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One Monetary Policy and Two Bank Lending Standards: A Tale of Two Europes

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Abstract

What accounts for contrasting economic paths between core and periphery countries in the euro area? Unlike many studies focusing on fiscal problems, we highlight the interplay of bank mortgage lending standards and imbalances created by the common monetary policy framework. To illustrate the mechanism, we derive a country-specific monetary policy stance gap and estimate the panel VAR model of core and periphery countries, respectively. While the widening monetary policy stance gap—the accommodative stance of the ECB given individual economic conditions—induces a similar increase in the demand for mortgage credit in both regions, it is followed by sharply different responses of the supply side of mortgage credit: bank mortgage lending standards are relaxed (tightened) in periphery (core) countries, which can rationalize vastly different paths in mortgage credit, residential investment, and housing prices between the two Europes. In searching for the source of different bank lending behaviors, we find that banks in core countries, where macroprudential policies on mortgage credit are tightened and bank lending margin decreases, increase their cross-border lending to periphery countries, which could fuel excessive risk-taking in periphery countries.

JEL Classification: E21; E32; E44; F52; G21

Keywords: Euro area; Mortgage credit; Monetary policy stance gap; Bank lending survey; Macroprudential policy; Cross-border banking flows; Panel VARs.

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I. Introduction

Since the introduction of the euro and a common monetary policy framework, core and periphery countries in the euro area experienced very different economic paths during the global financial crisis and the European sovereign debt crisis. What accounts for such divergent economic paths between the regions? Most existing studies have focused on the external debt problem (e.g., Arellano et al., 2015), the lack of an internal stabilizing mechanism under a common currency framework (e.g., Lane, 2012), and the failure of structural reforms (e.g., Fernández-Villaverde et al., 2013), which are not necessarily mutually exclusive explanations. Building on earlier works, we provide an alternative and complementary explanation focusing on private bank *mortgage lending standards* as a crucial driver of different economic outcomes; these standards exacerbated the imbalance created by the common monetary policy framework in the euro area.

Our focus on mortgage credit is motivated by recent literature that has paid great attention to its role in amplifying booms and busts, especially via housing prices. Since the global financial crisis, many empirical studies focusing on the interaction among mortgage credit, housing prices, and growth (e.g., Dell'Ariccia et al., 2014; Jordà et al., 2015; Mian et al., 2017) have provided support for a large theoretical literature—including Holmström and Tirole (1997), Kiyotaki and Moore (1997), and Diamond and Rajan (2001)—that highlights the role of private credit supply in understanding sources of fluctuation in the macroeconomy.

To identify factors leading to divergent economic outcomes between core and periphery countries, we focus on the imbalance created by the common monetary policy framework. The European Central Bank (ECB) does not adjust to developments of individual countries' economic conditions in its monetary policy decisions. To the extent that economic conditions vary greatly among the countries in the euro area, common monetary policy changes can be too stringent or too accommodative at the same time, yielding a source of distortion (e.g., Barigozzi et al., 2014; Beckworth, 2017). As a result, there have been many studies on understanding the heterogeneous

effect of euro area monetary policy shocks across its member countries (e.g., Ciccarelli et al., 2013; Georgiadis, 2015; Burriel and Galesi, 2018; Corsetti et al., 2022; Mandler et al., 2022).

However, our study is distinct from those focusing on the heterogeneous effects of common monetary policy *shocks*. Instead, we are interested in the macroeconomic consequences of the *imbalance* created by common monetary policy, which is country-specific by construction. To be more specific, following Albuquerque (2019) who compute U.S. state-specific monetary policy stances as deviations from an aggregate Taylor rule, we estimate the monetary policy stance gap (MPSG) for each member country, which is computed as the difference between the interest rate prescribed by the Taylor rules for each country and that from the euro area aggregate. As a result, the MPSG measures how expansionary or contractionary the common monetary policy is for each country given its own economic conditions, motivated by the so-called "one size does not fit all" concern for the euro area (Nechio, 2011).

We investigate the effect of monetary policy imbalance on the macroeconomy, with a particular focus on mortgage credit as an amplifying mechanism. However, identifying a causal link between credit supply and the macroeconomy is challenging because of the apparent endogeneity problem. While changes in credit are positively correlated with subsequent changes in output, credit demand effects confound credit supply effects (e.g., Bernanke and Lown, 1991; Bernanke and Gertler, 1995; Peek et al., 2003; Jiménez et al., 2014; Amiti and Weinstein, 2018). To identify whether the supply or demand side of mortgage credit is causing the difference between the two Europes, we employ the ECB Bank Lending Survey, which provides information on bank lending conditions in the euro area, such as information on the supply of and demand for loans to households.

Equipped with a measure of monetary policy imbalance and proxies for the supply and demand side of mortgage credit, we estimate the panel Vector Autoregression (PVAR) model of twelve euro area countries from 2003Q1 to 2019Q4, but separately for six core countries (Austria, Belgium, Finland, France, Germany, Luxembourg) and six periphery countries (Cyprus, Greece, Italy, Malta, Portugal, Spain). Considering the relatively short history of the common monetary

policy framework in the euro area, we assume homogeneity in the slope coefficients among the countries within the same group but still allow for heterogeneity in the intercept coefficients via country-fixed effects and in the slope coefficients across the regions.

We find that the relatively accommodative monetary policy stance, captured by the widening MPSG, has had sharply different consequences between the two Europes. While household mortgage credit expanded rapidly in the periphery, it did not increase in the core countries. This sharp distinction explains the fact that periphery countries experienced much stronger increases in residential investment and housing prices than did core countries.

Most importantly, mortgage lending standards show a strikingly different pattern: banks in the periphery relaxed their standards, while banks in the core tightened their standards for mortgage lending. Since loan demand increasing in both regions, we conclude that distinct credit market outcomes between the regions are mainly driven by the supply side of credit. Interestingly, lending standards for consumer credit behave similarly in both regions, suggesting that the risk-taking channel of monetary policy in which monetary expansion induces financial institutions to take on greater risks is most powerful for mortgage credit in periphery countries.

Given the symmetry in the VAR model, the excessive risk-taking behavior of periphery banks during good times (i.e., under loose monetary conditions) is followed by their excessive reluctance in lending during bad times (i.e., under tightened monetary conditions), thereby contributing to macroeconomic instability. In contrast, more "leaning against the wind" bank lending standards in core countries dampen the buildup of credit and housing price booms during good times, which also allows them to avoid busts during bad times. We further show that responses of bank non-performing loans (NPLs) to the widening MPSG are much stronger in periphery countries than in core countries.

Then how can periphery banks relax their lending standards and significantly extend mortgage credit to households? In searching for the answer, we extend the baseline model to consider the open economy feature of the euro area. We find that in response to the widening MPSG, core

countries experience net capital outflows, while periphery countries receive net capital inflows. Using bilateral cross-border bank lending data from the Bank for International Settlements (BIS), we further confirm that core banks indeed increase their lending to periphery countries, allowing them to lend more. On the other hand, periphery banks do not extend lending to core countries under the same condition, explaining the asymmetry between the two Europes.

Then, the last missing link in this chain of actions is why core banks increased their lending to foreign borrowers in periphery countries, but not to domestic borrowers. By employing new comprehensive databases on macroprudential policy in Cerutti et al. (2017) and Alam et al. (2019), we show that macroprudential policies regarding mortgage credit (e.g., LTV, DTI, LTD, and loan restrictions) were tightened in response to widening MPSG in core countries. This finding provides a potential explanation for the aggressive cross-border lending of core banks to periphery countries, given the restrictions on domestic lending. Interestingly, broader measures of macroprudential policy, including those on bank capital or liquidity requirements and foreign currency loans, are actually relaxed in core countries, corroborating this interpretation.

In sum, countercyclical mortgage-targeting macroprudential policies in core countries might have had unintended consequences for periphery countries by encouraging procyclical bank mortgage lending behaviors in those countries, which is supported by the aggressive risk-taking of core banks with limited domestic lending opportunities. Although macroprudential policies in periphery countries were still tightened, they failed to dampen excessive mortgage credit booms and busts, driven by procyclical bank mortgage lending standards. The novel mechanism suggested in this paper is certainly an underappreciated factor in explaining the euro-area crisis.

The remainder of the paper is organized as follows. Section II explains the empirical framework adopted in the paper, including the estimation procedure of the MPSG and the PVAR model. Section III presents the main findings on different mortgage lending behaviors and provides a series of robustness checks and extended analyses to rationalize the main findings. Section IV concludes.

II. Empirical Framework

A. Data

In contrast to prior studies that have identified monetary policy surprises or shocks in the euro area, our interest is in the effect of a sustained or persistent imbalance created by the common monetary policy framework on economic outcomes, especially through the behavior of banks. To reflect the monetary policy stance felt by a given country in the currency union, we first estimate the monetary policy stance gap (MPSG) for each member country. The MPSG is derived by estimating the aggregate Taylor rule of the European Central Bank (ECB) and embedding economic conditions in each member country.

First, in the estimation of the euro area Taylor rule, we use the Euro Overnight Index Average (EONIA) as the central bank policy rate[1] and employ real-time expectations data based on ECB staff projections of annual percentage changes in the Harmonized Index of Consumer Prices (HICP) and the real GDP growth rate for the euro area. The ECB publishes a staff assessment of the economic outlook every last month of its quarters, providing important economic analysis that the ECB's Governing Council considers when deciding its monetary policy stance. In addition, as a proxy for economic slack, we use an output gap series from the European Commission for the entire euro area.

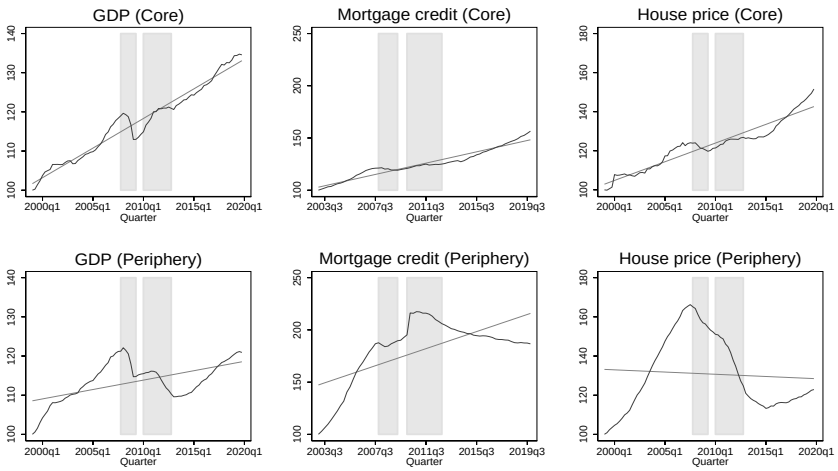
When deriving the prescribed interest rate for each country according to the estimated Taylor rule, we use the real GDP growth rate, output gaps, and the annualized inflation rate from the HICP overall index of Eurostat in the absence of country-specific real-time expectation data at

[1] Using the EONIA rate has an important advantage given the presence of non-standard policy measures during our sample period. Although the ECB has been lending liquidity through fixed-rate full-allotment auctions since October 2008, changes in the EONIA rate, determined in the market, also reflect non-standard policy measures (Ciccarelli et al., 2015).

a quarterly frequency. Output gaps of each country are derived from the log of each country's real GDP from 1995Q1 to 2019Q4 by applying the Hamilton filter (Hamilton, 2018).[2]

In addition to the country-specific MPSG, real GDP, and the consumer price index, the baseline PVAR model includes quarterly data on bank mortgage credit as a key variable. Our focus on mortgage credit is motivated by the recent observation of the contrasting macroeconomic implications of household and business credit (e.g., Büyükkarabacak and Valev, 2010; Bahadir and Gumus, 2016; Mian et al., 2017). Mortgage credit is outstanding amounts of loans for house purchases, originating from the balance sheets of Monetary Financial Institutions (MFIs).[3] In addition to mortgage credit, we include mortgage interest rates, which are applied to mortgage loans. These mortgage interest rates are calculated from the average value of interest rates of outstanding mortgage loans. To provide a comprehensive understanding of the consequences of the imbalance between common monetary policy and country-specific economic conditions, the PVAR analysis also contains a real residential property price index from BIS statistics and residential investment.

Figure 1. Evolution of output, mortgage credit, and housing prices



[2] The Hamilton filter estimates the cyclical component from detrending nonstationary time series data; it is suggested as an alternative filtering method to the Hodrick-Prescott filter.

[3] MFIs refer to the collection of financial institutions including the Eurosystem, credit institutions, and non-credit institutions that receive deposits and lend credit to other non-MFIs, i.e., households or firms, or invest them in securities.

Note: The graph shows the evolution of real GDP, real mortgage credit, and real housing prices for each group (top: core; bottom: periphery) by taking a GDP-weighted average of those values for the countries in the group. The data are normalized to 100 for the base year. The shaded areas in the graph represent the global financial crisis (2007Q4 to 2009Q2) and the European sovereign debt crisis (2010Q1 to 2012Q4).

