EUROPEAN CENTRAL BANK

EUROSYSTEM

Working Paper Series

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Monetary policy spillovers and the role of prudential policies in the European Union

No 2854

Abstract

This paper empirically examines the extent to which prudential policies can help to reduce the macro-financial spillover effects of foreign monetary policy for all 28 EU countries. Using local projection methods, I show that EU countries with tighter prudential policies face significantly smaller, and less negative spillovers to bank credit and house prices from US, UK and EA monetary policy tightening shocks. Measures of a macroprudential policy nature such as capital buffers, lending standards restrictions and limits to credit growth appear to be particularly effective at mitigating the spillover effects of US monetary policy, while measures of a microprudential nature as minimum capital requirements, risk weights and limits on large exposures prove effective in mitigating spillovers effects of UK monetary policy. Results indicate that domestic prudential policies can dampen EU countries' exposure to foreign monetary policy and may be a useful tool in the face of spillovers coming from centre countries and within the EU.

JEL Codes: E52, E58, E61, F42, F45.

Key Words: International spillovers; Local projections; Policy Interactions; Monetary policy; Prudential policy.

Non-Technical Summary

The influence of US on the global financial cycle ensures that US monetary policy is a timeless concern amongst policymakers around the world, as well as in EU countries. The tight links that the UK has to the EU market - notwithstanding Brexit - may also raise concerns about the influence of UK monetary policy on the remaining members of the EU. In EU countries, which are one of the most active countries world-wide at enacting prudential measures, I show that in the face spillovers, (macro)prudential policies in EU countries can help to offset foreign monetary policy spillovers, helping to resolve policymakers' 'dilemma'.

I use data from the MaPPED database which cover a wide range of (macro)prudential policy actions in 28 EU countries from 2000 to 2018, spanning measures such as capital buffers, lending standard restrictions, limits of credit growth and volume, risk weights, minimum capital requirements, limits on large exposures and concentration. Together with measures of unexpected US, UK and Euro Area monetary policy shocks, I estimate the interaction between foreign monetary policy and EU (macro)prudential policies in a panel local projections setup. I examine how domestic indicators of financial stability nature such as bank lending and house prices in EU respond to various foreign monetary policy shocks, and particularly I show which domestic (macro)prudential policies can prove effective at offsetting some of the monetary policy spillovers.

The main result from the analysis is that an EU country with tighter prudential policies faces significantly smaller reductions in bank credit and house prices following a monetary policy tightening shock from the US and the UK, and to some extent from EA. A +1pp exogenous tightening of US monetary policy leads to a 2pp fall in bank credit and a 2.5pp fall in house prices on average, after around 15 months, in EU countries with no prudential policy actions in place. Further, a +1pp tightening of UK monetary policy leads to a 3.7pp fall in house prices and a 1pp drop in bank credit for EU countries. Results show that an EU country with an additional (one standard deviation) macroprudential policy tightening action - such as capital buffers - faces a substantially smaller spillover in the face of US monetary policy, with an offsetting effect of up to 1.9pp for bank credit and 1.3pp for house prices respectively. Measures such as risk weights and limits on large exposures, have a similar offsetting effect of up to 1.5pp and respective up to 2.4 for house prices in EU countries that are facing UK monetary policy spillovers. These findings indicate that even an additional prudential policy tightening can significantly reduce or offset the monetary policy spillover. This implies that national prudential policies can help to insulate EU countries against spillovers of monetary policy coming from centre countries (such as the US or the UK), especially given the current environment where central banks tighten their monetary policy in an attempt to curb rising inflation.

The findings have important implications, suggesting that macroprudential policies (such as capital buffers and lending standards restrictions) can effectively reduce the spillover effects of US monetary policy shocks, while microprudential policies (such as risk weights, minimum capital requirements, limits on large exposures) are effective at reducing spillover effects from within the EU market, namely from the UK and EA monetary policy shocks. These findings could help policymakers to maintain monetary policy autonomy in the face of spillovers and the global financial cycle, and better decide which measure to activate to safeguard their respective economies.

1 Introduction

As a consequence of the 2007-09 global financial crisis, the Basel Committee on Banking Supervision (BCBS) introduced a distinct toolbox of microprudential and macroprudential measures, that will *"allow the banking system to support the real economy through the economic cycle"*. Since then, governments and financial regulatory authorities in the European Union (EU) and other parts of the world, have been actively working to implement these measures. Policymakers have at their disposal several tools to address various risks, ranging from the pursuit of price stability via monetary policy, soundness of financial institutions via microprudential policy and safeguarding the stability of the financial system as a whole via macroprudential policy.

The focus of this paper is specifically on prudential policies in EU countries, both micro and macroprudential, which according to the flagship ESRB (2014) report, contribute to a more robust and sustainable financial system. Both macro and microprudential policies perspectives are important to this framework, as the financial system as a whole cannot be made safer simply by aiming to make individual banks sound, while is also possible that attempts by individual institutions to remain solvent can have repercussions on the whole system.

The main goal of prudential policy is to preserve financial stability and to prevent the build-up of systemic risk that may have adverse effects on the functioning of the financial system and the real economy (Buch et al. (2018b)). However, their effects are still debated in the literature. On one hand, they are seen to be able to contain risks and contribute to macroeconomic stability (Galati and Moessner, 2018); on the other, some have suggested they could harm macroeconomic activity (Sánchez and Röhn, 2016). This paper aims to contribute to this debate from a different angle and assess which domestic prudential policies in EU countries prove effective at offsetting the spillovers from foreign monetary policy shocks. EU countries' policymakers have been employing prudential policies for a long time, with Kelber and Monnet (2014) summing a European historical perspective of the use of prudential policies. Nevertheless, EU countries are one of the most active countries in the world at using prudential policy measures, justifying the focus of this paper.

Foreign monetary policy can have side effects on financial stability and ultimately on individual institutions. EU countries are often disproportionately hit by spillovers from shocks emanating from centre countries. The sensitivity of countries to foreign shocks is somewhat related to the well-documented 'global financial cycle' (Passari and Rey, 2015), characterised by a high degree of cross-border co-movement in capital flows and credit growth in the world economy. The influence of US monetary policy on the global cycle (Miranda-Agrippino and Rey, 2019) ensures that US monetary policy is a timeless concern amongst policymakers around the world, as well as in EU countries. The tight links that the UK has to the EU market - notwithstanding Brexit - may also raise concerns about the influence of UK monetary policy on the remaining members of the EU.

Rey (2015) argues that policymakers face a dilemma in the face of the global financial cycle: domestic policymakers can pursue independent monetary policy if they have recourse to capital controls or macroprudential policies. With this in mind, this paper aims to analyse the extent to which domestic prudential policies are an effective tool for helping to offset the spillover effects of US monetary policy. I also examine other monetary policy spillovers, such as the ones from the UK, and within the EU by looking at the effects of the common EA monetary policy. Prudential policies can ultimately benefit monetary policy, as the instruments can be more targeted, and thus tightened or loosened in specific markets, segments or institutions. Further, as shown in empirical studies such as Bussière et al. (2021a); Coman and Lloyd (2022); Fernandez-Gallardo (2023), proactive prudential policies enhance the resilience of the financial system. This paper asks two questions. First, to what extent do EU prudential policies offset the spillover effects of centre-country monetary policies, such as in the US and UK, and from within the EU? Second, which specific prudential policies are most effective in facing foreign monetary policy spillovers? As tighter prudential policy can reduce the risk-taking channel of monetary policy (Altavilla et al. (2020)), these questions are at the heart of current policy debates, attempting to demonstrate that a policy mix is needed to address the undesirable spillovers of monetary policy, without compromising foreign monetary policy objectives. In doing so, four distinct transmission channels of monetary policy will be examined, ranging from financial indicators such as bank credit and their indirect effect on house prices, as well as real economy indicators such as real GDP and inflation [1]. By examining the effects of foreign monetary policy on these particular channels, we will first uncover the magnitude of the spillovers and then which prudential instruments are best equipped at offsetting or reducing the monetary policy spillovers.

With a panel dataset summarising prudential policy actions in EU countries, this paper

[1]Further details on the definition of the channels and subsequent references are included in Table 1, following the approach of Georgiadis (2016).

shows that the macro-financial spillovers from US, UK and EA monetary policy shocks differ depending on the prudential policies already activated by EU countries. The main result from the analysis is that an EU country with tighter prudential policies faces significantly smaller reductions in bank credit and house prices following a monetary policy tightening shock from the US and the UK, and to some extent from EA. A +1pp exogenous tightening of US monetary policy leads to a 2pp fall in bank credit and a 2.5pp fall in house prices on average, after around 15 months, in EU countries with no prudential policy actions in place. Further, a +1pp exogenous tightening of UK monetary policy leads to a 3.7pp fall in house prices and a 1pp drop in bank credit for EU countries.

Results show that an EU country with an additional (one standard deviation) prudential policy tightening action - such as capital buffers - faces a substantially smaller spillover in the face of US monetary policy, with an offsetting effect of up to 1.9pp for bank credit and 1.3pp for house prices respectively. While measures such as risk weights and limits on large exposures, have a similar offsetting effect of up to 1.5pp and respective up to 2.4 for house prices in EU countries that are facing UK monetary policy spillovers. These findings indicate that even an additional prudential policy tightening can significantly reduce or offset the monetary policy spillover. This implies that national prudential policies can help to insulate EU countries against spillovers of monetary policy coming from centre countries, especially given the current environment when central banks tighten their monetary policy in an attempt to curb rising inflation.

