Macroprudential and Monetary Policies: The Need to Dance the Tango in Harmony

José David Garcia Revelo* Yannick Lucotte† Florian Pradines-Jobet‡

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Abstract

Considering a sample of 37 emerging and industrialised economies from 2000Q1 to 2014Q4, we empirically assess the effectiveness of macroprudential policies in curbing domestic credit growth, and whether this effectiveness is affected by monetary policy conditions. We obtain three important results. First, in line with previous research, our findings suggest that an overall tightening in macroprudential policies is associated with a reduction in credit growth. Second, we show that a restrictive monetary policy enhances the impact of macroprudential tightening actions on credit growth. Third, we find evidence that monetary policy helps to reduce the transmission delay of macroprudential policy actions. Consequently, results that we obtain confirm the need for coordination between both policies.

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*Univ. Orléans, CNRS, LEO, FRE 2014, F-45067, Orléans, France. First author. E-mail: josedavidgarciarevelo@gmail.com

†Univ. Orléans, CNRS, LEO, FRE 2014, F-45067, Orléans, France & PSB Paris School of Business, Department of Economics. Corresponding author. E-mail: ylucotte@gmail.com

‡PSB Paris School of Business, Department of Economics, 59 rue Nationale, 75013 Paris, France. E-mail: florianpradinesjobet@gmail.com

1 Introduction

In the wake of the 2007-2008 global financial crisis, macroprudential policy has attracted considerable attention among policymakers and researchers. Indeed, while macroprudential policy tools have been in use in a number of emerging countries well before the crisis, substantial progress have been made in both emerging and industrialised economies to put in place dedicated institutional arrangements for macroprudential policy. The main objective of macroprudential policy is to safeguard the stability of the financial system as a whole by strengthening its resilience and preventing the build-up of systemic risk. To ensure the achievement of this primary objective, the European Systemic Risk Board (ESRB/2013/1) defines five intermediate objectives that macroprudential policy should aim to achieve: (i) mitigating and preventing excessive credit growth and leverage; (ii) mitigating and preventing excessive maturity mismatch and market illiquidity; (iii) limiting direct and indirect exposure concentrations; (iv) limiting the systemic impact of misaligned incentives with a view to reducing moral hazard; and (v) strengthening the resilience of financial infrastructures. The aforementioned intermediate objectives are seen as transitional steps towards achieving robust financial stability.

Mitigating and preventing excessive credit growth and leverage is particularly important to safeguard financial stability. Indeed, one important lesson of the global financial crisis is that the development of financial imbalances was largely due to the procyclical behavior of the banking industry. Such a behavior tends to put upward pressure on asset prices and is often viewed as a key driver of the occurrence and severity of banking crises. That is why several macroprudential tools have been designed to curb excessive credit growth and mitigate procyclicality of domestic credit. Such instruments include for instance the countercyclical capital buffer and the loan-to-value ratio.

However, the implementation of macroprudential policies raises a number of challenges. A first challenge is the evaluation of the effectiveness of macroprudential policies. While still in its infancy, a growing body of empirical literature addresses this issue (see, e.g., Galati and Moessner, 2018). Especially, the findings seem to confirm the effectiveness of macroprudential tools in containing credit growth and housing prices. More importantly, a second challenge concerns the interactions of macroprudential policy with other policies that also have an impact on financial stability, such as fiscal and monetary policies.

In particular, the fact that macroprudential and monetary policies pursue different primary objectives could result in conflicts of objectives. As mentioned above, the macroprudential policy primarily aims at promoting financial stability, while the primary objective of monetary policy is to maintain price stability. Consequently, the conduct of each policy can have "side effects" on the objective of the other, and then enhance or reduce the effectiveness of each policy. Side effects from monetary policy pose significant challenges for the conduct of macroprudential policy if they are detrimental to financial stability.

Monetary policy can have detrimental side effects on financial stability through different channels (IMF, 2013). First, if we consider a decrease of the policy interest rate, monetary policy can worsen financial stability through two channels: the risk-taking channel and the asset prices channel. The risk-taking channel refers to the fact that a low interest rate environment may encourage banks to expand their balance sheets and take more risk, which in turn may contribute to an excessive expansion of credit, and hence to amplify boom-bust cycles (Adrian and Shin, 2010; Borio and Zhu, 2012). These effects are often argued to be worse if the policy interest rate is maintained "too low for too long". A low interest rate environment can also lead to sharp increases in asset prices through the so-called "financial accelerator" mechanism (Bernanke and Gertler, 1989; Bernanke and Gertler, 1995). Such a rise in asset prices tends to intensify the financial cycle, which may lead to a bubble.

If we now consider an increase of the policy interest rate, monetary policy can negatively affect financial stability through three different channels: the balance sheet channel, the risk-shifting channel and, for small open economies, the exchange rate channel. Concerning the balance sheet channel, it refers to the fact that a tightening of the monetary policy stance can adversely affect the capacity of borrowers to repay their loans, possibly leading to higher default rates and financial instability (see, e.g., Allen and Gale, 2001; Illing, 2007). The risk-shifting effect operates through the balance sheets of banks. As banks typically issue short-term deposits and make long-term loans, changes in the policy rate have a greater influence on interest rate applied to short-term deposits than on that of loans. An increase of the policy rate then reduces intermediation margins, and leads financial intermediaries to seek more risk in order to maintain profits (Bhattacharya, 1982). As a result, monetary tightening is expected to increase financial instability. Finally, monetary policy can impact financial stability though the exchange rate channel. Indeed, the policy rate is an important determinant of capital inflows. The latter can in turn drive credit growth and, owing to the presence of exchange rate externalities, contribute to excessive increases in leverage. Consequently, contrary to one would expect, raising the policy rate may induce an excessive credit growth, especially in emerging markets and small open economies. Of course, the strength of these side effects can vary with the financial cycle. As financial imbalances build up, monetary easing tends to reduce default rates, but can induce banks to make riskier loans and increase leverage. When the policy rate is increased close to the peak of the financial cycle, this can induce risk-shifting and borrower defaults.

More importantly, these side effects highlight the potential tradeoffs and complementarities between monetary policy and macroprudential measures. Interactions between both policies have been extensively studied by a recent theoretical literature. Most work in this area uses New-Keynesian Dynamic Stochastic General Equilibrium (DSGE) models with financial frictions (see, e.g., Loisel, 2014). These models usually consider two authorities that conduct their policies separately and independently, focusing on their respective objective. Their results suggest that macroprudential and monetary policies are complements rather than substitutes, although the results vary by type of shock. In the wake of a financial shock, both policies should work in the same direction, even if the reaction in terms of macroprudential policy should be larger. In the presence of productivity and demand shocks, results suggest that policy responses could differ depending on the size and nature of the shocks. More recently, DSGE models go a step further by explicitly assessing the benefits of coordination between macroprudential and monetary policy. To this end, they differentiate between two cases: the perfect coordination policy and the non-coordination policy. They find that the coordination of both policies stabilises the effect of real and financial shocks to the macro-environment, and maximises the social welfare.

Despite the apparent emerging consensus in the theoretical literature on the benefits of synchronisation between macroprudential and monetary policies, little is known from an empirical perspective. Indeed, very few empirical studies have addressed this issue and their results are far from conclusive (Bruno et al., 2017; Gambacorta and Murcia, 2019; Zhang and Tressel, 2017). Moreover, they only focus on a small sample of economies. Against this background, our paper aims to fill this gap in the existing literature by investigating for a sample of 37 emerging and industrialised countries whether the effectiveness of macroprudential policy is conditional to the monetary policy conditions.

Our findings suggest that the effectiveness of macroprudential policy in curbing credit growth is strengthened when macroprudential and monetary policies dance the tango in harmony. Considering different measures of macroprudential stance and using the Taylor gap as a measure of monetary policy stance, we obtain two important results. First, we find that a restrictive monetary policy enhances the impact of macroprudential tightening actions on domestic credit growth. Second, we find evidence that monetary policy helps to reduce the transmission delay of macroprudential policy actions. To the best of our knowledge, it is the first empirical paper in the literature that formally confirms the benefits of synchronisation between macroprudential and monetary policies.

The remainder of the paper is organised as follows. Section 2 reviews the existing empirical literature on the effectiveness of macroprudential policies and the potential role of monetary policy. Section 3 presents the measures of macroprudential policy stance and monetary policy stance that we consider. Section 4 presents some descriptive statistics, describes our econometric approach and discusses our results. Section 5 concludes and gives some policy recommendations.

2 Literature Review

In this section, we give an overview of the existing literature that analysed the effects of macroprudential policies on various measures of financial vulnerability and stability by discussing whether these studies deal with the challenges discussed above.[1] Nabar and Ahuja [2011] and Lim et al. [2011] are the first to use a cross-country analysis to assess the effectiveness of macroprudential policies. Considering a sample of 49 emerging and advanced economies, Nabar and Ahuja [2011] investigate whether the implementation of two macroprudential instruments, namely the loan-to-value and the debt-service-to-income ratios, influence the property sector and the stability of the banking sector. Results that they obtain show that loan-to-value caps have a negative effect on the growth in housing prices and mortgage lending, while debt-service-to-income caps only lower property lending growth. Findings concerning the stability of the banking sector are more mixed. Indeed, Nabar and Ahuja [2011] find that loan-to-value caps improve credit quality by reducing non-performing loans, but debt-service-to-income caps appear not statistically significant. Considering a larger set of macroprudential instruments, Lim et al. [2011] analyse whether the adoption of these instruments are effective to reduce credit procyclicality. Their evidence suggests that tools such as caps on loan-to-value and debt-service-to-income ratios, limits on credit growth, reserve requirements, and dynamic provisioning rules, can mitigate the procyclicality of credit.

In the same vein, Cerutti et al. [2017a] investigate whether a more developed macroprudential framework is associated with lower growth in credit and house prices. To this end, they construct an aggregate macroprudential index for a large sample of 119 countries over the 2000-2013 period. This index, which comprises 12 macroprudential instruments, aims at measuring the number of instruments in place in a given country. Results that they obtain confirm the effectiveness of macroprudential policies in curbing credit growth, especially in developing and emerging countries, while their effects on real housing prices growth appear not statistically significant. Furthermore, Cerutti et al. [2017a] also consider two sub-indexes by distinguishing between borrower-targeted instruments and financial institution-targeted instruments. Results on the full sample indicate that both categories of instruments are significantly associated with a lower credit growth. However, they do not find a significant effect of these

[1] For a comprehensive literature review on the effects of macroprudential policy, see Galati and Moessner [2018].

indexes on credit growth in advanced economies.

In addition to these cross-country studies, there are some papers that assess the effectiveness of macroprudential policies at the micro-level. Using bank balance-sheet data, they usually analyse whether the adoption of a macroprudential policy framework helps in taming credit supply cycles and mitigating bank risk. In comparison to a cross-country perspective, the main advantage of such an approach is to deal with a potential endogeneity issue, since macroprudential tools are less likely to be adopted in response to individual bank behavior than to developments in macroeconomic and financial variables at the aggregate country-level (Claessens et al., 2013; Galati and Moessner, 2018). But it has the disadvantage to focus only on specific risks and markets segments. It does not allow to assess the effects of macroprudential policies on the stability of the financial system as a whole, which is the main objective of the macroprudential regulation. For instance, Jiménez et al. [2017] find for the case of Spain that dynamic provisioning rules are useful in smoothing credit supply cycles. More importantly, they find evidence that such a countercyclical macroprudential policy can help to mitigate credit crunches during downturns, upholding firm credit availability and performance during recessions. Using a large panel dataset of banks around the world, Claessens et al. [2013] assess the effects of different macroprudential instruments on the growth in leverage, asset and noncore to core liabilities. Results that they obtain suggest in particular that caps on loan-to-value and debt-to-income are effective in reducing level growth in all three measures, especially during boom times.