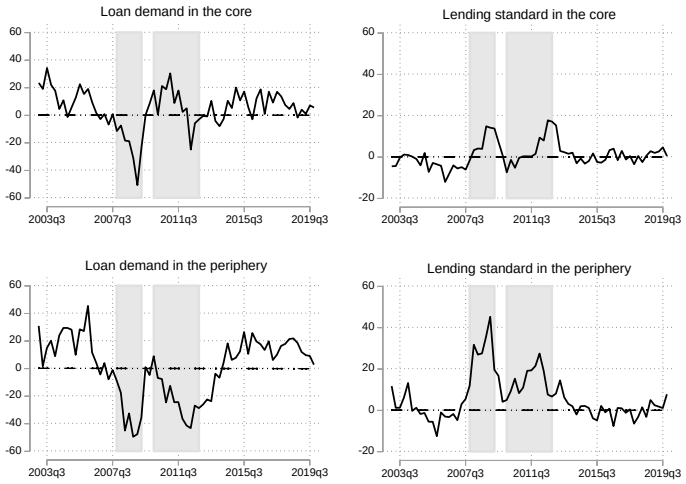
Figure 1 shows the main economic indicators (real GDP, real mortgage credit, and real housing prices) for both core and periphery countries. We take the GDP-weighted average of these variables for each group and, to enhance visualization, normalize the data to 100 for a base period. Figure 1 clearly shows distinct paths of key economic outcomes between the regions. Compared with core countries, periphery countries experienced much stronger booms and busts in these variables. Such divergent economic conditions between the regions also suggest that the common monetary policy of the ECB is unlikely to achieve simultaneous stability in both regions.

We further include quarterly Bank Lending Survey (BLS) data in our empirical analysis because the main information (bank lending standards and loan demand) in the bank loan officer survey proxies supply and demand factors of bank credit (e.g., Lown and Morgan, 2006; Helbling et al., 2011; Hristov et al., 2012; Meeks, 2012; Bassett et al., 2014). A bank loan officer survey is especially useful in identifying an underlying cause of fluctuations in bank credit when the price of bank credit (i.e., the bank lending rate) does not instantly adjust toward equilibrium due to credit market imperfections or banking sector regulations (Choi, 2021). To the extent that, in the euro area, the pass-through of monetary policy rates to bank lending rates may not be perfect (Hristov et al., 2014; Horvath et al, 2018), or may be time-varying and heterogeneous (Altavilla et al., 2020), this feature of the survey helps identify whether the supply or demand side of credit markets accounts for differences in the evolution of mortgage credit and housing prices between core and periphery countries.

The ECB conducts a quarterly-basis survey on bank lending standards and loan demand; the survey contains questions about behavioral aspects of representative banks, acquiring information by requesting a survey be completed by senior officers. The survey involves data on past and future assessments of each commercial bank's overall bank lending standard and loan

demand for each type of loan.[4] To assess the credit market impact of monetary policy stances, VAR analysis focuses on loans for house purchases, which account for about 40% of private credit in the euro area. Survey data is available from 2003, so this dictates the beginning of the main sample period.

Figure 2. Bank lending standards and loan demand for household mortgage credit



Note: The graph shows the average lending standards and loan demands for household mortgage credit. The first column shows the average mortgage loan demands for core and periphery countries. The second column shows the average mortgage leading standards. The shaded areas in the graph represent the global financial crisis (2007Q4 to 2009Q2) and the European sovereign debt crisis (2010Q1 to 2012Q4).

We use a diffusion index on bank lending standards and loan demand for household mortgage credit, shown in Figure 2 for core and periphery countries, respectively.[5] Before the global financial crisis, lending standards for mortgage credit in both core and periphery countries were quite relaxed, reflecting strong economic activity, which drives a rapid expansion of credit. Standards were tightened during the global financial crisis and again during the European sovereign debt crisis, with

[4] For further details on the euro-area BLS data, see Maddaloni and Peydró (2011), Ciccarelli et al. (2015), and Neuenkirch and Nöckel (2018).

[5] In the Bank Lending Survey data, the diffusion index refers to the weighted difference between the share of banks reporting credit standards of "considerably tightened" and "somewhat tightened" and the share of banks reporting "considerably eased" and "somewhat eased". As this is a weighted measure of the difference, a respondent who answered "considerably" will be given twice as high a score as a respondent who answered "somewhat". In the case of loan demand, the diffusion index will be the weighted difference between the share of banks which reported "increase" and the share of banks which reported "decline".

a simultaneous decline in the demand for mortgage loans. Interestingly, bank lending standards show qualitatively similar patterns between the two regions despite the contrasting economic conditions between the regions.

To compare the effects of monetary policy imbalance on mortgage credit with those on consumer credit, we collect data about consumer credit. When estimating the PVAR model of consumer credit, we include outstanding consumer credit and consumer credit interest rates. To make the two models comparable, the loan demand and lending standards for mortgage credit are replaced by those for consumer credit. To complete the model, the VAR analysis includes total consumption expenditure instead of residential investment.

To consider the consequences of the common monetary policy framework from an open economy perspective, we collect data on net exports and real exchange rates. Net export data are taken from Eurostat; we include a ratio of net exports to nominal GDP in the PVAR model to learn the response of capital flows to changes in the monetary policy stance. We take the broad real effective exchange rate (REER) index from BIS statistics, which provides information on the price competitiveness of each nation in relation to its trading partners. To the extent that all countries in our sample use the same currency, any difference in the real exchange rate is entirely driven by relative prices.

We also collect information on country-specific macroprudential policy to shed light on whether policy responses of the financial authority can explain the different economic outcomes, especially those related to mortgage lending behavior, between regions. As a baseline measure of macroprudential policy, we use the integrated Macroprudential Policy (iMaPP) of the International Monetary Fund (IMF), which collects country-level information on macroprudential policy worldwide. The database divides macroprudential policy actions into 17 categories. The major feature of this database is that it contains country-specific monthly data on financial regulations with dummy-type variables for 17 instruments. A value of 1 represents tightening of macroprudential actions; a value of -1 represents loosening actions. By focusing on policies regarding

mortgage credit, we examine how macroprudential policies respond to the monetary policy stance in the euro area and whether responses differ systematically between the core and periphery countries.

Lastly, our analysis integrates data on NPLs to understand the consequence of a widening MPSG on banking sector soundness. We use annual data on the ratio of bank non-performing loans to gross loans from the Financial Soundness Indicators of the International Monetary Fund and linearly interpolate annual data into quarterly frequency. The list and sources of the data used in our analysis are summarized in Table A.1 in Appendix A.

B. Estimation of monetary policy stance gap

Under the standard Taylor rule, the central bank adjusts the target interest rate to deviations of inflation from its desired level and to deviations of real GDP (or unemployment) from its potential (or natural) level. Although economists do not necessarily agree on how much emphasis to place on each deviation, the Taylor rule framework continues to be a useful benchmark for central banks. Similar to Albuquerque (2019) who compute U.S. state-specific monetary policy stances as deviations from an aggregate Taylor rule, estimating a measure of country-specific monetary policy stance gap starts with the estimation of the Taylor rule coefficients of the ECB, which makes monetary policy decisions based on aggregate macroeconomic variables of the entire euro area. Following Carvalho et al. (2021), the estimation of the Taylor rule coefficients is based on the Ordinary Least Squares (OLS) method with Newey-West robust standard errors, given by the equation below:

$$i_t = c + \delta i_{t-1} + \varphi_\pi E_{t-}\pi_{t+1,t+2} + \varphi_x E_{t-}x_t + \varphi_{\Delta y} E_{t-}\Delta y_t + \varepsilon_t, \tag{1}$$

where the interest rate i_t is EONIA, which is frequently referred to as the policy rate of the ECB; π_t is the annualized inflation rate, which is the year-on-year growth rate of the aggregate euro area HICP; x_t is output gap; and Δy_t is the quarterly real GDP growth rate.

Following Coibion and Gorodnichenko (2012), to capture the persistence of policy interest rates, the equation contains a lagged variable of the interest rate at t-1. At the moment of decision, because the central bank's decision on the policy rate is confined to the interest rate, the policy rate usually features inertia of policy action. The constant term, c includes time-invariant factors of the Taylor rule. Unlike the classical Taylor rule, the equation contains forward-looking variables, which can address the endogeneity problems of the OLS regression of the Taylor rule coefficients. The forward-looking variables are the expectations of inflation and real GDP growth. Each variable with an indicator E_{t-} is a forecast of the macroeconomic variable before the monetary decision of the ECB. We employ the staff assessment of the aggregate euro area to obtain the expectational values of macroeconomic variables.

We use the output gap data at time t to measure the degree of economic slack. For the expectational values of future inflation π, we take the average forecast values of t+1 and t+2, as in Coibion and Gorodnichenko (2012). For the forecast values of the real GDP growth rate Δy, we include the staff assessment value of time t, but this value is acquired before the central bank's policy decision. As these forecast indicators are reported to the Governing Council and the ECB's Executive Board and published after the press conference date of the end of its quarter, we adjust the meeting dates to the press conference dates of each quarter. In other words, we take daily EONIA data on the press conference dates at the end of each quarter. The sample period encompasses 1999Q1 to 2016Q1 because the ECB faced a Zero Lower Bound (ZLB) in 2016Q1.[6]

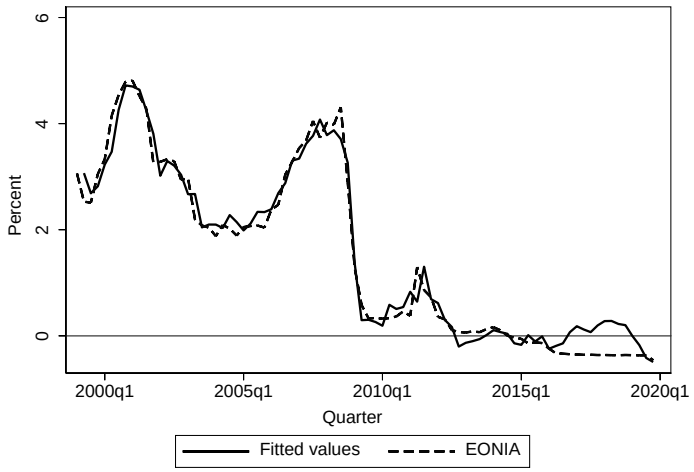
$$\underset{}{\hat{i}_t} = \underset{}{-0.2} + \underset{(0.05)}{0.82^{***} i_{t-1}} + \underset{(0.06)}{0.20^{***} E_{t-}\pi_{t+1,t+2}} + \underset{(0.05)}{0.09^{**} E_{t-} x_t} + \underset{(0.17)}{0.53^{***} E_{t-}\Delta y_t} + \varepsilon_t. \tag{2}$$

Equation (2) reports the estimation results of the aforementioned Taylor rule. The coefficients of the included terms show statistically significant results with the expected sign. The

[6] One of the key ECB interest rates, the Main Refinancing Operation (MRO) rate, reached zero on March 12, 2016. The ECB's policy rate under normal circumstances refers to MRO. Estimating the Taylor rule including the ZLB period can distort the relationship between monetary policy and the real economy, so we exclude it from the sample.

coefficient of the lagged dependent variable indicates a substantial persistence, which is consistent with findings in the literature. The high R-squared value (0.98) of the regression confirms that most of the variables included in Equation (1) can explain the ECB's policy decisions or policy rate changes in our sample period before the ZLB. In addition, the ECB appears to follow the Taylor principle as the long-run coefficient of inflation is greater than one. Figure 3 plots both the actual EONIA rate and the estimated Taylor rule (i.e., the fitted policy rate). These estimated values of the Taylor coefficients are employed in constructing the country-specific MPSG.

Figure 3. Actual vs. fitted policy rate in euro area



Note: The dashed line shows the EONIA rate and the solid line represents the fitted value of the aggregate Taylor rule from 1999Q1 to 2019Q4. When estimating the aggregate Taylor rule coefficients, we use the sample period ranging from 1999Q1 to 2016Q1, as the official key interest rate of the ECB reached the Zero Lower Bound in March 2016. Thus, the fitted values between 2016Q2 and 2019Q4 represent out-of-sample estimates.

