MRC Working Papers

No 18/2019

MACROPRUDENTIAL AND MONETARY POLICIES: THE NEED TO DANCE THE TANGO IN HARMONY

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ISSN 2534-9465

March 2019

JEL classification: E43, E44, E52, E58, G18, G28

Keywords: Monetary policy, Macroprudential policies, Effectiveness, Financial stability, Interaction

Abstract

The Great Recession during the late 2000s and early 2010s has led to a strength- ening of macroprudential policies over the world in order to address systemic risk concerns. However, the effectiveness of those measures remains unclear. The ex- isting literature fails to demonstrate clearly that macroprudential policies address effectively financial vulnerabilities. Moreover, the impact of these policies is often assessed regardless of the monetary policy stance, which is another main determi- nant of financial stability. This empirical paper aims to fill this gap by at least two ways. Based on a sample of 37 countries covering the period from 2000Q1 to 2014Q4, we first propose to re-evaluate the effectiveness of the macropruden- tial policies to limit excessive credit growth by considering different measures accounting for the macroprudential policy stance. Second, we also test whether the impact of prudential policies is strengthened by the monetary policy stance, measured through the Taylor gap. Our results indicate that changes in macropru- dential policies effectively reduce the credit growth, but there is a transmission delay approximately of one year to be effective. Interestingly, this delay fell to one quarter when macroprudential and monetary policies move in the same direction simultaneously which is a new finding.

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1 Introduction

Before the Global Financial Crisis (GFC) of 2007 - 2008, the idea of regulating the financial sector was limited to a micro-level. Hence, the micro-prudential regulation was suited and considered enough, taking into account only the soundness of individual institutions or specific markets. The financial distress was thus the moment of rethinking the way of economies regulated the financial system. Consequently, the prudential regulation acknowledged the inherent risk of the financial system as a whole, making it the main objective of the current macroprudential regulation: contain systemic risk developments, accounting for its cross-sectional and time dimensions. The cross-sectional dimension is related to the interconnectedness of the financial system and analyses the contagion effects and the dependencies to common shocks among the financial institutions. The latter dimension is related to the inherent procyclicality of the financial system, thus, to the development of financial imbalances and systemic risk over time. Overall, macroprudential policies aim to contain financial developments during the financial cycle' expansion and increase the agents' soundness and resilience to financial shocks.

At the same time, the ultimate objective of macroprudential policy count on operational specifications as intermediate objectives in order to achieve their target. According to the European Systemic Risk Board (ESRB), the intermediate objectives should include: to mitigate and prevent excessive credit growth and leverage; to mitigate and prevent excessive maturity mismatch and market illiquidity; to limit direct and indirect exposure concentrations; to limit the systemic impact of misaligned incentives with a view to reducing moral hazard; and to strengthen the resilience of financial infrastructures.

Worldwide, macroprudential instruments have been extensively accepted. As developed as emerging markets have recently adopted several macroprudential instruments, building up and strengthening the defenses against the adverse effects of the financial cycle. This implementation has rapidly become the focus of intensive research efforts to better understand their transmission mechanism and their effectiveness. In particular, a number of empirical contributions have tried to assess the effect of some macroprudential tools on a range of intermediate target variables, such as credit growth, assets prices, credit risk, and credit cycle. However, assessing the performance of macroprudential policies is challenging for several reasons (see, e.g., Galati and Moessner, 2018).

The first challenge is the problem of limited time depth. Indeed, the use of macroprudential measures is relatively recent and still in its infancy. In many countries, especially developed countries, macroprudential tools have to a large extent been introduced only in response to the recent global financial crisis. This makes it difficult to assess their effects on financial variables and transmission channels. To deal with this issue, most of the recent studies conduct a cross-country analysis by considering economies in different stages of policy implementation. A second challenge is that different macroprudential tools may be effectively applied to address specific risks. This could explain why studies usually focus on one macroprudential instrument, such as the loan-to-value ratio or the countercyclical capital requirements, or consider a wide range of possible tools using an aggregate macroprudential index. Such an index can reflect the characteristics of the macroprudential policy framework, the number of tools in place, or the direction of the macroprudential policy actions. Finally, the main challenge faced by the empirical literature on macroprudential policy is that this policy interacts with other policies that have also a bearing on financial conditions and financial stability. For instance, a lack of coordination of macroprudential policy with monetary and fiscal policies could make the former less effective. In these circumstances, it may be difficult to isolate the effects of macroprudential tools. As a matter of fact, a major challenge for macroprudential policy is to interact with other policies in a way which fosters its effective conduct in pursuit of financial stability [Kuttner and Shim, 2016].

An important issue in both the academic and the policy debate concerns the interaction between macroprudential policy and monetary policy. Certainly, the conduct of each policy can have "side effects" on the objectives of the other. For instance, monetary policy can undermine the financial stability through the borrower balance sheets channel, the default channel, the risk-taking and risk-shifting channels, the asset price channel and the exchange rate channel [Nier and Kang, 2016].