One important drawback of studies cited above concerns the way of measuring the macroprudential policy. Indeed, by focusing only on the existence of macroprudential instruments, these studies do not capture the direction of macroprudential policy actions and the cross-country heterogeneity in macroprudential activism (Boar et al., 2017). To overcome this shortcoming, some recent studies go a step further by considering the evolution of macroprudential policy in terms of its tightening and loosening over time (Vandenbussche et al., 2015; Kuttner and Shim, 2016; Zhang and Zoli, 2016; Cerutti et al., 2017b; Akinci and Olmstead-Rumsey, 2018; Altunbas et al., 2018; Carreras et al., 2018). Using the IMF Global Macroprudential Policy Instruments (GMPI) survey and national sources, Akinci and Olmstead-Rumsey [2018] analyse the evolution of macroprudential policies in 57 advanced and emerging economies over the 2000:Q1-2013:Q4 period, depending on whether the prudential tools considered in the dataset were tightened or loosened in a given quarter. Using a cumulative macroprudential policy stance indicator, which corresponds for each country to the sum of tightenings net of easings since 2000, they find that tightening is associated with lower bank credit growth, housing credit growth, and house price appreciation. Their findings also suggest that borrower-targeted macroprudential instruments tend to be more effective in curbing credit growth. Similar results are obtained by Zhang and Zoli [2016] for a sample of Asian economies.

Considering a cointegration framework, Carreras et al. [2018] reinvestigate this issue for OECD countries. To this end, they use the database compiled by Cerutti et al. [2017b] and consider both the cumulative and quarter-by-quarter changes in macroprudential policy measures. Similarly to Akinci and Olmstead-Rumsey [2018], they find a negative and significant relationship between the cumulative changes in macroprudential tools and the quarterly growth rate of housing price and household credit. On the contrary, the relationship appears not statistically significant when they consider the quarter-by-quarter changes. As argued by Akinci and Olmstead-Rumsey [2018], this result could be explained by the fact that macroprudential policies may be delayed in their effect. Carreras et al. [2018] also consider individually the stance of each macroprudential tool. However, contrary to Akinci and Olmstead-Rumsey [2018], they do no find a significant relationship between the cumulative changes in loan-to-value ratio and the growth rate of housing price.

Other studies focus specifically on the effects of the stance of macroprudential policy on the real estate market (see, for instance, McDonald, 2015, Vandenbussche et al., 2015, Kuttner and Shim, 2016). Kuttner and Shim [2016] assess the relative effectiveness of macroprudential and housing-related tax policies in curbing housing credit and house prices. Concerning the growth rate in housing credit, Kuttner and Shim [2016] find that both policies have a negative impact on this variable. Results are more mixed when they consider housing price growth as endogenous variable. Indeed, while changes in taxes still have a statistically significant impact on house prices, this is not the case for some of the macroprudential tools considered, such as the debt-to-service ratio. As argued by Kuttner and Shim [2016], this result can be easily explained by the fact that, contrary to macroprudential tools, tax policies such as the deductibility of mortgage interest and property taxes affect directly the cost of buying a house, and then the demand and price in the real estate market. More importantly, results obtained by Kuttner and Shim [2016] confirm that one major challenge for macroprudential policy is to interact with other policies in a way which fosters the effective conduct of this policy in pursuit of its objective of financial stability.

A key issue in both the academic literature and the policy debate concerns the interactions between macroprudential policy and monetary policy. Indeed, as discussed in the introduction, the conduct of each policy can have "side effects" on the objectives of the other. In particular, it is widely recognised that monetary policy can have side effects on financial stability, for instance by maintaining policy rates "too low for too long". When monetary policy is very accommodative, this rise incentives to borrow at low interest rates that are difficult for macroprudential policy to fully contain. Consequently, an important empirical question is to assess to which extent monetary policy stance affects the effectiveness of macroprudential policy.

However, the existing empirical literature on this issue is still scarce. To the best of our knowledge, only some studies try to address this issue (Bruno et al., 2017; Gambacorta and Murcia, 2019; Zhang and Tressel, 2017). Considering a sample of 12 Asia-Pacific economies over the 2004-2013 period, Bruno et al. [2017] investigate two supplementary issues. First, distinguishing between the pre- and post-2007 period, they investigate whether macroprudential policies are synchronised with monetary policy rate changes.[2] Before 2007, they find that monetary policy is usually changed in tandem with macroprudential measures. An opposite result is found for the post-2007 period. Indeed, after 2007, the average monetary policy rate in the region was in a slightly downward trend, while macroprudential measures were slightly in the tightening mode. Second, they assess the effectiveness of macroprudential policy measures in curbing cross-border banking flows growth. They find that macroprudential policies effectively reduced banking inflows over the 2004-2007 period, while they were not effective after 2007. These findings indirectly suggest that monetary and macroprudential policies tend to be more successful when they are pulling in the same direction rather than they act in the opposite direction.

Gambacorta and Murcia [2019] and Zhang and Tressel [2017] investigate this issue more specifically by assessing whether the effectiveness of macroprudential policies on credit growth depends on monetary policy conditions. Using meta-analysis techniques and credit registry data for a sample of 5 Latin American countries, Gambacorta and Murcia [2019] find that the effectiveness of macroprudential tools in dampening credit cycles is reinforced when monetary policies push in the same direction. Indeed, considering the change in the real money rate as a monetary policy indicator, Gambacorta and Murcia [2019] find that a macroprudential policy tightening has a stronger impact on credit growth when it is accompanied by the use of a countercyclical monetary policy. Zhang and Tressel [2017] adopt a similar approach to gauge this issue for Euro area countries. More precisely, they focus on the loan-to-value (LTV) ratio and assess whether the macroprudential policy is more effective in containing credit growth and housing prices when monetary policy is tightened. To this end, they interact the LTV ratio with an interest rate gap computed using a Taylor rule. However, results that they obtain are relatively mixed. Especially, the sign and the significance of the estimated coefficients associated to the interaction term are unstable according to the lag order considered.

As we can see, empirical studies that tried to assess the role of monetary policy conditions on the effectiveness of macroprudential policies only focus on a small sample of economies and their findings are relatively mixed. Against this background, our paper contributes to the existing literature by explicitly investigating, for a large

[2] Akinci and Olmstead-Rumsey [2018] investigate a similar issue for a sample of emerging and industrialised economies. They find a relatively high correlation between macroprudential measures and other policy actions.

sample of emerging and industrialised countries, whether the synchronisation between macroprudential and monetary policies is a good way to strengthen the impact of macroprudential tools on domestic credit growth. Furthermore, in comparison to the existing literature, we consider in our empirical analysis an extensive set of prudential tools to capture the stance of the overall macroprudential policy. By this way, our paper fills a gap in the literature and provides the first formal answer to an extensive academic and policy debate.

3 Measuring the Stance of Macroprudential and Monetary Policies

3.1 Measuring the stance of macroprudential policy.

In order to analyse the effectiveness of macroprudential instruments at curbing the credit cycle, we first need to assess the overall macroprudential policy stance. Efforts have been made recently in the academic literature to develop datasets that capture usage of macroprudential policies in a large sample of emerging and industrialised economies.

Two types of dataset can be distinguished. First, considering a large set of macroprudential tools, some studies provide information on the number of instruments adopted by countries. By this way, they give a picture of the evolution of the macroprudential policy framework. For instance, using the IMF's 2017 Macroprudential Policy Survey (IMF, 2018) and national sources, Cerutti et al. [2017a] construct an aggregate macroprudential index in which each considered instrument is coded as a simple binary variable, equal to 1 if the instrument is in place, and zero otherwise. Their results indicate the increasing use of macroprudential measures across countries.

Other studies go a step further by providing data on the quarterly changes in macroprudential tools (Vandenbussche et al., 2015; Kuttner and Shim, 2016; Cerutti et al., 2017b; Akinci and Olmstead-Rumsey, 2018; Alam et al., 2019). By using information on easing and tightening of different macroprudential policy instruments, the main objective of these datasets is then to reflect the policy direction.

In this paper, we use the database provided by Cerutti et al. [2017b], which is one of the most comprehensive datasets on macroprudential policy actions. Using the same survey than Cerutti et al. [2017a], Cerutti et al. [2017b] consider five types of prudential instruments across a sample of 64 countries over the period 2000Q1-2014Q4. The five types of instruments are capital buffers, interbank exposure limits, concentration limits, loan-to-value ratio limits and reserve requirements. More precisely, capital buffers are divided into four sub-indexes: general capital requirements, specific capital buffers related to real estate credit, specific capital buffers related to consumer credit, and other specific capital buffers. Reserve requirements are also divided into two sub-indexes: reserve requirements on foreign currency-denominated accounts and reserve requirements on local currency-denominated accounts.

Then, Cerutti et al. [2017b] record the number of easing and tightening measures for each type of macroprudential instruments implemented by each country in each quarter. For a given instrument, a tightening action is coded +1, a loosening action is coded -1, while 0 represents the case where no change occurs during the quarter. If multiple actions are taken within a given quarter, reported values correspond to the sum of all changes recorded. This means that tightening and loosening actions taken within the same quarter cancel each other out. An instrument that is not adopted by a given country is coded as missing until its implementation by policymakers. Table 1 details the number of events for each macroprudential policy instrument, by distinguishing between net tightening and net loosening events. As we can see, reserve requirements on local and foreign currency-denominated accounts and capital requirements are the most frequently used instruments.

Table 1: Macroprudential policy instruments: number of events

Instruments	Target	Nb. of events	Nb. of net tightening events	Nb. of net loosening events
CB REC	Lender	33	28	5
CB CC	Lender	9	7	2
CB OS	Lender	11	7	4
CAP REQ	Lender	65	65	0
CONC	Lender	15	14	1
IBEX	Lender	16	16	0
LTV	Borrower	47	33	14
RR FC	Lender	56	33	23
RR LC	Lender	108	47	61
Total events		360	250	110
[share]		[17.86%]	[12.41%]	[5.46%]

Source: Cerutti et al. [2017b].
Note: CB REC: real estate credit related specific capital buffers; CB CC: consumer credit related specific capital buffers; CB OS: other specific capital buffers; CAP REQ: capital requirements; CONC: concentration limits; IBEX: limits on interbank exposures; LTV: loan-to-value ratio; RR LC: reserve requirements for deposit accounts denominated in local currency; RR FC: reserve requirements for deposit accounts denominated in foreign currency. The number of events is based on our sample of 37 countries from 2000Q1 to 2014Q4.

Given these characteristics of the dataset provided by Cerutti et al. [2017b], we consider six different measures for assessing the stance of macroprudential policies. Two of them, $PruC$ and $PruC2$, have been originally developed by Cerutti et al. [2017b], and we also propose four alternative measures. The latter aim to give a better view of cross-country differences in terms of macroprudential policy conduct.

$PruC$ is a country index based on the sum of the quarterly changes of the nine instruments. It can take three different values: -1, 0, +1. Formally, $PruC$ is defined as follows:

$$PruC_{i,t} = \begin{cases} +1 & \text{if} \quad \sum\limits_a x_{a,i,t} > 0 \\ 0 & \text{if} \quad \sum\limits_a x_{a,i,t} = 0 \\ -1 & \text{if} \quad \sum\limits_a x_{a,i,t} < 0 \end{cases} \tag{1}$$

where subscripts i and t refer to country and time period, respectively, while the subscript a represents a given macroprudential instrument among the nine tools recorded in the database. It is nonetheless important to note that the number of instruments considered can vary across countries depending on whether an instrument is adopted or not. Indeed, as mentioned above, the absence of legislation that authorises the use of a macroprudential instrument by policymakers is coded as missing in the database. $x_{a,i,t}$ reflects the orientation of the instrument a, in country i at time t. More precisely, for each instrument, it corresponds to the difference between the number of tightening actions and the number of easing actions. Positive values of $x_{a,i,t}$ indicate a net tightening of the macroprudential policy instrument a, while negative values indicate a net easing. Then, if $PruC$ is equal to +1, this means that the overall macroprudential policy framework has been tightened during the quarter. Conversely, $PruC$ is equal to -1 if the framework has been loosened. Finally, $PruC$ equal to 0 can correspond to two cases: no change in all instruments, or the same number of tightening and loosening actions during the quarter.