The empirical study uses a local projection-based setup for monetary policy spillovers to study the interactions of monetary policy with domestic prudential policy in the EU. Exogenous US monetary policy shocks are identified via external instruments (Gürkaynak, Sack, and Swanson, 2005; Gertler and Karadi, 2015) to obtain unbiased estimates of coefficients of interest. In measuring prudential policies, data spanning all 28 EU countries from 2000:Q1 to 2018:Q4 is used, summarising policy actions of a macroprudential nature from the Budnik and Kleibl (2018) MaPPED database. The dataset covers changes in several widely used prudential tools, with both micro-and macro-prudential objectives, specifically: capital requirements, capital buffers, risk weights, lending standards restrictions etc. Although the dataset captures prudential policy actions within a given quarter, the approach of this paper is following the existing literature (Bussière et al. (2021a), Coman and Lloyd (2022)) and cumulates actions over two years, to proxy the prudential policy actions relevant for monetary policy spillovers and to account for possible implementation, activation and transmission lag. Using the rich granularity of the MaPPED dataset, this paper aims to investigate which individual prudential measures are effective at (partially) mitigating the spillover effects of various monetary policy shocks.

Following a short literature review, the paper is structured as follows. Section 2 goes into details regarding the empirical specification and data. Section 3 briefly shows evidence of US, UK and EA monetary policy spillovers to EU countries, to offer context to our analysis. Section 4 presents estimates of the interaction between EU prudential policies and various monetary policy shocks. Section 5 concludes.

Related Literature As mentioned in Rey (2015), independent monetary policies are possible if and only if the capital account is managed, with prudential policy being used as an additional tool to potentially shield countries from the global financial cycle and reduce their spillovers caused by external monetary policy shocks (e.g. Bruno and Shin (2015)).

This paper aims to contribute to a growing literature on interactions between monetary and prudential policies. Much of this literature focused so far on within-country policy interactions, with theoretical (e.g Angelini, Neri, and Panetta, 2014; Quint and Rabanal, 2014; Chen and Columba, 2016) and empirical (e.g. Bruno, Shim, and Shin, 2017; Coman and Lloyd, 2022) contributions, while Bussière et al. (2021a) covers findings of the International Banking Research Network initiative examining the interaction between monetary policy and prudential policy in determining international bank lending.

The empirical literature on the interaction between the monetary and prudential policy is scarce and in its infancy, focusing more on the interaction of domestic policies and cross-border implications. A series of empirical papers study the interaction between domestic prudential and monetary policies, with Takáts and Temesvary (2019) investigating the effect of prudential measures on cross-border lending during the episode of the US taper tantrum and the cross-border lending flows in Takáts and Temesvary (2021), and Avdjiev et al. (2021) examining cross-border spillovers.

The most recent literature related to this paper is mainly focused either on: (i) studies of individual prudential measures, mostly on borrower based measures such as DSTI and LTVs (Kuttner and Shim, 2016); (ii) individual country studies - United Kingdom and France (Bussière et al., 2021b), Sweden (Cao et al., 2021), Ireland and the Netherlands (Everett et al., 2021), Germany (Imbierowicz et al., 2021), United States (Niepmann et al., 2021), Israel (Benchimol et al., 2021), Argentina, Brazil and Uruguay (Rojas et al., 2020) ; (iii) single episodes - US taper tantrum (Takáts and Temesvary, 2019). Most studies stir away from comparing the effectiveness of many prudential policies, hence, this paper identifies a gap in the literature which will be the aim in the following sections - namely looking at the interactions of many prudential policies with foreign monetary policy shocks. One aspect, where this paper has a contribution to the literature (due to the use of a local projection approach) is the ability to identify the dynamic effects of prudential policies and to show how these dynamic effects potentially differ across different channels and prudential instruments. This angle has not received much attention in the literature, with similar studies using local projections such as Arbatli-Saxegaard et al. (2022) mostly focusing only on US Monetary Policy spillovers and not on the interactions with prudential policies.

The MaPPED database by Budnik and Kleibl (2018) offers a detailed overview of all measures of a prudential nature taken in EU countries, with studies using the database emerging in the past years. Recent studies that use the MaPPED database mostly focus on: assessing the impact of prudential tools and their design on the banks' systemic risk (Meuleman and Vennet (2020)), lending restriction measures and their effectiveness in curbing house prices and credit (Poghosyan (2020)), analysing the effects of prudential policies on leverage and insolvency risk (Niţoi et al. (2019)), and measuring prudential policy shocks and their effects on credit cycle variables (Schryder and Opitz (2021)).

In comparison to this existing literature, the contribution of this paper is threefold. First, the focus is on spillovers to macro-financial variables of EU countries. Second, a series of monetary policy shocks are considered and not just a single episode like the US Taper Tantrum. Third, the Budnik and Kleibl (2018) is one of the most granular datasets of prudential policy measures in EU countries, which allows for a detailed overview of which policies prove effective to curb various monetary policy spillovers. In doing so, this current empirical paper shows how prudential policy can be an effective tool at increasing the resilience of domestic EU countries against foreign monetary policy shocks.

2 Empirical Specification

The methodology used to estimate the interaction of several monetary policy shocks with EU prudential policies is local projections (Jordà, 2005). Compared to more commonly used vector autoregressive methods, for this analysis, three major advantages are to be considered when working with a local projections setup. A first advantage is that a standard local projections spillover framework can be extended to account for prudential policy interactions. When compared to alternative empirical specifications, a second advantage is that the local projection setup is more robust to misspecification, a key concern in the case of analysing the effect of various heterogeneous prudential policy instruments. A third consideration is that local projections are better able to capture the dynamic interaction effects between monetary and prudential policy, a key aspect of this analysis, by directly regressing forward lags of the variables on contemporaneous policy actions.

Monetary Policy Spillovers The monetary policy spillover regression marks a starting point for this proposed empirical specification and provides context to the analysis of policy interactions. The proposed model shows the impact of monetary policy shocks $MP_t^{\$}$ in quarter t, on the variable of interest $y_{i,t+h}$ in country i at quarter $t+h$ using the below local projection specification:

$$y_{i,t+h} - y_{i,t-1} = \alpha^h + \eta_{mp}^h MP_t^{\$} + \boldsymbol{\gamma}^h \mathbf{X}_{i,t-1} + \boldsymbol{\theta}^h \mathbf{G}_{t-1} + f_i^h + \varepsilon_{i,t+h} \quad (1)$$

for $h = 0, 1, ..., H$ and with $\$$ taking the form of US, UK or EA monetary policy. $\mathbf{X}_{i,t-1}$ is a $K \times 1$ vector of control variables that are known before the $MP_t^{\$}$ monetary policy shock, with $\boldsymbol{\gamma}^h$ the coefficients for $\mathbf{X}_{i,t-1}$. f_i^h stand for country fixed effects, which capture the potentially confounding factors which are specific to countries and fixed over time. As the monetary policy shock $MP_t^{\$}$ is the same for all countries, time-fixed effects cannot be included in (1) as they would absorb all variation in the explanatory variables. Therefore, variables summarising the global cycle in $\mathbf{G}_{t-1}$, a $J \times 1$ vector with coefficients $\boldsymbol{\theta}^h$ are included in the equation. With the assumption that the conditional mean can be linearly approximated, in this model η_{mp}^h measures the average effect of a period-t monetary policy shock on $y_{i,t+h}$ at $t+h$.

A series of dependent variables are explored as main channels,[2] spanning all 28 EU coun-

[2] More details on the indicators sources in Appendix (A.1)

tries and reflecting the full country coverage in the prudential policy actions dataset. The macro-financial dataset includes aggregate measures of financial stability in a country such as bank credit as well as house prices. In this paper, bank credit is defined by domestic bank lending to the private sector (households, corporate and other financial institutions), while house prices are shown as the index of residential property prices across all 28 EU countries. Related literature has emphasised the role of credit growth as a leading indicator of financial crises (as depicted in e.g. Schularick and Taylor, 2012; Lloyd et al., 2021), motivating the selection of this lending variable. Data on house prices are included as several macroprudential policies—such as lending standards restrictions—have been tightened with a focus on curbing real estate related risks. Macro variables, such as real GDP and inflation, are also included in the analysis as dependent variables to illustrate the overall effect on the real economy. Two lags of GDP, inflation and the dependent variable (quarterly changes) in the set of country-varying controls $\mathbf{X}_{i,t-1}$ are included to capture the prevailing macroeconomic state of country i ahead of monetary policy innovation. The global controls $\mathbf{G}_{t-1}$ include two lags of GDP, VIX and past monetary policy shocks for the US, UK and EA respectively, to reflect external economic and financial conditions.