Based on the estimated coefficients of the euro area Taylor rule, we construct a measure of country-specific monetary policy stance originating from the common monetary policy (MPSG). As the ECB does not consider a particular country's economic conditions as input for its decision-making, each of the member countries will face heterogeneous impacts from changes in ECB monetary policy unless all member countries are under the same economic condition. The MPSG gives a measure of the relative monetary policy stance of each country, taking the ECB's aggregate Taylor rule for the entire euro area as a benchmark. By differencing the prescribed interest rates at

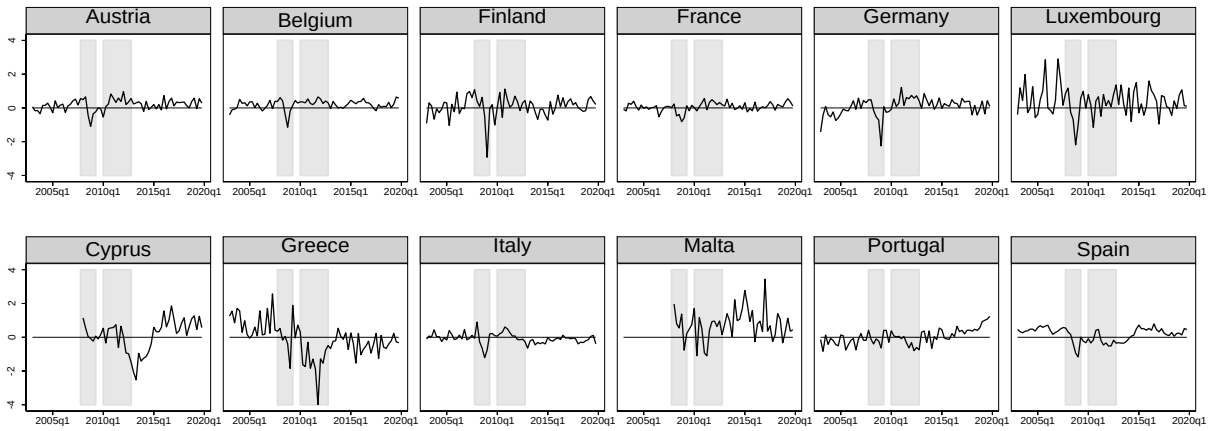
the country level and the aggregate level, we construct the MPSG. The following equation shows the idea more concretely:

$$MPSG_{i,t} = \hat{\imath}_{i,t} - \hat{\imath}_t \text{ and } \hat{\imath}_{i,t} = c + \hat{\delta} i_{t-1} + \hat{\varphi}_x x_{i,t} + \hat{\varphi}_\pi \pi_{i,t+1,t+2} + \hat{\varphi}_{\Delta y} \Delta y_{i,t}, \tag{3}$$

where each of the coefficients in Equation (3) is taken from the estimated aggregate Taylor rule in (2): $\hat{\varphi}_x$ refers to the estimated coefficient of output gap measure, $\hat{\varphi}_\pi$ represents the coefficient of the expected inflation rate, and $\hat{\varphi}_{\Delta y}$ stands for the Taylor coefficient of the expected GDP growth rate term in (2). As we assume the same reaction function for all countries, the Taylor rules for each country have the same coefficients as those of the aggregate Taylor rule. By differencing the prescribed interest rates $\hat{\imath}_{i,t}$ for country i and aggregate euro area $\hat{\imath}_t$, we obtain the MPSG.

As all the coefficients in (2) are positive, if individual country i experiences a boom relative to the entire euro area (i.e., higher output, higher output gaps, or higher inflation rate), the same monetary policy stance will be relatively accommodative or expansionary, with a positive value of $MPSG_{i,t}$, for country i. On the contrary, a negative value for $MPSG_{i,t}$ implies the country i faces a relatively tightened monetary policy stance compared to the entire euro area.

Figure 4. Monetary policy stance gap of euro area countries



Note: The first row represents the monetary policy stance gap of core countries; the second row displays that gap for periphery countries. This time series starts in 1999Q1 and ends in 2019Q4, except for Cyprus and Malta. For these countries, the data start in 2008Q1, because they became euro-area members later, in 2008. The shaded areas in the graph represent the global financial crisis (2007Q4 to 2009Q2) and the European sovereign debt crisis (2010Q1 to 2012Q4).

Figure 4 shows the value of MPSG over the sample period for each economy. The MPSGs of periphery countries tended to be larger in absolute terms than those of core countries in the run-up to the global financial crisis, corroborating the "one size does not fit all" narrative (e.g., Nechio, 2011). Moreover, from the perspective of periphery countries, ECB monetary policy was too expansionary during good times, while too contractionary during bad times. This is one of the common explanations for the sovereign debt crisis and the diverging economic paths between core and periphery countries (e.g., Beckworth, 2017). However, our goal is to investigate how such an imbalance created by the common monetary policy framework interacts with the banking sector's lending behavior in generating a credit boom and bust cycle, and whether there is a systematic difference in this interplay between core and periphery countries.

C. Panel vector autoregression model

In this section, we briefly describe the main empirical framework used in the paper. We use the PVAR model to estimate responses of various macroeconomic variables to widening MPSG (i.e., common monetary policy becomes accommodative given individual economic conditions). By pooling information from each unit (country), we estimate the model more efficiently while accounting for cross-country heterogeneity, which is invariant over time. Since we are interested in the forces driving sharply different economic outcomes between core and periphery countries, we pool countries belonging to each region, assuming homogeneity in slope coefficients across countries in the same region but allowing for heterogeneity in slope coefficients across regions.[7]

Consider the following reduced-form VAR system with nine endogenous variables:

$$Y_{i,t} = A(L)Y_{i,t-1} + \lambda_i + e_{i,t}, \qquad e_{i,t} \sim N(0, \Sigma_i) \tag{4}$$

where $Y_{i,t} = [MPSG_{i,t}, GDP_{i,t}, CPI_{i,t}, Credit^S_{i,t}, Credit^D_{i,t}, Credit_{i,t}, Rate_{i,t}, INV_{i,t}, HP_{i,t}]'$ in the baseline VAR model, $A(L)$ is a conforming matrix with lagged variables, $e_{i,t}$ is a vector of residuals,

[7] See Canova and Ciccarelli (2013) for further details of the estimation of the panel VAR model and its distinct features compared with alternative models such as the large-scale Bayesian VAR model or the Global VAR model.

$t = 1, \ldots, T$ indexes time (quarter) and $i = 1, \ldots, N$ indexes country, and λ_i are country-fixed effects. We assume that reduced-form residuals $e_{i,t}$ follow an *i.i.d* normal distribution and are linear combinations of the underlying structural shocks.

In the baseline nine-variable model, $MPSG_{i,t}$ is the country-specific monetary policy stance gap explained above, $GDP_{i,t}$ is the log of real GDP, and $CPI_{i,t}$ is the log of the Harmonized Index of Consumer Prices (HICP).[8] One distinct aspect of our model from a standard VAR model of monetary policy is that we include a direct proxy for the supply $Credit^S_{i,t}$ and demand factor $Credit^D_{i,t}$ of mortgage credit, in addition to the real value of mortgage credit $Credit_{i,t}$. To complete the transmission channel of a widening MPSG, we also include the log of real residential investment, the mortgage interest rate, and the log of real housing prices. Country-fixed effects are introduced to control for time-invariant country-level heterogeneity, which could affect the dynamics of endogenous variables, such as geographical location, industry share, and demographic structure.[9]

Our identification strategy uses a Cholesky decomposition with a lower triangular matrix restriction and the same ordering as Equation (4). This setup indicates that variables that appear later in the ordering affect variables that appear earlier only with a lag. Our identification strategy builds on the unique institutional setting in the euro area, where the monetary policy stance is independent of developments in each member country. Under this identifying assumption, we treat real housing prices as the most endogenous variable. Our identifying assumption also allows the equilibrium quantity and price of mortgage credit to be contemporaneously affected by not only

[8] While both real GDP and the HICP index are used in the estimation of $MPSG_{i,t}$, we still include these variables to (i) confirm that a widening MPSG indeed has a correct consequence on output and inflation and (ii) control for the direct effect of these variables on credit and housing market variables. Our findings are robust to dropping these two variables from the VAR model.

[9] It is true that a country's industry share and demographic structure vary over time, but they change only gradually. Given the quarterly frequency of our analysis, country-fixed effects will largely absorb any persistent cross-country heterogeneity.

monetary policy, real GDP, and inflation, but also by the supply and demand factors of mortgage credit.

When estimating the panel model, dealing with the non-stationarity of endogenous variables is an important issue that often yields different estimation results and implications; thus, we discuss this issue in greater detail. First, the monetary policy stance gap is stationary by construction, and its stationarity cannot be rejected at a conventional significance level, so it is always included in the system in level. Second, GDP, CPI, volumes of credit and investment, and housing prices are non-stationary, so they are I(1) variables. Third, factors proxying the supply and demand for credit are stationary. When we estimate VARs, these variables are entered in (log) levels to preserve potential medium to long-term dynamics among the variables. Estimating the system in levels will produce consistent estimates of impulse responses and this type of estimation is robust to the cointegration of unknown forms.[10]

The baseline PVAR model spans 2003Q1 to 2019Q4 for the six core countries (Austria, Belgium, Finland, France, Germany, and Luxembourg) and the six periphery countries (Cyprus, Greece, Italy, Malta, Portugal, and Spain). Like Holtz-Eakin et al. (1988), we abstract from the heterogeneous dynamic effects of the MPSG by assuming that the cross-sectional units share the same underlying data-generating process within each group. As discussed above, this choice is driven by practical consideration of the properties of our data and the main research question. We estimate the model with four lags; this approach appears conservative compared to the statistics provided by Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). We report a 68% confidence interval of the impulse response functions using 200 repetitions of the Monte Carlo simulation.

[10] When there is uncertainty about the nature of common trends in the data, estimating the VAR in levels is a conservative approach, as advocated by, for example, Hamilton (2020).

Note that in our PVAR model, the size of the time (T) dimension is greater than that of the cross-sectional dimension (N).[11] In a $T > N$ setting like ours, concern about the Nickell bias may not be too much of an issue because the Nickell bias from OLS tends toward zero as T goes to infinity (Alvarez and Arellano, 2003).[12] Given the quarterly availability of data spanning 15 years, providing us $T \gg 30$, we estimate the model using OLS, following Judson and Owen's (1999) suggestion.

III. Empirical Findings

A. Main results

Before providing the key results of the baseline analysis, we demonstrate why considering a country-specific monetary policy stance is crucial to answering our question. In doing so, we show that common monetary policy action can have contrasting macroeconomic effects between core and periphery countries because the seemingly tightening of euro area monetary policy can still be expansionary for countries with strong inflationary pressure and positive output gaps.

To the extent that core and periphery countries have different economic conditions on average, this feature of the common monetary policy induces an imbalance between the two regions. While using an exogenous shock to the common monetary policy (e.g., identified by Taylor residuals

[11] On the one hand, if $T \gg N$, then one can use the mean-group estimator proposed by Pesaran and Smith (1995). The mean-group estimator exploits many time-series observations available for each country and provides an important alternative to the fixed-effect estimator, while allowing for heterogeneous dynamic effects. In other words, when T is large, the average of the responses estimated unit by unit is consistent with the mean response. On the other hand, if $N \gg T$, then we should not use the Ordinary Least Squares (OLS) estimator because bias induced by the joint inclusion of lagged dependent variables and country-fixed effects can be substantial (Nickell, 1981). In this case, it is desirable to use the dynamic panel GMM estimators proposed by Anderson and Hsiao (1982) or Arellano and Bover (1995), which use past information as instruments.

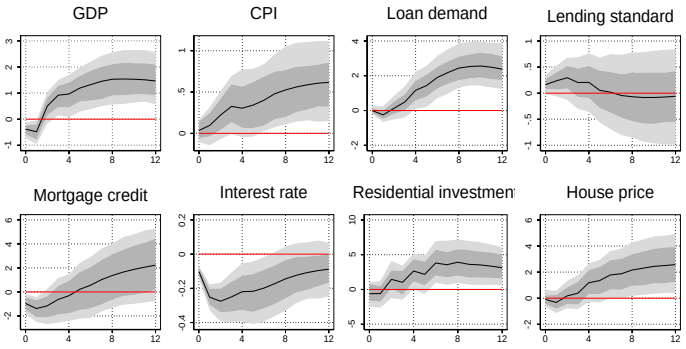
[12] As Nickell (1981) demonstrated, bias arises because the demeaning process, which subtracts the individual's mean value of the dependent variable and each covariate from the respective variable, creates a correlation between regressor and error. The size of the bias is proportional to 1/T, so Nickell bias is a serious problem in the small T and large N setup, which is unlikely in our case. For example, Kiviet (1995) and Judson and Owen (1999) demonstrate that fixed-effect panel regression using lagged dependent variables performs relatively well when the time dimension is relatively large ($T > 30$).

or a high-frequency approach using financial data) can sharpen the identification of the causal effect on economic outcomes, it cannot tell us much about how imbalances driven by the common monetary policy stance interact with private sector responses. To demonstrate this point, we estimate the PVAR model by replacing $MPSG_{i,t}$ in Equation (4) with euro area Taylor residuals (i.e., $i_t - \hat{i}_t$).

