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

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

February 1, 2020

Abstract

Considering a sample of 37 emerging and advanced economies from 2000Q1 to 2014Q4, we empirically assess how effective macroprudential policies are in curbing domestic credit growth, and whether their effectiveness is affected by monetary policy conditions. We obtain three important results. First our findings suggest in line with previous research 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 on credit growth. Third, our results seem to suggest that monetary policy helps to reduce the transmission delay of macroprudential policy actions. Consequently our results confirm the need for coordination between the two policies.

JEL Codes: E43, E58, G18, G28

Keywords: Macroprudential policy, Monetary policy, Financial stability, Excessive credit growth, Policy synchronisation.

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Considering a sample of 37 emerging and advanced economies from 2000Q1 to 2014Q4, we empirically assess how effective macroprudential policies are in curbing domestic credit growth, and whether their effectiveness is affected by monetary policy conditions. We obtain three important results. First our findings suggest in line with previous research 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 on credit growth. Third, our results seem to suggest that monetary policy helps to reduce the transmission delay of macroprudential policy actions. Consequently our results confirm the need for coordination between the two policies.

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1 Introduction

In the wake of the 2007-2008 global financial crisis, macroprudential policy has attracted considerable attention from policymakers and researchers. A number of emerging countries were using macroprudential policy tools well before the crisis, but substantial progress has subsequently been made in both emerging and industrialised economies in putting 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. These intermediate objectives are seen as transitional steps towards achieving robust financial stability.

Mitigating and preventing excessive growth in credit and leverage is particularly important for safeguarding financial stability. One important lesson of the global financial crisis is that financial imbalances largely developed because of the procyclical behaviour of the banking industry. Such behaviour tends to put upward pressure on asset prices and is often viewed as a key driver of banking crises and how severe they are. This is why several macroprudential tools have been designed to curb excessive credit growth and mitigate the 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. The first of these is to evaluate how effective the policies are. The empirical literature on this is still in infancy, but there is a growing body of it (see, e.g., Galati and Moessner, 2018). The findings seem especially to confirm that macroprudential tools are effective at containing credit growth and housing prices. The second challenge more importantly concerns how macroprudential policy interacts with other policies that also have an impact on financial stability, such as fiscal and monetary policies.

Most notably, macroprudential and monetary policies pursue different primary objectives that could be in conflict with one another. As already noted, macroprudential policy primarily aims to promote financial stability, while the primary objective of monetary policy is to maintain price stability. Consequently, each policy can have “side effects” on the objective of the other and make it more effective or less so. 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 various channels (IMF, 2013). If the policy interest rate is cut, monetary policy can worsen financial stability through two channels, the risk-taking channel and the asset prices channel. The risk-taking channel means that a low interest rate environment may encourage banks to expand their balance sheets and take on more risk, which in turn may contribute to an excessive expansion of credit and may in this way amplify boom-bust cycles (Adrian and Shin, 2010; Borio and Zhu, 2012). It is often argued that these effects are worse if the policy interest rate is held “too low for too long”. A low interest rate environment can also lead to sharp rises in asset prices through the “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.

When the policy interest rate rises, monetary policy can affect financial stability negatively through three different channels: the balance sheet channel, the risk-shifting channel, and for small open economies, the exchange rate channel. The balance sheet channel means that a tightening of the monetary policy stance can hurt the capacity of borrowers to repay their loans, which can lead 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 take in short-term deposits and make long-term loans, changes in the policy rate affect the interest rate applied to short-term deposits more than that for loans. A rise in the policy rate then reduces intermediation margins, and leads financial intermediaries to seek more risk in order to maintain their profits. As a result, monetary tightening is expected to increase financial instability. Finally, monetary policy can impact financial stability through the exchange rate channel, as the policy rate is an important determinant of capital inflows. These inflows can in turn drive credit growth and, owing to the presence of exchange rate externalities, contribute to excessive increases in leverage. The consequence is that, contrary to expectations, raising the policy rate may induce excessive growth in credit, 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 their leverage. When the policy rate is raised 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 the two policies have been extensively studied by the 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 the objective of each. Their results suggest that macroprudential and monetary policies are complements rather than substitutes, although the results vary for different types 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 have gone a step further by explicitly assessing the benefits of coordination between macroprudential policy and monetary policy. To this end, they differentiate between two cases: the perfect coordination of policy and the non-coordination of policy. They find that coordinating the two policies stabilises the effect of real and financial shocks to the macro-environment and maximises social welfare.

Despite the apparent consensus emerging in the theoretical literature about the benefits of synchronisation between macroprudential and monetary policies, little is known from an empirical perspective. 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 from a sample of 37 emerging and advanced countries whether the effectiveness of macroprudential policy is conditional on monetary policy conditions.¹

¹Our selection of sample countries is driven by data availability. Our sample contains countries listed in Table A2 in the Appendix, and twelve euro area countries, namely Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.

Our findings suggest macroprudential policy is more effective at curbing credit growth when macroprudential and monetary policies are both working in the same direction in harmony. Considering different measures of the macroprudential stance and using the Taylor gap as a measure of the monetary policy stance, we obtain two important results. First, we find that a restrictive monetary policy enhances the impact of macroprudential tightening on domestic credit growth. Second, our results suggest 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. A battery of robustness checks is conducted in section 5, while section 6 concludes and gives some policy recommendations.

2 Literature Review

In this section, we review the existing empirical literature that has analysed how macroprudential policies affect various measures of financial vulnerability and stability by discussing whether these studies deal with the challenges discussed above.² Nabar and Ahuja [2011] and Lim et al. [2011] were 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] find 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 reduce the growth in property lending. Considering a larger set of macroprudential instruments, Lim et al. [2011] find that macroprudential policies are effective at reducing credit procyclicality. 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 designed to measure the number of instruments in place in a given country. Their results confirm that macroprudential policies are effective at curbing credit growth, especially in developing and emerging countries, but they do not appear to have a statistically significant effect on the growth in real housing prices.

One important drawback of studies cited above is the way of measuring macroprudential policy. As they focus 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 how macroprudential policy evolves over time by being tightened or loosened (Vandembussche 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). For instance, using a cumulative macroprudential policy stance indicator, Akinci and Olmstead-Rumsey [2018] find that macroprudential policy tightening is associated with lower growth in bank credit, housing credit, and house prices. Their findings also suggest that borrower-targeted macroprudential instruments tend to be more effective at curbing credit growth. Similar results are obtained by Zhang and Zoli [2016] for

²For a comprehensive literature review on the effects of macroprudential policy, see Galati and Moessner [2018].

a sample of Asian economies, and by Carreras et al. [2018] for the OECD countries.

Other studies focus specifically on how the stance of macroprudential policy affects the real estate market (see for instance McDonald, 2015; Vandebussche 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. They find that both policies have a negative impact on the growth rate in housing credit. The results are more mixed when they consider housing price growth as an endogenous variable. Changes in taxes still have a statistically significant impact on house prices, but this is not the case for some of the macroprudential tools considered, such as the debt service ratio. As argued by Kuttner and Shim [2016], this result can easily be explained because the cost of buying a house, and consequently demand and prices in the real estate market, is directly affected by tax policies such as the deductibility of mortgage interest and property taxes, but not so much by macroprudential tools. More importantly, the results of Kuttner and Shim [2016] confirm that one major challenge for macroprudential policy is to interact with other policies in a way that 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 is the interaction between macroprudential policy and monetary policy. As discussed in the introduction, each policy can have “side effects” on the objectives of the other. It is particularly widely recognised that monetary policy can have side effects on financial stability, for instance when policy rates are held “too low for too long”. When monetary policy is very accommodative, there are greater incentives to borrow at low interest rates that are difficult for macroprudential policy to contain fully. Consequently, an important empirical issue is to assess how far the monetary policy stance affects how effective macroprudential policy is.

However, there is still very little empirical literature on this issue. To the best of our knowledge, only few studies try to address this question (Bruno et al., 2017; Gambacorta and Murcia, 2019; Zhang and Tressel, 2017). A sample of 12 Asia-Pacific economies over the period 2004-2013 is used by Bruno et al. [2017] to investigate two supplementary issues. First they distinguish between the pre and post-2007 periods and investigate whether macroprudential policies are synchronised with changes in monetary policy rates.³ They find that before 2007 monetary policy usually changed in tandem with macroprudential measures, but the opposite result is found after 2007. After 2007, there was a slight downward trend in the average monetary policy rate in the region, while macroprudential measures were tightening slightly. Second, they assess how effective macroprudential policy measures are in curbing growth in cross-border banking flows. They find that macroprudential policies effectively reduced banking inflows over the period 2004-2007, but 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 when they act in opposite directions.

Gambacorta and Murcia [2019] and Zhang and Tressel [2017] investigate this issue more specifically by assessing whether the impact of macroprudential policies on credit growth depends on monetary policy conditions. Using meta-analysis techniques and credit registry data for a sample of five Latin American countries, Gambacorta and Murcia [2019] find macroprudential tools to be made more effective at dampening credit cycles when monetary policies are pushing in the same direction. Indeed, considering the change in the real money rate as a monetary policy indicator, they find that a macro-

³Akinci 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.

prudential policy tightening affects credit growth more when it is accompanied by 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 macroprudential policy is more effective in containing credit growth and housing prices when monetary policy is tightened. They do this by interacting the LTV ratio with an interest rate gap computed using a Taylor rule. However, their results are relatively mixed especially since the sign and the significance of estimated coefficients associated with the interaction term are unstable depending on the lag order.

As we can see, empirical studies that assess the impact 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 sample of emerging and industrialised countries whether synchronising macroprudential and monetary policies is a good way to strengthen the impact of macroprudential tools on domestic credit growth. Furthermore, in contrast to the existing literature, our empirical analysis considers an extensive set of prudential tools to capture the overall stance of macroprudential policy. In 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.

To analyse how effective macroprudential instruments are 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 the use of macroprudential policies in a large sample of emerging and industrialised economies.

Two types of dataset can be distinguished. First, some studies consider a large set of macroprudential tools to provide information on the number of instruments adopted by countries. This lets them give a picture of the evolution of the macroprudential policy framework. For instance, the IMF's 2017 Macroprudential Policy Survey (IMF, 2018) and national sources are used by Cerutti et al. [2017a] to construct an aggregate macroprudential index in which each instrument considered 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). The main objective of these datasets is to use information on easing and tightening of different macroprudential policy instruments 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 as Cerutti et al. [2017a], Cerutti et al. [2017b] consider five types of prudential instrument across a sample of 64 countries over the period 2000Q1-2014Q4. The five types of instrument 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 of reserve requirements on foreign currency-denominated accounts and reserve requirements on local currency-denominated accounts.