Interactions of Spillovers with Receiving-Country Prudential Policy This regression will be the main focus of this paper and shows the interactions between monetary policy and prudential policy. To analyse how prudential policies in EU countries interact with spillovers from monetary policy shocks, equation (1) is adapted and modified to account for country i prudential policy $Pru_{i,t}$:

$$\begin{aligned} y_{i,t+h} - y_{i,t-1} =& \alpha^h + \beta^h_{pru} Pru_{i,t-1} + \delta^h \left(MP^{\$}_t \times Pru_{i,t-1} \right) \\ &+ \boldsymbol{\gamma}^h \mathbf{X}_{i,t-1} + f^h_i + f^h_t + \varepsilon_{i,t+h} \end{aligned} \tag{2}$$

where $Pru_{i,t-1}$ is an indicator of prudential actions, that takes positive values for a (net) tightening and negative values for a (net) loosening. In addition to what was included in (1), time fixed effects f^h_t are added to account for potentially confounding factors that are the same for all countries in a given period (e.g. the state of the global financial cycle). Because the time fixed effects f^h_t account for all observed *and* unobserved global factors that vary over time,

$\mathbf{G}_{t-1}$ and $MP_t^{\$}$ variables are excluded from equation (2).[3]

The controls $\mathbf{X}_{i,t-1}$, which vary by time *and* country, are the same as in (1). The *sign* of coefficient estimates from equation (1) can help to interpret results from equation (2).[4] The coefficient of interest in the latter, capturing policy interactions, is δ^h. If for a given dependent variable $y_{i,t+h}$, monetary policy spillovers are negative $\hat{\eta}^h_{mp} < 0$, then a positive interaction coefficient $\hat{\delta}^h > 0$ implies that tighter prudential policy helps to *offset* some of the negative spillover effects of a monetary policy tightening. In contrast, if the interaction coefficient is negative $\hat{\delta}^h < 0$, tighter prudential policy *does not mitigate* the negative spillover effects of tighter monetary policy.[5] The sequence $\{\hat{\delta}^h\}_{h=0}^H$ can be interpreted as the average interactions associated with a monetary policy impulse at time t.

It is worth mentioning that prudential policy is included with a lag in equation (2) to treat endogeneity (a similar approach to Akinci and Olmstead-Rumsey (2015)), and to avoid accounting for policy actions that could occur *in response* to a monetary policy shock or simultaneity of economic conditions and domestic prudential policy. By following this approach, prudential policy actions explicitly assess if, in advance of monetary policy innovation, they can help to offset some of the spillover effects of the centre country's monetary policy.

In all regressions, Driscoll and Kraay (1998) standard errors are used to account for potential cross-sectional and temporal dependence in inference, and impulse responses are reported up to a two-year horizon—i.e. $H = 8$.

2.1 Prudential Policy Data

The macroprudential policy actions dataset, *Macroprudential Policies Evaluation Database (MaPPED)*, by Budnik and Kleibl (2018) is used to calculate the $Pru_{i,t-1}$ indicators and includes a detailed overview of policy instruments that are either genuinely macroprudential or are essentially microprudential but likely to have a significant impact on the whole banking system. Compared to other granular prudential policies databases, [6] the MaPPED database covers in greater detail

[3]Time fixed effects f_t^h capture all observed and unobserved time-varying factors, therefore equation (2) is the preferred specification for statistical inference in this paper.

[4]A direct comparison of coefficients from (1) and (2) is not quantitatively possible, as the former specification excludes time fixed effects f_t^h while the latter includes them. Section (4.1.1) discusses a hybrid specification, which enables a direct comparison of the two coefficients

[5]The opposite holds if the monetary policy spillover is positive $\hat{\eta}^h_{mp} > 0$. Then the interpretation is that a negative interaction coefficient $\hat{\delta}^h < 0$ reflects an offsetting policy interaction, and a positive coefficient $\hat{\delta}^h > 0$ a non-offsetting one.

[6]Such as IMF database from Lim et al. (2011), BIS database for policy actions on housing markets from Shim et al. (2013), the macroprudential policies data based on the IMF survey in Cerutti et al. (2017a), the iMaPP database

and over a longer period all the measures in EU countries, offering information about when a measures is announcement and when it enters in force, hence a more suited database for this paper. The main advantage of the MaPPED database comes from circumventing reporting biases by having an exhaustive list of instruments and actions based on cross-checks by National Competent Authorities from all 28 EU countries.

The events depicted in the dataset track the introduction - recalibration - termination of eleven categories and 53 subcategories of instruments.[7] The dataset spans all 28 EU member states (including the United Kingdom that was still an EU member state at the last update of the dataset), the same countries as in our panel of macro-financial data. The prudential policy data is quarterly, from 1995:Q1 to 2018:Q4,[8] and covers eleven categories of policy instruments with both micro-and macro-prudential objectives: (a) minimum capital requirements; (b) capital buffers; (c) risk weights; (d) leverage ratio; (e) loan-loss provisioning; (f) lending standards restrictions; (g) limits on credit growth and volume; (h) levies/taxes on financial institutions; (i) limits on large exposures and concentration; (j) liquidity requirements and limits on currency and maturity mismatch; (k) other measures.

The Budnik and Kleibl (2018) dataset is based on a carefully designed questionnaire completed by the European Central Bank in cooperation with experts from national central banks and supervisory authorities of all EU member states. The raw data depicts *changes* in prudential policy instruments within a quarter, marking a 'Policy tightening' or 'Policy loosening' for each measure. For this analysis, a value of $+1$ is assigned to a given prudential policy if it was tightened in a specific quarter, a value of -1 if it was loosened, and 0 if no change occurred. For each policy instrument, the dataset offers further information regarding the exact type of policy action: activation of a new tool; changes in the level of an existing instrument; changes in the scope of an existing instrument; deactivation of an existing tool; maintaining the existing scope and level of an existing instrument.

To suit this study, the raw MaPPED dataset is processed as follows. First, the announcement date is taken as the start of the action for each measure, by country. When the announcement date is missing, the date of the measures being in force is taken. The reason why announcement date is taken as the start of the action is because the announcement date is the moment when the banks start preparing for the measures, while when a measures is already in force, the action

described in Alam et al. (2019)

[7]The complete list of MaPPED instruments is listed in Appendix (A.2)

[8]Budnik and Kleibl (2018) dataset has been extended by its authors to 2018:Q4.

is already implemented (as in the iMaPP database of Alam et al. (2019)). Second, prudential policy actions are summed for each of the eleven categories over several quarters. The moving sum reflects the fact that changes in prudential policies in a single quarter are unlikely to solely influence the spillovers from monetary policy shocks accounting for potential implementation lags, activation lags, transmission lags, and persistence and level of prudential policies. In the baseline formulation, actions will be summed over two years such that the prudential policy measure at time $t-1$, $Pru_{i,t-1}$, includes information on all prudential policy changes from $t-8$ to $t-1$, inclusive.[9] The choice of a two-year summation period in the baseline specification balances a compromise and follows the approach of recent related literature (Bussière et al., 2021a; Cao et al., 2021; Coman and Lloyd, 2022; Everett et al., 2021; Niepmann et al., 2021). Further variations of $Pru_{i,t-1}$ are presented in the Robustness section (A.4).

On the one hand, a long enough summation period is needed to capture sufficient variation in prudential policy measures over time, as well as proxy aspects of cross-country differences in their level. On the other hand, there is a need to ensure that the summation period is not too long such that it suppresses variation in the prudential measure because of policy reversals over time. This indicates that even prudential policies announced just before a foreign shock can help to lessen the spillovers it generates for EU countries, implying that activating prudential measures is never too late to help offset potential spillovers from centre countries. The measures of each prudential policy category of MaPPED are constructed, by summing cumulated measures of all instruments in the respective section. The analysis is performed using cumulated measures of individual prudential policies categories, to isolate their differential impacts across dependent variables.

To account for a more balanced panel, only the variables from 2000:Q1 to 2018:Q4 are used in the analysis. Summary statistics of the two-year cumulated prudential policy proxy are presented in Table 3. The sample is across all 28 EU countries and is covering the full sample period, and one can observe that most measures were tightened on average. All categories of prudential measures take a range of positive and negative values, with other measures and

[9] An illustrative formula calculating $Pru_{i,t-1}$ =

$$\sum_{t-8}^{t-1} Pru_a + ... + \sum_{t-8}^{t-1} Pru_z$$

where i are individual categories of policy instruments noted from 1 to 11 in Appendix (A.2), and a to z are their respective individual instruments.

liquidity measures being the most active measures in terms of policy tightening.

2.2 Monetary Policy Shocks

The definition of a monetary policy shock in this analysis is more in a structural sense, meaning that monetary policy innovation is independent of all other macroeconomic perturbations (e.g. demand and supply shocks) and follows the approach of the most recent literature (Bussière et al. (2021a) and the references within). This type of definition is most commonly identified within a vector autoregression (VAR) framework (e.g. Gertler and Karadi (2015)). It is worth noting that the purpose of monetary policy shocks is to identify unbiased estimates of the coefficients of interest. In this analysis, a central concern is that the measure of foreign monetary policy $MP_t^{\$}$ is exogenous to attain unbiased estimates of the parameters of interest.

To study various types of foreign monetary policy shocks and which prudential measures are useful in offsetting the spillovers, several shocks are considered. The following subsections detail the methodology for constructing monetary policy shocks for the US, UK and Euro Area from structural VAR models identified using high-frequency identification techniques. Importantly, the shocks are exogenous to other macroeconomic factors that could drive interest rate changes, allowing the identification of causal monetary policy effects within the proposed econometric framework for this analysis. The identification strategy is based on the widely used external instrument VAR approach of Mertens and Ravn (2013) and Stock and Watson (2018), applied to monetary policy in the US by Gertler and Karadi (2015) and in the UK by Cesa-Bianchi et al. (2016) and Gerko and Rey (2017).

The premise is to use interest rate surprises, which capture movements in financial markets in short windows around central bank announcements, as instruments for the identification of structural monetary policy shocks. The plausible identification assumption is that, within the monetary policy surprise window, no other macroeconomically relevant information, which could drive both private sector behaviour and monetary policy decisions, is revealed. The US shocks are estimated by extending the Gertler and Karadi (2015) methodology to 2018:Q3, using the same data and identification assumptions as in their original paper. UK shocks are estimated by extending the Gerko and Rey (2017) methodology to 2018:Q3 again, by using the same data and identification assumptions. Euro area shocks are taken from the Euro Area Monetary Policy Event-Study Database (EA-MPD), constructed by Altavilla et al. (2019).