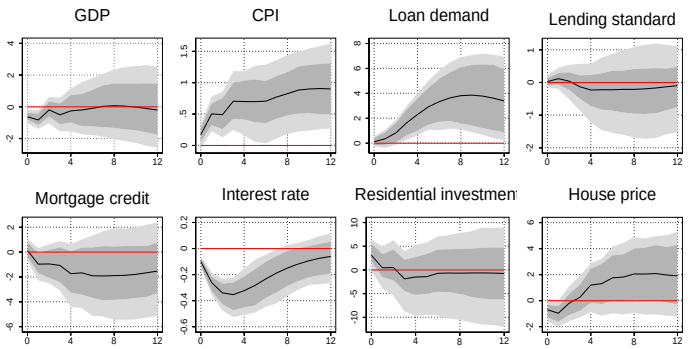
Figure 5 reports estimation results obtained using the common monetary policy shocks. Here, the sign of the shock is switched to denote exogenous easing of the euro area monetary policy. In core countries, real GDP starts to increase after two quarters and a maximum increase of 1.5% occurs after three years, consistent with many theoretical predictions and empirical evidence on the effects of monetary easing. There is no price puzzle observed. However, in periphery countries, real GDP decreases statistically significantly on impact and it never increases during the three-year horizon. While stronger output response to common monetary policy shock in the core countries than in the periphery countries is largely consistent with the recent findings in Mandler et al. (2022), the absence of output increase after monetary easing in periphery countries highlights the pitfall of the common monetary policy framework in stabilizing the economic conditions of member countries.

Figure 5. Effects of common monetary policy shocks

A) Core countries



B) Periphery countries

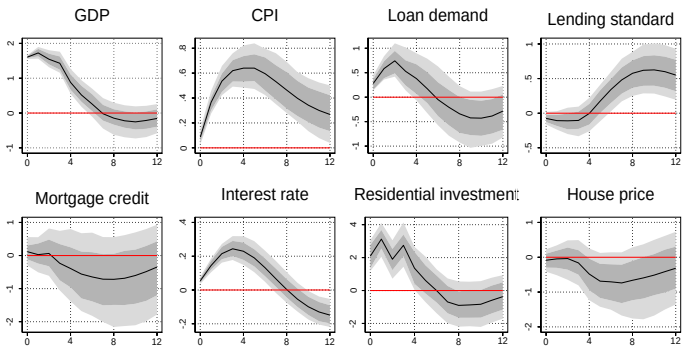


Note: This figure shows impulse response functions of real GDP, HICP, mortgage loan demand, mortgage lending standards, outstanding amount of household mortgage loans, mortgage interest rate, residential investment, and real house price index in one unit of the euro-area Taylor residuals in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence intervals were calculated using a Monte Carlo simulation with 200 repetitions.

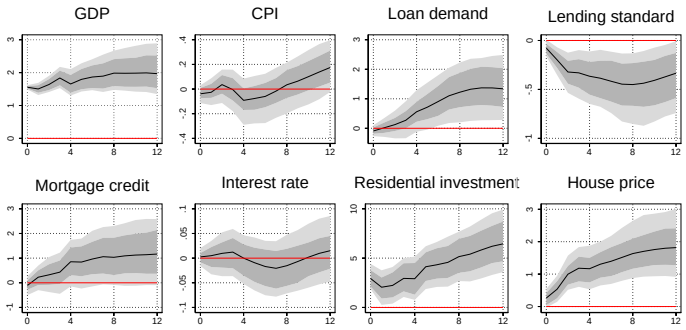
As a result, the responses of other variables of interest are also counterintuitive, especially in periphery countries. For example, given exogenous monetary policy easing, mortgage credit persistently decreases and residential investment falls, except for some increase on impact, which is difficult to be reconciled with the standard theoretical prediction. These results should be seen as a pitfall of the common monetary policy framework in the euro area, where the same policy action by the ECB is felt differently between regions given their different economic conditions. With this caveat, we now investigate how a widening monetary policy stance gap interacts with bank lending standards toward mortgage loans and how this interplay ultimately affects mortgage credit and housing prices. Figure 6 shows responses of key variables to one unit of country-specific MPSG for the panel of six core countries and the panel of six periphery countries, respectively.

Figure 6. Effects of widening monetary policy stance gap in mortgage credit model

A) Core countries



B) Periphery countries



Note: This figure shows the impulse response functions of real GDP, HICP, mortgage loan demand, mortgage lending standards, outstanding amount of household mortgage loans, mortgage interest rate, residential investment, and real house price index to one unit of MPSG in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

As a first pass, we check whether the identified shock to the MPSG has expected effects on output and prices in both regions. In both regions, relative monetary accommodation is followed by an immediate increase in real GDP, so we do not encounter the same problem when using a common monetary policy shock, as shown in Figure 5.[13] Although magnitudes of the impact effects are similar by construction, responses are much more persistent in periphery countries, which is explained by different private behaviors between regions.

We next compare responses of variables related to mortgage credit and the housing sector between the two regions. As expected, household demand for mortgage loans increases in both regions because a widening MPSG indicates that the euro area monetary policy stance becomes accommodative compared to what is warranted by economic conditions in the given region. However, bank lending standards respond differently between the regions: banks in core countries tighten their lending standards, whereas those in periphery countries relax their standards.

While the lending standard response in periphery countries is consistent with the risk-taking channel of monetary policy in the euro area (Gambacorta, 2009; Delis and Kouretas, 2011;

[13] Such an immediate response does not indicate that changes in monetary policy have an instant impact on output, because we do not identify an exogenous unexpected shock to the common monetary policy, *per se*. Note that a positive shock to the MPSG implies that euro area monetary policy becomes more expansionary than what is warranted by the economic conditions in a given country.

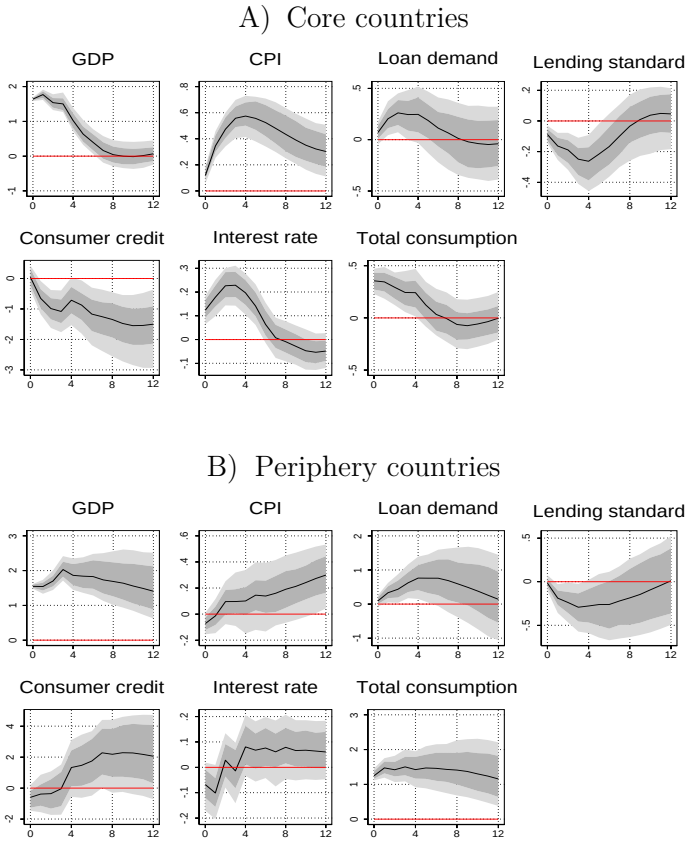
Neuenkirch and Nöckel, 2018), the distinct response between core and periphery countries is not documented in existing studies. For example, Neuenkirch and Nöckel (2018) found that bank lending standards were relaxed in both crisis and non-crisis countries after expansionary monetary policy shocks when the main refinancing rate, which is common to all euro-area countries, is used as a measure of monetary policy. The contrasting lending standard response also accounts for a significant increase in the volume of mortgage loans in periphery countries and an insignificant change in the volume of mortgage loans in core countries, although both regions experience the same degree of expansionary ECB monetary policy given their economic conditions.

The response of country-level mortgage rates also supports the idea of different bank lending behaviors between the regions as a key mechanism: the mortgage rate increases temporarily in core countries, whereas it declines somewhat in periphery countries, which is consistent with the shifts in a supply-demand model of the mortgage credit market. As a result, while residential investment increases in both regions, the increase is much larger and more persistent in periphery countries. Driven by a sharp increase in mortgage credit, periphery countries also experience a strong housing market boom, which is absent in core countries.

This finding is interesting because we identify an underappreciated factor explaining the different economic outcomes between core and periphery countries. It appears that what drives different economic outcomes between the two Europes, especially for mortgage credit, residential investment, and housing prices, is the supply side of credit, which is captured by contrasting bank lending behaviors. Bank mortgage loan demands are procyclical in both regions, but bank mortgage lending standards are countercyclical in core countries, which dampens any excessive buildup of credit, residential investment boom, or housing price appreciation. This stabilizing mechanism is missing in periphery countries because of procyclical bank mortgage lending standards; the lack of this mechanism amplifies macroeconomic instability in the region induced by imbalances created by the common monetary policy framework.

However, the contrasting lending behaviors of banks in response to the accommodative monetary policy stance exist only in mortgage markets. Other types of household loans (i.e., consumer credit) do not exhibit contrasting behavioral responses of banks between core and periphery countries. As the Bank Lending Survey contains data on loan demand and lending standards for consumer credit, we test whether the responses of commercial banks differ between core and periphery via parallel analysis, as shown in Figure 6. Figure 7 displays impulse response functions of the alternative PVAR model, which replaces variables related to mortgage loans with those of consumer loans (i.e., interest rate for consumer credit, outstanding amount of consumer credit, and total consumption).

Figure 7. Effects of widening monetary policy stance gap in consumer credit model



Note: This figure shows the impulse response functions of real GDP, HICP, consumer credit demand, lending standards for consumer credit, outstanding amount of consumer credit, consumer credit interest rate, and total consumption to one unit of MPSG in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

When core countries face a widening monetary policy stance gap, the demand for consumer credit increases and consumer credit lending standards are relaxed. This contrasts with the results in Figure 6, as lending standards show a distinct pattern: mortgage lending standards are tightened in core countries. In other words, the demand and supply factors of consumer credit in periphery countries are not different from those in the core countries, suggesting that bank lending behaviors toward consumer credit are not likely to be the main cause of the difference we are looking for.

B. Robustness checks

In this section, we provide a battery of sensitivity tests to confirm that contrasting bank mortgage lending behaviors in response to widening MPSG between the two Europes are robust to various specifications. First, as there can be an issue in our baseline PVAR model with giving equal weight to small countries like Cyprus, Malta, and Luxembourg, we check whether dropping these countries from the sample influences our main findings. Figure B.1 in Appendix B shows results consistent with the main findings, in which mortgage lending standards still show strikingly different responses between core and periphery countries, and responses of other key variables are in line with the baseline results.

As an alternative to MPSG, we use country-specific Taylor residuals, which also account for different economic conditions across countries. For example, Maddaloni and Peydró (2011) estimated the effect of such country-specific Taylor residuals on bank lending standards in the euro area and found that a soft monetary policy stance induced softer bank lending standards. By imposing common coefficients for euro member states under the common monetary policy framework, we estimate the coefficients with the fixed-effect panel regression and derive country-specific Taylor residuals by taking the difference between the prescribed interest rate (using each member country's GDP growth, inflation rate, and output gap) and the ECB policy rate (i.e., $\tilde{\imath}_{i,t} - i_t$).[14] We estimate

[14] $\tilde{\imath}_{i,t}$ represents the interest rate prescribed for each country by the Taylor rule: $\tilde{\imath}_{i,t} = c_i + \widehat{\varphi}_x x_{i,t} + \widehat{\varphi}'_x x_{i,t-1} + \widehat{\varphi}_\pi \pi_{i,t} + \widehat{\varphi}'_\pi \pi_{i,t-1} + \widehat{\varphi}_{\Delta y} \Delta y_{i,t} + \widehat{\varphi}'_{\Delta y} \Delta y_{i,t-1}$. In this equation, $x_{i,t}$, $\pi_{i,t}$, and $\Delta y_{i,t}$ refer to the output gap, inflation rate, and GDP growth respectively. Following Maddaloni and Peydró (2011), each coefficient is estimated by Panel Least Squares

the alternative PVAR model using country-specific Taylor residuals. As shown in Figure B.2, the responses of mortgage lending standards are still sharply different between the regions, while the responses of mortgage loan demand are similar between core and periphery countries.