First, financial stability can be undermined when monetary policy affects the agents' financial conditions. For instance, a laxer monetary policy stimulates the demand for credit by increasing the asset prices used as collateral, inducing borrowers to take more leverage (borrower balance sheet channel). Meanwhile, a tighter monetary policy increases the debt services, and reduce, at the same time, revenue streams and loan repayment capacities, by finally increasing the probability to default (default channel).

Second, during relatively long periods with a relaxed monetary policy, the reduction of borrowers' probability to default makes financial intermediates to increase their leverage and reduce efforts in screening borrowers. As a consequence, it changes risk-taking preferences by leading measured risk to go down and risk-weighted capital to go up (risk-taking channel). Alongside, an increase in policy rates reduces intermediation margins, lead financial institution, particularly the poorly capitalized ones, to seek more risk in order to maintain the profitability of operating (risk-shifting channel).

Third, during periods of loosening monetary policy, borrowers' asset prices increase stimulating the increase on leverage, which can trigger a positive feedback loop known as the financial accelerator (asset price channel).

Finally, increases in the policy rate can attract capital inflows (when the policy rate differential with foreign economies is positive) leading an appreciation of the local currency. As a consequence, it will increase the agents' leverage denominated in foreign currency (exchange-rate channel).

Consequently, an important empirical question is to assess to which extent monetary policy stance affects the effectiveness of macroprudential policy. The existing evidence on this issue is still scarce. To the best of our knowledge, only two empirical studies explicitly address this issue (Bruno et al., 2017; Zhang and Tressel, 2017). However, results that they obtain are relatively mixed. Against this background, our paper attempts to fill this gap by empirically investigating how effective is the macroprudential policy conditional on the monetary policy stance. To do so, first we compute the monetary policy and macroprudential policy stances. Second, we reinvestigate the effectiveness of macroprudential instruments by regressing different measures of credit growth against our measures of macroprudential policy stance. Finally, we interact the monetary policy with the macroprudential policy in order to test how effective macroprudential tools are conditional to the monetary policy stance. The main results of our paper are threefold. First, we find evidence of a three to four quarters delay of transmission of the macroprudential policy. Second, there is a strengthening of macroprudential policy effectiveness when both macroprudential and monetary policy go in the same direction (tight-tight or loose-loose). And third, when a tightening on macroprudential policy is accompanied and coordinated by a contemporaneously tightening of monetary policy, the delay of transmission is reduced to one quarter.

The remainder of the paper is organised as follows. Section 2 discusses the existing empirical literature on the effectiveness of macroprudential policies. Section 3 describes how we measure the macroprudential and monetary policies stance. Section 4 describes the econometric approach and discusses the results that we obtain. In Section 5, we check the robustness of our findings. Finally, Section 6 concludes and gives some policy recommendations.

2 Literature Review

In this section, we give an overview of the existing literature that analysed the effects of macroprudential policies on various measures of financial vulnerability and stability by discussing whether these studies deal with the challenges discussed above[1] Nabar

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

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

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

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

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

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

Other studies focus specifically on the effects of the stance of macroprudential policy on the real estate market. For instance, considering a sample of 17 advanced and emerging economies over the 1990-2012 period, McDonald [2015] assesses whether a tightening or loosening of the loan-to-value and the debt-to-income ratios has asymmetric effects on housing credit growth and house price inflation. McDonald [2015] obtains two important results. First, he finds that tightening measures tend to be more effective than loosening measures. Indeed, the impact of loosening measures on housing credit growth and house price inflation appears not statistically significant. Second, in line with Cerutti et al. [2017a], McDonald [2015] finds that the relative effectiveness of tightening vs. loosening macroprudential measures depends on where in the housing cycle they are implemented. In particular, results obtained suggest that tightening measures have greater effects during the boom periods.

Kuttner and Shim [2016] extend the analysis of McDonald [2015] by comparing the relative effectiveness of macroprudential and housing-related tax policies in curbing housing credit and house prices, with tightening and loosening actions recorded separately for the two policies. Concerning the quarterly growth rate in housing credit, Kuttner and Shim [2016] find that both policies have a negative impact on this variable. Results are more mixed when they consider housing price growth as endogenous variable. Indeed, while changes in taxes still have a statistically significant impact on house prices, this is not the case for some of the macroprudential tools considered, such as the debt-to-service ratio. As argued by Kuttner and Shim [2016], this result can be easily explained by the fact that, contrary to macroprudential tools, tax policies such as the deductibility of mortgage interest and property taxes affect directly the cost of buying a house, and then the demand and price in the real estate market.