2.2.1 US Monetary Policy Shocks

Of particular concern in the proposed setting are potentially omitted factors, such as global financial moves that could simultaneously affect the US monetary policy stance as well as macro-financial outcomes in EU countries, especially if they have heterogeneous effects across the EU. The monetary policy shocks used in this paper (Figure 15) have been also used in the paper by Coman and Lloyd (2022), where the authors looked at interactions between US monetary policy and prudential measures in emerging markets (EMs).

Based on extensive literature, monetary policy shocks are identified with the widely used external instruments VAR approach of Mertens and Ravn (2013) and Stock and Watson (2018), applied to US monetary policy by Gertler and Karadi (2015). Relative to Gertler and Karadi (2015), one change is made to the used VAR specification: estimating it with data up to the end of 2018 (instead of 2012). Like Gertler and Karadi (2015), the VAR consists of four monthly frequency US variables: industrial production, the consumer price index, the 1-year zero-coupon government bond yield, and the excess bond premium (Gilchrist and Zakrajsek, 2012). The model is estimated with 12 lags of monthly variables, using monthly data from 1979 to 2018. Quarterly monetary policy shocks are constructed from the monthly VAR, by cumulating monthly shocks within the quarter. To identify a monetary policy shock, high-frequency monetary policy surprise measures are used from Gürkaynak et al. (2005)—changes in monetary policy expectations in a short time window (30 minutes) around Federal Open Market Committee (FOMC) announcements—as instruments for the reduced-form monetary policy innovation. The key identifying assumption is that no other potentially confounding events, which could simultaneously drive private sector behaviour and the monetary policy decision, can occur within the short time window around the FOMC announcements. Despite the sample extension, the instrument—changes in the three-month-ahead federal funds futures rate in 30-minute windows around FOMC announcements—continues to pass tests for instrument validity, with a first-stage F-statistic over 10.

2.2.2 UK Monetary Policy Shocks

The UK monetary policy shocks (Figure **??**) are constructed by extending the model of Gerko and Rey (2017) using the monetary policy surprises in their baseline specification as the instrument and their VAR specification from 1982:01 to 2018:12. The VAR includes five variables that match the baseline specification in Gerko and Rey (2017), namely: 5-year government bond interest rate, RPIX, industrial production, sterling-US dollar exchange rate and a measure of corporate credit spreads. 12 lags of monthly variables (i.e. p = 12) are included, with a first-stage F-statistic of 19.8.

2.2.3 EA Monetary Policy Shocks

In this analysis, the Euro Area monetary policy shock (Figure **??**) is taken from the Euro Area Monetary Policy Event-Study Database (EA-MPD) by Altavilla et al. (2019). The EA-MPD database contains intraday asset price changes around the policy decision announcements, as well as around the ECB monetary policy press conference. The data is considered to be a standard in monetary policy research for the Euro Area and is regularly updated and made available online. Euro Area monetary policy is measured as a potentially two-dimensional process with possible Target/Timing and Path (Forward Guidance) components. It is then allowed for a third dimension after the onset of the financial crisis to capture the information about non-standard measures and especially QE. EA-MPD database presents a wide range of measures, including various Overnight index swaps (OIS). In this paper the OIS of 6 months is used as the main measure of EA monetary policy, in line with most relevant related literature (Imbierowicz et al., 2021; Bussière et al., 2021b; Everett et al., 2021).

3 Monetary Policy Spillovers

To contextualise the estimates of prudential policy interactions, an estimate of the spillover effects of several monetary policies to EU countries using equation (1) is first described in this section. The estimates show the spillover coefficient for (log) dependent variables in EU countries and are used to provide context for the results of the policy interaction in the next section.

The coefficient estimates can be interpreted as average impulse responses to a +1pp monetary policy tightening shock to EU countries. The results indicate that a +1pp exogenous tightening of several monetary policies leads to a fall in the dependent variable of EU countries after several months. The impulse responses are plotted up to 24 months and the expectation is to observe a negative spillover effect to various dependent variables.

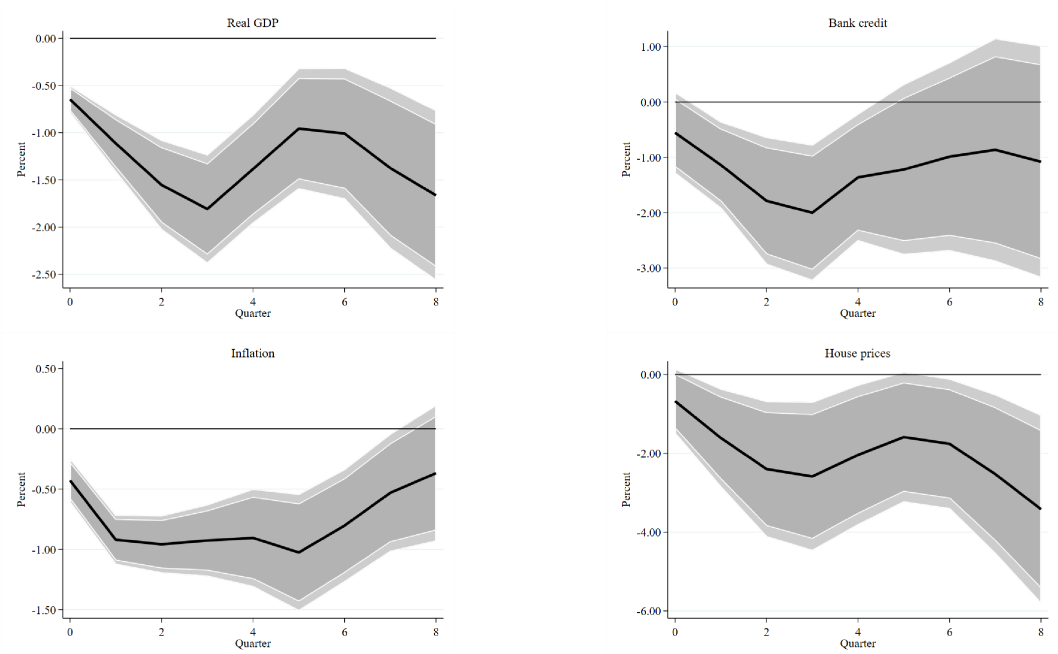
3.1 US Monetary Policy Spillovers

Figure 1 presents estimates of the US monetary policy spillover coefficient for (log) bank credit, house prices, as well as GDP and inflation in EU countries, while Columns (1), (4), (7) and (10) of Table 4 contain the corresponding point estimates and standard errors at each horizon for the respective variables. The coefficient estimates can be interpreted as average impulse responses to a +1pp US monetary policy tightening shock.

The results show that a US monetary policy tightening is associated with a financial tightening abroad, impacting the EU economy, a finding which is in line with the existing literature (Dedola et al. (2017), Iacoviello and Navarro (2019)). Bank credit and house prices fall significantly in EU countries within two years of a US monetary policy shock. As well as being statistically significant, the spillovers are economically significant: following a +1pp US monetary policy tightening shock, house prices in EU countries fall by up to 3.4pp in a two years horizon after the shock (Table 4 - Column 4). The corresponding peak for bank credit is a fall of around 2pp, which occurs in less than one year (Table 4 - Column 1). To take the analysis a step further, I break down the EU countries sample into Euro Area (EA) countries (Table 8) and non-Euro Area EU countries (Table 9). We can observe an even deeper and longer lasting spillover of US monetary policy on bank credit of EA countries (Table 8 - Column (1)), which is not observed for the bank credit of non-EA EU countries (Table 9 - Column (1)), possibly reflecting the tighter linkages of EA banks with the US economy.

In terms of effects on the real economy, the spillovers are more subdued, though still sig-

Figure 1: US monetary policy spillovers to Real GDP, Inflation , Bank credit and House prices in EU countries



Notes: $\{\eta^h_{mp}\}^8_{h=0}$ estimates with (log) real GDP, inflation, bank credit and house prices for 28 EU countries as dependent variable in regression (1). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors.

nificant. Figure 1 shows the spillover coefficient estimates for real GDP and inflation, which are negative at all horizons for EU countries. A US monetary policy tightening is associated with a reduction in EU countries' GDP and inflation of up to -1.6pp (Table 4 - Column 7) and respective -1pp (Table 4 - Column 10), on a two year horizon. Looking at the breakdown of EU countries, the spillover effects of US monetary policy are deeper reaching a -2.7pp fall for the GDP of non-EA EU countries over a 2 year horizon (Table 9 - Column (7)), an effect which is not observed for the EA countries that gradually recover after a 1 year horizon (Table 8 - Column (7)). A possible explanation of the divergent results between the two countries blocks would be that the non-EA EU countries still have their own currencies and did not ascent to the common Euro currency, making them more exposed to the US monetary policy shocks mainly due to exchange rates.

3.2 UK Monetary Policy spillovers

The negative spillover effects of UK monetary policy are more prominent than the ones from US monetary policy, Figure 2 showing a noticeable impact mostly on real GDP and house prices.