Cerutti et al. [2017b] then record the number of easing and tightening measures for each type of macroprudential instrument implemented by each country in each quarter. For a given instrument, a tightening action is coded +1 and a loosening action is coded -1, while 0 means that no change occurs during the quarter. If multiple actions are taken within a given quarter, the reported values correspond to the sum of all the changes recorded, so 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 it is applied by policymakers. Table 1 details the number of events for each macroprudential policy instrument, distinguishing between net tightening and net loosening events.⁴ As can be seen, 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	No. of events	No. of net tightening events	No. 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*, were originally developed by Cerutti et al. [2017b], and we also propose four alternative measures. These measures 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

⁴TableA1 in the Appendix gives a cross-country perspective of the number of events, by distinguishing between OECD and non-OECD countries.

can take three different values: -1, 0, +1. Formally, $PruC$ is defined as follows:

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

where subscripts i and t refer respectively to country and time period, while the subscript a represents a given macroprudential instrument from among the nine recorded in the database. It is important though to note that the number of instruments considered can vary across countries depending on which instruments have or have not been adopted. As mentioned above, the absence of legislation authorising the use of a particular macroprudential instrument by policymakers is coded in the database as missing. $x_{a,i,t}$ reflects the orientation of 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. So if $PruC$ is equal to +1, the overall macroprudential policy framework has been tightened during the quarter, but if $PruC$ is equal to -1, then the framework has been loosened. $PruC$ being equal to 0 can correspond to two cases: no change in any instruments, or the same number of tightening and loosening actions during the quarter.

$PruC2$ is computed in a similar fashion to $PruC$. The only difference between these two country indexes is 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:

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

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

$$PruC3_{i,t} = \sum_a x_{a,i,t} \quad (3)$$

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. A larger positive value of this index indicates a more restrictive macroprudential policy, while a larger negative value reflects a more accommodative policy.

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

$$PruC4_{i,t} = \frac{PruC3_{i,t}}{n_{i,t}} \quad (4)$$

where $n_{i,t}$ corresponds to the number of instruments adopted in country i at time t . Like this, *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 actually been changed and those for which no action has been taken. To handle this we go a step further by computing an index that reflects the macroprudential policy stance conditional on the number of instruments actually changed during a given quarter. This index, called *PruC5*, is defined as follows:

$$PruC5_{i,t} = \frac{PruC3_{i,t}}{e_{i,t}} \quad (5)$$

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

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

$$PruC6_{i,t} = \frac{\sum_T x_{T,i,t}}{Tight_{i,t}} + \frac{\sum_L x_{L,i,t}}{Loose_{i,t}} \quad (6)$$

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 $Loose_{i,t}$ stand for the number of net tightening instruments and the number of net easing instruments. *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. In comparison to *PruC5*, the *PruC6* index is notably better able to evaluate the stance of macroprudential policy when some macroprudential tools move in opposite ways. 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 the Russian Federation, where different macroprudential policy actions have been taken during a given quarter (see Table 2). As expected, the other macroprudential measures that we propose in this article tend to discriminate the macroprudential policy stance across countries better than *PruC* and *PruC2* do. Looking at Colombia, we can see that *PruC6* is higher in absolute terms than *PruC5*. This confirms the relevance of this index when the number of tightening actions per instrument is lower than the number of loosening actions per instrument.

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
No. of adopted inst.	8	9	7	7
No. of tightened inst.	2	1	3	0
No. of loosened inst.	0	1	0	2
<i>PruC</i>	1	-1	1	-1
<i>PruC2</i>	1	0	1	-1
<i>PruC3</i>	10	-1	3	-6
<i>PruC4</i>	1.25	-0.11	0.43	-0.86
<i>PruC5</i>	5	-0.5	1	-3
<i>PruC6</i>	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.

3.2 Measuring the stance of monetary policy.

To assess the monetary policy stance, we need to differentiate between “rule-based” monetary policy and “discretionary” monetary policy. We do this by following the existing literature (see, e.g., Bogdanova and Hofmann, 2012; Bruno et al., 2017) and using the well-known Taylor rule (Taylor, 1993). The Taylor rule constitutes an approximation of the behaviour of a central bank and has become popular in the academic literature for describing the monetary policy stance. The Taylor rule is a reaction function that defines the central bank interest rate as a function of inflation and a measure of economic activity, typically the output gap. Comparing the policy rate with the empirically estimated Taylor rate then gives an understanding of how far policy rate setting has deviated from the Taylor rule.

In line with Bogdanova and Hofmann [2012] and using historical time series for each country 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.⁵ A positive relationship could be expected between

⁵Because our sample includes inflation targeting and non-inflation targeting countries, we do not consider the inflation gap in Equation (7). In most non-inflation targeting countries, the central bank does not publicly announce a numerical inflation target 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 .

the inflation rate, the output gap, and the policy rate, meaning $\beta_\pi > 0$ 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. Real GDP is taken from the OECD Statistics for the OECD countries, and from the IFS for the others. The 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 actual real GDP and its trend, computed using the traditional Hodrick-Prescott filter.

Following Clarida et al. [2000] and the related literature, we estimate Equation (7) using the Generalised Method of Moments (GMM) estimator to overcome the issue of potential endogeneity. Furthermore, the time period for estimating Equation (7) covers the longest available data time span so as to give consistent estimates, and then differs across the 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. The Taylor rule estimates are reported in Table A2 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, the use of the policy rate as the main monetary policy instrument can be challenged, and some industrialised economies actually adopted unconventional monetary policies in the aftermath of the 2007-08 financial crisis. This means that assessing the impact of the unconventional measures implemented and understanding the overall monetary policy stance using the Taylor gap can be inappropriate. To address this issue, as 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 recently been 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; Lombardi and Zhu, 2018). Indeed, when the zero lower bound is binding, the policy interest rate does not display meaningful variation and so no longer conveys information about the monetary policy stance. The shadow rate meanwhile 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 [2015] 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

Using the insights from the existing literature and the arguments presented above, our empirical analysis aims to gauge the effectiveness of macroprudential policies in curbing credit growth and

whether the monetary policy stance drives this effectiveness. Given data availability, we do this by considering a sample of 37 advanced and emerging economies over the period 2000Q1-2014Q4. However, before turning to the econometric analysis, this section presents some descriptive statistics and preliminary findings.

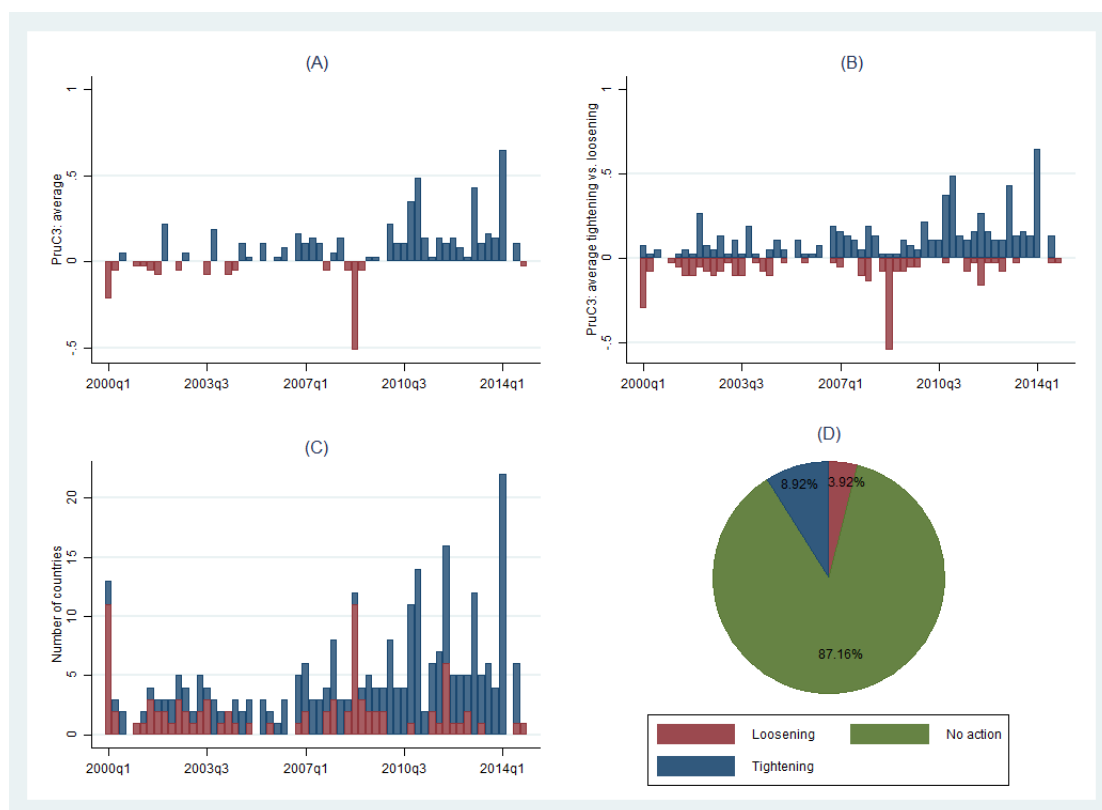
4.1 Preliminary findings

We start our empirical investigation by analysing in Figure 1 the evolution of the macroprudential policy stance in our sample of countries. Panels (A) and (B) focus on the *PruC3* index, which is the most explicit indicator for giving a clear picture of the overall evolution of macroprudential policies. Panel (A) represents the cross-sectional average value of the *PruC3* index for each quarter. The blue bars indicate positive values, while the red bars indicate negative values. As would be expected, 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 the economies in our sample conducted their macroprudential policy in the same direction. To illustrate this we split our sample of countries into two categories in panel (B) of countries with a net tightened macroprudential policy stance during a given quarter, and those with a net loosened macroprudential policy stance. The blue bars correspond to the average value of the *PruC3* index for the first category of countries, while the red bars indicate the average value of the *PruC3* index for the second category of countries. 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, and it also distinguishes the orientation of this change. The red bars correspond to the number of countries with a net loosened macroprudential policy stance, while the blue bars correspond to the number of countries with a net tightened macroprudential policy stance. It shows that macroprudential activism tended to increase over the period considered. Finally, panel (D) presents the frequency of quarterly observations with a net tightened or a net loosened macroprudential policy stance. It shows that net tightening actions are more than twice as common 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 total credit to the private non-financial sector from banks. The residuals are obtained by regressing credit growth on the annual GDP growth lagged by one period. They capture the part of credit that is not driven by real economic activity and so 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, the cross-correlation coefficient is negative for most countries, suggesting that a net tightened macroprudential stance is associated with 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 larger 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 changes in macroprudential policy with the monetary policy stance. In panels (A), (B) and (C), grey bars represent the number of countries in each period where both policies exhibit the same stance. Not surprisingly, panel (C) shows that monetary policy tended to desynchronise from macroprudential policy in the aftermath of the global financial crisis. During this period, most central banks around the world conducted accommodative monetary policies, and many countries strength-

Figure 1: Descriptive statistics on macroprudential policy stance



Source: Cerutti et al. [2017b] and authors' calculations.