Our sample starts from 2003Q1 because BLS data is available from this time; the reason it ends in 2019Q4 is to have as long a sample as possible pre-pandemic. If we restrict the VAR sample from 2003Q1 to 2016Q1 (before the ECB faced negative interest rates), our main results do not change, which is confirmed in Figure B.3. In the baseline analysis, the estimation of the euro-area Taylor rule used the sample up to 2016Q1, which raises a concern of overfitting stemming from vastly different economic outcomes experienced between core and periphery countries. In other words, the contrasting behaviors between the two Europes documented in Figure 6 might be an artificial product of using the entire crisis sample when estimating the Taylor rule. To guard against this possibility, we re-estimate the Taylor rule in Equation (2) using data only up to 2007Q4. As shown in Figure B.4, the main finding about different mortgage lending behaviors between the regions hardly changes.

A remaining concern is the homogeneity assumption of the slope coefficients in the VAR system belonging to the same group in our panel VAR model. To the extent that all economies still experienced somewhat different economic paths, even within a group, the common parameter assumption might have disregarded interesting heterogeneity. Moreover, the grouping of crisis countries vs. non-crisis countries seems clear with the benefit of hindsight now but it might have exploited too much *ex-post* information on economic outcomes. To check whether our main finding is forced by the homogeneity assumption, we use the mean-group estimator proposed by Pesaran and Smith (1995), which allows for heterogeneous dynamic effects.

A practical problem in this approach is that the time-series dimension of our sample is not sufficiently long, which restricts the number of parameters to be estimated. To keep the model

regression with country fixed effect, c_i, and we impose the same slope coefficient across all 19 member countries in the euro area.

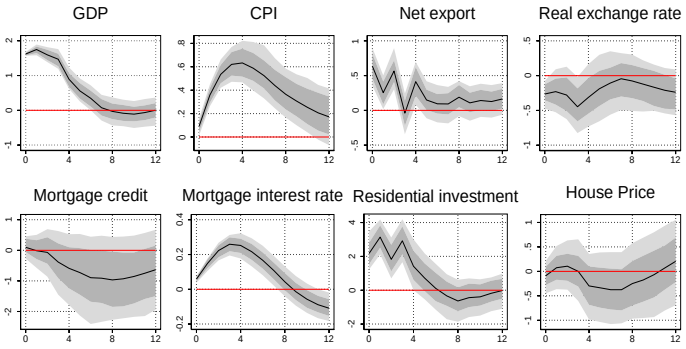
parsimonious, we instead estimate the trivariate VAR model only with MPSG, mortgage loan demand, and mortgage lending standards. Although this approach does not impose any commonality among countries in the same group, Figure B.5 shows that contrasting mortgage lending behaviors amid similar increases in loan demand are still found.

C. Extensions

Open economy consideration. Although all countries in our sample are small open economies, we have not incorporated the open economy perspective in our analysis. Now, we extend the baseline model to embed the open economy feature of the euro area by including the real exchange rate and net exports. To keep the number of parameters to be estimated manageable, BLS variables are replaced with these variables. Figure 8 displays the responses of the real exchange rates and net exports that proxy the balance of payment conditions in each economy. In response to a widening MPSG, both country groups show a depreciation of the real exchange rate, although the depreciation is stronger for periphery countries.[15] This finding is expected because a widening MPSG indicates an accommodative monetary policy stance.

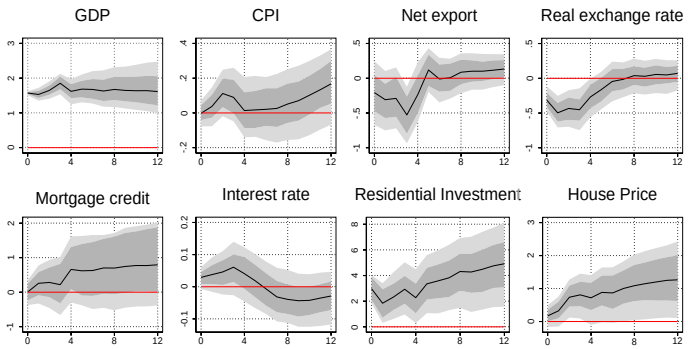
Figure 8. Effects of widening monetary policy stance gap in open economy model

A) Core countries



B) Periphery countries

[15] Since we use the real effective exchange rate index, an increase denotes appreciation.



Note: This figure shows the impulse response functions of real GDP, HICP, net exports, real effective exchange rate, outstanding amount of mortgage loans, mortgage interest rate, residential investment, and the real house price index to one unit of the MPSG in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

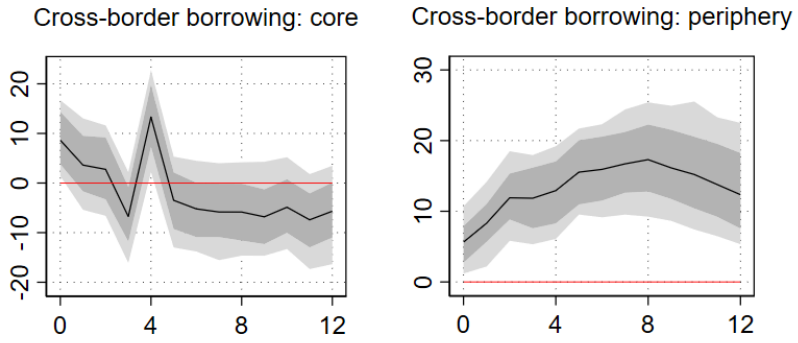
However, the responses of net exports differ between core and periphery countries. Net exports increase (decrease) in core (periphery) countries after a widening MPSG, suggesting that there are net capital outflows from core countries and net capital inflows to periphery countries. Although mortgage markets in the euro area are quite segmented and domestic households borrow from domestic banks, banks in periphery countries could have relaxed their lending standards through foreign borrowing, as shown in net capital inflows. When net capital inflows turn into net outflows following a reversing MPSG, the same mechanism that used to allow for rapid mortgage credit expansion makes banks more reluctant to extend mortgage credit, thereby exacerbating credit and housing price busts.

The rapid increase in intra-region financial flows from the core to periphery countries since the adoption of the euro has been identified as a source of credit and housing booms in periphery countries (Hale and Obstfeld, 2016). We provide corroborating evidence by showing that the imbalance created by the common monetary policy is behind the financial flows from the core to periphery countries. We use data on cross-border claims from the Bank for International Settlements (BIS) Locational Banking Statistics (LBS) to identify intra-euro area banking flows. This dataset provides a geographical breakdown of banks' counterparties and information about the currency composition of their balance sheets. In this regard, the major advantage of the BIS LBS data, compared to the banking flows collected from the BoP statistics, is a detailed breakdown of reported

series by recipient countries. See Bank for International Settlements (2017) and Albrizio et al. (2020) for further details on the LBS data.[16]

For each country in the sample, we take the sum of cross-border bank borrowing from counterparty countries only if a counterparty country belongs to the other region (i.e., periphery countries for a given core country and core countries for a given periphery country). By doing so, we can directly measure banking flows between core and periphery countries. Figure 9 shows the results when net exports are replaced by the log of the stock of loans and deposits. We confirm that in response to the widening MPSG, periphery countries' foreign borrowing from banks in core countries increases, while core countries' foreign borrowing from banks in periphery countries does not respond much.

Figure 9. Effect of widening monetary policy stance gap on cross-border borrowing



Note: This figure shows the impulse response functions of the sum of cross-border borrowing from the counterparty country group to one unit of the MPSG in the core (left) and periphery (right) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

[16] The LBS dataset captures outstanding claims and liabilities of internationally active banks located in reporting countries against counterparties residing in more than 200 countries. The data is compiled following the residency principle, which is consistent with the BoP statistics. Banks record their positions on an unconsolidated basis, including intragroup positions between offices of the same banking group. Currently, banking offices located in 46 countries, including many offshore financial centers, report to LBS. The LBS dataset captures around 95 percent of all cross-border interbank business (Bank for International Settlement, 2017). The bulk of cross-border bank claims and liabilities takes the form of loans and securities of the domestic banking sector vis-à-vis all counterparty sectors (including banks and non-banks, and the private and public sectors). Another main advantage of the BIS LBS is that the currency composition of cross-border claims and liabilities is available, so that cross-border banking flows, expressed in USD, are adjusted for movements in exchange rates.

Given that most recent severe financial crises have been combinations of substantial current account deficits and credit booms (e.g., Laeven and Valencia, 2013), and that banking crises preceded by credit booms are significantly more likely to occur when they are fueled by sizeable external borrowing (e.g., Davis et al., 2016), the contrasting capital flow responses driven by the imbalance in monetary policy further contribute to diverging economic paths between core and periphery countries.[17]

Unintended consequences of macroprudential policies. Then what explains aggregate cross-border lending by core banks to periphery countries? To the extent that macroprudential policies can influence the mortgage market in the euro area, we extend our analysis to investigate the role of macroprudential policy in driving different economic outcomes. Since some ingredients of these macroprudential policies are not directly applied to household mortgage credit, we narrow our focus to policies aimed at directly regulating household lending, including the loan-to-value (LTV) ratio, the debt-service-to-income (DSTI) ratio, the loan-to-deposit (LTD) ratio, and loan prohibitions based on household loan characteristics (e.g., maturity, size, and type of interest rate).

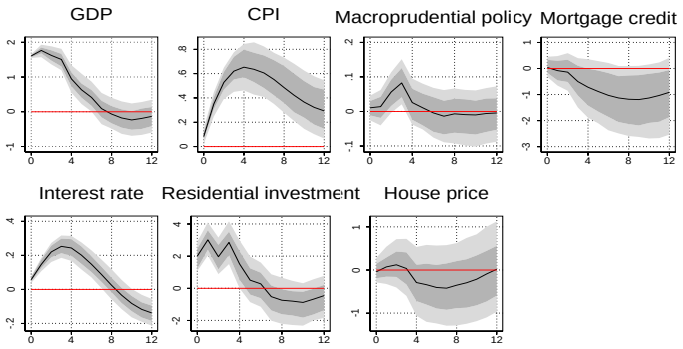
The responses of mortgage-targeted macroprudential policy to a widening MPSG in core and periphery countries are presented in Figure 10, which shows tightening in both regions. The tightened mortgage-targeted macroprudential policy in core countries provides a potential explanation for the aggressive cross-border lending to periphery countries documented in Figure 9. Given the restrictions on domestic mortgage lending, core banks could have an incentive to expand their business to periphery countries to search for yield. The response of the bank mortgage lending margin—computed as the difference between MFIs' interest rates on new business loans and a weighted average interest rate on new deposits from households and non-financial corporations—shown in Figure B.6. in Appendix B actually supports this interpretation. In response to the

[17] Especially during the pre-crisis period, there existed a divergence between domestic deposit growth and credit growth in the European banking system. To finance the discrepancy between them, banks issued bonds and raised funds by borrowing short-term on international money markets, suggesting that the domestic credit boom was accelerated by inter-bank lending; this resonates with the fact that current account deficits and credit growth are positively correlated (Lane and McQuade, 2014).

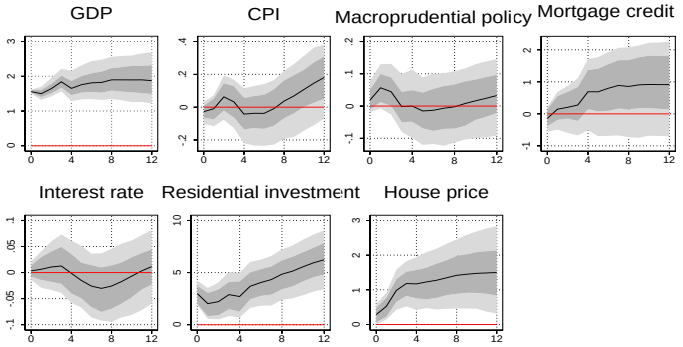
widening MPSG, bank lending margin, which proxies bank profitability, declines sharply in core countries, whereas it increases in periphery countries.

Figure 10. Response of macroprudential policies directly related to household mortgage credit

A) Core countries



B) Periphery countries



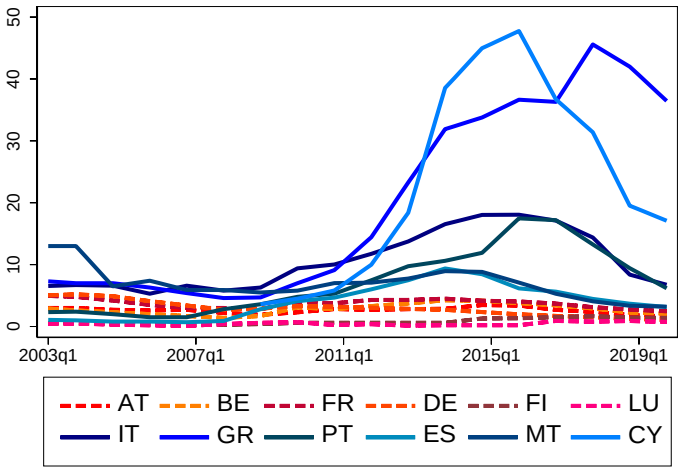
Note: This figure shows the impulse response functions of real GDP, HICP, the measure of macroprudential policies that directly regulates household mortgage credit, the outstanding amount of household mortgage loans, mortgage interest rate, residential investment, and the real house price index to one unit of the MPSG in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

As a further robustness check, we use the overall macroprudential policy index—the sum of the 17 categories in iMaPP—instead of the policies targeting only mortgage credit. Interestingly, macroprudential policy is actually relaxed in core countries (see Figures B.7), suggesting that the overall macroprudential policy response differs from that of mortgage credit. In contrast, no such discrepancy is found in periphery countries, implying that countercyclical mortgage-targeting macroprudential policies in core countries had unintended consequences in periphery countries.