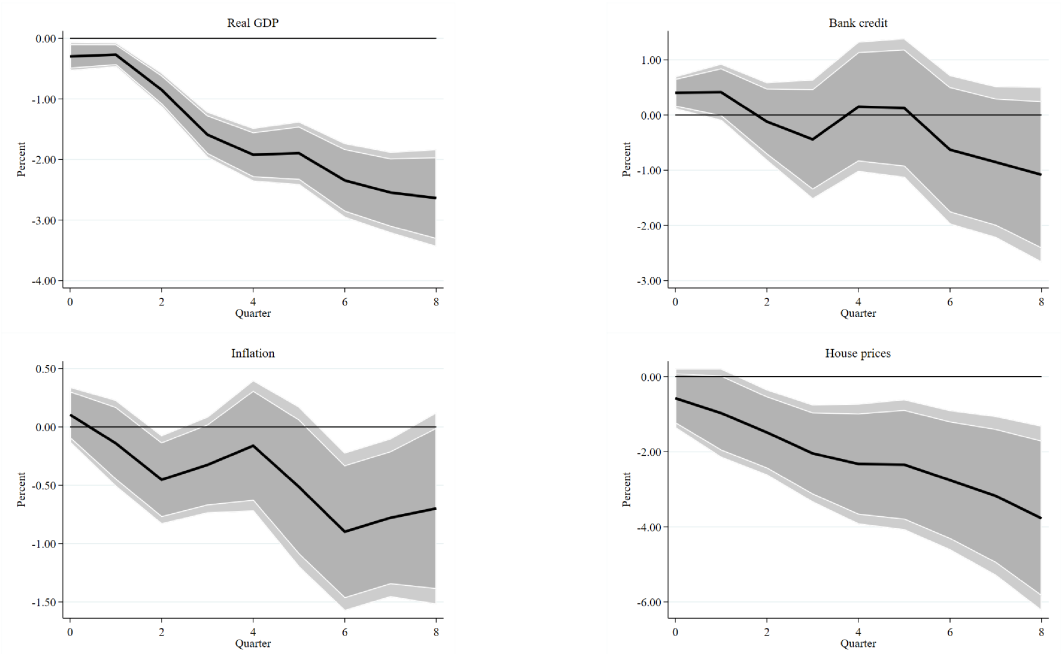
The results show that a UK monetary policy tightening does not immediately affect the bank credit and inflation of EU countries, while house prices and real GDP fall significantly and remain negative in EU countries within two years of a UK monetary policy shock. Although the point estimates for bank credit are mostly statistically insignificant, the wide confidence bands, in part, reflect heterogeneity across EU countries.

Columns (2), (5), (8) and (11) of Table 4 show the point estimates and standard errors at each horizon for bank credit, house prices, real GDP and inflation. The coefficient estimates can be interpreted in the same way as the previous section - as average impulse responses to a +1pp UK monetary policy tightening shock. As well as being statistically significant, in Figure 2 the spillovers of UK monetary policy to the EU countries are economically significant: following a +1pp UK monetary policy tightening shock, house prices in EU countries fall by up to 3.7pp in the two years after the shock (Table 4 - Column 5), bank credit by up to 1pp (Table 4 - Column 2), while EU countries GDP fall by up to 2.6pp in the two years horizon (Table 4 - Column 8) and inflation up to -0.9pp (Table 4 - Column 11). In the case of non-EA EU countries, the spillover effects are even deeper for GDP, dropping to 3.2pp (Table 9 - Column (8)), possibly reflecting the exchange rate links of local currencies with the pound. While most of the studies showing the spillover effects of UK monetary policy focus on transmission to the real economy through bank lending (Buch et al. (2018a)), this section illustrates a novel channel through which a tightening in UK monetary policy can affect the EU countries, namely through house prices.

3.3 EA Monetary Policy spillovers

In comparison to previous sections, the negative spillover effects of EA monetary policy on EU countries are smaller, with Figure 3 showing a noteworthy impact on bank credit and house prices. An EA monetary policy tightening affects the EU countries in a more subdued way compared to spillovers from US or UK, mostly since the Euro is adopted by 19 out of the 28 countries in the sample. Bank credit and house prices fall in EU countries within two years of an EA monetary policy shock, while in the real economy the same effect is subdued for real GDP and delayed by two quarters for inflation. The related literature (Potjagailo (2017)) shows how EA monetary policy shocks affect EU countries' financial variables such as interest rates and stock market volatilities (Bruno and Shin (2015)), as well as real activity variables and

Figure 2: UK monetary policy spillovers to Real GDP, Inflation , Bank credit and House prices in EU countries

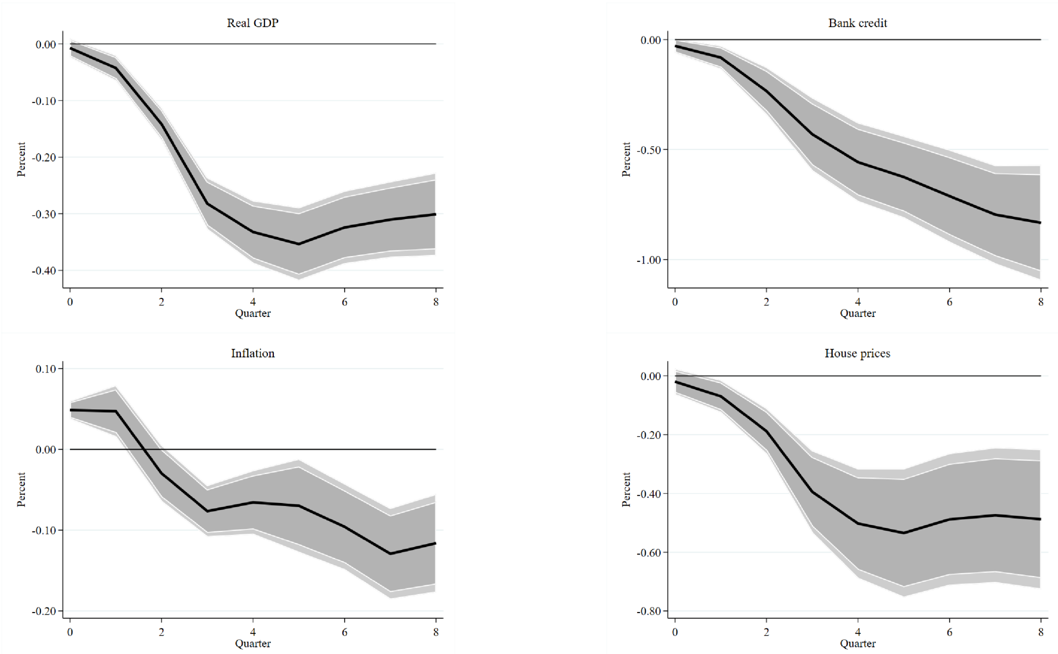


Notes: $\{\eta_{mp}^{h}\}_{h=0}^{8}$ estimates with (log) real GDP, inflation, bank credit and house prices for 28 EU countries as dependent variable in regression (1). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors. The UK dropped from the sample, reflecting the results of EU27 countries.

prices, while Figure 3 findings show different channels of EA monetary policy spillovers to EU countries.

The estimates are summarized in Columns (3), (6), (9) and (12) of Table 4, which show the point estimates and standard errors at each horizon for our main variables of interest. The average impulse response to a +1pp EA monetary policy tightening to the EU countries are statistically significant: bank credit falls by up to 0.83pp (Table 4 - Column 3), house prices in EU countries fall by up to 0.53pp in the two years after the shock (Table 4 - Column 6), while real GDP drops by 0.3pp (Table 4 - Column 9) and inflation drops by 0.13pp (Table 4 - Column 12). An interesting finding is that bank credit from non-EA EU countries falls deeper up to 1.27pp on a two year horizon (Table 9 - Column (3)), possibly reflecting the tighter ties of non-EA EU banks with the EA banks, which proves to be a transmission channel for EA monetary policy shocks.

Figure 3: EA monetary policy spillovers to Real GDP, Inflation , Bank credit and House prices in EU countries



Notes: $\{\eta^h_{mp}\}^8_{h=0}$ estimates with (log) real GDP, inflation, bank credit and house prices for 28 EU countries as dependent variable in regression (1). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors.

4 Prudential Policy Interactions

To assess how the prudential policies in EU countries interact with the spillovers from US monetary policy, equation (2) will be estimated using different categories of prudential policy measures $Pru_{i,t-1}$. The results in this section show how an EU country with an additional prudential policy tightening action, $Pru_{i,t-1} = 1$, is facing (on average) a substantially smaller spillover to a $+1$pp monetary policy tightening shock coming from US, UK or the EA.[10] The expected result is that prudential policies should increase the resilience of banks and borrowers, by curbing excessive credit growth when intended, a similar finding to Ampudia et al. (2021).

In the face of spillovers from monetary policy shocks and the associated global financial cycle, the results indicate that EU countries can rely on policies, both microprudential and macroprudential, to significantly reduce the extent to which various monetary policy drives cyclical fluctuations in credit conditions and house prices in particular, but also in the real economy. Following an unexpected monetary policy tightening, EU countries with tighter macropruden-

[10]Further robustness checks are included in Appendix A.4

tial policies face smaller falls in bank lending, consistent with their financial sector being better placed to absorb the adverse spillovers of tighter monetary policy due to domestic macroprudential policies. This empirical finding could provide a basis for the calibration of policy response and could become a familiar weapon in the authorities' arsenal, as a suggested way forward in Borio (2008).

Categorising prudential policy When analysing the policy interactions is worth differentiating between the types of measures in terms of microprudential or macroprudential policy instruments. Macroprudential policies have the objective of limiting financial system-wise distress to avoid costs to the real economy linked to financial instability. On the other side, microprudential measures have the objective of limiting the distress of individual institutions to ultimately have consumer protection. Both types of measures enable banks to use the capital set aside to absorb losses and support lending. The Budnik and Kleibl (2018) MaPPED dataset shows a clear differentiation of each category into either:[11] (i) Macroprudential, (ii) Microprudential, (iii) Macroprudential, Microprudential. The merit of the classification comes from the fact that the MaPPED dataset was built and checked in collaboration with all National Competent Authorities from all 28 countries, which enhances the reliability of the information included. As macroprudential measures have in general an application to all banks in one country, while the microprudential measures are mostly bank-specific, the analysis below will differentiate between the scope of the MaPPED measures: those set at country level - macroprudential policies and those set at bank-level - microprudential policies. Due to the nature of the MaPPED database, microprudential measures are aggregated at the country level and do not reflect individual bank-level policies.

