta(1+\lambda_y^2)}\epsilon_s + \frac{1}{\beta}\epsilon_d$$

References

Adrian, T. and Liang, N. (2016). Monetary policy, financial conditions, and financial stability. *Federal Reserve Bank of New York Staff Reports*, (690).

Adrian, T. and Shin, H. S. (2009). Financial intermediaries and monetary economics. Federal reserve bank of new york, staff reports 398.

Altunbas, Y., Gambacorta, L., and Marques-Ibanez, D. (2014). Does Monetary Policy Affect Bank Risk? *International Journal of Central Banking*, 10(1):95–136.

Angelini, P., Neri, S., and Panetta, F. (2012). Monetary and macroprudential policies. ECB Working Paper Series 1449.

Basten, C. and Koch, C. (2015). Higher bank capital requirements and mortgage pricing: evidence from the Counter-Cyclical Capital Buffer. Bis working paper no. 511.

Beau, D., Clerc, L., and Mojon, B. (2011). Macro-prudential policy and the conduct of monetary policy. Banque de France Occasional papers 8.

Bernanke, B. and Gertler, M. (1999). Monetary policy and asset price volatility. *Economic Review*, (4):17–51.

Bernanke, B. S. and Blinder, A. S. (1988). Credit, Money, and Aggregate Demand. *American Economic Review*, 78(2):435–39.

Blanchard, O., Dell Ariccia, G., and Mauro, P. (2013). Rethinking macro policy 2: Getting granular. *IMF Staff Discussion Note*, 13(03).

Blinder, A. S. (2010). How central should the central bank be? *Journal of Economic Literature*, 48(1).

BoE (2009). The role of macroprudential policy. *Bank of England Discussion Paper*.

Bofinger, P., Mayer, E., and Wollmershäuser, T. (2006). The bmw model: A new framework for teaching monetary economics. *The Journal of Economic Education*, 37(1):98–117.

Borio, C. and Lowe, P. (2002). Asset prices, financial and monetary stability: exploring the nexus. BIS Working Papers 114.

Borio, C. and Zhu, H. (2012). Capital regulation, risk-taking and monetary policy: A missing link in the transmission mechanism? *Journal of Financial Stability*, 8(4):236–251.

Brzoza-Brzezina, M., Kolasa, M., and Makarski, K. (2015). Macroprudential policy and imbalances in the euro area. *Journal of International Money and Finance*, 51:137–154.

Calza, A., Manrique, M., and Sousa, J. (2006). Credit in the euro area: An empirical investigation using aggregate data. *The Quarterly Review of Economics and Finance*, 46(2):211 – 226.

Carré, E., Couppey-Soubeyran, J., and Dehmej, S. (2015). La coordination entre politique monétaire et politique macroprudentielle. Que disent les modeles DSGE? *Revue Economique*, 66(3).

Cecchetti, S. G. and Kohler, M. (2014). When capital adequacy and interest rate policy are substitutes (and when they are not). *International Journal of Central Banking*, 10(3):205–231.

Cecchetti, S. G. and Li, L. (2008). Do Capital Adequacy Requirements Matter For Monetary Policy? *Economic Inquiry*, 46(4):643–659.

Cerutti, E., Claessens, S., and Laeven, L. (2017). The Use and Effectiveness of Macroprudential Policies: New Evidence. *Journal of Financial Stability*, (Vol. 28).

CGFS (2012). Operationalising the selection and application of macroprudential instruments. *BIS, CGFS Papers 48*.

Claessens, S., Ghosh, S., and Mihet, R. (2013). Macro-prudential policies to mitigate financial system vulnerabilities. *Journal of International Money and Finance*, 39:153–185.

Constancio, V. (2015a). Assessing the new phase of unconventional monetary policy at the ecb. *Panel remarks at the Annual Congress of the European Economic Association, University of Mannheim, 25 August 2015.*

Constancio, V. (2015b). Financial integration and macro-prudential policy. *Speech at the joint conference organised by the European Commission and the European Central Bank: European Financial Integration and Stability, 27 April 2015.*

Couppey-Soubeyran, J. and Dehmej, S. (2016). Pour une combinaison politique monetaire / politique macroprudentielle au service de la stabilite economique et financiere de la zone euro. *Revue d Economie Politique*, 126(1).

Curdia, V. and Woodford, M. (2010). Credit spreads and monetary policy. *Journal of Money, Credit and Banking*, 42:3–35.

Drehmann, M. and Gambacorta, L. (2012). The effects of countercyclical capital buffers on bank lending. *Applied Economics Letters*, 19(7):603–608.

ESRB (2014). Allocating macro-prudential powers. *Reports of the Advisory Scientific Committee*.

Gambacorta, L. (2003). Asymmetric bank lending channels and ECB monetary policy. *Economic Modelling*, 20(1):25–46.

Gambacorta, L. (2009). Monetary policy and the risk-taking channel. *BIS Quarterly Review, December*.

Gambacorta, L. and Signoretti, F. M. (2014). Should monetary policy lean against the wind? *Journal of Economic Dynamics and Control*, 43(C):146–174.

Kenen, P. (1969). The theory of optimum currency areas: An eclectic view. *in Mundell R. and A. Swoboda eds, Monetary Problems of the International Economy, The University of Chicago Press*.

Krugman, P. (2012). Revenge of the optimum currency area. *NBER Macroeconomics Annual*, 27.

Kuttner, K. N. and Shim, I. (2016). Can non-interest rate policies stabilize housing markets? Evidence from a panel of 57 economies. *Journal of Financial Stability*, 26(C):31–44.

Mankiw, N. (2016). *Macroeconomics*. Worth Publishers, 9 edition.

Minsky, H. (1975). *John Maynard Keynes*. Columbia essays on the great economists. Columbia University Press.

Mundell, R. (1962). The appropriate use of monetary and fiscal policy for internal and external stability. *IMF staff paper*, pages 70–79.

N'Diaye, P. (2009). Countercyclical macro prudential policies in a supporting role to monetary policy. IMF Working Papers 257.

Paoli, B. D. and Paustian, M. (2017). Coordinating monetary and macroprudential policies. *Journal of Money, Credit and Banking*, (Issue 2-3).

Peersman, G. and Wagner, W. (2015). Shocks to Bank Lending, Risk-Taking, Securitization, and their Role for U.S. Business Cycle Fluctuations. CEPR Discussion Papers 10547.

Poutineau, J.-C. and Vermandel, G. (2015). A primer on macroprudential policy. *The Journal of Economic Education*, 46(1):68–82.

Quint, D. and Rabanal, P. (2014). Monetary and macroprudential policy in an estimated dsge model of the euro area. *International Journal of Central Banking*, 10(2):169–236.

Romer, D. (2000). Keynesian macroeconomics without the LM curve. NBER Working Paper 7461.

Rubio, M. (2014). Macroprudential policy implementation in a heterogeneous monetary union. Discussion Papers 03, University of Nottingham, Centre for Finance, Credit and Macroeconomics (CFCM).

Schoenmaker, D. (2013). An Integrated Financial Framework for the Banking Union: Do Not Forget Macro-Prudential Supervision. Economic Papers 495, European Commission (DG ECFIN).

Smets, F. (2014). Financial Stability and Monetary Policy: How Closely Interlinked? *International Journal of Central Banking*, 10(2):263–300.

Stremmel, H. (2015). Capturing the financial cycle in europe. *ECB Working paper 1811*.

Svensson, L. (2016). Cost-benefit analysis of leaning against the wind: Are costs larger also with less effective macroprudential policy? *IMF Working Paper*, WP/16/3.