When using an alternative macroprudential policy measure constructed by Cerutti et al. (2017), covering a broader dimension beyond mortgage credit, we find the same conclusion (see Figure B.8). We use country-specific time series data for the sum of the cumulative changes in the nine prudential policy instruments for this exercise.[18]

Non-performing loans. To complete the last link in the model of credit growth and crisis, we investigate whether the imbalance created by the common monetary policy and different bank lending standards ultimately affects banking sector soundness, which is measured by the NPL ratio. In Figure 11, we find that the NPL ratio has sharply increased in periphery countries since 2010. In contrast, core countries did not experience any prominent changes in the NPL ratio.

Figure 11. Evolution of the NPL ratio

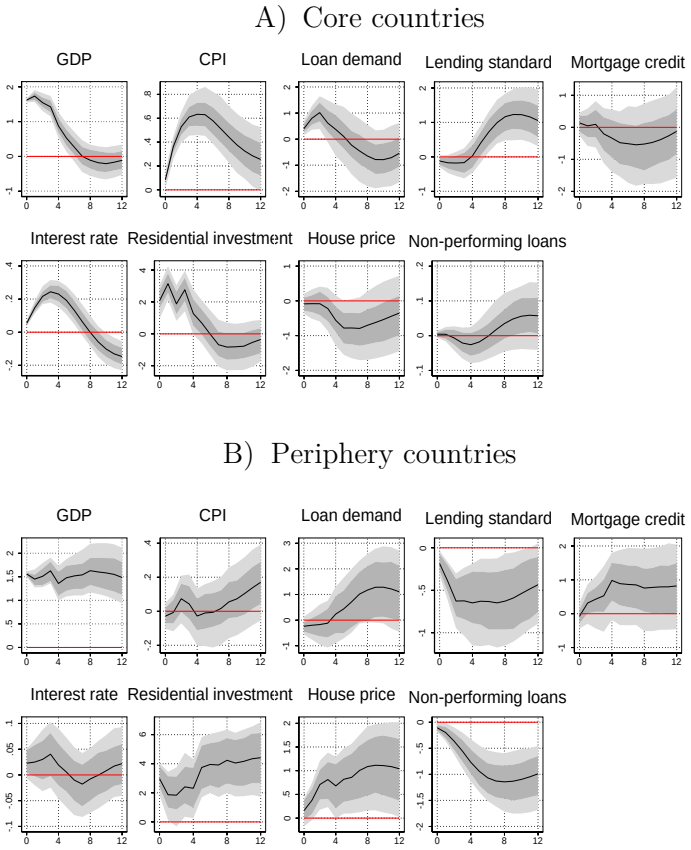


Note: This figure shows a time series of the ratio of bank non-performing loans to total gross loans in each country. The horizontal axis indicates quarters and the vertical axis indicates percentages. The dashed lines stand for core countries and the solid lines represent periphery countries.

[18] Its database contains quarterly changes for nine key prudential policy indexes conducted by each of the 64 countries from 2000 to 2018. Its prudential policy indexes are derived from nine prudential policy instruments: capital buffers, which are segregated into four types (general capital requirements, specific capital buffers related to real estate credit, specific capital buffers related to consumer credit, and other specific capital buffers); interbank exposure limits; concentration limits; LTV ratio limits; and reserve requirements divided into two sub-indexes: domestic currency capital requirements and foreign-currency capital requirements. Tightening episodes of each type of prudential policy instrument are recorded as positive values in the index, and loosening episodes are recorded as negative values.

To investigate whether the imbalance created by the common monetary policy accounts for the diverging patterns in banking sector soundness, we incorporate the NPL ratio into the baseline VAR model. As shown in Figure 12, in core countries, the NPL ratio does not respond to a widening MPSG. On the contrary, the reaction of the NPL ratio in periphery countries exhibits a sizable decline, which indicates a surge in the NPL ratio when the monetary policy stance gap reverses. The distinct responses of the NPL ratio complete our narrative of problems in the euro area.

Figure 12. NPL response to widening monetary policy stance gap



Note: This figure shows the impulse response functions of real GDP, HICP, mortgage loan demand, mortgage lending standards, the outstanding amount of household mortgage loans, mortgage interest rate, residential investment, the real house price index, and the non-performing loan ratio to one unit of the MPSG in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

IV. Conclusion

In search of a factor that contributes to much stronger booms and busts for mortgage credit, residential investment, and housing prices in periphery countries compared with core countries, we find that different bank lending behaviors in response to the imbalance created by the common monetary policy framework in the euro area are key to understanding the dramatic contrast between the two Europes. In response to the widening monetary policy stance gap (i.e., the common monetary policy becomes accommodative given country-specific economic conditions), mortgage loan demand increases in both country groups.

Although countercyclical bank lending standards in core countries dampen the expansion of mortgage credit and the appreciation of housing prices driven by the accommodative ECB monetary policy stance, procyclical bank lending standards in periphery countries accelerate the growth in mortgage credit and housing prices under the same condition. Interestingly, we do not find much difference in bank lending standards for consumer credit loans, highlighting a distinct role of the supply side of mortgage credit in understanding the euro area experience.

The extension of the baseline analysis offers a potential explanation for different bank lending standards between the two Europes and completes the novel perspective taken in the paper. In response to the widening monetary policy stance gap, capital flows out of core countries and moves into periphery countries, which can explain why mortgage lending standards behave differently. Aggressive cross-border lending by core banks to periphery countries may be driven by limited domestic mortgage lending opportunities, implying an unintended consequence of countercyclical macroprudential policy targeted at mortgage credit in core countries. In other words, the interaction between the monetary policy imbalance and mortgage-targeting macroprudential policies in core countries can be a hidden culprit of the excessive credit cycle problem in periphery countries; this idea deserves deeper analysis with micro-level data.

References

Alam, Zohair, Adrian Alter, Jesse Eiseman, Gaston Gelos, Heedon Kang, Machiko Narita, Erlend Nier, and Naixi Wang. "Digging Deeper—Evidence on the Effects of Macroprudential Policies from a New Database." IMF Working Papers 2019, no. 066 (2019).

Albrizio, Silvia, Sangyup Choi, Davide Furceri, and Chansik Yoon. "International bank lending channel of monetary policy." Journal of International Money and Finance 102 (2020): 102124.

Albuquerque, Bruno. "One size fits all? Monetary policy and asymmetric household debt cycles in US states." Journal of Money, Credit and Banking 51, no. 5 (2019): 1309-1353.

Altavilla, Carlo, Fabio Canova, and Matteo Ciccarelli. "Mending the broken link: Heterogeneous bank lending rates and monetary policy pass-through." Journal of Monetary Economics 110 (2020): 81-98.

Alvarez, Javier, and Manuel Arellano. "The time series and cross-section asymptotics of dynamic panel data estimators." Econometrica 71, no. 4 (2003): 1121-1159.

Amiti, Mary, and David E. Weinstein. "How much do idiosyncratic bank shocks affect investment? Evidence from matched bank-firm loan data." Journal of Political Economy 126, no. 2 (2018): 525-587.

Anderson, Theodore Wilbur, and Cheng Hsiao. "Formulation and estimation of dynamic models using panel data." Journal of Econometrics 18, no. 1 (1982): 47-82.

Arellano, Cristina, Andrew Atkeson, and Mark Wright. "External and Public Debt Crises." NBER Macroeconomics Annual 30 (2015): 191-244.

Arellano, Manuel, and Olympia Bover. "Another look at the instrumental variable estimation of error-components models." Journal of Econometrics 68, no. 1 (1995): 29-51.

Bahadir, Berrak, and Inci Gumus. "Credit decomposition and business cycles in emerging market economies." Journal of International Economics 103 (2016): 250-262.

Bank for International Settlements. "BIS Quarterly Review." 2017

Barigozzi, Matteo, Antonio M. Conti, and Matteo Luciani. "Do euro area countries respond asymmetrically to the common monetary policy?" Oxford Bulletin of Economics and Statistics 76, no. 5 (2014): 693-714.

Bassett, William F., Mary Beth Chosak, John C. Driscoll, and Egon Zakrajšek. "Changes in bank lending standards and the macroeconomy." Journal of Monetary Economics 62 (2014): 23-40.

Beckworth, David. "The monetary policy origins of the eurozone crisis." International Finance 20, no. 2 (2017): 114-134.

Bernanke, Ben S., and Cara S. Lown. "The Credit Crunch." Brookings Papers on Economic Activity 22, no. 2 (1991): 205-248.

Bernanke, Ben S., and Mark Gertler. "Inside the black box: the credit channel of monetary policy transmission." Journal of Economic Perspectives 9, no. 4 (1995): 27-48.

Burriel, Pablo, and Alessandro Galesi. "Uncovering the heterogeneous effects of ECB unconventional monetary policies across euro area countries." European Economic Review 101 (2018): 210-229.

Büyükkarabacak, Berrak, and Neven T. Valev. "The role of household and business credit in banking crises." Journal of Banking & Finance 34, no. 6 (2010): 1247-1256.

Canova, Fabio, and Matteo Ciccarelli. "Panel Vector Autoregressive Models: A Survey." In VAR models in macroeconomics–new developments and applications: Essays in honor of Christopher A. Sims. Emerald Group Publishing Limited, 2013.

Carvalho, Carlos, Fernanda Nechio, and Tiago Tristao. "Taylor rule estimation by OLS." Journal of Monetary Economics 124 (2021): 140-154.

Cerutti, Eugenio, Ricardo Correa, Elisabetta Fiorentino, and Esther Segalla. "Changes in Prudential Policy Instruments-A New Cross-Country Database." International Journal of Central Banking 13, no. 2 (2017): 477-503.

Choi, Sangyup. "Bank Lending Standards, Loan Demand, and the Macroeconomy: Evidence from the Korean Bank Loan Officer Survey." International Journal of Central Banking 17, no. 5 (2021): 1-46.

Ciccarelli, Matteo, Angela Maddaloni, and José-Luis Peydró. "Heterogeneous transmission mechanism: monetary policy and financial fragility in the eurozone." Economic Policy 28, no. 75 (2013): 459-512.

Ciccarelli, Matteo, Angela Maddaloni, and José-Luis Peydró. "Trusting the bankers: A new look at the credit channel of monetary policy." Review of Economic Dynamics 18, no. 4 (2015): 979-1002.

Coibion, Olivier, and Yuriy Gorodnichenko. "Why are target interest rate changes so persistent?" American Economic Journal: Macroeconomics 4, no. 4 (2012): 126-62.

Corsetti, Giancarlo, Joao B. Duarte, and Samuel Mann. "One Money, Many Markets." Journal of the European Economic Association 20, no. 1 (2022): 513-548.

Davis, J. Scott, Mack, Adrienne, Phoa Wesley, and Vandenabeele, Anne. "Credit booms, banking crises, and the current account," Journal of International Money and Finance 60 (2016): 360-377.

Delis, Manthos D., and Georgios P. Kouretas. "Interest rates and bank risk-taking." Journal of Banking & Finance 35, no. 4 (2011): 840-855.

Dell'Ariccia, Giovanni, Deniz Igan, Luc Laeven, and Hui Tong. "Policies for macrofinancial stability: Dealing with credit booms and busts." Financial crises: Causes, consequences, and policy responses (2014): 325-364.

Diamond, Douglas W., and Raghuram G. Rajan. "Liquidity risk, liquidity creation, and financial fragility: A theory of banking." Journal of Political Economy 109, no. 2 (2001): 287-327.

Fernández-Villaverde, Jesús, Luis Garicano, and Tano Santos. "Political credit cycles: the case of the Eurozone." Journal of Economic perspectives 27, no. 3 (2013): 145-66.

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

Georgiadis, Georgios. "Examining asymmetries in the transmission of monetary policy in the euro area: Evidence from a mixed cross-section global VAR model." European Economic Review 75 (2015): 195-215.

Hale, Galina, and Maurice Obstfeld. "The Euro and the geography of international debt flows." Journal of the European Economic Association 14, no. 1 (2016): 115-144.

Hamilton, James D. "Why you should never use the Hodrick-Prescott filter." Review of Economics and Statistics 100, no. 5 (2018): 831-843.

Hamilton, James D. "Time Series Analysis." Princeton University Press, 2020.