4.1 Interaction with US Monetary Policy Spillovers

The first study shows the interaction of US monetary policy with various specific measures of EU prudential policy, using granular measures from the Budnik and Kleibl (2018) dataset. Within the dataset, there are eleven categories of prudential policies and up to 53 individual instruments. A particular focus is given to flagship macroprudential policy instruments from categories such as (i) capital buffers, (ii) lending standards restrictions, and (iii) limits on credit growth.

[11] More details on the exact classification of each category in Appendix (A.2)

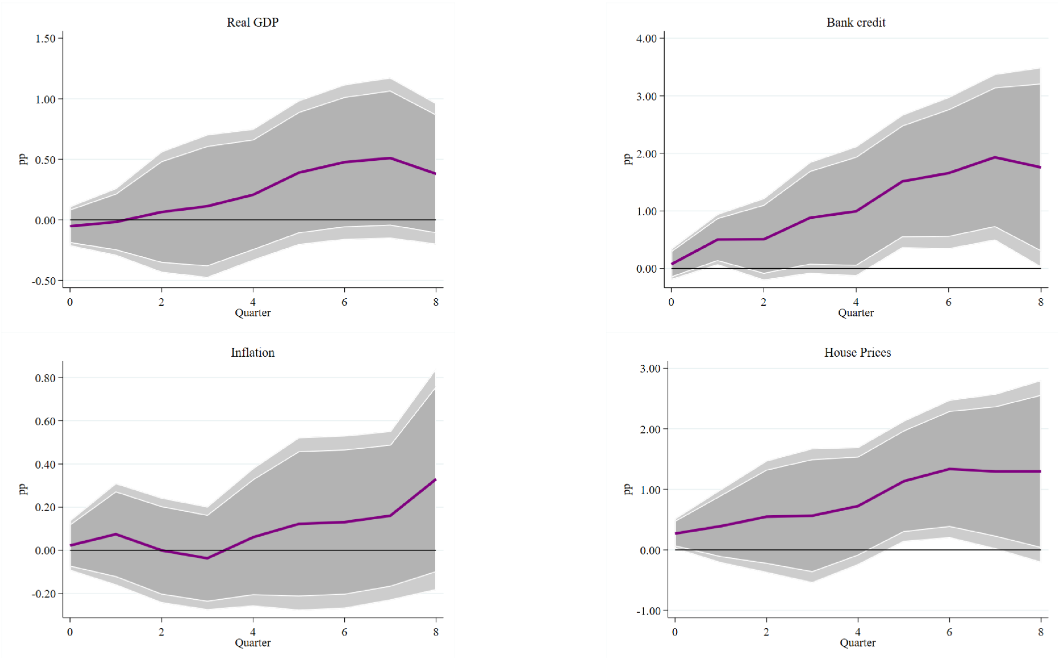
The results in this section are summarised in Table 5 and show that macroprudential policies set at the country level (such as capital buffers, limits of credit growth, lending standards restrictions) are particularly effective at offsetting the spillover effects of US monetary policies and dampening a country's exposure to the associated global credit cycle. This is an important finding through which Borio (2010) and Claessens et al. (2013) identify these macroprudential policies to be potentially used by national authorities as an effective means to counter-cyclically dampen an expected credit boom or credit crunch. A further breakdown of the EU sample in EA and non-EA EU countries are summarised in Table 10 and 11 respectively.

4.1.1 Capital buffers

Capital buffers are viewed as the flagship macroprudential measures and the MaPPED dataset includes a wide range of buffers for the EU countries. For this subcategory, the $Pru_{i,t-1}$ indicator sums up measures in EU countries such as the countercyclical capital buffer (CCyB), the capital conservation buffer (CCoB), the systemic risk buffer (SRB) as well as global systemically important institutions (G-SII) and other systemically important institutions (O-SII) capital buffers, among others. The capital buffers have a systemic and macro angle, with a broad application, especially to lending. According to the ESRB Handbook, the measures help mitigate risks from excessive credit growth and aim at addressing systemic bank and structural systemic risks by raising banks' loss-absorbing capacity, hence strengthening the resilience of the financial system as a whole. In this subsection, equation (2) is estimated with the two-year cumulated capital buffers measures, hypothesising that these buffers should significantly interact with US monetary policy spillovers for economic and financial indicators, mostly for bank credit and house prices.

Figure 4 and estimates in Table 5, show that the interaction coefficient is positive at a range of horizons for all indicators from GDP, to inflation, and most prominently and statistically significant for bank credit (Table 5 - Column 1) and house prices (Table 5 - Column 4). The interpretation of the positive coefficients is as follows: controlling for time fixed effects, an EU country with an additional capital buffer measure tightening enacted in advance of a +1pp US monetary policy tightening can (on average) partially offset spillovers effects, over a 12-18 months horizon. The capital buffers seem to fully offset the spillovers effects of US monetary policy on EA house prices (Table 10 - Column 4), proving an effective protective tool. As the

Figure 4: Interaction of US monetary policy spillovers with capital buffers in recipient EU countries for real GDP, inflation, bank credit and house prices

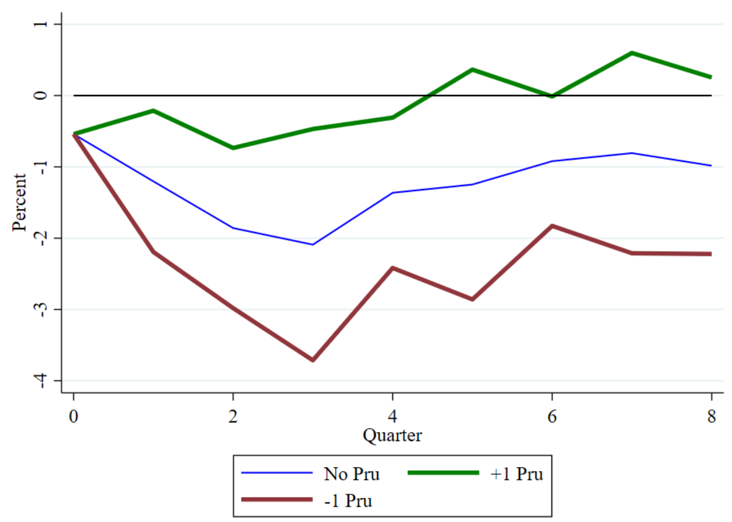


Notes: $\{\delta^h\}_{h=0}^{8}$ estimates with (log) GDP, CPIP, bank credit and house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors.

$Pru_{i,t-1}$ index is presented as a +1/1 at its base, the coefficient δ^h can be interpreted as the influence of an additional macroprudential policy tightening on the cross-border monetary spillover relative to its mean. The findings are similar to literature by Budnik (2020) where capital buffers are proven helpful in reducing the pass-through of monetary policy, Jiménez et al. (2017) where countercyclical bank capital buffers mitigate cycles in credit supply and have a positive effect on firm-level aggregate financing and Lim et al. (2011) where the effects of countercyclical capital requirements on credit are validated.

Economic significance A direct comparison of coefficient estimates between equations (1) and (2) is not possible as the last includes time fixed effects f_t^h, while the first does not. To illustrate the economic significance of the headline results of capital buffer interactions with US monetary policy spillovers, a hybrid version of equation (2) is estimated in Figure 5, an approach which is also made in similar studies such as Bussière et al. (2021b) and Coman and Lloyd (2022). The hybrid version includes the monetary policy variable $MP_t^{\$}$ and omits time fixed effects f_t^h, replacing them with time-varying global control variables $\mathbf{G}_{t-1}$, similar to

Figure 5: US monetary policy spillovers with capital buffers in recipient EU countries for bank credit



Notes: $\{\eta^h_{mp} + \delta^h\}^8_{h=0}$ estimates with (log) bank credit for 28 EU countries as dependent variable in hybrid version of regression (2), that excludes time fixed effects f^h_t, but includes lagged global controls $\mathbf{G}_{t-1}$. The blue line shows the estimated spillover from a +1pp US monetary policy tightening shock to an EU country with a macroprudential policy value of 0. The green line shows the comparable spillover estimate for an EU country with a +1 - additional tightening of a macroprudential policy action. The red line shows the effect of the spillover for an EU country with a -1 - loosening of a macroprudential policy action.

regression specification (1). This enables concurrent estimation of the direct average spillover effect of US monetary policy to EU countries η^h_{mp} and the interaction coefficient with domestic macroprudential policy δ^h. This hybrid specification is used to compare the two coefficients and understand the economic significance of the main findings.

As an illustrative example of the effects of even one prudential policy tightening, Figure 5 shows how the estimated spillover from a $+1$pp US monetary policy tightening varies depending on the lagged capital buffers macroprudential policy actions carried out in an EU country. The blue line plots the estimated spillover to an EU country with zero net macroprudential policy actions, $Pru_{i,t-1} = 0$, indicating that a $+1$pp exogenous tightening of US monetary policy leads to around a 2pp fall in bank credit in such EU countries after around 6 to 12 months. An EU country with an additional macroprudential policy tightening action, $Pru_{i,t-1} = 1$, is estimated to face a substantially smaller spillover as seen in the green line estimate. The peak spillover of a US monetary policy tightening shock is around 0.7pp, indicating that an additional macroprudential policy tightening in capital buffers can offset by three times the monetary policy spillover.