More importantly, results obtained by Kuttner and Shim [2016] confirm that one major challenge for macroprudential policy is to interact with other policies in a way which fosters the effective conduct of this policy in pursuit of its objective of financial stability. A key issue in both the academic literature and the policy debate concerns the interactions between macroprudential policy and monetary policy. Indeed, as discussed in the introduction, the conduct of each policy can have “side effects” on the objectives of the other. In particular, it is widely recognised that monetary policy can have side effects on financial stability, for instance by maitaining policy rates “too low for too long”. Indeed, when monetary policy is very accommodative, this rise incentives to borrow at low interest rates that are difficult for macroprudential policy to fully contain. Consequently, an important empirical question is to assess to which extent monetary policy stance affects the effectiveness of macroprudential policy. The existing evidence on this issue is still scarce. To the best of our knowledge, only two empirical studies explicitly address this issue (Bruno et al., 2017; Zhang and Tressel, 2017). However, results that they obtain are relatively mixed. While Bruno et al. [2017] find for a sample of Asia-Pacific economies that macroprudential policies tend to be more successful when they complement monetary policy, Zhang and Tressel [2017] find on the contrary for the Euro area countries that loan-to-value constraints tend to be more effective in containing credit growth and housing price appreciation when monetary policy is loose. Our paper aims to fill this gap in the literature.

3 Measuring the Stance of Macroprudential and Monetary Policies

3.1 Measuring the stance of macroprudential policy.

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

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

Other studies go a step further by providing data on the quarterly changes in macroprudential tools (Vandenbussche et al., 2015; Kuttner and Shim, 2016; Cerutti et al., 2017b; Akinci and Olmstead-Rumsey, 2018). By using information on easing and tightening of different macroprudential policy instruments, the main objective of these datasets is then to reflect the policy direction. One challenge is that the intensity of macroprudential policy actions differs across countries. While Vandenbussche et al. [2015] quantify the intensity of the changes in prundential policy measures, Kuttner and Shim [2016], Cerutti et al. [2017b] and Akinci and Olmstead-Rumsey [2018] only record the direction of the changes. However, compared with Cerutti et al. [2017b], the databases provided by Vandenbussche et al. [2015], Kuttner and Shim [2016] and Akinci and Olmstead-Rumsey [2018] have several drawbacks. Indeed, Vandenbussche et al. [2015] only considers in their sample Central, Eastern and Southeastern European countries. Concerning Akinci and Olmstead-Rumsey [2018], their dataset covers a larger sample of countries, but it primary focuses on macruprudential tools applied to address housing-sector developments. Kuttner and Shim [2016] and Cerutti et al. [2017b] provide the most comprehensive datasets on macroprudential policy actions. In particular, they consider a broad set of macroprudential tools. However, by providing data until 2014Q4, the dataset compiled by Cerutti et al. [2017b] contains a larger number of post-crisis observations. This is not a minor detail, because as the study of Cerutti et al. [2017b] suggests, a number of macroprudential policy changes occured in the recent period. This explains why we use in this paper the database provided by Cerutti et al. [2017b].

Using the same survey than Cerutti et al. [2017a], Cerutti et al. [2017b] consider five types of prudential instruments across a sample of 64 countries over the period 2000Q1-2014Q4. The five types of instruments are capital buffers, interbank exposure limits, concentration limits, loan-to-value ratio limits and reserve requirements. More precisely, capital buffers are divided into four sub-indexes: general capital requirements, specific capital buffers related to real estate credit, specific capital buffers related to consummer credit, and other specific capital buffers. Reserve requirements are also divided into two sub-indexes: reserve requirements on foreign currency-denominated accounts and reserve requirements on local currency-denominated accounts.

Then, Cerutti et al. [2017b] record the number of easing and tightening measures for each type of macroprudential instruments implemented by each country in each quarter. For a given instrument, a tightening action is coded +1, a loosening action is coded -1, while 0 represents the case where no change occurs during the quarter. If multiple actions are taken within a given quarter, reported values correspond to the sum of all changes recorded. This means that tightening and loosening actions taken within the same quarter cancel each other out. An instrument that is not adopted by a given country is coded as missing until its implementation by policymakers.

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

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

$$PruC_{i,q} = \begin{cases} +1 & \text{if } \sum_a x_{a,i,q} > 0 \\ 0 & \text{if } \sum_a x_{a,i,q} = 0 \\ -1 & \text{if } \sum_a x_{a,i,q} < 0 \end{cases} \tag{1}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$PruC6_{i,q} = \frac{\sum_{t} x_{t,i,q}}{T_{i,q}} + \frac{\sum_{l} x_{l,i,q}}{L_{i,q}} \tag{6}$$

where $x_{t,i,q}$ corresponds to the recorded value of the macroprudential instrument t that is characterised by a net tightening during the quarter, while $x_{l,i,q}$ corresponds to the recorded value of the instrument l that is characterised by a net loosening. $T_{i,q}$ and $L_{i,q}$ refer to the number of net tightening instruments and the number of net easing instruments, respectively. $PruC6$ is then complementary to the previous indexes described above, as it reflects both the macroprudential policy stance and the more or less balanced path of the policy. A higher value of this index indicates a more restrictive macroprudential policy.