Helbling, Thomas, Raju Huidrom, M. Ayhan Kose, and Christopher Otrok. "Do credit shocks matter? A global perspective." European Economic Review 55, no. 3 (2011): 340-353.

Holmstrom, Bengt, and Jean Tirole. "Financial intermediation, loanable funds, and the real sector." Quarterly Journal of Economics 112, no. 3 (1997): 663-691.

Holtz-Eakin, Douglas, Whitney Newey, and Harvey S. Rosen. "Estimating vector autoregressions with panel data." Econometrica (1988): 1371-1395.

Horvath, Roman, Jana Kotlebova, and Maria Siranova. "Interest rate pass-through in the euro area: Financial fragmentation, balance sheet policies and negative rates." Journal of Financial Stability 36 (2018): 12-21.

Hristov, Nikolay, Oliver Hülsewig, and Timo Wollmershäuser. "Loan supply shocks during the financial crisis: Evidence for the Euro area." Journal of International Money and Finance 31, no. 3 (2012): 569-592.

Hristov, Nikolay, Oliver Hülsewig, and Timo Wollmershäuser. "The interest rate pass-through in the Euro area during the global financial crisis." Journal of Banking & Finance 48 (2014): 104-119.

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina. "Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking?" Econometrica 82, no. 2 (2014): 463-505.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. "Betting the house." Journal of International Economics 96 (2015): S2-S18.

Judson, Ruth A., and Ann L. Owen. "Estimating dynamic panel data models: a guide for macroeconomists." Economics Letters 65, no. 1 (1999): 9-15.

Kiviet, Jan F. "On bias, inconsistency, and efficiency of various estimators in dynamic panel data models." Journal of Econometrics 68, no. 1 (1995): 53-78.

Kiyotaki, Nobuhiro, and John Moore. "Credit cycles." Journal of Political Economy 105, no. 2 (1997): 211-248.

Laeven, Luc, and Fabian Valencia. "Systemic banking crises database." IMF Economic Review 61, no. 2 (2013): 225-270.

Lane, Philip R. "The European sovereign debt crisis." Journal of Economic Perspectives 26, no. 3 (2012): 49-68.

Lane, Philip R., and Peter McQuade. "Domestic credit growth and international capital flows." Scandinavian Journal of Economics 116, no. 1 (2014): 218-252.

Lown, Cara, and Donald P. Morgan. "The credit cycle and the business cycle: new findings using the Loan officer opinion survey." Journal of Money, Credit and Banking (2006): 1575-1597.

Maddaloni, Angela, and José-Luis Peydró. "Bank risk-taking, securitization, supervision, and low interest rates: Evidence from the Euro-area and the US lending standards." Review of Financial Studies 24, no. 6 (2011): 2121-2165.

Mandler, Martin, Michael Scharnagl, and Ute Volz. "Heterogeneity in Euro Area Monetary Policy Transmission: Results from a Large Multicountry BVAR Model." Journal of Money, Credit and Banking 54, no. 2-3 (2022): 627-649.

Meeks, Roland. "Do credit market shocks drive output fluctuations? Evidence from corporate spreads and defaults." Journal of Economic Dynamics and Control 36, no. 4 (2012): 568-584.

Mian, Atif, Amir Sufi, and Emil Verner. "Household debt and business cycles worldwide." Quarterly Journal of Economics 132, no. 4 (2017): 1755-1817.

Nechio, Fernanda. "Monetary policy when one size does not fit all." FRBSF Economic Letter 18 (2011): 13.

Neuenkirch, Matthias, and Matthias Nöckel. "The risk-taking channel of monetary policy transmission in the euro area." Journal of Banking & Finance 93 (2018): 71-91.

Nickell, Stephen. "Biases in dynamic models with fixed effects." Econometrica (1981): 1417-1426.

Peek, Joe, Eric S. Rosengren, and Geoffrey MB Tootell. "Identifying the macroeconomic effect of loan supply shocks." Journal of Money, Credit and Banking (2003): 931-946.

Pesaran, M. Hashem, and Ron Smith. "Estimating long-run relationships from dynamic heterogeneous panels." Journal of Econometrics 68, no. 1 (1995): 79-113.

Appendix

Appendix A. Data description

Table A.1. Definition and sources of data

Variables	Definition	Time span	Data source
Aggregate Euro area data			
Euro Overnight Index Average (EONIA)	EONIA rate of monetary policy decision date for every last month of its quarter	1999:Q1-2019:Q4	ECB Data Warehouse
Inflation (forecast)	Staff assessment of inflation rate	1999:Q1-2019:Q4	ECB Macroeconomic Projection Database
GDP growth (forecast)	Staff assessment of GDP growth	1999:Q1-2019:Q4	ECB Macroeconomic Projection Database
Output gap (forecast)	Estimated data from the Output Gaps Working Group in European Commission (annual)	1999-2019	European Commission
12 Euro area country data			
Inflation	Quarterly average of the monthly inflation rate	2003:Q1-2019:Q4	ECB Data Warehouse
GDP growth	Quarterly growth rate of real GDP	2003:Q1-2019:Q4	Author's calculation
Output gap	Cyclical component of real GDP from Hamilton filter (Hamilton, 2018)	2003:Q1-2019:Q4	Author's calculation
(Real) GDP	Gross domestic product at market prices, constant prices (the base year of 2015), calendar adjusted	1995:Q1-2019:Q4	Datastream
HICP	Quarterly average of the monthly HICP index (the base year of 2015), Seasonally adjusted with X-12 ARIMA	2003:Q1-2019:Q4	ECB Data Warehouse, author's calculation
Loan demand for mortgage loans	Diffusion index, the weighted difference between the share of banks reporting "substantially stronger" and "moderately stronger" and the share of "moderately weaker" and "substantially weaker" for mortgage loans in the percentage of the total number of banks	2003:Q1-2019:Q4	ECB's Bank Lending Survey data
Lending standard for mortgage	Diffusion index, the weighted difference between the share of banks reporting "substantially tightened" and "moderately tightened" and the share of "moderately	2003:Q1-2019:Q4	ECB's Bank Lending Survey data

	eased" and "substantially eased" for mortgage loans in the percentage of the total number of banks		
Loan demand for consumer loans	Diffusion index, the weighted difference between the share of banks reporting "substantially stronger" and "moderately stronger" and the share of "moderately weaker" and "substantially weaker" for consumer loans in the percentage of the total number of banks	2003:Q1-2019:Q4	ECB's Bank Lending Survey data
Lending standard for consumer loans	Diffusion index, the weighted difference between the share of banks reporting "substantially tightened" and "moderately tightened" and the share of "moderately eased" and "substantially eased" for consumer loans in the percentage of the total number of banks	2003:Q1-2019:Q4	ECB's Bank Lending Survey data
Mortgage credit oustanding	Outstanding amounts of mortgage loans at the end of the period	2003:Q1-2019:Q4	ECB Data Warehouse
Consumer credit outstanding	Outstanding amounts of loans for consumption at the end of the period	2003:Q1-2019:Q4	ECB Data Warehouse
Mortgage interest rate	Quarterly average of the mortgage interest rate for outstanding loans	2003:Q1-2019:Q4	ECB Data Warehouse
Consumer credit interest rate	Interest rate for loans for consumption at the end of the period for new business loans	2003:Q1-2019:Q4	ECB Data Warehouse
Lending margin	The difference between MFIs' interest rates on new business loans and a weighted average interest rate on new deposits from households and non-financial corporations.	2003:Q1-2019:Q4	ECB Data Warehouse
House price	Residential property price index from BIS statistics (the base year of 2010)	2003:Q1-2019:Q4	BIS
Residential investment	Gross fixed capital formation in the housing sector, constant prices	2003:Q1-2019:Q4	Datastream
Total consumption	GDP Expenditure approach, Private Final Consumption, Chained volume estimates, National reference year, Quarterly, SA	2003:Q1-2019:Q4	OECD statistics
Macroprudential policy measure	Alam et al. (2019): Dummy-type variables for 17 instruments of macroprudential policy. We used the sum of dummy-type variables for 17 instruments and the sum of those for the loan-targeted macroprudential policy in each quarter.	2003:Q1-2019:Q4	Alam et al. (2019), Cerutti et al. (2017)

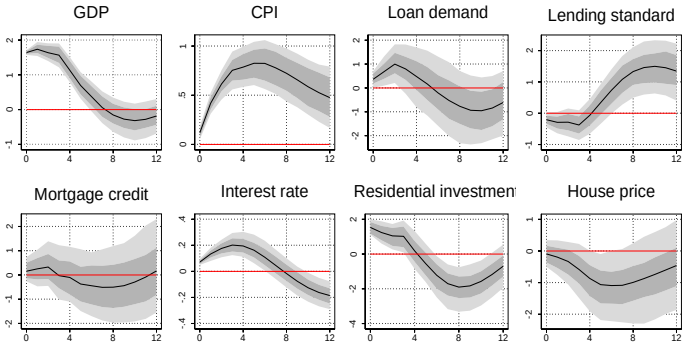
	Cerutti et al. (2017): Database for prudential policy indexes, which are derived from 9 key prudential policy instruments. We employed the sum of the cumulative changes in each instrument.		
Net export	External balance of goods and services	2003:Q1-2019:Q4	Eurostat
Real exchange rate	Real effective exchange rate, the broad index	2003:Q1-2019:Q4	BIS
Cross-border borrowing	Bilateral cross-border claims, loans, and deposits	2003:Q1-2019:Q4	BIS Locational Banking Statistics
Non-performing loans ratio	Share of non-performing loans in total bank loans (annual)	2003-2019	IMF Financial Soundness Indicators

Note: This table provides the definition, time span, and sources of variables used in the analysis.

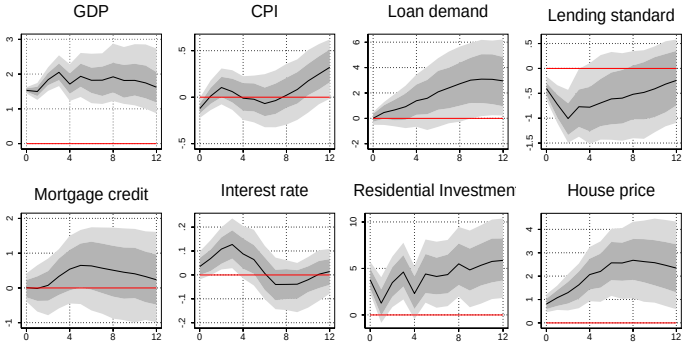
Appendix B. Robustness checks

Figure B.1. Robustness checks: alternative classification of core and periphery countries