The hybrid specification allows for directly comparing estimates of US spillovers and policy interactions of EU countries, showing that tighter capital buffers ahead of a US monetary policy shock can partially offset the spillovers in the 1 to 12 months horizon, while completely offsetting the spillovers in the 12-24 months horizon. Hence, an even larger prudential policy tightening could neutralise the effects of US monetary policy on EU countries' domestic lending.[12] The question of which the optimal level of bank capital buffers (Clerc et al. (2015)) cannot be answered in the current paper. However, as a macroprudential policy tightening of capital buffers is likely to target less resilient banks by ensuring they hold sufficient buffers to withstand economic shocks, this finding is in line with the logic of the bank-lending channel in an international context, which suggests that the mechanism can operate more strongly for less resilient intermediaries. Similar to findings from Budnik et al. (2019), higher capitalisation allows banks in EU countries to withstand negative shocks, while studies such as Cappelletti et al. (2019) show that capital requirements such as O-SIIs could have a positive disciplining effect by reducing banks' risk-taking.

4.1.2 Lending standards restrictions

In this subsection, $Pru_{i,t-1}$ takes the form of lending standards restrictions and refers to borrower-based macroprudential measures, summing the most prominent measures of loan-to-value (LTV), loan-to-income (LTI), debt-to-income (DTI), debt-service-to-income (DSTI) limits, as well as maturity restrictions and limits of interest rates on loans. Most of these limits restrict the maximum amount an individual can borrow against their collateral and are in general the most widely used macroprudential measures, especially by advanced economies whose usage is associated in general with lower credit growth (Cerutti et al. (2017a)). Quantitative limits on LTV and LTI ratios can create buffers at the level of borrowers, and in consequence can be useful for dampening a boom in consumer lending, particularly in mortgage lending practices. Lending standard restrictions measures increase the resilience of both banks and borrowers, by restricting the quantity of credit relative to the value of the collateral or the borrower's income, hence also dampening the credit cycle.

Figure 6 shows estimates using the two-year cumulated lending standards restrictions indices as the macroprudential policy measure in regression (2). The results show that the es-

[12] Table 18 includes the full estimates of the hybrid specification, including $Pru_{i,t-1} = 1$ in the specification, as a means of comparison with the main results of Tables 4 and 5.

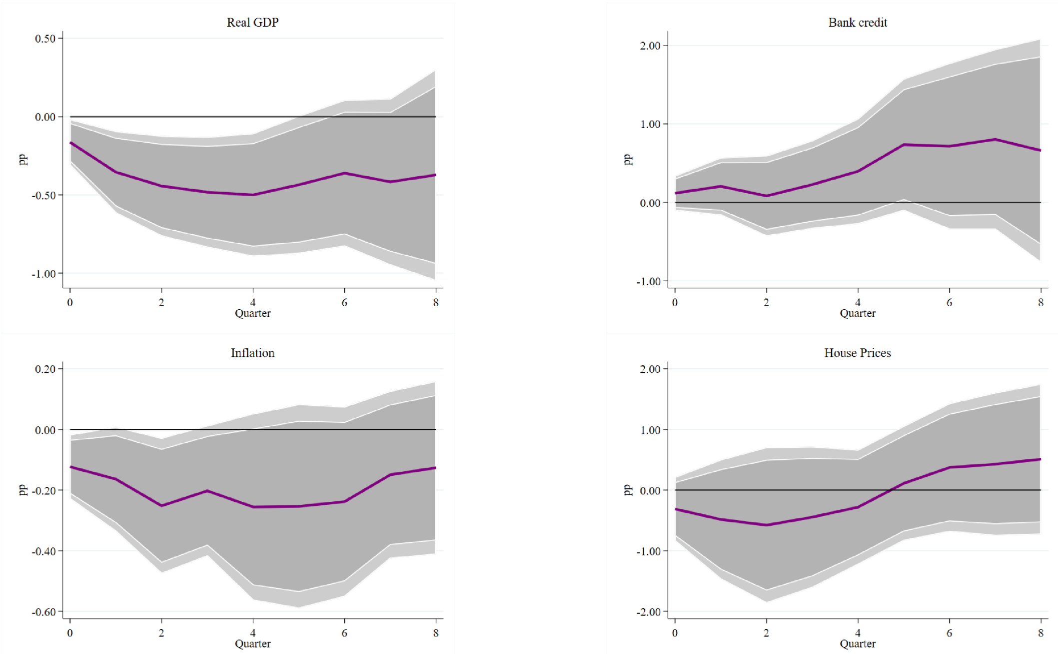
timates are positive at a range of horizons, particularly for bank lending, with house prices having a delayed effect of positive results after the 4th quarter, however, the results are not statistically significant. The coefficients in Table 5 show the interaction coefficients for real GDP (Column 8) and inflation (Column 11), which can be interpreted as EU countries with tighter macroprudential policies experiencing smaller spillovers from US monetary policy to GDP and inflation, however, the lending standard restrictions do not have an offsetting effect. Tighter lending standards restrictions are associated with smaller cyclical fluctuations in lending and show lagged effects on house prices, which suggests that indeed macroprudential tightening on household leverage in the form of lending restrictions positively affects lending and house prices in the face of US monetary policy spillovers. Although not statistically significant, these results are in line with related literature (Rubio and Carrasco-Gallego (2014),Vandernbussche et al. (2015), Zhang and Zoli (2016),Richter et al. (2019), Poghosyan (2020), Acharya et al. (2020)) and perhaps not surprising as in a market, like the housing market, the majority of adjustment in response to cyclical fluctuations occur in prices and not quantities, as real estate purchases are largely financed by debt. However, real estate is the most important form of storage of wealth across EU countries, and the exposure of banks to residential real estate is large in relation to bank capital in some EU countries.

4.1.3 Limits of credit growth and volume

In the Budnik and Kleibl (2018) dataset, limits of credit growth and volume consist of reserve requirements related to banks' liabilities and asset-based reserve requirements and represent all changes imposed on deposit accounts with macroprudential policy objectives. Given their broad application, equation (2) is estimated with the two-year cumulated limits of credit growth and volume measures, with the hypothesis that these policies should significantly interact with US monetary policy spillovers for both bank credit and house prices.

Figure 7 and estimates from Table 5 depict the interaction coefficient estimates across horizons for bank credit (Column 3) and house prices (Column 6). In line with our hypothesis, the estimates are significantly positive at a range of horizons for bank credit, indicating that reserve requirements can help offset the spillover effects of US monetary policy shocks in EU countries, and can fully offset the negative spillovers from US monetary policy tightening after 2 years. The offsetting effect is even more prominent for non-EA EU countries, that have

Figure 6: Interaction of US monetary policy spillovers with lending standards restrictions in recipient EU countries for bank credit and house prices



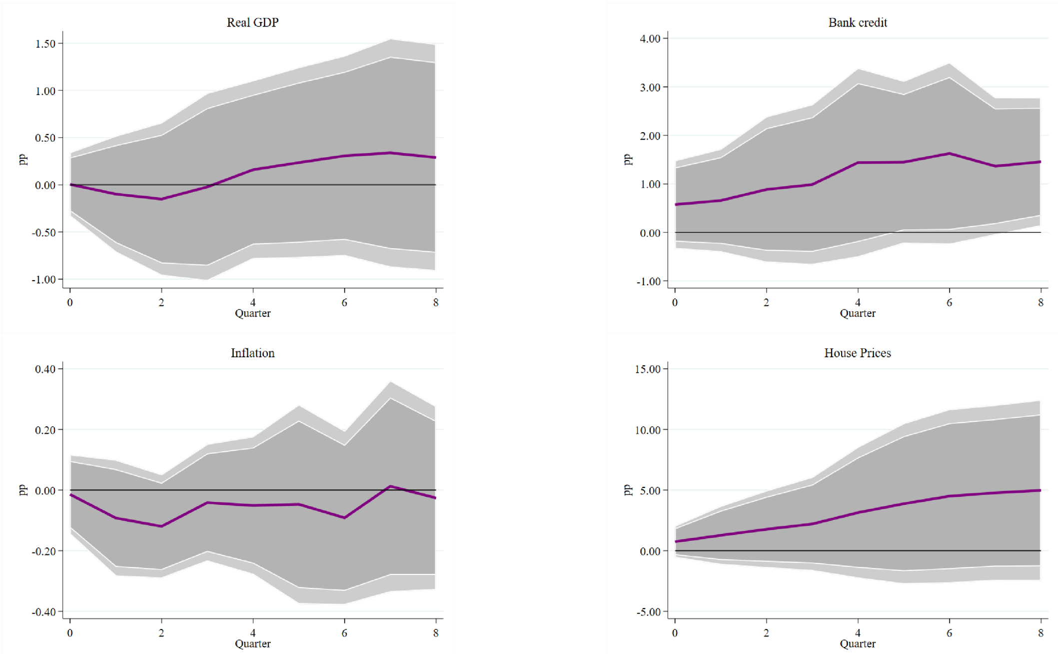
Notes: $\{\delta^h\}_{h=0}^{8}$ estimates with (log) bank credit and house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors.

positive and significant interactions for both bank credit (11 - Column 3) and full offsetting effect especially on house prices (11 - Column 6), possible reflecting the effect of reserve requirements on bank branches outside the EA. This finding is in line with more recent literature of Coman and Lloyd (2022), who also find that reserve requirements are an effective tool for curbing spillover effects from US monetary policy, albeit for emerging markets. Other relevant studies (Franch et al. (2021)) find that instruments directed towards restricting funding, such as reserve requirements, lead to an increase in lending in Euro Area banks, particularly through branches. Further robustness checks for the main results in this subsection are discussed in the Appendix A.4.