3.2 Measuring the stance of monetary policy.

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

In line with Bogdanova and Hofmann [2012] and using historical time series for each country considered in our sample, we estimate the following reaction function:

$$i_q = \rho i_{q-1} + (1-\rho)[\alpha + \beta_\pi(\pi_q) + \beta_y(y_q - \bar{y}_q)] + \varepsilon_q \tag{7}$$

where i_q 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_q is the contemporaneous inflation rate, $y_q - \bar{y}$ is the output gap, and ε_q is the error term.[2] One would expect a positive relationship between the inflation rate, the output gap, and the policy rate, i.e. $\hat{\beta}_\pi > 0$ and $\hat{\beta}_y > 0$.

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

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

Hodrick-Prescott filter.

Following Clarida et al. [2000] and the related literature, to overcome a potential endogeneity issue, we estimate Equation (7) using the Generalised Method of Moments (GMM) estimator. Furthermore, to obtain consistent estimates, the time period for estimating Equation (7) covers the longest available data time span, and then differs across countries in our sample. An important consideration with such an approach is the selection of valid instruments. This selection is based on the overidentification test developed by Hansen [1982]. This implies that the set of instruments considered can be different for each country. Taylor rule estimates are reported in Table A1 in the Appendix.

The Taylor gap then corresponds to the difference between the actual policy rate and the estimated Taylor rate ($i_q - \hat{i_q}$). 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 accomodative monetary policy.

However, considering the policy rate as the main monetary policy instrument can be challenged. Indeed, some industrialised economies adopted unconventional monetary policies in the aftermath of the 2007-08 financial crisis. Therefore, assessing the impact of implemented unconventional measures and understanding the overall monetary policy stance using the Taylor gap can be inappropriate. To address this issue, as it is usual in the literature, we do not consider the gap between the actuel policy rate and the Taylor rate, but the difference between the shadow rate and the Taylor rate.

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

4 Methodology and Results

To gauge empirically whether the monetary policy stance drives the effectiveness of the macroprudential policy, we consider a sample of industrialised and emerging economies. Due to data availability, our sample contains 37 countries over the period 2000Q1-2014Q4. The econometric approach and results are detailed below.

4.1 Econometric approach

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

The baseline model that we estimate is the following:

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

where $\Delta Credit_{i,q}$ is the yearly growth of our different measures of credit, $MaP_{i,q-k}$ 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). Indeed, some of macroprudential actions may be delayed in their effect. $X_{i,q-1}$ represents the vector of control variables. Following the existing literature, we consider two control variables: the annual GDP growth rate and the change in the nominal monetary policy rate. These two variables are lagged one period, and taken from the IFS database and the BIS, respectively. One would expect a negative relationship between the change in policy rate and the growth of credit, while a higher GDP growth would be associated with a higher credit growth. Indeed, the GDP growth rate is included to control for the procyclicality of credit (Athanasoglou et al., 2014), and then allows us to capture the part of credit that is not driven by real economic activity, i.e. excess credit growth. $Crisis_q$ 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 $s_{i,q}$ is the error term. One would expect $\hat{\beta}_k < 0$, meaning that a more restrictive macroprudential policy helps to curb domestic credit growth.

In a second step, we extend our previous baseline model to assess the effectiveness of macroprudential policies conditional on the monetary policy stance. More precisely, the equation that we estimate is the following:

4 4

$$\Delta Credit_{i,q} = \alpha + \sum_{k=1} \beta_k MaP_{i,q-k} + \sum_{k=1} \gamma_k \left(MaP_{i,q-k} \times Ttt_{i,q-k} \right) + \eta X_{i,q-1} + \theta Crisis_q + \mu_i + s_{i,q} \quad (9)$$

where the additional term ($MaP_{i,q-k} \times Ttt_{i,q-k}$) captures the interaction between macroprudential and monetary policies stance. $Ttt_{i,q-k}$ corresponds to the Taylor gap described in the previous section.

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

$$\frac{\delta \, \Delta Credit_{i,q}}{\delta MaP_{i,q-k}} = \beta_k + \gamma_k \, Ttt_{i,q-k} \tag{10}$$

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

4.2 Results

Results that we obtain are reported in Tables 1 and 2. In Table 1, we report the results when we consider $PruC$, $PruC2$ and $PruC3$ as alternative measures of macroprudential policy stance, while Table 2 displays the results obtained with $PruC4$, $PruC5$ and $PruC6$. To have a better view of the importance of monetary policy stance in the conduct of macroprudential policy, we present side by side the results of the baseline and extended models. For each macroprudential index considered, odd columns display the results obtained when we consider only the effects of macroprudential policy stance on credit growth, while even columns report the results obtained when we take into account the monetary policy stance.