$PruC2$ is computed in a similar fashion than $PruC$. The only difference between these two country indexes concerns the way in which the orientation of individual macroprudential instruments is recorded. The orientation is now bounded between -1 and +1. For a given quarter, an instrument takes the value +1 if the difference between tightening and loosening actions is positive, -1 if this difference is negative, and 0 otherwise. $PruC2$ is computed as follows:

$$PruC2_{i,t} = \begin{cases} +1 & \text{if} \quad \sum\limits_a y_{a,i,t} > 0 \\ 0 & \text{if} \quad \sum\limits_a y_{a,i,t} = 0 \\ -1 & \text{if} \quad \sum\limits_a y_{a,i,t} < 0 \end{cases} \tag{2}$$

where $y_{a,i,t} = \{-1, 0, +1\}$ summarises the orientation of the instrument a, in country i at time t. Consequently, contrary to $PruC$, $PruC2$ gives the same weight to each adopted instrument, whatever the number of tightening or loosening actions taken during a quarter for a given instrument. $PruC2$ then corresponds to the difference between the number of tightening instruments and the number of easing instruments. $PruC2$ is equal to +1 if the number of tightening instruments during the quarter is higher than the number of easing instruments, -1 if the difference between tightening and loosening instruments is negative, and 0 otherwise.

In addition to the measures proposed by Cerutti et al. [2017b], we compute four alternative country indexes. First, to have a more granular view of the macroprudential policy stance, we compute an overall index, called $PruC3$, which corresponds for a given quarter to the difference between the sum of tightening actions and the sum of loosening actions. Formally, $PruC3$ is defined as follows:

$$PruC3_{i,t} = \sum_{a} x_{a,i,t} \tag{3}$$

where, as in Equation (1), $x_{a,i,t}$ corresponds for each instrument a, in country i at time t, to the difference between tightening and loosening actions. Hence, a larger positive value of this index indicates a more restrictive macroprudential policy. Conversely, a larger negative value reflects a more accommodative policy.

As for $PruC$ and $PruC2$ proposed by Cerutti et al. [2017b], one shortcoming of the $PruC3$ index is that it does not take into account the fact that the number of adopted instruments can differ across countries. Indeed, one would expect that the number of actions is partly driven by the number of adopted instruments, especially if all instruments move in the same direction. To address this issue, we compute an additional index, called $PruC4$, which is defined as follows:

$$PruC4_{i,t} = \frac{PruC3_{i,t}}{n_{i,t}} \tag{4}$$

where $n_{i,t}$ corresponds to the number of adopted instruments in country i at time t. Then, $PruC4$ captures the overall direction of the macroprudential policy conditional on the number of tools implemented.

However, one potential drawback of the $PruC4$ index is that we do not distinguish between instruments that have been effectively changed and those for which no action has been taken. To this end, we go a step further by computing an index that reflects the macroprudential policy stance conditional on the number of instruments effectively changed during a given quarter. This index, called $PruC5$, is defined as follows:

$$PruC5_{i,t} = \frac{PruC3_{i,t}}{e_{i,t}} \tag{5}$$

where $e_{i,t}$ corresponds to the number of instruments in country i at time t that have been effectively changed.

The last measure that we consider aims to distinguish between tightening and loosening actions. This measure, called $PruC6$, is computed as follows:

$$PruC6_{i,t} = \frac{\sum\limits_{T} x_{T,i,t}}{Tight_{i,t}} + \frac{\sum\limits_{L} x_{L,i,t}}{Loose_{i,t}} \tag{6}$$

where $x_{T,i,t}$ corresponds to the recorded value of the macroprudential instrument T that is characterised by a net tightening during the quarter, while $x_{L,i,t}$ corresponds to the recorded value of the instrument L that is characterised by a net loosening. $Tight_{i,t}$ and $Loose_{i,t}$ refer to the number of net tightening instruments and the number of net easing instruments, respectively. $PruC6$ is then complementary to the previous indexes described above, as it reflects both the macroprudential policy stance and the more or less balanced path of the policy. Especially, in comparison to $PruC5$, the $PruC6$ index is more able to evaluate the stance of macroprudential policy when some macroprudential tools move in an opposite way. A higher value of this index indicates a more restrictive macroprudential policy.

To illustrate the pattern of our macroprudential indexes following policy changes, we consider four countries (Argentina, Colombia, Poland and Russian Federation) where different macroprudential policy actions have been taken during a given quarter (see Table 2. As expected, in comparison to $PruC$ and $PruC2$, the other macroprudential measures that we propose in this article tend to better discriminate the macroprudential policy stance across countries. If we now focus on Colombia, we can see that $PruC6$ is higher in absolute term than $PruC5$. This confirms the interest of this index when the number of tightening actions per instrument is lower than the number of loosening actions per instrument.

3.2 Measuring the stance of monetary policy.

To assess the monetary policy stance, we need to differentiate between the "rule-based" monetary policy and the "discretionary" monetary policy. To this end, following the existing literature (see, e.g., Bogdanova and Hofmann, 2012; Bruno et al., 2017), we use the well-known Taylor rule (Taylor, 1993). The Taylor rule constitutes an approximation of the behavior of a central bank, and then has become popular in the academic literature to describe the monetary policy stance. Indeed, the Taylor rule is a reaction function, that prescribes the central bank interest rate as a function of inflation and a measure of economic activity, typically the output gap. Then, comparing the policy rate with the empirically estimated Taylor rate allows to understand in what way policy rate setting has deviated from the Taylor rule.

In line with Bogdanova and Hofmann [2012] and using historical time series for

Table 2: Changes in the macroprudential indexes: country case studies

	Argentina 2002Q1	Colombia 2008Q3	Poland 2012Q2	Russian Fed. 2008Q4
Macroprudential policy actions (+): tightening actions (-): loosening actions	RR LC: +5 RR FC: +5	RR LC: +1 RR FC: -2	CB REC: +1 CB CC: +1 CB OS: +1	RR LC: -3 RR FC: -3
Nb. of adopted inst.	8	9	7	7
Nb. of tightened inst.	2	1	3	0
Nb. of loosened inst.	0	1	0	2
$PruC$	1	-1	1	-1
$PruC2$	1	0	1	-1
$PruC3$	10	-1	3	-6
$PruC4$	1.25	-0.11	0.43	-0.86
$PruC5$	5	-0.5	1	-3
$PruC6$	5	-1	1	-3

Source: Cerutti et al. [2017b] and authors' calculations.
Note: RR LC: reserve requirements for deposit accounts denominated in local currency; RR FC: reserve requirements for deposit accounts denominated in foreign currency; CB REC: real estate credit related specific capital buffers; CB CC: consumer credit related specific capital buffers; CB OS: other specific capital buffers.

each country considered in our sample, we estimate the following reaction function:

$$i_t = \rho\, i_{t-1} + (1-\rho)[\alpha + \beta_\pi(\pi_t) + \beta_y(y_t - \bar{y}_t)] + \varepsilon_t \quad (7)$$

where i_t is the actual short-term policy rate of a given country, which is lagged one period on the right side of Equation (7) to capture interest rate smoothing. As in the original Taylor rule, this assumes a gradual adjustment of policy rates to their benchmark level. π_t is the contemporaneous inflation rate, $y_t - \bar{y}$ is the output gap, and ε_t is the error term.[3] One would expect a positive relationship between the inflation rate, the output gap, and the policy rate, i.e. $\beta_\pi > 0$ and $\beta_y > 0$.

The central bank policy rates are taken from the database provided by the Bank for International Settlements (BIS). As these data are collected on a monthly basis, we consider the end-of-quarter rates. The annual inflation rate comes from the International Monetary Fund's International Financial Statistics (IFS) database. The real GDP is taken from the OECD Statistics for the OECD countries, and from IFS for the others. Inflation and GDP data series are seasonally adjusted using the US Census Bureau X-11-ARIMA method. Finally, the output gap corresponds to the difference between the actual real GDP and its trend, computed using the traditional Hodrick-Prescott filter.

Following Clarida et al. [2000] and the related literature, to overcome a potential endogeneity issue, we estimate Equation (7) using the Generalised Method of Moments (GMM) estimator. Furthermore, to obtain consistent estimates, the time period for estimating Equation (7) covers the longest available data time span, and then differs across countries in our sample. An important consideration with such an approach is the selection of valid instruments. This selection is based on the overidentification test developed by Hansen [1982]. This implies that the set of instruments considered can be different for each country. Taylor rule estimates are reported in Table A3 in the Appendix.

The Taylor gap then corresponds to the difference between the actual policy rate and the estimated Taylor rate $(i_t - \hat{i_t})$. This gap reflects the monetary policy stance. A positive difference can be interpreted as a restrictive monetary policy, while a negative difference can be understood as an accommodative monetary policy.

However, considering the policy rate as the main monetary policy instrument can be challenged. Indeed, some industrialised economies adopted unconventional monetary policies in the aftermath of the 2007-08 financial crisis. Therefore, assessing the

[3] Because our sample includes inflation targeting and non-inflation targeting countries, we do not consider the inflation gap in Equation (7). Indeed, in most non-inflation targeting countries, the central bank does not publicly announce a numerical inflation target and/or the horizon of this target. However, under the assumption that the target is constant over time, it is captured in the constant term α.

impact of implemented unconventional measures and understanding the overall monetary policy stance using the Taylor gap can be inappropriate. To address this issue, as it is usual in the literature, we do not consider the gap between the actual policy rate and the Taylor rate, but the difference between the shadow rate and the Taylor rate.

The shadow rate, first introduced by Black [1995], has been recently used by a number of papers to quantify the stance of monetary policy in a "zero lower bound" environment (see, e.g., Krippner, 2013; Wu and Xia, 2016; Wu and Xia, 2017; Lombardi and Zhu, 2018). Indeed, when the zero lower bound is binding, the policy interest rate does not display meaningful variation and thus no longer conveys information about the monetary policy stance. On the contrary, the shadow rate is not bounded and can freely take on negative values to reflect unconventional monetary policy actions. Krippner [2015] and Wu and Xia [2016] argue that the shadow rate can be used in place of the policy rate to describe the stance and effects of the monetary policy in a "zero lower bound" environment. In this paper, we use the shadow rates provided by Krippner [2013] for the Euro Area, Japan, the United Kingdom and, the United States. These data are available on the website of the Reserve Bank of New Zealand.

4 Empirical analysis

Based on the insights from the existing literature and on the arguments developed above, our empirical analysis aims at gauging the effectiveness of macroprudential policies in curbing credit growth and whether the monetary policy stance drives this effectiveness. To this end, given data availability, we consider a sample of 37 industrialised and emerging economies over the period 2000Q1-2014Q4. Nonetheless, before turning to the econometric analysis, this section presents some descriptive statistics and preliminary findings.

4.1 Preliminary findings

We start our empirical investigation by analysing in Figure 1 the evolution of macroprudential policy stance in our sample of countries. Panels (A) and (B) focus on the $PruC3$ index, which is the most explicit indicator to give a clear picture of the overall evolution of macroprudential policies. Panel (A) represents for each quarter the cross-sectional average value of the $PruC3$ index. Blue bars refer to positive values, while red bars refer to negative values. As one would expect, it appears that a broad range of macroprudential instruments have been significantly tightened in the aftermath of the global financial crisis. However, this does not mean that all economies of our sample conducted their macroprudential policy in the same direction. To illustrate this fact, we split in panel (B) our sample of countries in two categories: countries characterised by a net tightened macroprudential policy stance during a given quarter, and those characterised by a net loosened macroprudential policy stance. Blue bars correspond to the average value of the $PruC3$ index for the first category of countries, while red bars refer to the average value of the $PruC3$ index for the second category of countries. Indeed, a loose macroprudential policy can be observed in some countries since mid-2009. Panel (C) goes a step further by providing a picture of macroprudential activism. It represents the number of countries in which the macroprudential policy stance changed over a given quarter. It also distinguishes the orientation of this change. Red bars correspond to the number of countries characterised by a net loosened macroprudential policy stance, while blue bars correspond to the number of countries characterised by a net tightened macroprudential policy stance. As we can see, macroprudential activism tends to increase over the period considered. Finally, panel (D) represents the frequency of quarterly observations characterised by a net tightened or a net loosened macroprudential policy stance. We can observe that net tightening actions are more than twice as many as net loosening actions in our sample.