A) Core countries

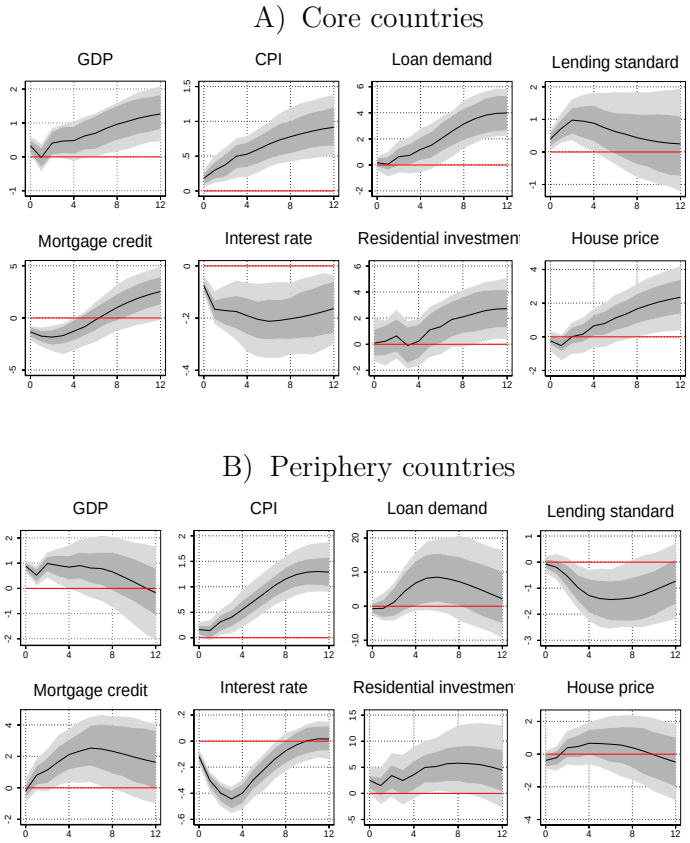


B) Periphery countries



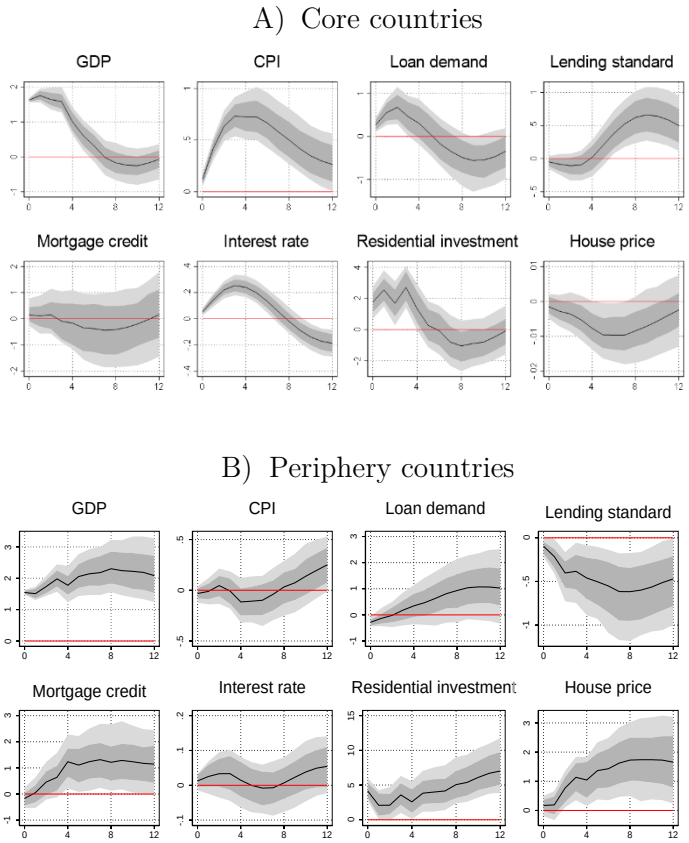
Note: This figure shows the impulse response functions of real GDP, HICP, mortgage loan demand, mortgage lending standards, outstanding amount of household mortgage loans, mortgage interest rate, residential investment, and real house price index to one unit of MPSG in the core (top) and periphery (bottom) countries. Core countries are Austria, Belgium, France, Germany, and Finland. Periphery countries are Greece, Italy, Portugal, and Spain. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

Figure B.2. Robustness checks: country-specific Taylor rule residuals



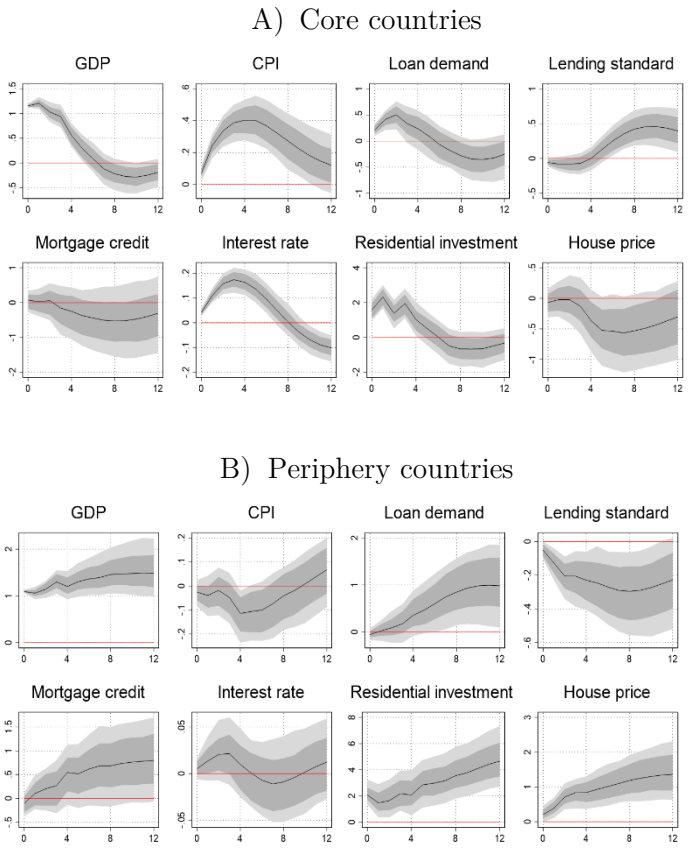
Note: This figure shows the impulse response functions of real GDP, HICP, mortgage loan demand, mortgage lending standards, outstanding amount of household mortgage loans, mortgage interest rate, residential investment, and real house price index to one unit of the country-specific Taylor residual shock in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

Figure B.3. Robustness checks: dropping the ZLB period



Note: This figure shows the impulse response functions of real GDP, HICP, mortgage loan demand, mortgage lending standards, outstanding amount of household mortgage loans, mortgage interest rate, residential investment, and real house price index to one unit of MPSG in the core (top) and periphery (bottom) countries. The estimation sample runs from 2003Q1 to 2016Q1. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

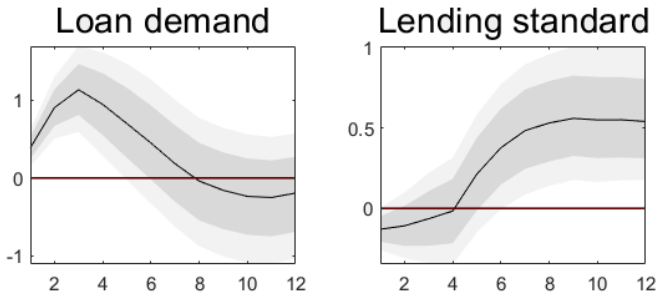
Figure B.4. Robustness checks: estimating the Taylor rule using pre-crisis data only



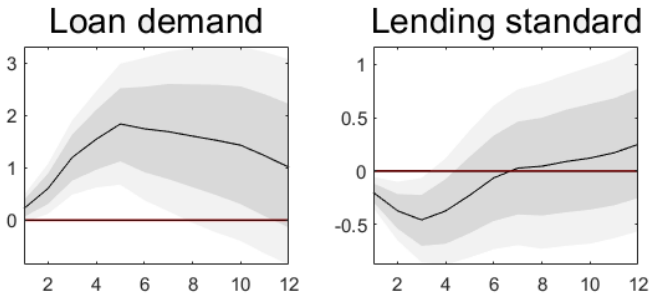
Note: This figure shows the impulse response functions of real GDP, HICP, mortgage loan demand, mortgage lending standards, outstanding amount of household mortgage loans, mortgage interest rate, residential investment, and real house price index to one unit of MPSG in the core (top) and periphery (bottom) countries. The euro-area Taylor rule is estimated using the pre-crisis data only (until 2007Q4). The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

Figure B.5. Robustness checks: using mean-group estimator

A) Core countries



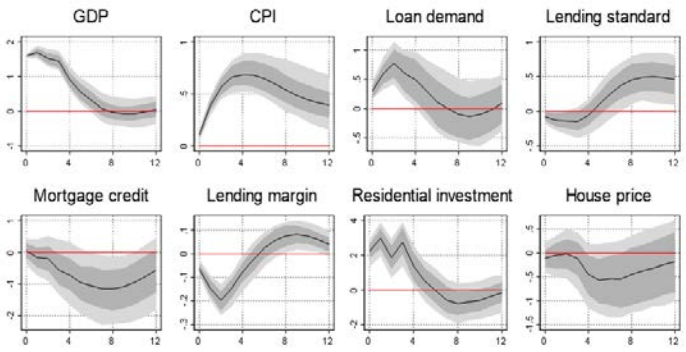
B) Periphery countries



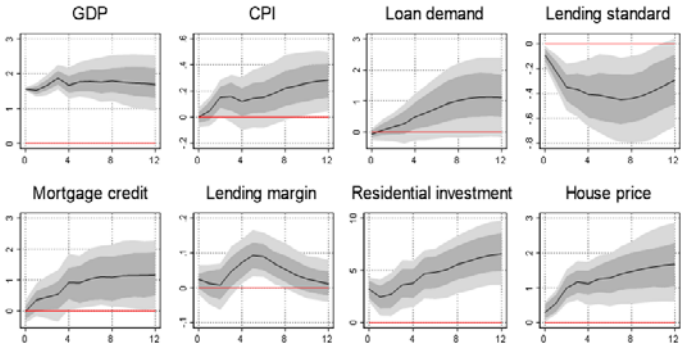
Note: This figure shows the impulse response functions of mortgage loan demand and mortgage lending standards to one unit of MPSG in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated by using a bootstrapping with 5,000 resamples.

Figure B.6. Robustness checks: response of bank mortgage lending margin

A) Core countries

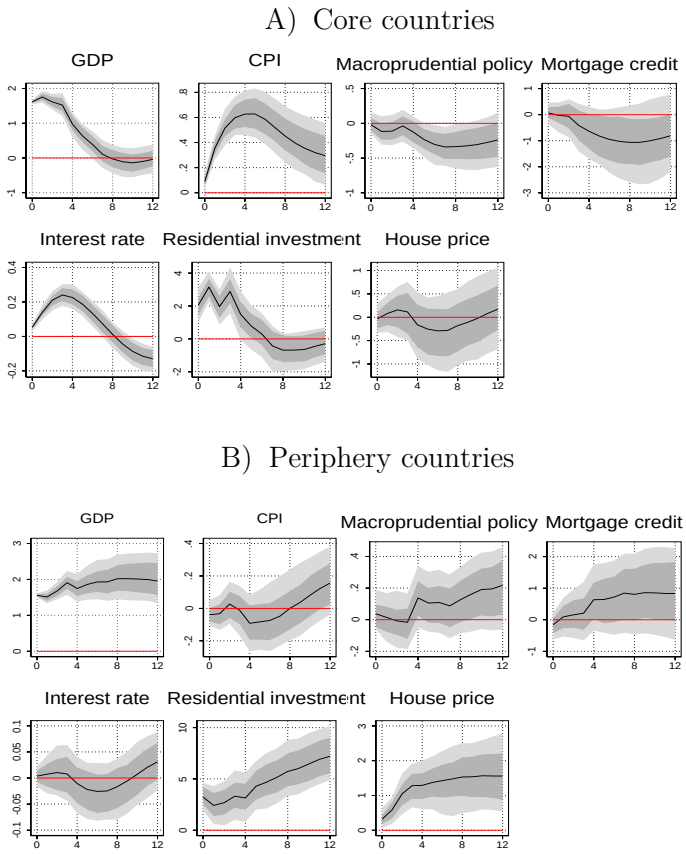


B) Periphery countries



Note: This figure shows the impulse response functions of real GDP, HICP, mortgage loan demand, mortgage lending standards, outstanding amount of household mortgage loans, mortgage lending margin, residential investment, and real house price index to one unit of MPSG in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

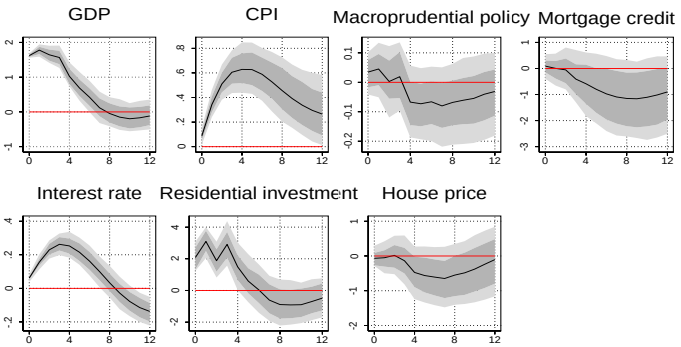
Figure B.7. Robustness checks: overall macroprudential policy response



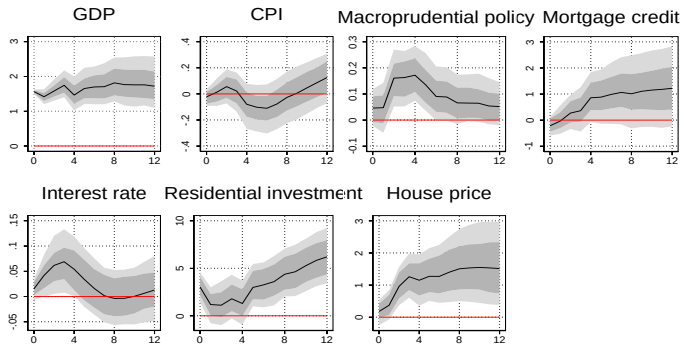
Note: This figure shows the impulse response functions of real GDP, HICP, overall macroprudential policy index, outstanding amount of household mortgage loans, mortgage interest rate, residential investment, and real house price index to one unit of MPSG in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.

Figure B.8. Robustness checks: alternative measure of macroprudential policies

A) Core countries



B) Periphery countries



Note: This figure shows the impulse response functions of real GDP, HICP, alternative macroprudential policy measure by Cerutti et al. (2017), outstanding amount of household mortgage loans, mortgage interest rate, residential investment, and real house price index to one unit of MPSG in the core (top) and periphery (bottom) countries. The horizontal axis indicates quarters and the vertical axis indicates percentage change. Each graph plots 68% and 90% confidence intervals with shaded areas. The confidence interval is calculated using a Monte Carlo simulation with 200 repetitions.