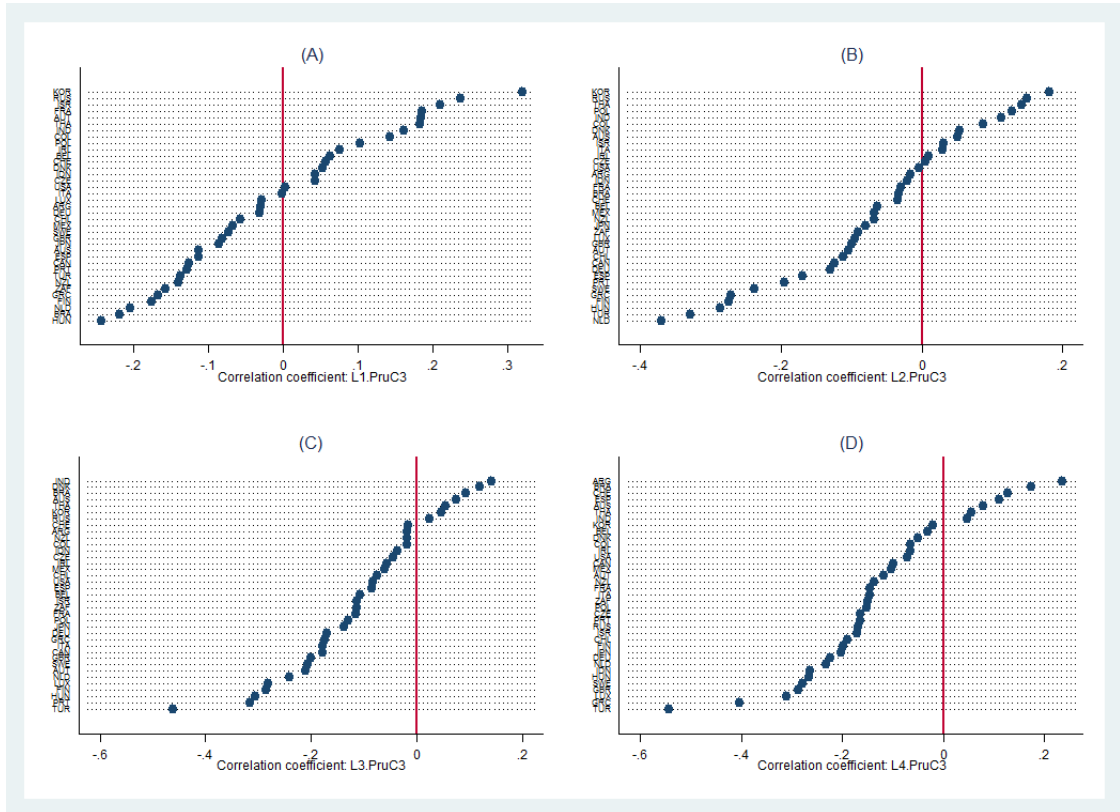
Note: All panels are based on our sample of 37 countries. Panel (A) presents the cross-sectional average value of the *PruC3* index for each quarter. In panel (B), the blue bars correspond to the average value of the *PruC3* index of countries with a net tightened macroprudential policy stance, and the red bars correspond to the average value of the *PruC3* index of countries with a net loosened macroprudential policy stance. Panel (C) presents the number of countries in which the macroprudential policy stance changed over a given quarter by distinguishing between tightened and loosened stances. Panel (D) presents the share of quarterly observations with 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.

ened their macroprudential framework at the same time [see panel (A)]. This picture is confirmed in panel (D), which represents the trend of the cross-sectional correlation between the *PruC3* index and the Taylor gap for each quarter.⁶

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 are illustrated by the red points, while the blue points indicate the correlation coefficients reported in Figure 2. Overall, the partial correlation coefficients are higher than the pairwise correlation coefficients regardless of the lag order considered. When the coefficient is negative, this means that taking account of the monetary policy stance reduces the correlation between the macroprudential policy stance and credit growth. These preliminary findings then confirm the importance of monetary policy for the effectiveness of macroprudential policy in curbing credit growth. This issue is investigated in more detail in the next sub-section.

⁶See, for instance, Borio and Shim [2007] and Bruno et al. [2017] for further evidence. See also the Table A1 in the Appendix for a cross-country comparison of the pairwise correlation between the *PruC3* index and the Taylor gap.

Figure 2: Correlation between the 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 total credit to the private non-financial sector from banks. The residuals are obtained by regressing credit growth on GDP growth lagged by one period. 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 we follow the existing literature by reinvestigating how our different measures of the macroprudential policy stance affect credit growth. To this end we consider two alternative measures of domestic credit, which are total credit to the private non-financial sector from banks and 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:

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

where $\Delta Credit_{i,t}$ is the yearly growth of our different measures of credit, and $MaP_{i,t-k}$ 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), as some 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, which are the annual GDP growth rate and the change in the nominal monetary policy rate. These two variables are lagged one period and are taken from the IFS database and the BIS respectively. A negative relationship should be expected between the change in policy rate and the growth of credit, while higher GDP growth should be associated with higher credit

Figure 3: Synchronisation of the stances of macroprudential and monetary policies



Source: Cerutti et al. [2017b] and authors' calculations.

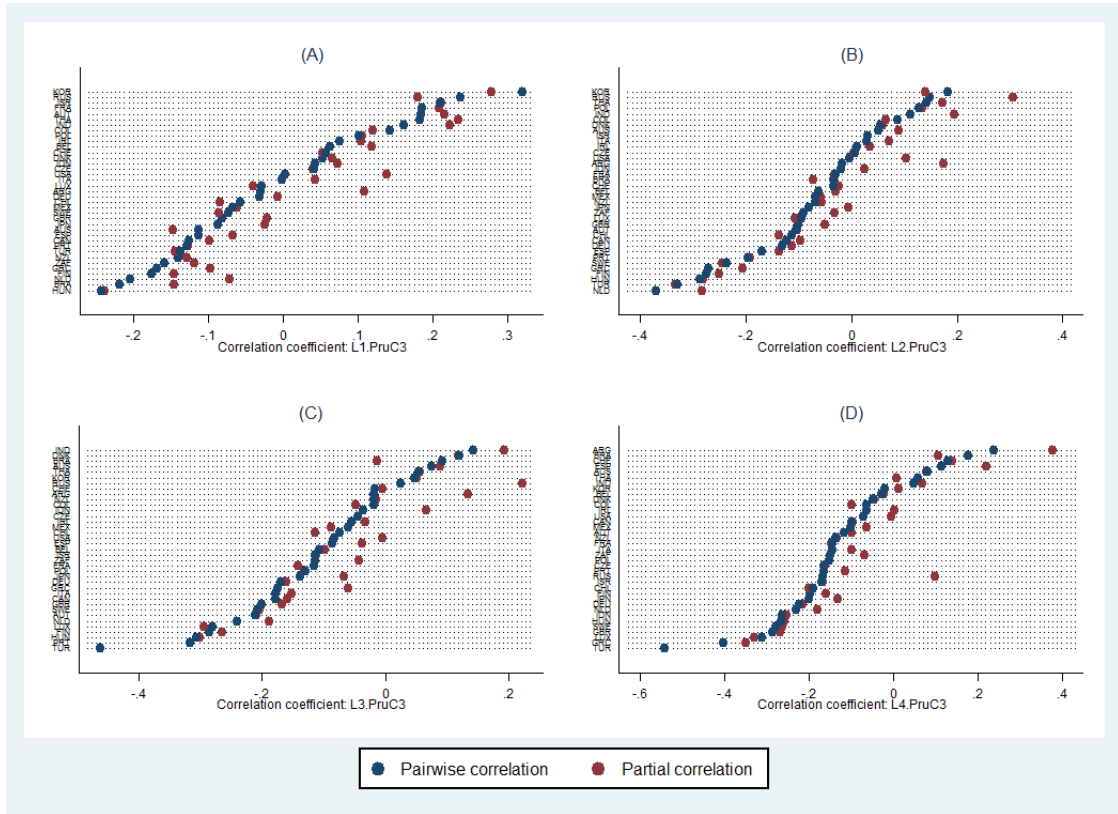
Note: All panels are based on our sample of 37 countries. Panels (A) and (B) represent the number of countries with a net tightened and a net loosened macroprudential policy stance respectively for each quarter. Panel (C) represents the number of countries in which the macroprudential policy stance changed over the given quarter, whatever the direction of the macroprudential policy. For each of these panels, the grey bars correspond to the number of cases where macroprudential and monetary policies move in the same direction. Panel (D) represents the trend of the cross-sectional correlation between the *Pruc3* index and the Taylor gap for each quarter. The trend is obtained using the Hodrick-Prescott filter.

growth. The GDP growth rate is included to control for the procyclicality of credit (Athanasoglou et al., 2014), and this then allows us to capture the part of credit that is not driven by real economic activity, which is excess credit growth. $Crisis_t$ is a dummy variable capturing a potential drop in credit growth during the 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. We could expect $\beta_k < 0$, meaning that a more restrictive macroprudential policy helps to curb domestic credit growth. In the second step, we extend our previous baseline model to assess whether a tighter macroprudential policy is more likely to curb domestic credit growth when it is accompanied by a restrictive monetary policy, giving a positive Taylor gap. More precisely, the equation that we estimate is the following:

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

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 in 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

Figure 4: Partial correlation between the 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 total credit to the private non-financial sector from banks. The 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.

additional effect of macroprudential policies on credit growth conditional on the stance of monetary policy.⁷

As we are primarily interested in assessing whether the monetary policy stance is an important determinant of the effectiveness of macroprudential policies, we focus particularly 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:

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

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. We 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 credit growth cannot be contained through macroprudential policy alone, but that this needs the

⁷It is justified to consider the dummy variable $D_{i,t-k}$ because 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, a negative coefficient would be expected, but if both variables are negative, a positive coefficient would be expected. This then justifies the use of a three-way interaction term to assess whether a tighter macroprudential policy is more likely to curb domestic credit growth when it is accompanied by a restrictive monetary policy.

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 the monetary policy orientation, meaning whether monetary policy has been tightened or loosened. Formally, the equation that we estimate is the following:

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

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 both positive in a given quarter, and 0 otherwise. As above, if monetary policy is an important driver of macroprudential policy effectiveness, we would expect $\gamma_k < 0$.⁸

4.3 Results

Our results are reported in Tables 3 to 5. In Table 3, we report the results when we consider *PruC* and *PruC2* as alternative measures of the 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 give a better view of how important the monetary policy stance is for the conduct of macroprudential policy, we present the results of the baseline and extended models side by side. 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 when we take the monetary policy stance into account, which is proxied using two alternative measures, the Taylor gap and its first difference.

We find 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. Other than for 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, and as might be expected, macroprudential policy actions take time to curb domestic credit growth effectively. For most specifications, we can see that the coefficients associated with macroprudential indexes are only significant at the third and fourth order lags.

Second, the results when we add the interaction term in the baseline model show that the monetary policy stance matters for the effectiveness of macroprudential policy. The 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. Equally, the results from considering the first difference of the Taylor gap show that the marginal effect on credit growth of tightening macroprudential instruments is affected by whether the prevailing monetary policy stance is tight or loose.