We obtain three important results. First, in line with the recent literature on macroprudential policy, our empirical findings suggest that an overall tightening in macroprudential policies is associated with a reduction in credit growth. Indeed, except two specifications (columns [1.9] and [2.1]), we find a negative and statistically significant relationship between our macroprudential indexes and domestic credit growth. Furthermore, as expected, macroprudential policy actions are delayed in their effect. For most specifications, we can see that coefficients associated with macroprudential indexes are only significant at the third and fourth order lags.

Second, if we now focus on the results obtained when we add the interaction term in the baseline model, we can see that monetary policy stance matters for the effectiveness of macroprudential policy. Indeed, results reported in even columns of Tables 1 and 2 show that coefficients associated with the interaction term are negative and statistically significant. This negative sign means that a restrictive monetary policy actually enhances the impact of macroprudential tightening actions on credit growth. In other words, the marginal effect of tightening macroprudential instruments on credit growth is affected by whether the prevailing monetary policy stance is tight or loose. The benefits of coordination between macroprudential and monetary policies are also confirmed in columns [1.10] and [2.2]. Indeed, while $PruC3$ and $PruC4$ did not ap- pear statistically significant in the baseline specification (columns [1.9] and [2.1]), 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. Indeed, we can see that coefficients associated with the interaction term are negative and significant at the first, second and third order lags. Results are more mixed when we consider the growth of credit to households as dependent variable.

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

Table 1: Results obtained with $PruC$, $PruC2$ and $PruC3$

	PruC				PruC2				PruC3			
	Credit to private sector		Credit to households		Credit to private sector		Credit to households		Credit to private sector		Credit to households	
	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)	(1.7)	(1.8)	(1.9)	(1.10)	(1.11)	(1.12)
MaP (q-1)	0.972	0.395	-0.377	-1.068	0.980	0.406	-0.416	-1.097	-0.025	0.276	-0.985	-0.938
	(1.184)	(0.950)	(1.638)	(1.329)	(1.199)	(0.958)	(1.651)	(1.335)	(0.719)	(0.712)	(0.993)	(1.056)
MaP (q-2)	-0.658	-1.168	-2.377	-2.962**	-0.721	-1.223	-2.450	-3.027**	-0.682	-0.558	-1.795	-1.657
	(1.132)	(0.933)	(1.679)	(1.439)	(1.162)	(0.955)	(1.705)	(1.454)	(0.662)	(0.690)	(1.130)	(1.196)
MaP (q-3)	-2.029	-2.452*	-4.030**	-4.436**	-2.082	-2.495*	-4.073**	-4.464**	-1.387	-1.060	-2.430*	-2.042
	(1.388)	(1.310)	(1.914)	(1.743)	(1.382)	(1.313)	(1.911)	(1.749)	(0.825)	(0.990)	(1.247)	(1.438)
MaP (q-4)	-3.073*	-3.417**	-5.769**	-6.090***	-3.053*	-3.387**	-5.727**	-6.037***	-1.526	-2.027*	-3.441*	-3.383*
	(1.775)	(1.531)	(2.472)	(2.209)	(1.768)	(1.525)	(2.481)	(2.218)	(1.269)	(1.148)	(1.941)	(1.696)
MaP × Taylor gap (q-1)		-0.897***		-0.648		-0.902***		-0.651		-0.097***		-0.056
		(0.187)		(0.463)		(0.188)		(0.465)		(0.024)		(0.062)
MaP × Taylor gap (q-2)		-0.617***		-0.622*		-0.622***		-0.625*		-0.075***		-0.059
		(0.182)		(0.333)		(0.183)		(0.335)		(0.014)		(0.036)
MaP × Taylor gap (q-3)		-0.754***		-0.844***		-0.754***		-0.844***		-0.077***		-0.070**
		(0.195)		(0.268)		(0.196)		(0.268)		(0.014)		(0.031)
MaP × Taylor gap (q-4)		0.235		-0.228		0.238		-0.226		0.025		-0.022
		(0.193)		(0.301)		(0.193)		(0.300)		(0.016)		(0.041)
Δ GDP (q-1)	2.460***	2.194***	2.725***	2.443***	2.458***	2.192***	2.719***	2.438***	2.466***	2.204***	2.706***	2.494***
	(0.256)	(0.243)	(0.296)	(0.364)	(0.256)	(0.244)	(0.294)	(0.365)	(0.267)	(0.237)	(0.297)	(0.348)
Δ Policy rate (q-1)	-0.793	1.344	-2.406	-0.882	-0.790	1.356	-2.403	-0.874	-0.733	1.473	-2.362	-1.223
	(0.722)	(1.191)	(2.173)	(3.454)	(0.725)	(1.196)	(2.177)	(3.460)	(0.834)	(1.460)	(2.471)	(4.064)
Crisis dummy	-4.246***	-4.733***	-5.568***	-6.174***	-4.237***	-4.724***	-5.548***	-6.154***	-4.294***	-4.765***	-5.738***	-6.208***
	(1.442)	(1.214)	(1.802)	(1.569)	(1.442)	(1.216)	(1.801)	(1.572)	(1.507)	(1.286)	(1.836)	(1.582)
Constant	5.974***	7.153***	8.480***	9.702***	5.981***	7.163***	8.493***	9.717***	5.969***	6.995***	8.479***	9.266***
	(1.173)	(0.912)	(1.210)	(1.177)	(1.172)	(0.913)	(1.208)	(1.181)	(1.138)	(0.946)	(1.179)	(1.145)
Observations	2,015	2,015	1,950	1,950	2,015	2,015	1,950	1,950	2,015	2,015	1,950	1,950
R-squared	0.251	0.270	0.251	0.268	0.251	0.270	0.251	0.268	0.249	0.265	0.248	0.257
Number of countries	37	37	37	37	37	37	37	37	37	37	37	37