In Figure 2 we represent the country-by-country cross-correlation coefficient between different lags of the $PruC3$ index and the residuals of the annual growth rate of the total credit to the private non-financial sector from banks. Residuals are obtained by regressing credit growth on the one period lagged annual GDP growth. Residuals capture the part of credit that is not driven by real economic activity and then can be viewed as a proxy for excess credit growth. Panels (A), (B), (C) and (D) consider 1, 2, 3 and 4 lags for the $PruC3$ index, respectively. As expected, for most countries, the cross-correlation coefficient is negative, suggesting that a net tightened macroprudential stance is associated with a lower credit growth. Furthermore, we can observe that the number of countries characterised by a negative correlation increases with the lag order and that a tightening in macroprudential policy is associated with a higher reduction in annual credit growth after one year.

In Figure 3, we give an overview of the synchronisation of macroprudential and monetary policies by comparing macroprudential policy changes with the monetary policy stance. In panels (A), (B) and (C), grey bars represent for each period the number of countries in which both policies exhibit the same stance. Not surprisingly, if we refer to panel (C), we can observe that monetary policy tends to desynchronise from macroprudential policy in the aftermath of the global financial crisis. Indeed, during this period, most central banks around the world conducted accommodative monetary policies, while in the same time, many countries strengthened their macroprudential framework [see panel (A)]. This picture is confirmed in panel (D), which represents for each quarter the trend of the cross-sectional correlation between the $PruC3$ index and the Taylor gap.[4]

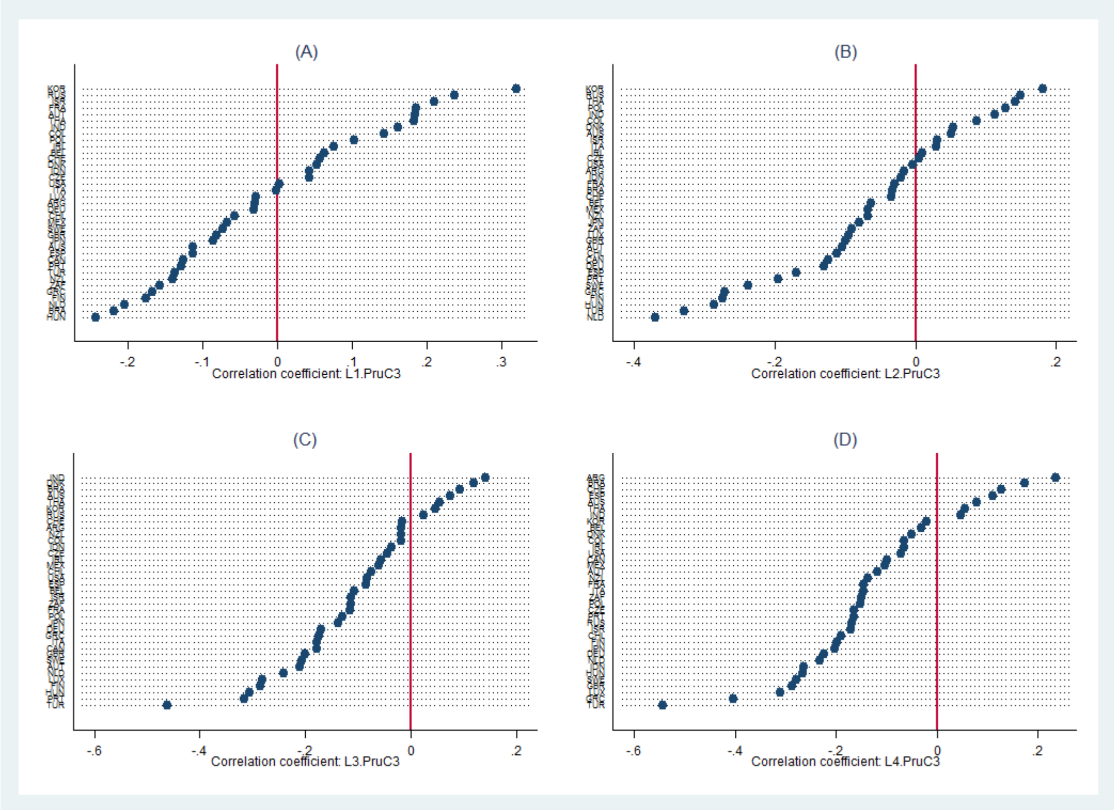
[4]See, for instance, Borio and Shim [2007] and Bruno et al. [2017] for further evidence.

Figure 1: Descriptive statistics on macroprudential policy stance

Source: Cerutti et al. [2017b] and authors' calculations.
Note: All panels are based on our sample of 37 countries. Panel (A) represents for each quarter the cross-sectional average value of the PruC3 index. In panel (B), blue bars correspond to the average value of the $PruC3$ index of countries characterised by a net tightened macroprudential policy stance, and red bars correspond to the average value of the $PruC3$ index of countries characterised by a net loosened macroprudential policy stance. Panel (C) represents the number of countries in which the macroprudential policy stance changed over a given quarter by distinguishing between tightened and loosened stances. Panel (D) represents the share of quarterly observations characterised by a net tightened or a net loosened macroprudential policy stance. No action corresponds to no change in all instruments or to the same number of tightening and loosening actions during a given quarter.

Finally, in Figure 4, we analyse whether the monetary policy stance drives the country-by-country cross-correlation between the $PruC3$ index and credit growth. To this end, we compute the partial correlation by controlling for the Taylor gap. The partial correlation coefficients correspond to the red points, while blue points refer to the correlation coefficients reported in Figure 2. Overall, regardless the lag order considered, we can observe that the partial correlation coefficients are higher than the pairwise correlation coefficients. In particular, when the coefficient is negative, this means that taking into account the monetary policy stance reduces the correlation between macroprudential policy stance and credit growth. These preliminary findings then confirm the important role played by monetary policy on the effectiveness of macroprudential policy in curbing credit growth. This issue is investigated in more detail in the next sub-section.

Figure 2: Correlation between macroprudential stance and credit growth



Source: Cerutti et al. [2017b], Bank for International Settlements and authors' calculations.
Note: All panels are based on our sample of 37 countries. They represent the country-by-country cross-correlation coefficient between the $PruC3$ index and the residuals of the growth rate of the total credit to the private non-financial sector from banks. Residuals are obtained by regressing credit growth on the one period lagged GDP growth. Panels (A), (B), (C) and (D) consider 1, 2, 3 and 4 lags for the $PruC3$ index, respectively.

4.2 Econometric approach

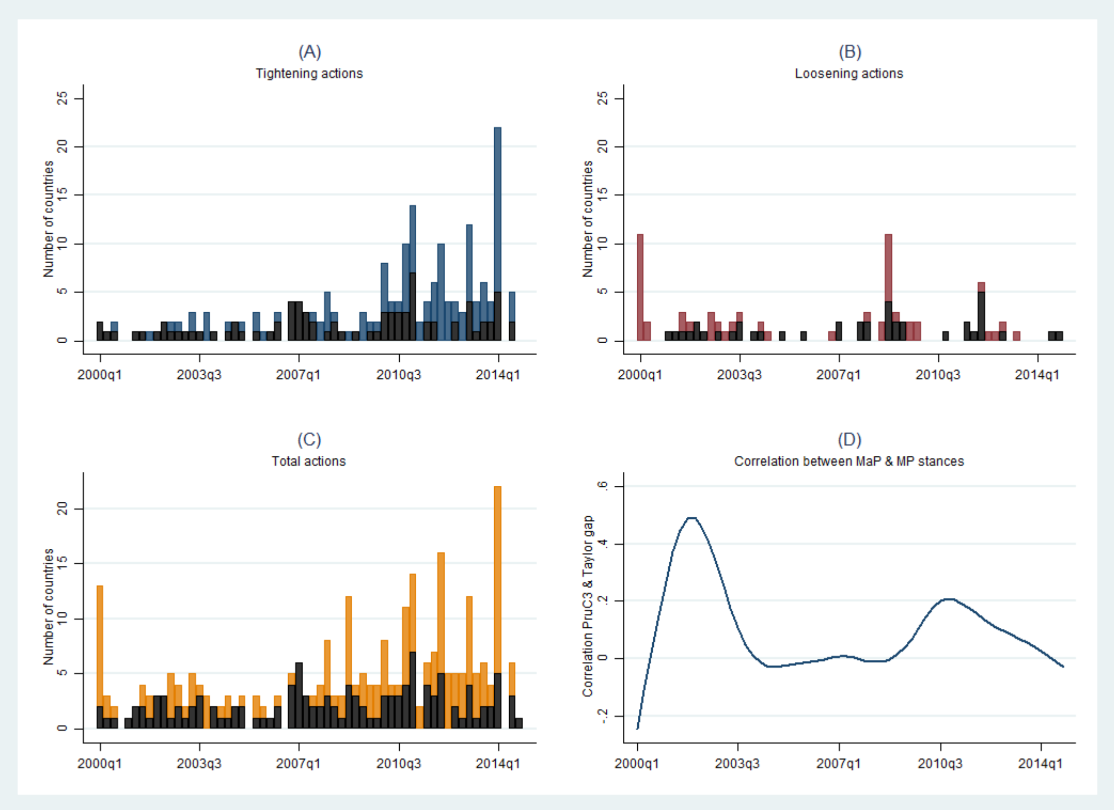
Our empirical analysis proceeds in two steps. First, following the existing literature, we reinvestigate the effects of our different measures of macroprudential policy stance on credit growth. To this end, we consider two alternative measures of domestic credit: the total credit to the private non-financial sector from banks and the total credit to households and non-profit institutions serving households. These data are taken from the BIS.

The baseline model that we estimate is the following:

$$\Delta Credit_{i,t} = \alpha + \sum_{k=1}^{4} \beta_k \, MaP_{i,t-k} + \eta \, X_{i,t-1} + \theta \, Crisis_t + \mu_i + \epsilon_{i,t} \tag{8}$$

where $\Delta Credit_{i,t}$ is the yearly growth of our different measures of credit, $MaP_{i,t-k}$

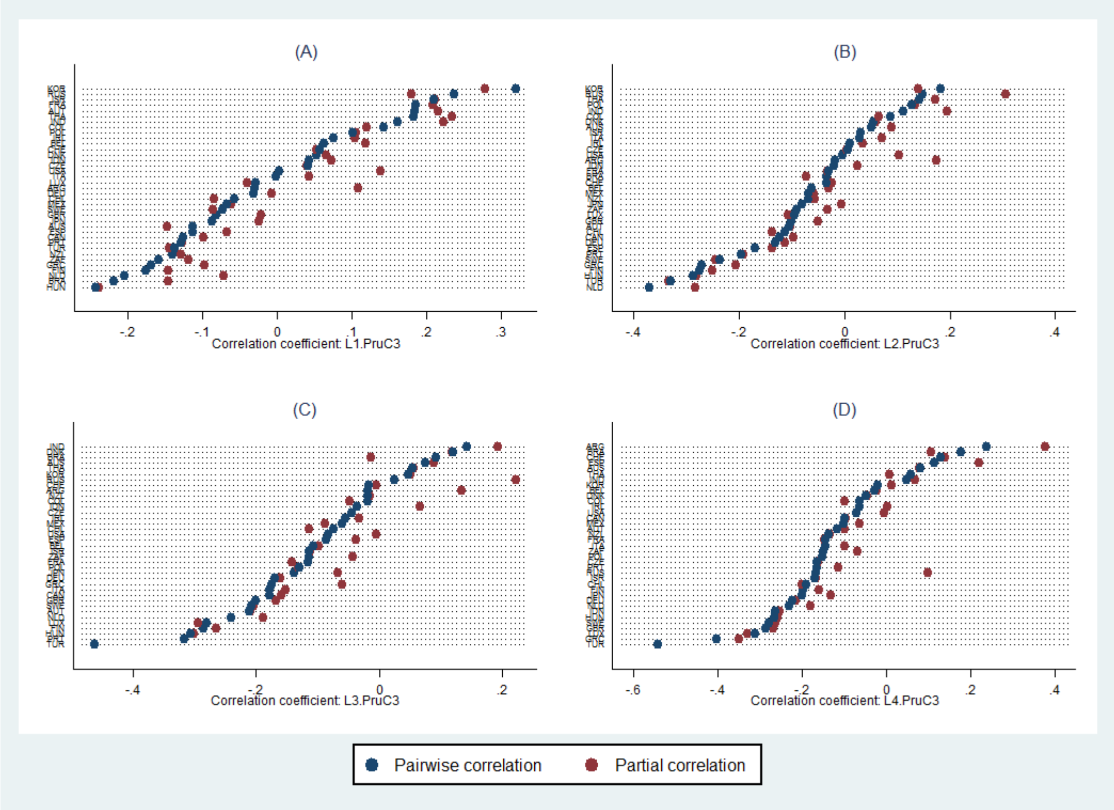
Figure 3: Synchronisation of macroprudential and monetary policies stance