⁸Please note that we also estimate Equation (11) by considering the policy interest rate variation as an additional measure of the monetary policy orientation. Detailed results are available upon request.

The benefits of synchronisation between macroprudential and monetary policies are also confirmed in columns [2.2], [2.3], [2.8] and [2.9]. 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 delay of macroprudential policy actions on private sector credit growth, as the coefficients associated with the interaction term are negative and significant at the first, second and third order lags. The results are more mixed when we consider the growth of credit to households as a dependent variable.

In sum, even though monetary and macroprudential policies pursue different primary objectives, our empirical analysis confirms that the two policies are complementary. Our results particularly 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*

	<i>PruC</i>				<i>PruC2</i>							
	Credit to private sector (1.1)	(1.2)	(1.3)	Credit to households (1.4)	(1.5)	(1.6)	Credit to private sector (1.7)	(1.8)	(1.9)	Credit to households (1.10)	(1.11)	(1.12)
L.MaP	0.972 (1.184)	0.931 (0.959)	0.743 (1.032)	-0.377 (1.638)	-0.557 (1.403)	-0.697 (1.437)	0.980 (1.199)	0.948 (0.973)	0.758 (1.044)	-0.416 (1.651)	-0.583 (1.418)	-0.724 (1.449)
L2.MaP	-0.658 (1.132)	-0.861 (0.937)	-1.007 (0.958)	-2.377 (1.679)	-2.556* (1.471)	-2.645* (1.467)	-0.721 (1.162)	-0.914 (0.966)	-1.060 (0.987)	-2.450 (1.705)	-2.616* (1.497)	-2.704* (1.489)
L3.MaP	-2.029 (1.388)	-2.285* (1.256)	-2.475* (1.227)	-4.030** (1.914)	-4.207** (1.703)	-4.356** (1.657)	-2.082 (1.382)	-2.324* (1.258)	-2.513** (1.229)	-4.073** (1.911)	-4.234** (1.708)	-4.382** (1.662)
L4.MaP	-3.073* (1.775)	-3.670** (1.473)	-3.675** (1.425)	-5.769** (2.472)	-5.987** (1.993)	-6.058** (1.968)	-3.053* (1.768)	-3.632** (1.468)	-3.637** (1.420)	-5.727** (2.481)	-5.927** (2.003)	-5.998** (1.977)
L.(MaP × TG × D)	-1.156*** (0.231)	-1.156*** (0.231)	-1.156*** (0.231)	-0.896 (0.604)	-0.896 (0.604)	-0.896 (0.604)	-1.154*** (0.231)	-1.154*** (0.231)	-1.154*** (0.231)	-0.891 (0.606)	-0.891 (0.606)	-0.891 (0.606)
L2.(MaP × TG × D)	-0.914*** (0.188)	-0.914*** (0.188)	-0.914*** (0.188)	-0.816* (0.433)	-0.816* (0.433)	-0.816* (0.433)	-0.911*** (0.189)	-0.911*** (0.189)	-0.911*** (0.189)	-0.811* (0.435)	-0.811* (0.435)	-0.811* (0.435)
L3.(MaP × TG × D)	-0.824*** (0.198)	-0.824*** (0.198)	-0.824*** (0.198)	-0.771* (0.387)	-0.771* (0.387)	-0.771* (0.387)	-0.821*** (0.198)	-0.821*** (0.198)	-0.821*** (0.198)	-0.767* (0.388)	-0.767* (0.388)	-0.767* (0.388)
L4.(MaP × TG × D)	0.215 (0.175)	0.215 (0.175)	0.215 (0.175)	-0.336 (0.515)	-0.336 (0.515)	-0.336 (0.515)	0.214 (0.175)	0.214 (0.175)	0.214 (0.175)	-0.337 (0.514)	-0.337 (0.514)	-0.337 (0.514)
L.(MaP × Δ TG × I)	-1.078*** (0.209)	-1.078*** (0.209)	-1.078*** (0.209)	-0.822 (0.545)	-0.822 (0.545)	-0.822 (0.545)	-1.077*** (0.209)	-1.077*** (0.209)	-1.077*** (0.209)	-0.818 (0.547)	-0.818 (0.547)	-0.818 (0.547)
L2.(MaP × Δ TG × I)	-0.931*** (0.136)	-0.931*** (0.136)	-0.931*** (0.136)	-0.833** (0.328)	-0.833** (0.328)	-0.833** (0.328)	-0.928*** (0.136)	-0.928*** (0.136)	-0.928*** (0.136)	-0.829** (0.330)	-0.829** (0.330)	-0.829** (0.330)
L3.(MaP × Δ TG × I)	-0.856*** (0.111)	-0.856*** (0.111)	-0.856*** (0.111)	-0.806*** (0.271)	-0.806*** (0.271)	-0.806*** (0.271)	-0.854*** (0.111)	-0.854*** (0.111)	-0.854*** (0.111)	-0.802*** (0.271)	-0.802*** (0.271)	-0.802*** (0.271)
L4.(MaP × Δ TG × I)	0.135 (0.169)	0.135 (0.169)	0.135 (0.169)	-0.382 (0.497)	-0.382 (0.497)	-0.382 (0.497)	0.134 (0.169)	0.134 (0.169)	0.134 (0.169)	-0.382 (0.496)	-0.382 (0.496)	-0.382 (0.496)
L.Δ GDP	2.460*** (0.256)	2.155*** (0.241)	2.142*** (0.234)	2.725*** (0.296)	2.442*** (0.363)	2.429*** (0.347)	2.458*** (0.256)	2.153*** (0.242)	2.140*** (0.234)	2.719*** (0.294)	2.437*** (0.365)	2.423*** (0.348)
L.Δ Policy rate	-0.793 (0.722)	2.415 (1.628)	2.452 (1.539)	-2.406 (2.173)	-0.340 (4.511)	-0.306 (4.315)	-0.790 (0.725)	2.408 (1.631)	2.446 (1.541)	-2.403 (2.177)	-0.355 (4.516)	-0.318 (4.318)
Crisis dummy	-4.246*** (1.442)	-4.707*** (1.291)	-4.692*** (1.293)	-5.568*** (1.802)	-6.119*** (1.620)	-6.075*** (1.612)	-4.237*** (1.442)	-4.698*** (1.293)	-4.682*** (1.295)	-5.548*** (1.801)	-6.098*** (1.622)	-6.054*** (1.614)
Constant	5.974*** (1.173)	7.356*** (0.957)	7.333*** (0.942)	8.480*** (1.210)	9.737*** (1.171)	9.671*** (1.124)	5.981*** (1.172)	7.360*** (0.957)	7.338*** (0.942)	8.493*** (1.208)	9.743*** (1.175)	9.679*** (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: Robust standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels respectively. MaP is 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 (2.1)	Credit to private sector (2.2)	Credit to private sector (2.3)	Credit to households (2.4)	Credit to households (2.5)	Credit to households (2.6)	Credit to private sector (2.7)	Credit to private sector (2.8)	Credit to private sector (2.9)	Credit to households (2.10)	Credit to households (2.11)	Credit to households (2.12)
L.MaP	-0.025 (0.719)	0.343 (0.718)	0.345 (0.736)	-0.985 (0.993)	-0.879 (1.082)	-0.855 (1.092)	0.017 (5.470)	2.462 (5.471)	2.459 (5.625)	-7.708 (7.828)	-7.098 (8.364)	-6.932 (8.455)
L2.MaP	-0.682 (0.662)	-0.502 (0.685)	-0.480 (0.682)	-1.795 (1.130)	-1.596 (1.201)	-1.555 (1.200)	-4.499 (4.889)	-3.103 (4.981)	-2.962 (4.970)	-13.076 (8.719)	-11.516 (9.122)	-11.221 (9.128)
L3.MaP	-1.387 (0.825)	-1.083 (0.973)	-1.075 (0.969)	-2.430* (1.247)	-2.108 (1.430)	-2.080 (1.427)	-10.072 (6.189)	-7.906 (7.130)	-7.870 (7.099)	-18.254* (9.717)	-15.966 (10.848)	-15.774 (10.839)
L4.MaP	-1.526 (1.269)	-2.020* (1.148)	-1.983* (1.135)	-3.441* (1.941)	-3.332* (1.679)	-3.285* (1.670)	-11.690 (9.217)	-14.994* (8.449)	-14.726* (8.348)	-26.257* (14.269)	-25.305* (12.639)	-24.966* (12.572)
L.(MaP × TG × D)	-0.099*** (0.024)	-0.099*** (0.024)	-0.099*** (0.024)	-0.059 (0.062)	-0.059 (0.062)	-0.059 (0.062)	-0.779*** (0.192)	-0.779*** (0.192)	-0.779*** (0.192)	-0.457 (0.504)	-0.457 (0.504)	-0.457 (0.504)
L2.(MaP × TG × D)	-0.079*** (0.015)	-0.079*** (0.015)	-0.079*** (0.015)	-0.060 (0.038)	-0.060 (0.038)	-0.060 (0.038)	-0.634*** (0.120)	-0.634*** (0.120)	-0.634*** (0.120)	-0.490 (0.306)	-0.490 (0.306)	-0.490 (0.306)
L3.(MaP × TG × D)	-0.075*** (0.014)	-0.075*** (0.014)	-0.075*** (0.014)	-0.065* (0.033)	-0.065* (0.033)	-0.065* (0.033)	-0.602*** (0.107)	-0.602*** (0.107)	-0.602*** (0.107)	-0.515* (0.263)	-0.515* (0.263)	-0.515* (0.263)
L4.(MaP × TG × D)	0.023 (0.017)	0.023 (0.017)	0.023 (0.017)	-0.025 (0.045)	-0.025 (0.045)	-0.025 (0.045)	0.175 (0.137)	0.175 (0.137)	0.175 (0.137)	-0.211 (0.369)	-0.211 (0.369)	-0.211 (0.369)
L.(MaP × Δ TG × I)	-0.092*** (0.022)	-0.092*** (0.022)	-0.092*** (0.022)	-0.055 (0.057)	-0.055 (0.057)	-0.055 (0.057)	-0.726*** (0.179)	-0.726*** (0.179)	-0.726*** (0.179)	-0.429 (0.460)	-0.429 (0.460)	-0.429 (0.460)
L2.(MaP × Δ TG × I)	-0.074*** (0.013)	-0.074*** (0.013)	-0.074*** (0.013)	-0.058* (0.034)	-0.058* (0.034)	-0.058* (0.034)	-0.601*** (0.105)	-0.601*** (0.105)	-0.601*** (0.105)	-0.468* (0.271)	-0.468* (0.271)	-0.468* (0.271)
L3.(MaP × Δ TG × I)	-0.071*** (0.012)	-0.071*** (0.012)	-0.071*** (0.012)	-0.062** (0.029)	-0.062** (0.029)	-0.062** (0.029)	-0.570*** (0.090)	-0.570*** (0.090)	-0.570*** (0.090)	-0.492** (0.231)	-0.492** (0.231)	-0.492** (0.231)
L4.(MaP × Δ TG × I)	0.021 (0.016)	0.021 (0.016)	0.021 (0.016)	-0.023 (0.041)	-0.023 (0.041)	-0.023 (0.041)	0.160 (0.128)	0.160 (0.128)	0.160 (0.128)	-0.196 (0.338)	-0.196 (0.338)	-0.196 (0.338)
L.Δ GDP	2.466*** (0.267)	2.209*** (0.237)	2.204*** (0.234)	2.706*** (0.297)	2.504*** (0.343)	2.493*** (0.336)	2.466*** (0.267)	2.209*** (0.236)	2.204*** (0.233)	2.710*** (0.298)	2.509*** (0.343)	2.498*** (0.336)
L.Δ Policy rate	-0.733 (0.834)	1.574 (1.508)	1.633 (1.454)	-2.362 (2.471)	-1.199 (4.191)	-1.114 (4.082)	-0.766 (0.827)	1.544 (1.524)	1.602 (1.469)	-2.384 (2.473)	-1.241 (4.242)	-1.157 (4.132)
Crisis dummy	-4.294*** (1.507)	-4.735*** (1.309)	-4.684*** (1.304)	-5.738*** (1.836)	-6.173*** (1.601)	-6.101*** (1.582)	-4.303*** (1.508)	-4.744*** (1.311)	-4.692*** (1.306)	-5.742*** (1.835)	-6.178*** (1.601)	-6.106*** (1.582)
Constant	5.969*** (1.138)	6.975*** (0.955)	6.931*** (0.951)	8.479*** (1.179)	9.227*** (1.125)	9.166*** (1.109)	5.959*** (1.135)	6.966*** (0.953)	6.922*** (0.949)	8.465*** (1.178)	9.214*** (1.134)	9.152*** (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: Robust standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels respectively. MaP is 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*