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

Table 2: Results obtained with $PruC4$, $PruC5$ and $PruC6$

	PruC4				PruC5				PruC6			
	Credit to private sector		Credit to households		Credit to private sector		Credit to households		Credit to private sector		Credit to households	
	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)	(2.7)	(2.8)	(2.9)	(2.10)	(2.11)	(2.12)
MaP (q-1)	0.017	2.019	-7.708	-7.497	-0.014	0.293	-1.318	-1.247	-0.015	0.306	-1.323	-1.245
	(5.470)	(5.433)	(7.828)	(8.208)	(1.008)	(0.980)	(1.347)	(1.344)	(1.009)	(0.976)	(1.347)	(1.341)
MaP (q-2)	-4.499	-3.476	-13.076	-11.940	-1.409*	-1.333	-3.003**	-2.900**	-1.416*	-1.333	-3.029**	-2.925**
	(4.889)	(5.049)	(8.719)	(9.122)	(0.830)	(0.858)	(1.379)	(1.419)	(0.829)	(0.853)	(1.388)	(1.423)
MaP (q-3)	-10.072	-7.745	-18.254*	-15.505	-2.526**	-2.276*	-4.237***	-3.915**	-2.552**	-2.307*	-4.287***	-3.971**
	(6.189)	(7.265)	(9.717)	(10.927)	(1.032)	(1.169)	(1.521)	(1.655)	(1.031)	(1.158)	(1.523)	(1.644)
MaP (q-4)	-11.690	-15.074*	-26.257*	-25.696*	-2.733*	-3.241**	-5.518**	-5.422**	-2.791*	-3.308**	-5.587**	-5.498***
	(9.217)	(8.440)	(14.269)	(12.741)	(1.611)	(1.475)	(2.300)	(2.032)	(1.594)	(1.467)	(2.278)	(2.016)
MaP × Taylor gap (q-1)		-0.767***		-0.438		-0.196***		-0.120		-0.196***		-0.121
		(0.190)		(0.502)		(0.048)		(0.126)		(0.048)		(0.125)
MaP × Taylor gap (q-2)		-0.602***		-0.475		-0.148***		-0.117		-0.148***		-0.118
		(0.115)		(0.292)		(0.030)		(0.075)		(0.030)		(0.074)
MaP × Taylor gap (q-3)		-0.616***		-0.557**		-0.152***		-0.136**		-0.152***		-0.136**
		(0.111)		(0.252)		(0.026)		(0.060)		(0.026)		(0.059)
MaP × Taylor gap (q-4)		0.194		-0.186		0.048		-0.050		0.048		-0.050
		(0.127)		(0.339)		(0.031)		(0.089)		(0.031)		(0.090)
Δ GDP (q-1)	2.466***	2.205***	2.710***	2.500***	2.485***	2.224***	2.732***	2.518***	2.488***	2.227***	2.740***	2.524***
	(0.267)	(0.237)	(0.298)	(0.349)	(0.269)	(0.238)	(0.300)	(0.347)	(0.271)	(0.238)	(0.303)	(0.346)
Δ Policy rate (q-1)	-0.766	1.441	-2.384	-1.265	-0.657	1.659	-2.295	-1.094	-0.661	1.658	-2.304	-1.098
	(0.827)	(1.473)	(2.473)	(4.111)	(0.794)	(1.507)	(2.418)	(4.188)	(0.789)	(1.503)	(2.418)	(4.182)
Crisis dummy	-4.303***	-4.772***	-5.742***	-6.210***	-4.194***	-4.648***	-5.623***	-6.091***	-4.198***	-4.652***	-5.634***	-6.102***
	(1.508)	(1.287)	(1.835)	(1.581)	(1.514)	(1.299)	(1.870)	(1.628)	(1.517)	(1.300)	(1.873)	(1.630)
Constant	5.959***	6.980***	8.465***	9.248***	6.025***	7.059***	8.604***	9.410***	6.021***	7.057***	8.597***	9.407***
	(1.135)	(0.944)	(1.178)	(1.156)	(1.131)	(0.939)	(1.163)	(1.144)	(1.131)	(0.938)	(1.163)	(1.142)
Observations	2,015	2,015	1,950	1,950	2,015	2,015	1,950	1,950	2,015	2,015	1,950	1,950
R-squared	0.249	0.265	0.249	0.258	0.253	0.269	0.255	0.264	0.253	0.269	0.256	0.265
Number of countries	37	37	37	37	37	37	37	37	37	37	37	37