Source: Cerutti et al. [2017b] and authors' calculations.
Note: All panels are based on our sample of 37 countries. Panel (A) and panel (B) represent for each quarter the number of countries characterised by a net tightened and a net loosened macroprudential policy stance, respectively. Panel (C) represents the number of countries in which the macroprudential policy stance changed over the given quarter, whatever the direction of the macroprudential policy. For each of these panels, grey bars correspond to the number of cases where macroprudential and monetary policies move in the same direction. Panel (D) represents for each quarter the trend of the cross-sectional correlation between the $PruC3$ index and the Taylor gap. The trend is obtained using the Hodrick-Prescott filter.

corresponds to our alternative macroprudential policy stance indexes, for which we include four lags (see, e.g., Kuttner and Shim, 2016; Zhang and Tressel, 2017). Indeed, some of macroprudential actions may be delayed in their effect. $X_{i,t-1}$ represents the vector of control variables. Following the existing literature, we consider two control variables: the annual GDP growth rate and the change in the nominal monetary policy rate. These two variables are lagged one period, and taken from the IFS database and the BIS, respectively. One would expect a negative relationship between the change in policy rate and the growth of credit, while a higher GDP growth would be associated with a higher credit growth. Indeed, the GDP growth rate is included to control for the procyclicality of credit (Athanasoglou et al., 2014), and then allows us to capture the part of credit that is not driven by real economic activity, i.e. excess credit growth. $Crisis_t$ is a dummy variable capturing a potential drop in credit growth during the

Figure 4: Partial correlation between macroprudential stance and credit growth



Source: Cerutti et al. [2017b], Bank for International Settlements and authors' calculations.
Note: All panels are based on our sample of 37 countries. Red points represent the country-by-country partial cross-correlation coefficient between the $PruC3$ index and the residuals of the growth rate of the total credit to the private non-financial sector from banks. Residuals are obtained by regressing credit growth on the one period lagged GDP growth. The partial correlation corresponds to the correlation between the $PruC3$ index and credit growth when controlling for the Taylor gap. Blue points are the cross-correlation coefficients reported in Figure 2. Panels (A), (B), (C) and (D) consider 1, 2, 3 and 4 lags for the $PruC3$ index, respectively.

recent crisis period. It is equal to 1 from 2008Q3 to 2012Q4, and 0 otherwise. Country-fixed effects μ_i allow for cross-country differences in average credit growth, and $\epsilon_{i,t}$ is the error term. One would expect $\beta_k < 0$, meaning that a more restrictive macroprudential policy helps to curb domestic credit growth.

In a second step, we extend our previous baseline model to assess whether a more tightened macroprudential policy is more likely to curb domestic credit growth when it is accompanied by a restrictive monetary policy, i.e. a positive Taylor gap. More precisely, the equation that we estimate is the following:

$$\Delta Credit_{i,t} = \alpha + \sum_{k=1}^{4} \beta_k \, MaP_{i,t-k} + \sum_{k=1}^{4} \gamma_k \left(MaP_{i,t-k} \times TG_{i,t-k} \times D_{i,t-k} \right) + \eta \, X_{i,t-1} + \theta \, Crisis_t + \mu_i + \epsilon_{i,t} \quad (9)$$

where $TG_{i,t-k}$ corresponds to the Taylor gap described in the previous section and $D_{i,t-k}$ is a dummy variable equal to 1 when macroprudential and monetary policies are both restrictive on a given quarter, and 0 otherwise. Consequently, the interaction term $(MaP_{i,t-k} \times TG_{i,t-k} \times D_{i,t-k})$ captures the additional effect of macroprudential policies on credit growth conditional on the stance of monetary policy.[5]

As we are primary interesting in assessing whether the monetary policy stance is an important determinant of the effectiveness of macroprudential policies, we especially focus on the marginal effect of our alternative macroprudential stance indexes on credit growth. Formally, this marginal effect can be derived from Equation (9) as follows:

$$\frac{\delta \, \Delta Credit_{i,t}}{\delta MaP_{i,t-k}} = \beta_k + \gamma_k \, (TG_{i,t-k} \times D_{i,t-k}) \tag{10}$$

If we find that $\beta_k < 0$ and $\gamma_k < 0$, this means that a more restrictive monetary policy reinforces the effect of macroprudential policies on credit growth. One can also expect the case where β_k is not statistically significant at the conventional levels ($\beta_k = 0$) and $\gamma_k < 0$. Such a result indicates that containing credit growth can not be achieved through macroprudential policy alone, but needs the support of monetary policy. In other words, macroprudential tightening actions are more likely to reduce credit growth if they are implemented in tandem with a restrictive monetary policy.

Finally, we re-estimate Equation (9) by considering the first difference of the Taylor gap as an alternative measure of the monetary policy stance. The Taylor gap reflects whether a monetary policy is accommodative or restrictive, while its first difference captures whether the monetary policy has been tightened or loosened, i.e. the monetary policy orientation. Formally, the equation that we estimate is the following:

$$\begin{aligned} \Delta Credit_{i,t} = \alpha + \sum_{k=1}^{4} \beta_k \, MaP_{i,t-k} + \sum_{k=1}^{4} \gamma_k \, (MaP_{i,t-k} \times \Delta TG_{i,t-k} \times I_{i,t-k}) \\ + \eta \, X_{i,t-1} + \theta \, Crisis_t + \mu_i + \epsilon_{i,t} \end{aligned} \tag{11}$$

where $\Delta TG_{i,t-k}$ is the first difference of the Taylor gap, and $I_{i,t-k}$ is a dummy variable equal to 1 if the macroprudential index considered and the first difference of the Taylor gap are positive on a given quarter, and 0 otherwise. As above, if monetary policy is an important driver of the macroprudential policy effectiveness, one would expect $\gamma_k < 0$.[6]

[5]Considering the dummy variable $D_{i,t-k}$ is justified by the fact that the macroprudential indexes and the Taylor gap can take positive and negative values. In this case, the estimated coefficient associated with the interaction term $(MaP_{i,t-k} \times TG_{i,t-k})$ cannot be interpreted properly. Indeed, if both variables are positive, one would expect a negative coefficient. On the contrary, if both variables are negative, one would expect a positive coefficient. This then justifies the use of a three-way interaction term to assess whether a more tightened macroprudential policy is more likely to curb domestic credit growth when it is accompanied by a restrictive monetary policy.

[6]Please note that we also estimate Equation (11) by considering the policy interest rate variation

4.3 Results

Results that we obtain are reported in Tables 3 to 5. In Table 3, we report the results when we consider $PruC$ and $PruC2$ as alternative measures of macroprudential policy stance, Table 4 displays the results obtained with $PruC3$ and $PruC4$, while Table 5 displays the results obtained with $PruC5$ and $PruC6$. To have a better view of the importance of monetary policy stance in the conduct of macroprudential policy, we present side by side the results of the baseline and extended models. For each macroprudential index considered, the first column displays the results obtained when we consider only the effects of macroprudential policy stance on credit growth. The next two columns report the results obtained when we take into account the monetary policy stance, proxied using two alternative measures, the Taylor gap and its first difference.

We obtain three important results. First, in line with the recent literature on macroprudential policy, our empirical findings suggest that an overall tightening in macroprudential policies is associated with a reduction in credit growth. Indeed, except two specifications (columns [2.1] and [2.7]), we find a negative and statistically significant relationship between our macroprudential indexes and domestic credit growth. Furthermore, as expected, macroprudential policy actions take time to effectively curbing domestic credit growth. For most specifications, we can see that coefficients associated with macroprudential indexes are only significant at the third and fourth order lags.

Second, if we now focus on the results obtained when we add the interaction term in the baseline model, we can see that monetary policy stance matters for the effectiveness of macroprudential policy. Indeed, as we can see, coefficients associated with the interaction term are negative and statistically significant. When we consider the Taylor gap in the interaction term, this negative sign means that a restrictive monetary policy actually enhances the impact of macroprudential tightening actions on credit growth. In the same line, results obtained by considering the first difference of the Taylor gap show that the marginal effect of tightening macroprudential instruments on credit growth is affected by whether the prevailing monetary policy stance is tight or loose. The benefits of synchronisation between macroprudential and monetary policies are also confirmed in columns [2.2], [2.3], [2.8] and [2.9]. Indeed, while $PruC3$ and $PruC4$ did not appear statistically significant in the baseline specification (columns [2.1] and [2.7]), we can now observe a significant marginal effect of both indexes on credit growth when macroprudential and monetary policies complement each other.

Finally, we find evidence that monetary policy helps to reduce the transmission

as an additional measure of the monetary policy orientation. A summary of the results that we obtain is reported in Tables A1 and A2 in the Appendix.

delay of macroprudential policy actions on private sector credit growth. Indeed, we can see that coefficients associated with the interaction term are negative and significant at the first, second and third order lags. Results are more mixed when we consider the growth of credit to households as dependent variable.

In sum, despite the fact that monetary and macroprudential policies pursue different primary objectives, our empirical analysis confirms that both policies are complementary. In particular, our results emphasise the importance of implementing a monetary policy that supports the macroprudential policy by moving in the same direction, and then attenuating its potential side effects on financial stability.

Table 3: Results obtained with *PruC* and *PruC2*

	PruC						*PruC2*					
	Credit to private sector			Credit to households			Credit to private sector			Credit to households		
	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)	(1.7)	(1.8)	(1.9)	(1.10)	(1.11)	(1.12)
L.MaP	0.972	0.931	0.743	-0.377	-0.557	-0.697	0.980	0.948	0.758	-0.416	-0.583	-0.724
	(1.184)	(0.959)	(1.032)	(1.638)	(1.403)	(1.437)	(1.199)	(0.973)	(1.044)	(1.651)	(1.418)	(1.449)
L2.MaP	-0.658	-0.861	-1.007	-2.377	-2.556*	-2.645*	-0.721	-0.914	-1.060	-2.450	-2.616*	-2.704*
	(1.132)	(0.937)	(0.958)	(1.679)	(1.471)	(1.467)	(1.162)	(0.966)	(0.987)	(1.705)	(1.497)	(1.489)
L3.MaP	-2.029	-2.285*	-2.475*	-4.030**	-4.207**	-4.356**	-2.082	-2.324*	-2.513**	-4.073**	-4.234**	-4.382**
	(1.388)	(1.256)	(1.227)	(1.914)	(1.703)	(1.657)	(1.382)	(1.258)	(1.229)	(1.911)	(1.708)	(1.662)
L4.MaP	-3.073*	-3.670**	-3.675**	-5.769**	-5.987***	-6.058***	-3.053*	-3.632**	-3.637**	-5.727**	-5.927***	-5.998***
	(1.775)	(1.473)	(1.425)	(2.472)	(1.993)	(1.968)	(1.768)	(1.468)	(1.420)	(2.481)	(2.003)	(1.977)
L.(MaP × TG × D)		-1.156***			-0.896			-1.154***			-0.891	
		(0.231)			(0.604)			(0.231)			(0.606)	
L2.(MaP × TG × D)		-0.914***			-0.816*			-0.911***			-0.811*	
		(0.188)			(0.433)			(0.189)			(0.435)	
L3.(MaP × TG × D)		-0.824***			-0.771*			-0.821***			-0.767*	
		(0.198)			(0.387)			(0.198)			(0.388)	
L4.(MaP × TG × D)		0.215			-0.336			0.214			-0.337	
		(0.175)			(0.515)			(0.175)			(0.514)	
L.(MaP × Δ TG × I)			-1.078***			-0.822			-1.077***			-0.818
			(0.209)			(0.545)			(0.209)			(0.547)
L2.(MaP × Δ TG × I)			-0.931***			-0.833**			-0.928***			-0.829**
			(0.136)			(0.328)			(0.136)			(0.330)
L3.(MaP × Δ TG × I)			-0.856***			-0.806***			-0.854***			-0.802***
			(0.111)			(0.271)			(0.111)			(0.271)
L4.(MaP × Δ TG × I)			0.135			-0.382			0.134			-0.382
			(0.169)			(0.497)			(0.169)			(0.496)
L.Δ GDP	2.460***	2.155***	2.142***	2.725***	2.442***	2.429***	2.458***	2.153***	2.140***	2.719***	2.437***	2.423***
	(0.256)	(0.241)	(0.234)	(0.296)	(0.363)	(0.347)	(0.256)	(0.242)	(0.234)	(0.294)	(0.365)	(0.348)
L.Δ Policy rate	-0.793	2.415	2.452	-2.406	-0.340	-0.306	-0.790	2.408	2.446	-2.403	-0.355	-0.318
	(0.722)	(1.628)	(1.539)	(2.173)	(4.511)	(4.315)	(0.725)	(1.631)	(1.541)	(2.177)	(4.516)	(4.318)
Crisis dummy	-4.246***	-4.707***	-4.692***	-5.568***	-6.119***	-6.075***	-4.237***	-4.698***	-4.682***	-5.548***	-6.098***	-6.054***
	(1.442)	(1.291)	(1.293)	(1.802)	(1.620)	(1.612)	(1.442)	(1.293)	(1.295)	(1.801)	(1.622)	(1.614)
Constant	5.974***	7.356***	7.333***	8.480***	9.737***	9.671***	5.981***	7.360***	7.338***	8.493***	9.743***	9.679***
	(1.173)	(0.957)	(0.942)	(1.210)	(1.171)	(1.124)	(1.172)	(0.957)	(0.942)	(1.208)	(1.175)	(1.128)
Observations	2,015	2,015	2,011	1,950	1,950	1,946	2,015	2,015	2,011	1,950	1,950	1,946
Number of countries	37	37	37	37	37	37	37	37	37	37	37	37
Adjusted R-squared	0.248	0.267	0.270	0.249	0.262	0.263	0.248	0.267	0.270	0.249	0.262	0.263