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

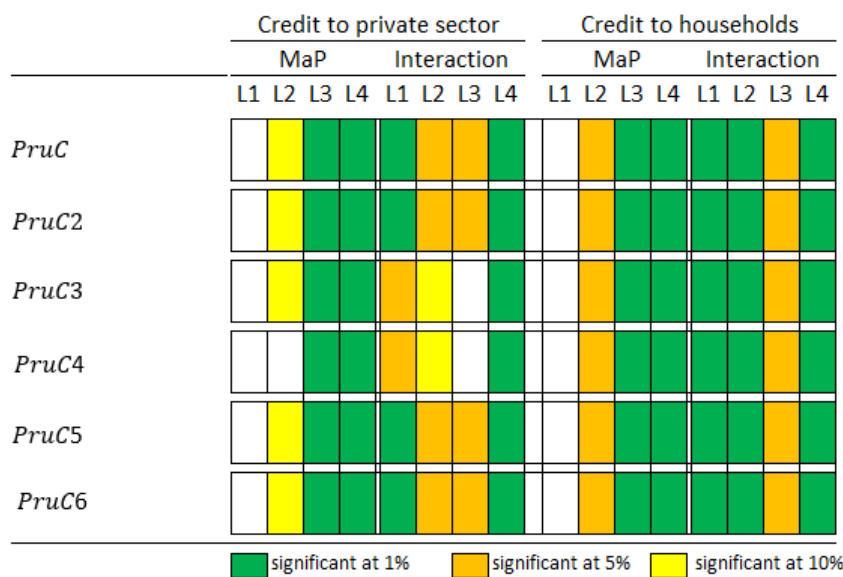
Note: Robust standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels respectively. MaP is the different macroprudential policy indexes considered, TG corresponds to the Taylor gap, Δ TG corresponds to the first difference of the Taylor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

5 Robustness checks

We check the robustness of our previous findings in five ways. First, we address the fact that our sample includes advanced and emerging countries by checking whether our initial findings remain unchanged when we focus only on OECD economies. Second, we check how our results are sensitive to alternative sets of control variables. Third, we take into account the potential sensitivity of the interest rate gap to the Taylor rule specification. Fourth, we check whether our initial results are robust when we consider alternative shadow rate measures. Finally, we address the potential endogeneity of macroprudential measures.

Sub-sample of OECD countries. Our sample contains 29 OECD countries and 8 non-OECD countries. We then re-estimate our different specifications by considering only the OECD countries in our sample. Figures 5 and 6 summarise the results that we obtain for the alternative macroprudential variables and the interaction terms.⁹ As we can see, results are very similar to those obtained on the whole sample. In particular, we still find that the estimated coefficients associated with the interaction term between the macroprudential policy indexes and our two measures of monetary policy stance is negative and statistically significant at the conventional levels. This then suggests that the coordination between macroprudential and monetary policies is especially important in OECD countries.

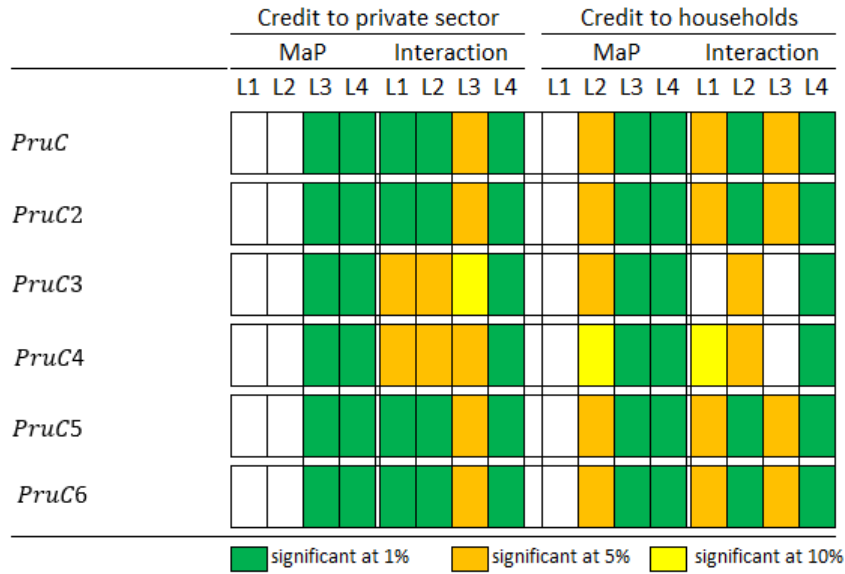
Figure 5: Robustness checks: OECD countries sub-sample - Taylor gap



Alternative sets of control variables. First, we replace the change in the nominal policy rate as a control variable by the change in the bank lending rate. Indeed, the transmission of monetary policy to credit markets takes time and transmission delays can differ considerably across countries. A number of empirical studies show that the pass-through of monetary policy shocks to bank lending rates is usually sluggish and incomplete, and depends on a number of determinants (see, e.g., Gigineishvili, 2011; Leroy and Lucotte, 2016; Horvath, 2018). As Illes et al. [2019] argue, there are two main reasons

⁹Detailed results are available upon request.

Figure 6: Robustness checks: OECD countries sub-sample - First difference of the Taylor gap



why bank lending rates diverge from policy rates. First, the policy rate is a very short-term rate, while the lending rates to firms and households normally reflect longer-term loans. The spread between the lending and policy rates therefore reflects the maturity risk premium alongside other factors that determine the transmission of monetary policy shocks to bank lending rates. Second, the policy rate does not represent the marginal cost of funds for banks. Banks obtain funds from a variety of sources including retail deposits, senior unsecured or covered bond markets and the interbank market, and these differ in nature from policy rates since they comprise a range of liabilities of different maturities and risk characteristics.

All these reasons certainly explain why our initial findings did not indicate a statistically significant relationship between the change in the policy rate, lagged one period, and the domestic credit growth. Consequently, it is important to check whether our initial findings are robust when we replace the nominal policy rate by the bank lending rate as a control variable. The main issue with the use of bank lending rates is the lack of harmonised data for a large sample of advanced and emerging economies. Then, as it is usual in the bank interest rate pass-through literature (see, e.g., Giginishvili, 2011), we use data on bank lending rates from different sources. For the euro area countries, we use the average of the composite cost-of-borrowing indicators computed by the European Central Bank (ECB). Four basic categories of lending rates are considered by the ECB: short-term and long-term lending rates both to non-financial corporations and to households for house purchase. For the non-euro area countries, we use the IFS database and, depending on data availability, we complete the database using data provided by national central banks.

To save space, we do not report the results, but detailed results are available upon request. We find that our main results are not impacted by the use of this alternative control variable. We still find a negative and significant relationship between the interaction terms and our measures of domestic credit growth, confirming that a restrictive monetary policy enhances the impact of macroprudential tightening actions on domestic credit growth. Concerning the bank lending rate, similarly to the nominal policy rate, we find that the estimated coefficients associated with the change in the bank

lending rate are not statistically significant at the conventional levels.

Second, we add in the set of control variables two alternative measures of capital controls. Indeed, capital controls are a potential important driver of domestic credit growth. As documented by Ehlers and McGuire [2017], international financial inflows can induce more rapid credit growth through two main channels. The first refers to the direct cross-border lending, whereby foreign banks provide credit directly to firms and households, in particular through their branches and subsidiaries. The second refers to the cross-border interbank credit, whereby domestic banks inside the country finance their domestic credit activity by funding it with cross-border liabilities. In both cases, the funding that supports the credit to the non-financial sector is sourced outside the borrower country.

Capital inflows can also drive credit demand by the private sector. As shown by Bremus and Neugebauer [2018] for a large sample of European small and medium-sized enterprises, credit inflows tend to reduce the financing costs of firms, which should induce a higher credit demand. Furthermore, Lane and McQuade [2014] argue that a higher level of financial inflows can also increase domestic credit growth by pushing up domestic asset prices and raising the level of domestic demand in goods markets, thereby encouraging greater investment and financial acquisitions.

The two alternative measures of financial openness that we consider are the KAOPEN index developed by Chinn and Ito [2006] and the KAI index of capital controls on inflows developed by Fernández et al. [2016]. These two measures have been widely used in the empirical literature on capital flows. The KAOPEN and the KAI indexes are *de jure* measures of financial openness that aim to traduce the degree of restrictions on cross-border financial transactions. They are based on information regarding restrictions in the International Monetary Fund's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)*. These two indexes are normalised between 0 and 1. The higher the value of these indexes is, the more open is the country to cross-border capital transactions.

We include alternatively the first lag of these two indexes as an additional control variable. To save space, we do not report the tables of results. Detailed results are available upon request. We find that the estimated coefficients associated with the KAOPEN and the KAI indexes are not statistically significant at the conventional levels. Nonetheless, this result could be explained by the low degree of cross-country heterogeneity in terms of financial openness and capital controls. Indeed, amongst the economies that we consider in our sample, most of them are OECD member countries. The degree of financial openness in this category of countries is relatively high.¹⁰ More importantly, results that we obtain when we consider these two additional control variables are very similar to our initial findings. In most specifications, we find that the interaction term between the macroprudential policy indexes and our two measures of monetary policy stance is negative and statistically significant at the conventional levels. This then confirms that monetary policy stance matters for the effectiveness of macroprudential policy.