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

5 Robustness checks

We check the robustness of our previous results in three ways. First, to take into account the potential sensitivity of the interest rate gap to the Taylor rule specification, we measure the monetary policy stance in a different way. More precisely, following Colletaz et al. [2018], we consider six additional Taylor rules (see Table 3) and compute the median of the resulting Taylor gaps. Figure A1 in the Appendix summarises the results that we obtain when we consider this alternative Taylor gap. As we can see, we find similar results than those reported in the previous section.

Table 3: Alternative measures of monetary policy stance

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

Source: Colletaz et al. [2018]

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

Second, in line with our previous results, we investigate in a different way the relevance of coordination between macroprudential and monetary policies. To this end, we estimate the following specification:

$$\Delta Credit_{i,q} = \alpha + \sum_{k=1}^{4} \beta_k MaP_{i,q-k} + \sum_{k=1}^{4} \gamma_k (MaP_{i,q-k} \times Ttt_{i,q-k} \times D_{i,q-k}) + \eta X_{i,q-1} + \theta Crisis_q + \mu_i + s_{i,q} \quad (11)$$

where ($MaP_{i,q-k} \times Ttt_{i,q-k} \times D_{i,q-k}$) is a three-way interaction term, and $D_{i,q-k}$ is a dummy variable that takes the value 1 when both policies move in the same direction, and 0 otherwise. Results that we obtain are summarised in Figure A2 in the Appendix. We still find that a supporting monetary policy helps boosting macroprudential policy effectiveness.

Finally, we consider an alternative measure of monetary policy stance. Instead of using the Taylor gap, we simply consider the variation of the central bank policy rate. As before, this variable is interacted with our different macroprudential policy indexes. Figure A3 in the Appendix displays results obtained. They confirm our previous findings.

6 Conclusion

Throughout this article, we attempt to answer an important empirical question assessing to which extent the monetary policy stance affects the effectiveness of macroprudential policy. First we compute the monetary policy and macroprudential policy stances. Second, we reinvestigate the effectiveness of macroprudential instruments by regressing different measures of credit growth against our measures of macroprudential policy stance. Finally, we interact the monetary policy with the macroprudential policy in order to test how effective macroprudential tools are conditional to the monetary policy stance. The main results of our paper are threefold. First, we find evidence of a three to four quarters delay of transmission of the macroprudential policy. Second, there is a strengthening of macroprudential policy effectiveness when both macroprudential and monetary policy go in the same direction (tight-tight or loose-loose). And third, when a tightening on macroprudential policy is accompanied and coordinated by a contemporaneously tightening of monetary policy, the delay of transmission is reduced to one quarter, which is a new finding.

Bibliography

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

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

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

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

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

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

Bruno, V., Shim, I., and Shin, H. S. (2017). Comparative assessment of macropruden- tial 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 macro- prudential policies: New evidence. *Journal of Financial Stability*, 28:203–224.

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

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

Clarida, R., Gali, J., and Gertler, M. (2000). Monetary Policy Rules and Macroe- conomic 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.

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

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

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

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

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

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

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

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

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.

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.*

Nier, E. and Kang, H. (2016). Monetary and macroprudential policies - exploring interactions. *BIS Papers*, (86):27–38.