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. MaP refers to the different macroprudential policy indexes considered, TG corresponds to the Taylor gap, Δ TG corresponds to the first difference of the Taylor gap, and D and I correspond to the alternative dummy variables capturing the stance of macroprudential and monetary policies.

Table 4: Results obtained with $PruC3$ and $PruC4$

	$PruC3$						$PruC4$					
	Credit to private sector			Credit to households			Credit to private sector			Credit to households		
	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)	(2.7)	(2.8)	(2.9)	(2.10)	(2.11)	(2.12)
L.MaP	-0.025	0.343	0.345	-0.985	-0.879	-0.855	0.017	2.462	2.459	-7.708	-7.098	-6.932
	(0.719)	(0.718)	(0.736)	(0.993)	(1.082)	(1.092)	(5.470)	(5.471)	(5.625)	(7.828)	(8.364)	(8.455)
L2.MaP	-0.682	-0.502	-0.480	-1.795	-1.596	-1.555	-4.499	-3.103	-2.962	-13.076	-11.516	-11.221
	(0.662)	(0.685)	(0.682)	(1.130)	(1.201)	(1.200)	(4.889)	(4.981)	(4.970)	(8.719)	(9.122)	(9.128)
L3.MaP	-1.387	-1.083	-1.075	-2.430*	-2.108	-2.080	-10.072	-7.906	-7.870	-18.254*	-15.966	-15.774
	(0.825)	(0.973)	(0.969)	(1.247)	(1.430)	(1.427)	(6.189)	(7.130)	(7.099)	(9.717)	(10.848)	(10.839)
L4.MaP	-1.526	-2.020*	-1.983*	-3.441*	-3.332*	-3.285*	-11.690	-14.994*	-14.726*	-26.257*	-25.305*	-24.966*
	(1.269)	(1.148)	(1.135)	(1.941)	(1.679)	(1.670)	(9.217)	(8.449)	(8.348)	(14.269)	(12.639)	(12.572)
L.(MaP × TG × D)		-0.099***			-0.059			-0.779***			-0.457	
		(0.024)			(0.062)			(0.192)			(0.504)	
L2.(MaP × TG × D)		-0.079***			-0.060			-0.634***			-0.490	
		(0.015)			(0.038)			(0.120)			(0.306)	
L3.(MaP × TG × D)		-0.075***			-0.065*			-0.602***			-0.515*	
		(0.014)			(0.033)			(0.107)			(0.263)	
L4.(MaP × TG × D)		0.023			-0.025			0.175			-0.211	
		(0.017)			(0.045)			(0.137)			(0.369)	
L.(MaP × Δ TG × I)			-0.092***			-0.055			-0.726***			-0.429
			(0.022)			(0.057)			(0.179)			(0.460)
L2.(MaP × Δ TG × I)			-0.074***			-0.058*			-0.601***			-0.468*
			(0.013)			(0.034)			(0.105)			(0.271)
L3.(MaP × Δ TG × I)			-0.071***			-0.062**			-0.570***			-0.492**
			(0.012)			(0.029)			(0.090)			(0.231)
L4.(MaP × Δ TG × I)			0.021			-0.023			0.160			-0.196
			(0.016)			(0.041)			(0.128)			(0.338)
L.Δ GDP	2.466***	2.209***	2.204***	2.706***	2.504***	2.493***	2.466***	2.209***	2.204***	2.710***	2.509***	2.498***
	(0.267)	(0.237)	(0.234)	(0.297)	(0.343)	(0.336)	(0.267)	(0.236)	(0.233)	(0.298)	(0.343)	(0.336)
L.Δ Policy rate	-0.733	1.574	1.633	-2.362	-1.199	-1.114	-0.766	1.544	1.602	-2.384	-1.241	-1.157
	(0.834)	(1.508)	(1.454)	(2.471)	(4.191)	(4.082)	(0.827)	(1.524)	(1.469)	(2.473)	(4.242)	(4.132)
Crisis dummy	-4.294***	-4.735***	-4.684***	-5.738***	-6.173***	-6.101***	-4.303***	-4.744***	-4.692***	-5.742***	-6.178***	-6.106***
	(1.507)	(1.309)	(1.304)	(1.836)	(1.601)	(1.582)	(1.508)	(1.311)	(1.306)	(1.835)	(1.601)	(1.582)
Constant	5.969***	6.975***	6.931***	8.479***	9.227***	9.166***	5.959***	6.966***	6.922***	8.465***	9.214***	9.152***
	(1.138)	(0.955)	(0.951)	(1.179)	(1.125)	(1.109)	(1.135)	(0.953)	(0.949)	(1.178)	(1.134)	(1.118)
Observations	2,015	2,015	2,011	1,950	1,950	1,946	2,015	2,015	2,011	1,950	1,950	1,946
Number of countries	37	37	37	37	37	37	37	37	37	37	37	37
Adjusted R-squared	0.246	0.261	0.261	0.245	0.252	0.252	0.246	0.261	0.261	0.246	0.253	0.252

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. MaP refers to the different macroprudential policy indexes considered, TG corresponds to the Taylor gap, Δ TG corresponds to the first difference of the Taylor gap, and D and I correspond to the alternative dummy variables capturing the stance of macroprudential and monetary policies.

Table 5: Results obtained with $PruC5$ and $PruC6$

	$PruC5$						$PruC6$					
	Credit to private sector			Credit to households			Credit to private sector			Credit to households		
	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)	(3.6)	(3.7)	(3.8)	(3.9)	(3.10)	(3.11)	(3.12)
L.MaP	-0.014	0.384	0.372	-1.318	-1.175	-1.156	-0.015	0.399	0.386	-1.323	-1.175	-1.156
	(1.008)	(0.998)	(1.023)	(1.347)	(1.371)	(1.388)	(1.009)	(0.995)	(1.020)	(1.347)	(1.368)	(1.385)
L2.MaP	-1.409*	-1.255	-1.240	-3.003**	-2.822*	-2.776*	-1.416*	-1.255	-1.240	-3.029**	-2.845*	-2.799*
	(0.830)	(0.851)	(0.858)	(1.379)	(1.424)	(1.431)	(0.829)	(0.844)	(0.851)	(1.388)	(1.426)	(1.434)
L3.MaP	-2.526**	-2.270*	-2.288*	-4.237***	-3.952**	-3.940**	-2.552**	-2.302**	-2.319**	-4.287***	-4.008**	-3.996**
	(1.032)	(1.145)	(1.143)	(1.521)	(1.642)	(1.643)	(1.031)	(1.135)	(1.133)	(1.523)	(1.631)	(1.634)
L4.MaP	-2.733*	-3.226**	-3.182**	-5.518**	-5.343**	-5.297**	-2.791*	-3.292**	-3.247**	-5.587**	-5.418**	-5.371**
	(1.611)	(1.485)	(1.467)	(2.300)	(2.017)	(2.006)	(1.594)	(1.478)	(1.460)	(2.278)	(2.003)	(1.992)
L.(MaP × TG × D)		-0.199***			-0.124			-0.200***			-0.125	
		(0.048)			(0.126)			(0.048)			(0.126)	
L2.(MaP × TG × D)		-0.157***			-0.121			-0.157***			-0.121	
		(0.031)			(0.078)			(0.031)			(0.078)	
L3.(MaP × TG × D)		-0.150***			-0.127*			-0.150***			-0.127**	
		(0.025)			(0.063)			(0.025)			(0.062)	
L4.(MaP × TG × D)		0.041			-0.059			0.042			-0.058	
		(0.035)			(0.099)			(0.035)			(0.099)	
L.(MaP × Δ TG × I)			-0.186***			-0.117			-0.186***			-0.117
			(0.044)			(0.114)			(0.044)			(0.115)
L2.(MaP × Δ TG × I)			-0.149***			-0.117*			-0.150***			-0.117*
			(0.026)			(0.068)			(0.026)			(0.068)
L3.(MaP × Δ TG × I)			-0.143***			-0.122**			-0.143***			-0.122**
			(0.020)			(0.054)			(0.020)			(0.053)
L4.(MaP × Δ TG × I)			0.036			-0.055			0.037			-0.055
			(0.033)			(0.091)			(0.033)			(0.091)
L.Δ GDP	2.485***	2.225***	2.218***	2.732***	2.525***	2.514***	2.488***	2.228***	2.222***	2.740***	2.532***	2.521***
	(0.269)	(0.238)	(0.234)	(0.300)	(0.343)	(0.335)	(0.271)	(0.238)	(0.235)	(0.303)	(0.342)	(0.334)
L.Δ Policy rate	-0.657	1.763	1.820	-2.295	-1.086	-0.997	-0.661	1.767	1.824	-2.304	-1.090	-1.001
	(0.794)	(1.570)	(1.503)	(2.418)	(4.339)	(4.212)	(0.789)	(1.569)	(1.502)	(2.418)	(4.338)	(4.211)
Crisis dummy	-4.194***	-4.631***	-4.583***	-5.623***	-6.069***	-6.001***	-4.198***	-4.634***	-4.587***	-5.634***	-6.079***	-6.011***
	(1.514)	(1.326)	(1.319)	(1.870)	(1.648)	(1.626)	(1.517)	(1.327)	(1.321)	(1.873)	(1.650)	(1.628)
Constant	6.025***	7.060***	7.018***	8.604***	9.386***	9.326***	6.021***	7.058***	7.016***	8.597***	9.381***	9.321***
	(1.131)	(0.950)	(0.946)	(1.163)	(1.127)	(1.110)	(1.131)	(0.950)	(0.946)	(1.163)	(1.126)	(1.108)
Observations	2,015	2,015	2,011	1,950	1,950	1,946	2,015	2,015	2,011	1,950	1,950	1,946
Number of countries	37	37	37	37	37	37	37	37	37	37	37	37
Adjusted R-squared	0.250	0.265	0.265	0.252	0.259	0.259	0.250	0.265	0.265	0.253	0.260	0.260

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. MaP refers to the different macroprudential policy indexes considered, TG corresponds to the Taylor gap, Δ TG corresponds to the first difference of the Taylor gap, and D and I correspond to the alternative dummy variables capturing the stance of macroprudential and monetary policies.