Finally, we test whether our initial findings are robust to the inclusion of the VIX index as an additional control variable. Created by the Chicago Board Options Exchange (CBOE), the VIX is a real-time market index that represents the market's expectation of 30-day forward-looking volatility. Derived from the price inputs of the S&P 500 index options, the VIX index can be viewed as a contrarian sentiment indicator that helps to determine when there is too much optimism or fear in

¹⁰For instance, if we consider the KAOPEN index, 60% of the observations in our sample are equal to 1, which corresponds to a fully liberalized capital account regime.

the market, and is usually used in the empirical literature as a proxy for global risk aversion. We take the VIX index from the Federal Reserve Economic Data of the Federal Reserve Bank of St. Louis.

As shown by Akinci [2013], real and financial conditions in small open economies are highly correlated with global risk conditions that are exogenous to these countries. Consequently, including the VIX index as a right-hand side variable aims to control for global cycles in financial conditions, and then allows to disentangle the effect of macroprudential policies on domestic credit growth (Akinci and Olmstead-Rumsey, 2018). More precisely, following Akinci and Olmstead-Rumsey [2018], we include the logarithm of the VIX index as an additional control variable. One would expect a negative relationship between the VIX index and credit growth. Results that we obtain, available upon request, suggest that the VIX index negatively and significantly impacts the growth rate of total credit to the private non-financial sector, while the estimated coefficients associated with the VIX index appear not statistically significant at the conventional levels when we consider the growth rate of total credit to households as the dependent variable. This result then suggests that credit to households is mainly driven by domestic economic and financial conditions. More importantly, our initial findings are not impacted by the inclusion of the VIX index as an additional control variable. We still find that monetary policy stance matters for the effectiveness of macroprudential policy.

Alternative Taylor rule specifications. We take into account the potential sensitivity of the interest rate gap to the Taylor rule specification by considering six alternative Taylor rules (see Table 6) and compute the median of the resulting Taylor gaps.

Table 6: Alternative measures of the monetary policy stance

Benchmark	Definition of the benchmark
Taylor (1)	$i_t^* = 0.9i_{t-1}^* + 0.1\{rr_t^* + \bar{\pi} + 1.5(\pi_t - \bar{\pi}) + 0.5\tilde{y}_t\}$
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)	$i_t^* = 0.9i_{t-1}^* + 0.1\{rr_t^* + \bar{\pi} + 1.5(\pi_{t+12} - \bar{\pi}) + 0.5\tilde{y}_t\}$
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 $y_t^* = HP(y_t)$

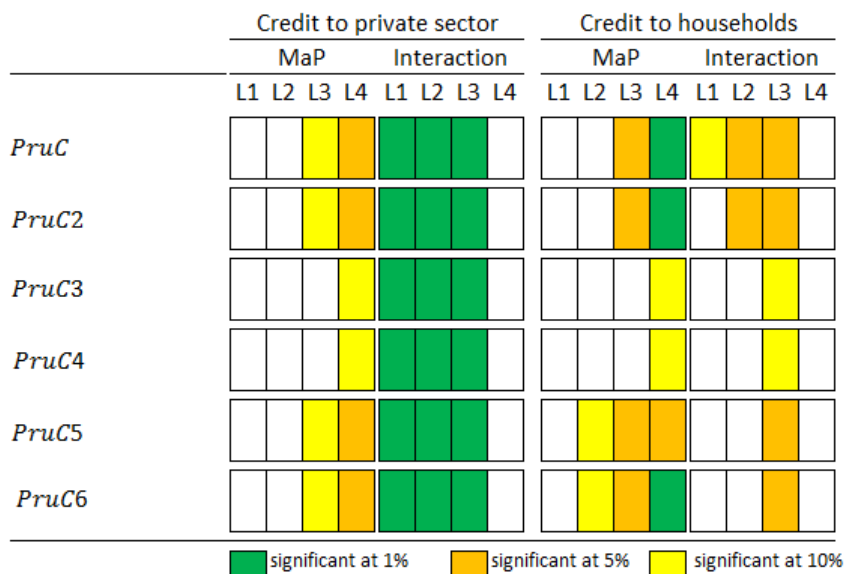
Source: Colletaz et al. [2018].

Note: $\tilde{y}_t = (y_t - y_t^*)$, with $y_t^* = HP(y_t)$. $HP(x)$ means Hodrick-Prescott Filter applied to 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^* . $\bar{\pi}$ corresponds to mean inflation over the sample period.

Figure 7 and Figure 8 summarise the results that we obtain by considering this alternative measure of the Taylor gap when we estimate Equation (9) and Equation (11).¹¹ Like with the results discussed in the previous section, we find that the tightening of macroprudential policy tools leads to a reduction in domestic credit growth, even if macroprudential policy actions seem to take time to curb credit growth effectively. As before, the estimated coefficients associated with macroprudential indexes are only significant at the third and fourth order lags for most specifications. 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.

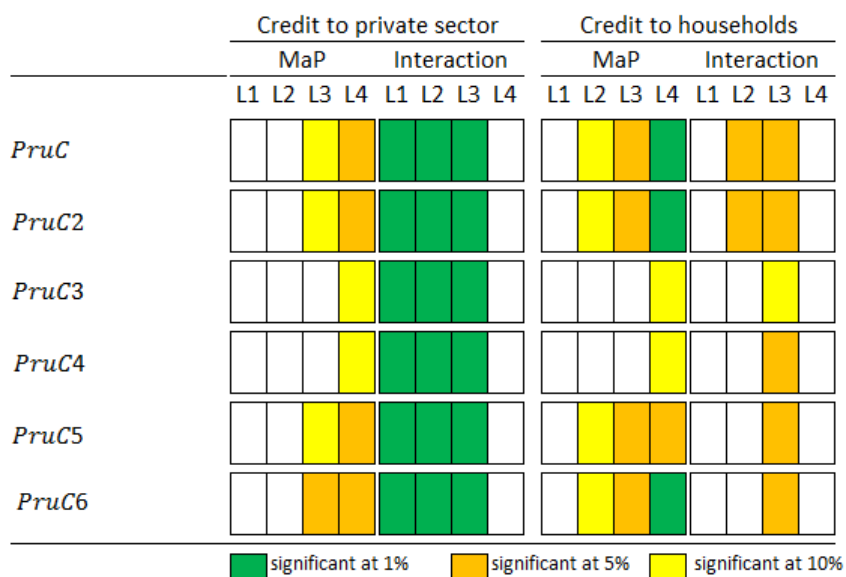
¹¹Detailed results are available upon request.

Figure 7: Robustness checks: results obtained with the median of the alternative Taylor gaps



Note: The results reported 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 8: Robustness checks: results obtained with the first difference of the median of the alternative Taylor gaps



Note: The results reported 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.

Alternative shadow rate measures. Different empirical approaches have been developed to estimate the shadow rate and gauge the overall monetary policy stance in a zero lower bound environment.¹² Most papers in this literature use a shadow rate term structure model à la Black [1995] to assess the effective stance of monetary policy in the context of unconventional measures (see, e.g., Christensen and Rudebusch, 2014; Krippner, 2015; Bauer and Rudebusch, 2016; Kortela, 2016; Wu and Xia, 2016; Lemke and Vladu, 2017). However, while all these papers build on the same theoretical approach, they often provide very different results in practice (Lombardi and Zhu, 2018). As shown by Christensen and Rudebusch [2014] and Krippner [2019], this is explained by the fact that shadow short rate estimates are very sensitive to model specification, like the number of factors used for modeling the term structure, the type of approximations chosen, or the way to count for the lower bound.

Given those sensitivities, we consider different shadow rate measures to capture the stance of monetary policy in countries where non-standard monetary policy measures have been implemented. As there is no consensus in the literature on the best shadow rate to be used, we employ an agnostic approach and consider all shadow rates for which we obtained data from the author(s). In total, we have eight different shadow rate measures. However, as the shadow rates are usually estimated for one specific central bank, the number of shadow rate series considered is different for each central bank. Table A3 in the Appendix details the shadow short rate measures that we consider, while Figure A1 in the Appendix plots the different shadow rate series.

We then compute the median of the different shadow rate series considered, and use this median to calculate the Taylor gap.¹³ More precisely, we consider two different Taylor gap series, depending on whether we consider the estimated Taylor rate to compute the Taylor gap ($i_t - \hat{i}_t$), or the median of the six alternative Taylor rates described above.

Figures 9 to 12 summarise the results that we obtain by considering alternative shadow rate series to compute the Taylor gap.¹⁴ Figures 9 and 10 correspond to the results obtained when we consider the estimated Taylor rate to compute the Taylor gap, while Figures 11 and 12 refer to the results obtained when we consider the median of the six alternative Taylor rules to compute the Taylor gap. As we can see, results are very similar to our initial findings with the Krippner [2015] shadow rate series. In most specifications, we find that the interaction term is negative and statistically significant at the conventional levels. Overall, the different robustness checks conducted in this section confirm that monetary policy stance matters for the effectiveness of macroprudential policy, and reinforce the idea that macroprudential and monetary policies complement each other.

¹²See Comunale and Striaukas [2017] for an extensive discussion of the different shadow short rate measures developed in the literature.

¹³Please note that, for the Japan, only the shadow rate estimates provided by Krippner [2015] are available.

¹⁴Detailed results are available upon request.