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

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

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

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

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

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

Appendix

Figure A1: Robustness check: Median of Taylor gap measures

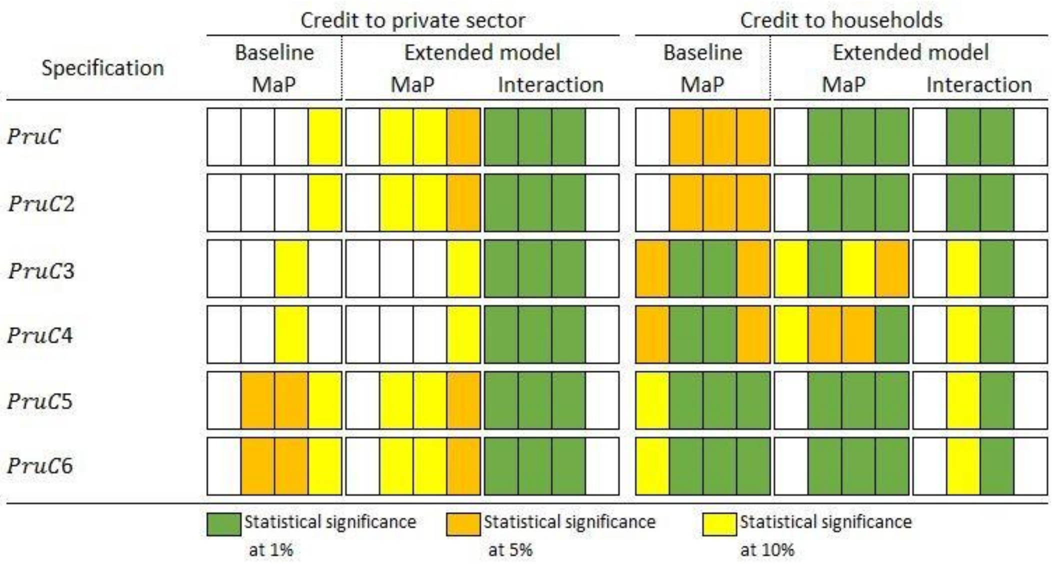

Figure A2: Robustness check: Only policy actions going in the same direction

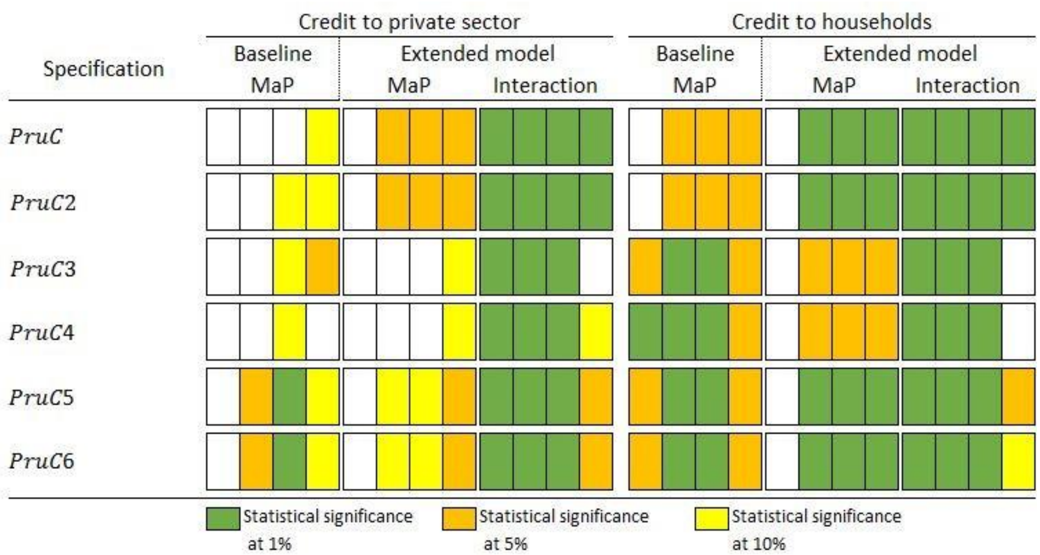

Figure A3: Robustness check: Interaction MaP × Policy interest rate variation

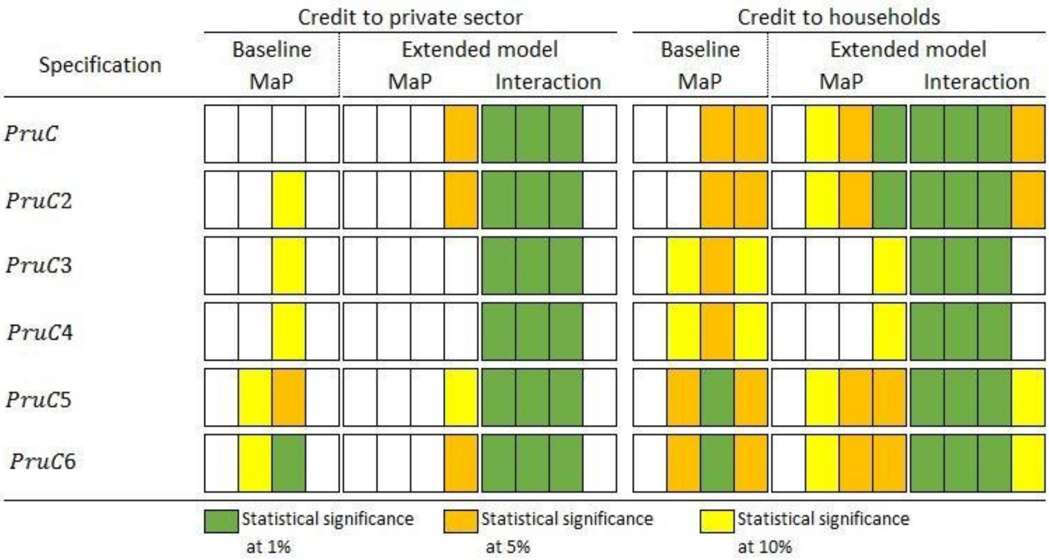

Table A1: Results of the Taylor rule estimations.

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

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