4.4 Robustness checks

We check the robustness of our previous findings by taking into account the potential sensitivity of the interest rate gap to the Taylor rule specification. To this end, following Colletaz et al. [2018], we consider six alternative Taylor rules (see Table 6) and compute the median of the resulting Taylor gaps.

Table 6: Alternative measures of monetary policy stance

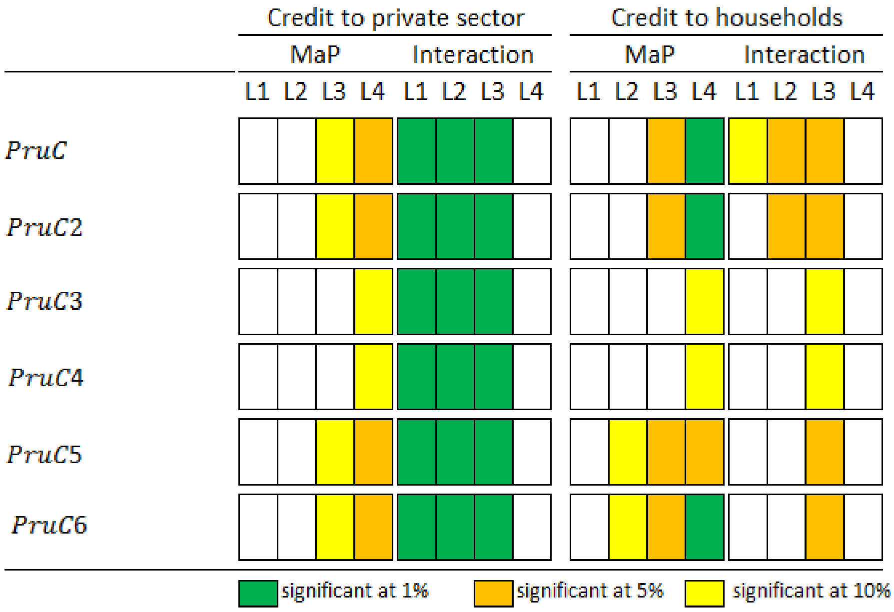
Benchmark	Definition of the benchmark
Taylor (1)	$i_t^* = 0.9 i_{t-1}^* + 0.1 \{rr_t^* + \bar{\pi} + 1.5 (\pi_t - \bar{\pi}) + 0.5 \tilde{y}_t\}$
Taylor (2)	$i_t^* = rr_t^* + \bar{\pi} + 1.5 (\pi_t - \bar{\pi}) + 0.5 \tilde{y}_t$
Taylor (3)	$i_t^* = 1.5 \pi_{t+12} + 0.5 \tilde{y}_t$
Taylor (4)	$i_t^* = 0.9 i_{t-1}^* + 0.1 \{rr_t^* + \bar{\pi} + 1.5 (\pi_{t+12} - \bar{\pi}) + 0.5 \tilde{y}_t\}$
Taylor (5)	$i_t^* = i_{t-1} + \Delta i_t^*$, with $\Delta i_t^* = 0.5 (\pi_{t+12} - \bar{\pi}) + 0.5 \Delta \tilde{y}_t$
Interest trend (6)	$i_t^* = HP(i_t)$
Equilibrium real rate	$rr_t^* = \Delta y_t^*$, *with* $y_t^* = HP(y_t)$

Source: Colletaz et al. [2018].
Note: $\tilde{y}_t = (y_t - y_t^*)$, with $y_t^* = HP(y_t)$. $HP(x)$ means Hodrick-Prescott Filter applied to a variable x. All measures of the monetary policy stance are computed as the difference between the actual interest rate i_t and the corresponding benchmark i_t^*, except for the *real rate gap* which is defined as the difference between the actual *ex post* real interest r_t and the estimated equilibrium real rate rr_t^*. $\bar{\pi}$ corresponds to the mean inflation over the sample period.

Figure 5 and Figure 6 summarise the results that we obtain by considering this alternative Taylor gap measure when we estimate Equation (9) and Equation (11), respectively.[7] Similarly to the results discussed in the previous section, we find that the tightening of macroprudential policy tools leads to the reduction of domestic credit growth, even if macroprudential policy actions seem to take time to effectively curbing credit growth. Indeed, as before, for most specifications, the coefficient estimates associated with macroprudential indexes are only significant at the third and fourth order lags. More importantly, our results confirm the importance of the monetary policy stance for the effectiveness of macroprudential policy. Regardless the measure of monetary policy stance considered, we find that the interaction term is negative and statistically significant at the conventional levels.

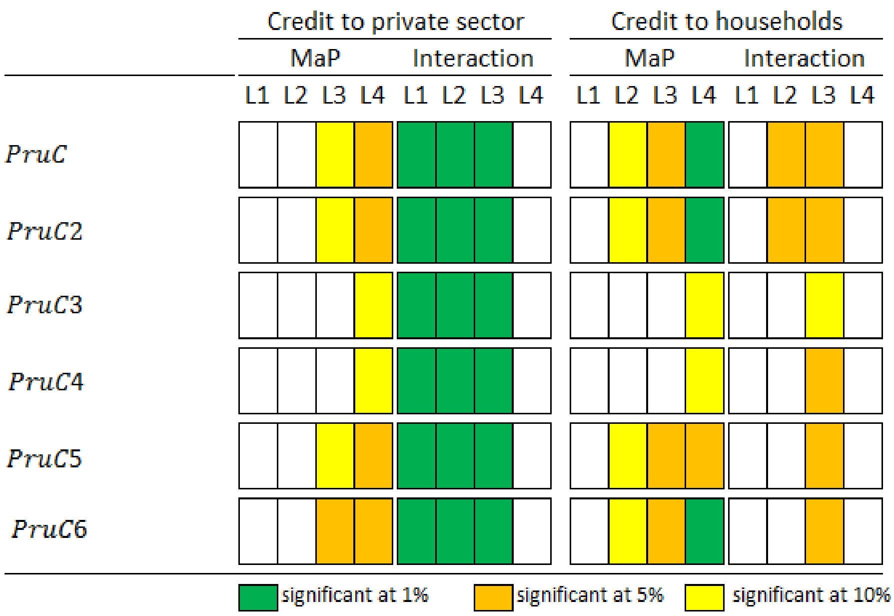
[7]Detailed results are available upon request.

Figure 5: Robustness checks: results obtained with the median of the alternative Taylor gaps



Note: Reported results are obtained by estimating Equation (9) and correspond to the coefficient estimates associated with the alternative macroprudential indexes and interaction terms. All significant coefficients have the expected negative sign.

Figure 6: Robustness checks: results obtained with the first difference of the median of the alternative Taylor gaps



Note: Reported results are obtained by estimating Equation (11) and correspond to the coefficient estimates associated with the alternative macroprudential indexes and interaction terms. All significant coefficients have the expected negative sign.

5 Conclusion

Since the 2007-2008 global financial crisis, the conduct of macroprudential policy raises several important issues. One of them is the interaction of macroprudential and monetary policies. This issue is currently at the heart of the academic and policy debate. Indeed, it is well-known that monetary policy can have detrimental side effects on financial stability, which is the primary objective of macroprudential policy. In other words, this means that monetary policy can reduce the effectiveness of macroprudential policy in achieving its objective and therefore suggests the need for synchronisation.

A growing number of theoretical studies address this issue and confirm the benefits of coordination between both policies, but little is known from an empirical standpoint. Our paper fills this gap in the existing literature by providing for a large sample of economies the first empirical evidence on the role of monetary policy conditions in the effectiveness of macroprudential policy.

More precisely, we obtain two important results. First, we find that a restrictive monetary policy enhances the impact of macroprudential tightening actions on domestic credit growth. Second, we find evidence that monetary policy helps to reduce the transmission delay of macroprudential policy actions. Our findings then confirm the complementarities between both policies and the potential coordination benefits highlighted by the theoretical literature.

To translate this result into a policy recommendation, a crucial open question is: what should be the appropriate institutional framework and governance structure for conducting macroprudential policy? There is no clear-cut consensus among economists about this issue and, in practice, countries have implemented different macroprudential policy frameworks. While in some countries macroprudential mandates have been assigned to an independent council, some other countries delegated macroprudential regulatory to the central bank (see, e.g., Masciandaro, 2018; Masciandaro and Romelli, 2018; Edge and Liang, 2019). This choice of assigning a leading role in macroprudential policy to the central bank is usually justified by the fact that it will facilitate policy coordination between both policies. It can also ensure that macroprudential policy draws on the expertise of the monetary authority in financial and macroeconomic analyses, and is expected to facilitate analyses of the side effects of each policy. Finally, as most of the central banks around the world are independent from the government, one would expect that such an institutional arrangement helps to protect the macroprudential policy function from political pressures. Then, it would be interesting to empirically investigate whether the institutional framework and the governance structure of macroprudential policy are key drivers of its effectiveness. We leave this issue for further research.

Bibliography

Adrian, T. and Shin, H. S. (2010). Chapter 12 - Financial intermediaries and monetary economics. In Friedman, B. M. and Woodford, M., editors, *Handbook of Monetary Economics*, volume 3, pages 601 – 650. Elsevier.

Akinci, O. and Olmstead-Rumsey, J. (2018). How effective are macroprudential policies? an empirical investigation. *Journal of Financial Intermediation*, 33:33 – 57.

Alam, Z., Alter, A., Eiseman, J., Gelos, G., Kang, H., Narita, M., Nier, E., and Wang, N. (2019). Digging deeper - Evidence on the effects of macroprudential policies from a new database. *IMF WP/19/66, International Monetary Fund.*

Allen, F. and Gale, D. (2001). Bubbles and crises. *The Economic Journal*, 110(460):236–255.

Altunbas, Y., Binici, M., and Gambacorta, L. (2018). Macroprudential policy and bank risk. *Journal of International Money and Finance*, 81:203–220.

Athanasoglou, P. P., Daniilidis, I., and Delis, M. D. (2014). Bank procyclicality and output: Issues and policies. *Journal of Economics and Business*, 72:58 – 83.

Bernanke, B. and Gertler, M. (1989). Agency costs, net worth, and business fluctuations. *The American Economic Review*, 79(1):14–31.

Bernanke, B. S. and Gertler, M. (1995). Inside the black box: The credit channel of monetary policy transmission. *The Journal of Economic Perspectives*, 9(4):27–48.

Bhattacharya, S. (1982). Aspects of monetary and banking theory and moral hazard. *The Journal of Finance*, 37(2):371–384.

Black, F. (1995). Interest rates as options. *The Journal of Finance*, 50(5):1371–1376.

Boar, C., Gambacorta, L., Lombardo, G., and da Silva, L. A. P. (2017). What are the effects of macroprudential policies on macroeconomic performance? *BIS Quarterly Review.*

Bogdanova, B. and Hofmann, B. (2012). Taylor rules and monetary policy: a global 'Great Deviation'? *BIS Quarterly Review*, September:37–49.

Borio, C. and Shim, I. (2007). What can (macro-)prudential policy do to support monetary policy? *BIS Working Papers No 242, Bank for International Settlements.*

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.

Bruno, V., Shim, I., and Shin, H. S. (2017). Comparative assessment of macroprudential policies. *Journal of Financial Stability*, 28:183–202.

Carreras, O., Davis, E. P., and Piggott, R. (2018). Assessing macroprudential tools in OECD countries within a cointegration framework. *Journal of Financial Stability*, 37:112–130.

Cerutti, E., Claessens, S., and Laeven, L. (2017a). The use and effectiveness of macroprudential policies: New evidence. *Journal of Financial Stability*, 28:203–224.

Cerutti, E., Correa, R., Fiorentino, E., and Segalla, E. (2017b). Changes in prudential policy instruments - A new cross-country database. *International Journal of Central Banking*, 13(2):477–503.

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

Clarida, R., Gali, J., and Gertler, M. (2000). Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory. *Quarterly Journal of Economics*, 115(1):147–180.

Colletaz, G., Levieuge, G., and Popescu, A. (2018). Monetary policy and long-run systemic risk-taking. *Journal of Economic Dynamics and Control*, 86:165–184.