Figure 9: Robustness checks: Taylor gap computed as the difference between the alternative shadow rate series and the estimated Taylor rate

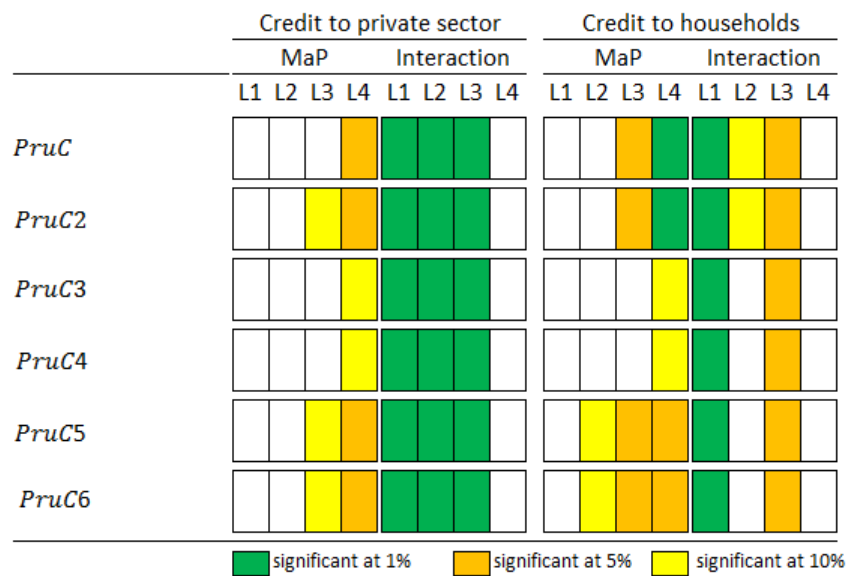


Figure 10: Robustness checks: first difference of the Taylor gap computed as the difference between the alternative shadow rate series and the estimated Taylor rate

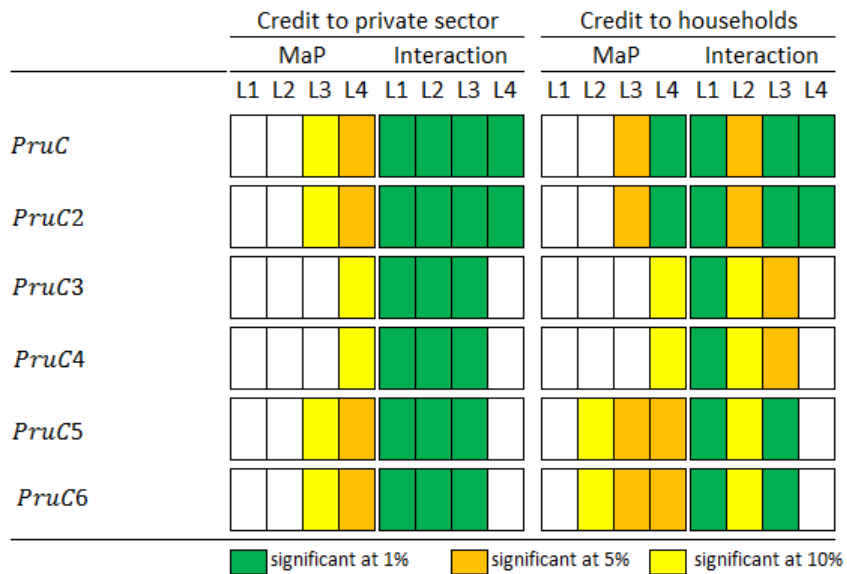


Figure 11: Robustness checks: Taylor gap computed as the difference between the alternative shadow rate series and the median of Taylor rates

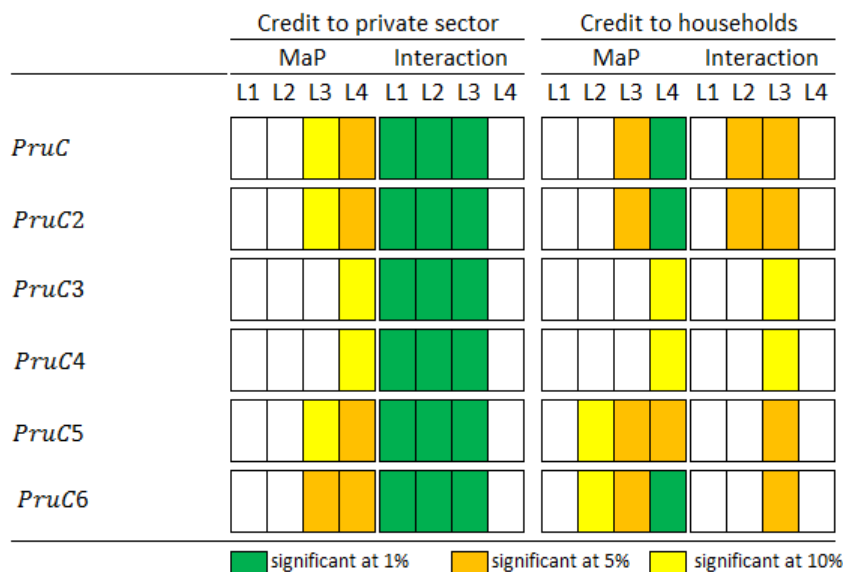
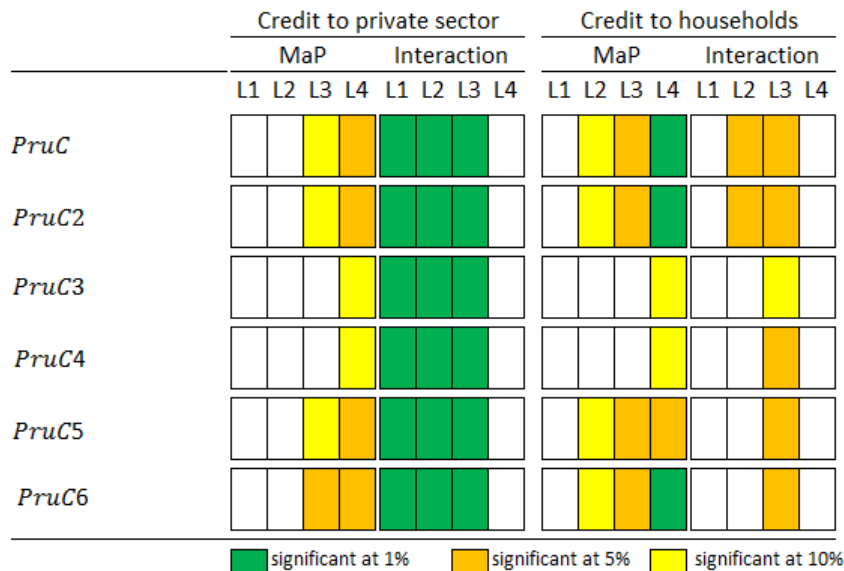


Figure 12: Robustness checks: first difference of the Taylor gap computed as the difference between the alternative shadow rate series and the median of Taylor rates



Endogeneity issue. Macroprudential tools can depend on domestic credit conditions. Indeed, as Akinci and Olmstead-Rumsey [2018] argue, one would expect that economies that experienced rapid credit growth are more likely to tighten their macroprudential policy. The GDP growth and the monetary policy stance are also subject to a similar endogeneity bias. To address this issue, following Cerutti et al. [2017a] and Akinci and Olmstead-Rumsey [2018], we consider a dynamic panel specification that we estimate using the system GMM estimator (Arellano and Bover, 1995; Blundell and Bond, 1998). This estimator addresses the two sources of endogeneity bias that we face in our case, namely the

correlation between the lagged dependent variables and country-fixed effects, and the endogeneity of the other right hand side variables.

More precisely, the equation that we estimate is the following:

$$\begin{aligned} \Delta Credit_{i,t} = & \alpha + \sum_{k=1}^3 \rho_k \Delta Credit_{i,t-k} + \sum_{k=1}^4 \beta_k MaP_{i,t-k} \\ & + \sum_{k=1}^4 \gamma_k (MaP_{i,t-k} \times TG_{i,t-k} \times D_{i,t-k}) + \eta X_{i,t-1} + \theta Crisis_t + \mu_i + \epsilon_{i,t} \end{aligned} \quad (12)$$

Except the crisis dummy, all the covariates are considered as endogenous. Similarly to the baseline estimates, we alternatively consider the Taylor gap and its first difference to measure the stance of monetary policy. Results that we obtain are reported in Tables A4 and A5 in the Appendix. More precisely, in Table A4, we report the results when we consider *PruC*, *PruC2* and *PruC3* as alternative measures of the macroprudential policy stance, while Table A5 displays the results obtained with *PruC4*, *PruC5* and *PruC6*. As we can see, correcting for the potential endogeneity bias does not impact our initial findings. Indeed, results tend to confirm that monetary policy stance matters for the effectiveness of macroprudential policy.

More importantly, the reliability of the system GMM estimator largely depends on the validity of the instruments and on the absence of serial correlation in the residuals. We check the validity of the instruments by using the Hansen [1982] *J*-test. The row for the Hansen *J*-test reports the p-values for the null hypothesis of the validity of the overidentifying restrictions, i.e. instruments are exogenous. In all specifications, we do not reject the null hypothesis, indicating that our instruments are valid. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first difference equation. As we can see, there is high first order autocorrelation, and no evidence for significant second order autocorrelation. The results of these tests suggest that our model is correctly specified.

6 Conclusion

Since the 2007-2008 global financial crisis, the conduct of macroprudential policy has raised several important issues. One of them is the interaction of macroprudential and monetary policies, and this issue is currently at the heart of the academic and policy debate. It is well-known that monetary policy can have detrimental side effects on financial stability, while financial stability is the primary objective of macroprudential policy. This means that monetary policy can make macroprudential policy less effective at achieving its objective, and this suggests the need for synchronisation.

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

More specifically, 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, our

results suggest that monetary policy helps to reduce the transmission delay of macroprudential policy actions. Our findings then confirm the complementarities between the two policies and the potential benefits of coordination highlighted by the theoretical literature.

To translate this result into a policy recommendation, a crucial open question concerns what the appropriate institutional framework and governance structure for conducting macroprudential policy should be. There is no clear-cut consensus among economists about this issue and in practice countries have implemented different macroprudential policy frameworks. While some countries have assigned macroprudential mandates to an independent council, some other countries have delegated macroprudential regulation 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 argument that it will facilitate policy coordination between the two policies. It can also ensure that macroprudential policy draws on the expertise of the monetary authority in financial and macroeconomic analysis, and is expected to facilitate analysis of the side effects of each policy. Finally, as most of the central banks around the world are independent of the government, it would be expected that such an institutional arrangement would help to protect the macroprudential policy function from political pressure. This suggests it would be interesting to investigate empirically whether the institutional framework and the governance structure of macroprudential policy are the 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. (2013). Global financial conditions, country spreads and macroeconomic fluctuations in emerging countries. *Journal of International Economics*, 91(2):358 – 371.
- 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.
- Arellano, M. and Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, 68(1):29–51.
- 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.
- Bauer, M. D. and Rudebusch, G. D. (2016). Monetary policy expectations at the zero lower bound. *Journal of Money, Credit and Banking*, 48(7):1439–1465.

- 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.
- Black, F. (1995). Interest rates as options. *The Journal of Finance*, 50(5):1371–1376.
- Blundell, R. and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1):115 – 143.
- 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.
- Bremus, F. and Neugebauer, K. (2018). Reduced cross-border lending and financing costs of SMEs. *Journal of International Money and Finance*, 80:35 – 58.
- 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.
- Chinn, M. D. and Ito, H. (2006). What matters for financial development? capital controls, institutions, and interactions. *Journal of Development Economics*, 81(1):163 – 192.
- Christensen, J. H. E. and Rudebusch, G. D. (2014). Estimating Shadow-Rate Term Structure Models with Near-Zero Yields. *Journal of Financial Econometrics*, 13(2):226–259.
- 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.
- Comunale, M. and Striaukas, J. (2017). Unconventional monetary policy: interest rates and low inflation. a review of literature and methods. *CORE Discussion Papers 2017/26, Université catholique de Louvain*.

- 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)*.
- Ehlers, T. and McGuire, P. (2017). Foreign banks and credit conditions in EMEs. *BIS Papers No 91, Bank for International Settlements*.
- Fernández, A., Klein, M. W., Rebucci, A., Schindler, M., and Uribe, M. (2016). Capital control measures: A new dataset. *IMF Economic Review*, 64(3):548–574.
- 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.
- Gigineishvili, N. (2011). Determinants of interest rate pass-through - do macroeconomic conditions and financial market structure matter? *IMF Working Papers 11/176, International Monetary Fund*.
- Hansen, L. P. (1982). Large sample properties of Generalized Method of Moments estimators. *Econometrica*, 50(4):1029–1054.
- Horvath, R. (2018). Financial market fragmentation and monetary transmission in the euro area: what do we know? *Journal of Economic Policy Reform*, 21(4):319–334.
- Ichiue, H. and Ueno, Y. (2018). A survey-based shadow rate and unconventional monetary policy effects. *IMES Discussion Paper Series 18-E-05, Bank of Japan*.
- Illes, A., Lombardi, M. J., and Mizen, P. (2019). The divergence of bank lending rates from policy rates after the financial crisis: The role of bank funding costs. *Journal of International Money and Finance*, 93:117 – 141.
- 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.
- Kortela, T. (2016). A shadow rate model with time-varying lower bound of interest rates. *Research Discussion Papers 19/2016, Bank of Finland*.
- 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.
- Krippner, L. (2019). A note of caution on shadow rate estimates. *Journal of Money, Credit and Banking*, forthcoming.

- 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.
- Lane, P. R. and McQuade, P. (2014). Domestic credit growth and international capital flows. *The Scandinavian Journal of Economics*, 116(1):218–252.
- Lemke, W. and Vladu, A. L. (2017). Below the zero lower bound: a shadow-rate term structure model for the euro area. *Working Paper Series 1991, European Central Bank*.
- Leroy, A. and Lucotte, Y. (2016). Structural and cyclical determinants of bank interest-rate pass-through in the eurozone. *Comparative Economic Studies*, 58(2):196–225.
- 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*.
- Pattipeilohy, C., Bräuning, C., van den End, J. W., and Maas, R. (2017). Assessing the effective stance of monetary policy: A factor-based approach. *DNB Working Papers 575, Netherlands Central Bank*.
- 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.
- 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: Macroprudential policy conduct: cross-country comparison

Countries	No. of MaP events	No. of net tightening events	No. of net loosening events	Correlation	
				PruC3 - TG	PruC3 - Δ TG
OECD countries					
Australia	8	5	3	-0.01	0.14
Austria	4	2	2	-0.01	0.02
Belgium	4	2	2	-0.16	-0.01
Canada	8	6	2	-0.09	-0.10
Chile	3	1	2	-0.17	-0.05
Czech Republic	4	2	2	0.02	-0.07
Denmark	6	4	2	-0.03	-0.03
Finland	5	3	2	-0.11	-0.07
France	8	6	2	0.02	0.07
Germany	8	6	2	-0.07	-0.01
Greece	4	2	2	-0.16	-0.03
Hungary	9	3	6	-0.06	-0.01
Ireland	7	5	2	-0.01	-0.05
Israel	10	10	0	-0.02	0.05
Italy	6	4	2	-0.08	0.04
Japan	2	2	0	-0.16	-0.05
Korea, Rep.	16	12	4	0.20	0.08
Luxembourg	6	3	3	0.02	0.38*
Mexico	4	4	0	-0.41*	-0.38*
Netherlands	10	8	2	-0.31*	-0.05
New Zealand	2	2	0	-0.06	-0.02
Poland	12	9	3	0.01	0.03
Portugal	5	3	2	-0.04	-0.15
Spain	7	3	4	-0.09	0.02
Sweden	8	8	0	0.02	-0.09
Switzerland	8	8	0	0.06	0.01
Turkey	38	29	9	-0.02	-0.01
United Kingdom	3	3	0	-0.14	0.06
United States	2	2	0	-0.30*	0.14
Mean - OECD [†]	7.48	5.41	2.07	-0.04	-0.01
Median - OECD	6.00	4.00	2.00	-	-
St. Dev - OECD	6.68	5.34	1.96	-	-
Non-OECD countries					
Argentina	52	26	26	0.71*	0.62*
Brazil	36	22	14	0.38*	0.29*
Colombia	9	6	3	0.09	-0.02
India	42	26	16	0.40*	0.39*
Indonesia	11	9	2	0.14	0.16
Russian Federation	39	22	17	-0.23	-0.21
South Africa	2	2	0	-0.18	-0.01
Thailand	11	8	3	0.28*	0.29*
Mean - Non-OECD [†]	25.25	15.13	10.13	0.45*	0.41*
Median - Non-OECD	23.50	15.50	8.50	-	-
St. Dev - Non-OECD	18.94	9.82	9.40	-	-

Source: Cerutti et al. [2017b] and authors' calculation.

Note: The number of events is based on our sample of 37 countries from 2000Q1 to 2014Q4. The number of MaP events corresponds to the number of quarters during which the overall macroprudential policy framework has been tightened or loosened. TG corresponds the Taylor gap and Δ TG corresponds to the first difference of the Taylor gap. * indicates statistical significance at the 5% level.

†: The pairwise correlations reported for the OECD and non-OECD countries are computed by considering all the observations in each sub-sample, and do not refer to the average of individual correlations.

Table A2: Results of the Taylor rule estimates.

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.

Table A3: Summary of shadow rate estimates

Paper	Methodology	Central bank	Period
Bauer and Rudebusch [2016]	Multifactor shadow rate term structure model, considering both "yields-only" and macro-finance shadow-rate models	ECB	2004Q4-2014Q4
Ichue and Ueno [2018]	Vector autoregressive (VAR) model based on survey forecasts of macroeconomic variables.	FED	2000Q1-2014Q4
Kortela [2016]	Multifactor shadow rate term structure model with a time-varying lower bound.	ECB	2000Q1-2014Q4
Krippner [2015]	Two-factor term structure model estimated using yield curve data.	ECB, FED, BoE, BoJ	2000Q1-2014Q4
Lemke and Vladu [2017]	Multifactor shadow rate term structure model including the possibility of an occasionally changing and possibly negative effective lower bound.	ECB	2000Q1-2014Q4
Lombardi and Zhu [2018]	Dynamic factor model based on a large set of variables reflecting unconventional monetary policy actions: interest rates, monetary aggregates, Federal Reserve balance sheet.	FED	2000Q1-2014Q4
Pattipeilohy et al. [2017]	Factor model based on yield curve data.	ECB	2004Q4-2014Q4
Wu and Xia [2016]	Multifactor shadow rate term structure model based on a simple analytical representation for bond prices.	ECB, FED, BoE	FED, BoE: 2000Q1-2014Q4 ECB: 2004Q4-2014Q4

Note: ECB: European Central Bank; FED: Federal Reserve; BoE: Bank of England; BoJ: Bank of Japan. The Bauer and Rudebusch [2016] shadow rate series are obtained from Komunale and Striaukas [2017].

Figure A1: Comparison of shadow rate series



Note: For Japan, for the periods when no target interest rate was adopted, the policy rate corresponds to the interest rate applied on excess reserves.

Table A5: Robustness checks: results obtained with a system GMM estimator

	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.Δ Credit	0.952*** (0.040)	0.934*** (0.033)	0.984*** (0.048)	0.985*** (0.033)	0.871*** (0.053)	0.960*** (0.052)
L2.Δ Credit	-0.112 (0.075)	-0.188* (0.111)	-0.188* (0.111)	-0.104*** (0.036)	-0.179 (0.138)	-0.186 (0.118)
L3.Δ Credit	-0.042 (0.060)	-0.136* (0.077)	0.041 (0.102)	-0.016 (0.099)	0.065 (0.149)	0.065 (0.109)
L.MaP	34.065 (22.833)	6.229* (3.105)	-20.579** (9.183)	0.565 (3.137)	0.802 (3.572)	3.236 (4.305)
L2.MaP	-13.239 (14.199)	2.691 (4.067)	-4.166 (10.942)	-4.359 (4.738)	-4.993 (5.152)	-4.453 (4.672)
L3.MaP	-3.910 (5.006)	-4.932 (4.350)	-2.026 (10.217)	0.557 (2.939)	1.781 (1.989)	3.265 (2.316)
L4.MaP	-9.093** (3.967)	-9.915** (4.356)	-25.845 (18.867)	-10.348*** (2.193)	-10.503 (6.589)	-10.124* (5.869)
L.(MaP x TG x D)	-0.723** (0.295)	-0.577 (0.608)	-0.577 (0.608)	-0.437** (0.186)	-0.484** (0.217)	-0.326 (0.196)
L2.(MaP x TG x D)	0.003 (0.286)	-0.940* (0.475)	-0.940* (0.475)	-0.294*** (0.079)	-0.325*** (0.094)	-0.204** (0.097)
L3.(MaP x TG x D)	-0.007 (0.137)	-0.514 (0.320)	-0.514 (0.320)	-0.292*** (0.101)	-0.356** (0.151)	-0.249* (0.134)
L4.(MaP x TG x D)	0.868*** (0.068)	0.330 (0.244)	0.330 (0.244)	0.254*** (0.032)	0.164 (0.105)	0.137 (0.084)
L.(MaP x Δ TG x I)	-0.318*** (0.075)	-0.191 (0.129)	-0.191 (0.129)	-0.082*** (0.018)	-0.083*** (0.018)	-0.055** (0.025)
L2.(MaP x Δ TG x I)	-0.363*** (0.092)	-0.274* (0.143)	-0.274* (0.143)	-0.090*** (0.020)	-0.090*** (0.020)	-0.068* (0.036)
L3.(MaP x Δ TG x I)	-0.173 (0.138)	-0.083 (0.193)	-0.083 (0.193)	-0.049 (0.034)	-0.048 (0.034)	-0.024 (0.048)
L4.(MaP x Δ TG x I)	0.751*** (0.073)	0.680*** (0.099)	0.680*** (0.099)	0.164*** (0.017)	0.165*** (0.017)	0.146*** (0.016)
L.Δ GDP	0.086 (0.114)	0.221* (0.124)	0.063 (0.159)	0.234* (0.124)	0.152 (0.179)	-0.045 (0.172)
L.Δ Policy rate	1.067 (0.919)	0.708 (0.565)	1.708 (1.135)	5.704*** (1.161)	5.313*** (1.276)	2.227 (1.428)
Dummy crisis	-1.287*** (0.433)	-1.162*** (0.391)	-1.240*** (0.539)	-1.449*** (0.620)	-1.662** (0.739)	-1.640*** (0.600)
Constant	1.647*** (0.473)	1.667*** (0.449)	2.304** (0.861)	3.583*** (0.617)	3.569*** (0.971)	2.800*** (0.901)
Observations	2,012	2,008	1,935	2,012	2,012	1,935
Number of countries	37	37	37	37	37	37
AR(1) test - p-value	0.000	0.000	0.000	0.000	0.005	0.002
AR(2) test - p-value	0.302	0.101	0.494	0.584	0.805	0.660
Hansen test - p-value	0.288	0.281	0.104	0.228	0.126	0.237
Number of instruments	19	13	24	28	11	16

Note: Robust standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels respectively. MaP is 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.