Edge, R. M. and Liang, J. N. (2019). New financial stability governance structures and central banks. *Finance and Economics Discussion Series 2019-019, Board of Governors of the Federal Reserve System (US).*

Galati, G. and Moessner, R. (2018). What do we know about the effects of macroprudential policy? *Economica*, 85(340):735–770.

Gambacorta, L. and Murcia, A. (2019). The impact of macroprudential policies in Latin America: an empirical analysis using credit registry data. *Journal of Financial Intermediation*, forthcoming.

Hansen, L. P. (1982). Large sample properties of Generalized Method of Moments estimators. *Econometrica*, 50(4):1029–1054.

Illing, G. (2007). Financial stability and monetary policy - A framework. *CESifo Working Paper Series No. 1971, Ifo Institute for Economic Research.*

IMF (2013). The interaction of monetary and macroprudential policies. Technical report, International Monetary Fund.

IMF (2018). The IMF's annual macroprudential policy survey - objectives, design, and country responses. Technical report, International Monetary Fund.

Jiménez, G., Ongena, S., Peydró, J.-L., and Saurina, J. (2017). Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the Spanish dynamic provisioning experiments. *Journal of Political Economy*, 125(6):2126–2177.

Krippner, L. (2013). Measuring the stance of monetary policy in zero lower bound environments. *Economics Letters*, 118(1):135 – 138.

Krippner, L. (2015). *Zero lower bound term structure modeling: A practitioner's guide.* Palgrave-Macmillan.

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*, 26:31–44.

Lim, C. H., Costa, A., Columba, F., Kongsamut, P., Otani, A., Saiyid, M., Wezel, T., and Wu, X. (2011). Macroprudential policy: What instruments and how to use them? Lessons from country experiences. *IMF WP/11/238, International Monetary Fund.*

Loisel, O. (2014). Discussion of "Monetary and macroprudential policy in an estimated DSGE model of the euro area". *International Journal of Central Banking*, 10(2):237–247.

Lombardi, M. and Zhu, F. (2018). A shadow policy rate to calibrate US monetary policy at the zero lower bound. *International Journal of Central Banking*, 14(5):305–346.

Masciandaro, D. (2018). Central banks and macroprudential policies: Economics and politics. *BAFFI CAREFIN Working Papers 1878, Universita Bocconi.*

Masciandaro, D. and Romelli, D. (2018). Central bankers as supervisors: Do crises matter? *European Journal of Political Economy*, 52:120 – 140.

McDonald, C. (2015). When is macroprudential policy effective? *BIS Working Papers 496, Bank for International Settlements.*

Nabar, M. and Ahuja, A. (2011). Safeguarding banks and containing property booms; Cross-country evidence on macroprudential policies and lessons from Hong Kong SAR. *IMF WP/11/284, International Monetary Fund.*

Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, 39:195 – 214.

Vandenbussche, J., Vogel, U., and Detragiache, E. (2015). Macroprudential policies and housing prices: A new database and empirical evidence for Central, Eastern, and Southeastern Europe. *Journal of Money, Credit and Banking*, 47(S1):343–377.

Wu, J. C. and Xia, F. D. (2016). Measuring the macroeconomic impact of monetary policy at the zero lower bound. *Journal of Money, Credit and Banking*, 48(2-3):253–291.

Wu, J. C. and Xia, F. D. (2017). Time-varying lower bound of interest rates in Europe. *Chicago Booth Research Paper No. 17-06.*

Zhang, L. and Zoli, E. (2016). Leaning against the wind: Macroprudential policy in asia. *Journal of Asian Economics*, 42:33 – 52.

Zhang, Y. and Tressel, T. (2017). Effectiveness and channels of macroprudential policies: Lessons from the Euro area. *Journal of Financial Regulation and Compliance*, 25(3):271–306.

Appendix

Table A1: Results obtained with the policy interest rate variation

	PruC		*PruC*2		*PruC*3	
	Credit to Private sector	Credit to Households	Credit to Private sector	Credit to Households	Credit to Private sector	Credit to Households
L.MaP	1.246	-0.408	1.265	-0.435	0.483	-0.951
	(1.120)	(1.615)	(1.140)	(1.636)	(0.741)	(1.223)
L2.MaP	-0.388	-2.341	-0.443	-2.404	-0.309	-1.682
	(1.099)	(1.753)	(1.134)	(1.789)	(0.701)	(1.365)
L3.MaP	-1.752	-4.002*	-1.795	-4.033*	-0.873	-2.232
	(1.417)	(2.062)	(1.416)	(2.067)	(1.044)	(1.683)
L4.MaP	-3.227**	-5.704**	-3.198**	-5.645**	-1.849	-3.370*
	(1.580)	(2.249)	(1.573)	(2.250)	(1.200)	(1.869)
L.(MaP $\times$ Δ PR $\times$ I)	-4.963***	-6.216***	-4.954***	-6.184***	-0.544***	-0.546***
	(0.552)	(0.715)	(0.556)	(0.713)	(0.083)	(0.098)
L2.(MaP $\times$ Δ PR $\times$ I)	-4.263***	-5.517***	-4.231***	-5.471***	-0.471***	-0.508***
	(1.219)	(1.242)	(1.234)	(1.255)	(0.048)	(0.071)
L3.(MaP $\times$ Δ PR $\times$ I)	-4.146***	-5.102***	-4.130***	-5.072***	-0.478***	-0.513***
	(1.290)	(1.315)	(1.293)	(1.319)	(0.067)	(0.086)
L4.(MaP $\times$ Δ PR $\times$ I)	-0.606	-2.097***	-0.613	-2.090***	0.017	-0.077
	(0.390)	(0.522)	(0.381)	(0.510)	(0.076)	(0.100)
L.Δ GDP	2.257***	2.447***	2.255***	2.441***	2.255***	2.469***
	(0.224)	(0.298)	(0.224)	(0.299)	(0.222)	(0.298)
Crisis dummy	-4.733***	-6.053***	-4.725***	-6.032***	-4.786***	-6.083***
	(1.247)	(1.551)	(1.248)	(1.552)	(1.269)	(1.512)
Constant	6.858***	9.719***	6.862***	9.725***	6.706***	9.352***
	(0.910)	(1.107)	(0.911)	(1.108)	(0.901)	(1.083)
Observations	2,007	1,942	2,007	1,942	2,007	1,942
Number of countries	37	37	37	37	37	37
Adjusted R-squared	0.262	0.260	0.262	0.260	0.260	0.252

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. MaP refers to the different macroprudential policy indexes considered, Δ PR corresponds to the policy interest rate variation, and I corresponds to the dummy variable capturing the stance of macroprudential and monetary policies.

Table A2: Results obtained with the policy interest rate variation

	$PruC4$		$PruC5$		$PruC6$	
	Credit to Private sector	Credit to Households	Credit to Private sector	Credit to Households	Credit to Private sector	Credit to Households
L.MaP	3.400	-7.615	0.546	-1.230	0.548	-1.223
	(5.621)	(9.215)	(1.038)	(1.457)	(1.033)	(1.447)
L2.MaP	-1.799	-12.138	-0.995	-2.899*	-1.000	-2.918*
	(5.005)	(10.092)	(0.857)	(1.559)	(0.840)	(1.546)
L3.MaP	-6.471	-16.870	-1.984	-4.082**	-2.016*	-4.137**
	(7.521)	(12.432)	(1.203)	(1.878)	(1.187)	(1.857)
L4.MaP	-13.793	-25.559*	-3.006*	-5.348**	-3.069*	-5.423**
	(8.777)	(13.849)	(1.549)	(2.203)	(1.539)	(2.186)
L.(MaP × Δ PR × I)	-4.280***	-4.309***	-1.046***	-1.121***	-1.049***	-1.126***
	(0.639)	(0.756)	(0.144)	(0.172)	(0.144)	(0.173)
L2.(MaP × Δ PR × I)	-3.803***	-4.129***	-0.900***	-1.006***	-0.902***	-1.008***
	(0.371)	(0.554)	(0.100)	(0.128)	(0.098)	(0.127)
L3.(MaP × Δ PR × I)	-3.826***	-4.112***	-0.924***	-1.000***	-0.923***	-0.999***
	(0.499)	(0.646)	(0.100)	(0.124)	(0.098)	(0.121)
L4.(MaP × Δ PR × I)	0.068	-0.681	-0.042	-0.243*	-0.038	-0.241*
	(0.562)	(0.741)	(0.110)	(0.130)	(0.109)	(0.130)
L.Δ GDP	2.255***	2.472***	2.279***	2.492***	2.283***	2.499***
	(0.221)	(0.298)	(0.223)	(0.299)	(0.224)	(0.300)
Crisis dummy	-4.789***	-6.087***	-4.686***	-5.990***	-4.688***	-6.001***
	(1.272)	(1.513)	(1.279)	(1.552)	(1.281)	(1.554)
Constant	6.701***	9.344***	6.757***	9.504***	6.754***	9.499***
	(0.899)	(1.083)	(0.904)	(1.092)	(0.904)	(1.093)
Observations	2,007	1,942	2,007	1,942	2,007	1,942
Number of countries	37	37	37	37	37	37
Adjusted R-squared	0.260	0.253	0.263	0.260	0.264	0.260

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. MaP refers to the different macroprudential policy indexes considered, Δ PR corresponds to the policy interest rate variation, and I corresponds to the dummy variable capturing the stance of macroprudential and monetary policies.

Table A3: Results of the Taylor rule estimations.

Country	ρ	α	β_π	β_y	Hansen test p-value	Observations	Period of estimation
Argentina	0.554***	9.155***	-0.171	0.392	0.844	85	1993Q2:2015Q3
Australia	0.667***	1.862***	1.247***	0.818	0.128	161	1976Q2:2017Q3
Brazil	0.841***	4.032	1.345**	2.634***	0.569	81	1996Q2:2017Q3
Canada	0.957***	-2.432	2.249***	4.054**	0.160	184	1970Q1:2017Q3
Chile	0.532***	3.016***	0.225	0.731***	0.162	54	2003Q1:2017Q3
Colombia	0.692***	1.702***	0.902***	1.047***	0.105	65	2000Q2:2017Q3
Czech Republic	0.924***	-0.482	0.903***	1.035**	0.140	82	1996Q1:2017Q3
Denmark	0.880***	-0.845	1.367***	0.880***	0.699	86	1995Q1:2017Q3
Euro Area	0.767***	0.450	0.831***	0.626***	0.169	71	1999Q1:2016Q4
Hungary	0.936***	-0.555	0.738***	2.647**	0.326	81	1995Q1:2017Q3
India	0.873***	6.768***	0.0381	1.179***	0.679	75	1996Q3:2017Q3
Indonesia	0.894***	7.538***	-0.0767	1.117***	0.303	80	2005Q3:2017Q3
Israel	0.880***	1.418***	0.723***	0.047	0.283	86	1995Q1:2017Q3
Japan	0.869***	0.178**	0.016	0.087	0.309	72	1994Q1:2013Q1
Korea, Rep.	0.928***	1.070	0.526	2.584***	0.144	69	1999Q2:2017Q3
Mexico	0.561***	2.593***	0.763***	0.521***	0.726	75	1998Q4:2017Q3
New Zealand	0.741***	3.960***	0.805*	1.529**	0.791	117	1988Q1:2017Q3
Poland	0.676***	1.681***	1.275***	0.104	0.228	86	1995Q1:2017Q3
Russian Federation	0.665***	7.356***	0.217***	0.164***	0.254	47	2003Q2:2017Q2
South Africa	0.696***	7.206***	0.464***	1.170	0.240	147	1980Q4:2017Q3
Sweden	0.929***	1.705*	0.914***	0.873	0.437	146	1980Q1:2017Q3
Switzerland	0.917***	0.437	0.763***	0.513**	0.164	186	1970Q1:2017Q3
Thailand	0.897***	0.513	0.847**	-0.280	0.360	66	2000Q2:2016Q4
Turkey	0.839***	0.771	0.877***	1.368***	0.198	61	2002Q1:2017Q3
United Kingdom	0.900***	2.086**	0.705	1.943**	0.290	113	1989Q1:2017Q3
United States	0.828***	-1.036	1.735***	0.920**	0.175	188	1970Q1:2017Q3

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% level, respectively.