4.2 Interaction with UK Monetary Policy Spillovers

The second study describes the interaction of UK monetary policy with various specific measures of EU prudential policy using regression (2). To better capture the interactions, UK values are omitted from the sample and the estimates show the interaction effects of prudential policy with UK monetary policy spillovers for 27 EU countries. The results in this section show

Figure 7: Interaction of US monetary policy spillovers with limits on credit growth and volume in recipient EU countries for real GDP, inflation, bank credit and house prices)



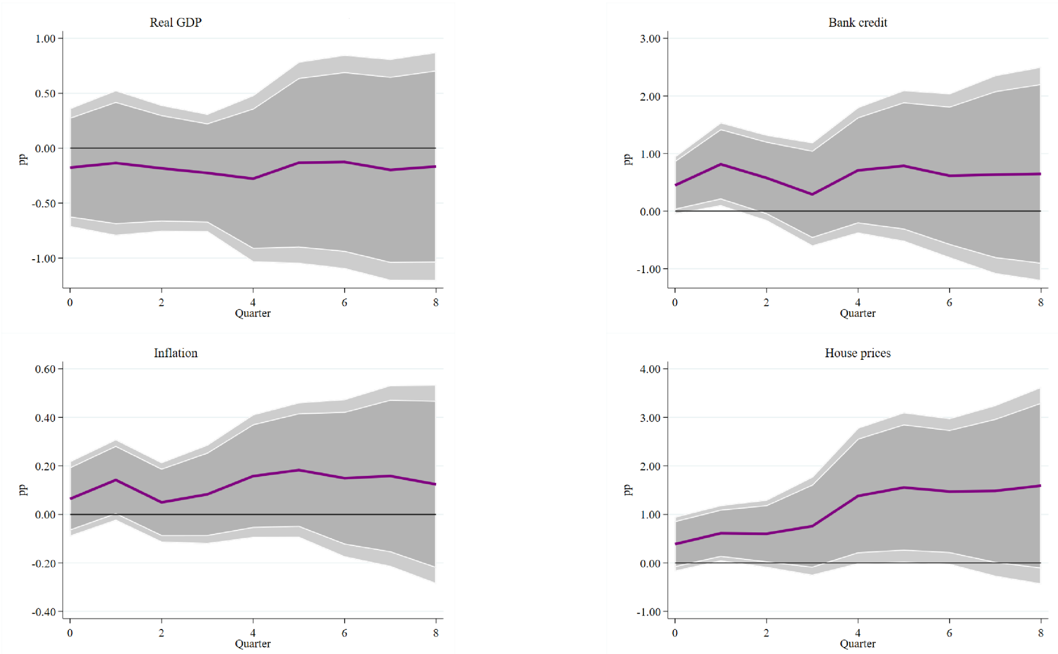
Notes: $\{\delta^h\}_{h=0}^{8}$ estimates with (log) GDP, inflation, bank credit and house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors.

that policies of a more microprudential nature and applied at the institution level, such as risk weights, minimum capital requirements, limits on large exposures and limits on credit growth, are particularly effective at offsetting or reducing the spillover effects of UK monetary policies, with positive and significant interactions being observed mostly for bank credit and house prices. The same positive effect is not observed in the other variables of interest, like the real economy indicators, meaning the prudential measures have a limited capability of offsetting the negative spillovers of UK monetary policy tightening on EU economies.

4.2.1 Risk weights

$Pru_{i,t-1}$ takes the form of risk weights in this subsection and is a sum of risk weights for loans backed by residential property, risk weights for loans backed by commercial property and other sectoral risk weights. The ESRB Handbook considers risk weights as indirect sectoral capital requirements that take the form of an increase of own funds ratios through one of the components used in the calculation of the ratio, such as risk weights. Equation (2) is estimated with the two-year cumulated risk weights, with the hypothesis that these policies should signifi-

Figure 8: Interaction of UK monetary policy spillovers with risk weights in recipient EU countries for bank credit and house prices



Notes: $\{\delta^h\}_{h=0}^{8}$ estimates with bank credit and house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors. The UK is dropped from the sample, reflecting results of EU27 countries.

cantly interact with US monetary policy spillovers for house prices, as well as for bank credit as it targets lending. The main objective of the risk weights measures is to increase banks' resilience by utilizing additional buffers for credit losses in the real estate sector.

Figure 8 and estimates from Table 6 show positive interaction coefficient estimates across all horizons for bank credit and house prices. In line with our hypothesis, the estimates are significantly positive across all horizons for bank credit (Table 6 - Column 1) and house prices (Table 6 - Column 5), indicating that risk weights can help to offset the spillover effects of UK monetary policy shocks in EU countries. The offsetting effects of risk weights are even more pronounced for the bank credit of non-EA EU countries (Table 13 - Column 1), suggesting that risk weights are an even better tool for non-EA countries in the face of UK monetary policy spillovers.

4.2.2 Minimum capital requirements

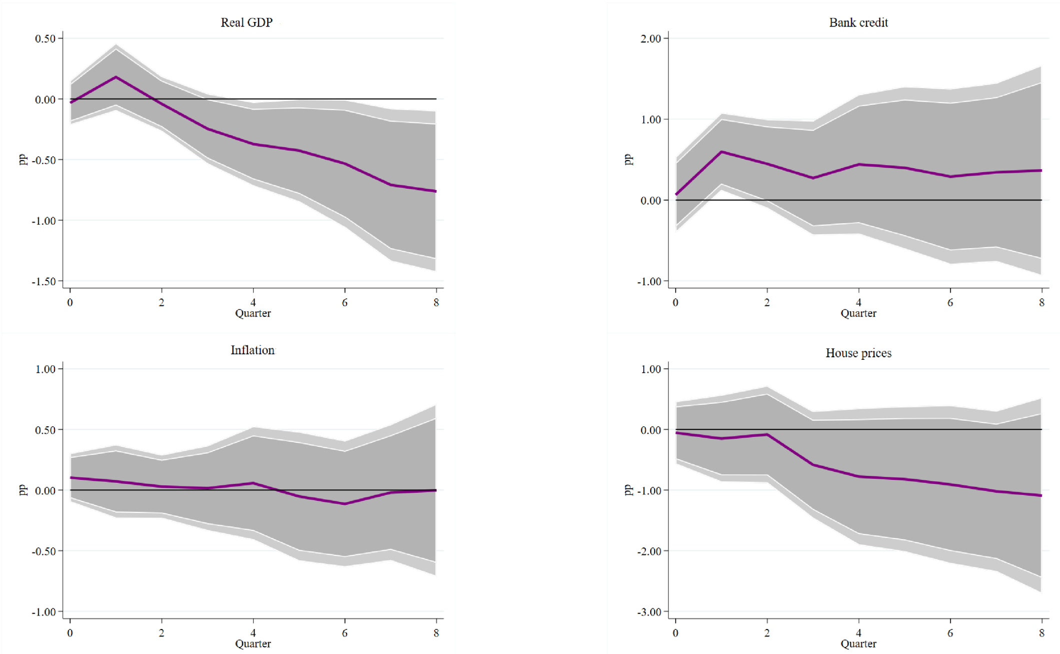
Minimum capital requirements instruments in the MaPPED dataset encompass measures of a microprudential nature, such as capital adequacy ratio (CAR), Tier 1 capital ratio, common equity Tier 1 ratio (CET1) and core Tier 1 capital ratio. Such requirements are usually bank-specific and fall under the Pillar 1 and Pillar 2 requirements of EU banks, in which banks that cannot meet the minimum own funds requirement are considered not viable. In this section equation (2) is estimated with the two-year cumulated minimum capital requirements and the hypothesis that these policies should significantly interact with US monetary policy spillovers for bank credit.

The interaction coefficient in the figure 9 and Table 6 - Column (2) shows that estimates for bank credit are positive across all horizons, however, only marginally statistically significant. This finding suggests that having limits such as minimum capital requirements already enacted in EU banks can help to partially offset the spillover effects of UK monetary policy shocks in EU countries for bank credit up to 0.6pp at peak. The offsetting effect is more prominent for bank credit of non-EA EU countries (Table 13 - Column (2)), a possible explanation being that minimum capital requirements applied to local banks are an effective tool even for banks outside the Euro Area and the Single Supervisory Mechanism (SSM). The same positive and statistically significant effect cannot be observed in the case of other indicators with Table 6. These findings are not surprising since minimum capital requirements are mostly enacted to directly curb lending, hence having limited interactions in the other channels.

4.2.3 Limits on large exposures and concentration

The limits on large exposures and concentrations are typical microprudential measures that are widely used by the EU countries in the MaPPED dataset and consist of measures such as: single client exposure limits; intragroup exposures; sector and market segment exposure limits; funding concentration limits; limits on qualified holdings outside financial sector; other exposure and concentration limits. Stricter large exposure requirements on intra-financial exposures can be useful instruments to address interconnectedness, concentration and contagion, putting an upper bound on losses from counterparty default and network effects. In doing so, according to the ESRB handbook, large exposure microprudential requirements aim to intensify the supervision of exposures to single counterparties when they reach critical levels and to restrict them beyond certain levels. The ultimate aim is to reduce the risk of concentration and contagion linked to counterparty default. Figure 10 and Table 6 - Column (7) show that estimates for house prices are significantly positive across all horizons, offsetting UK monetary policy

Figure 9: Interaction of UK monetary policy spillovers with minimum capital requirements in recipient EU countries for real GDP, inflation, bank credit and house prices



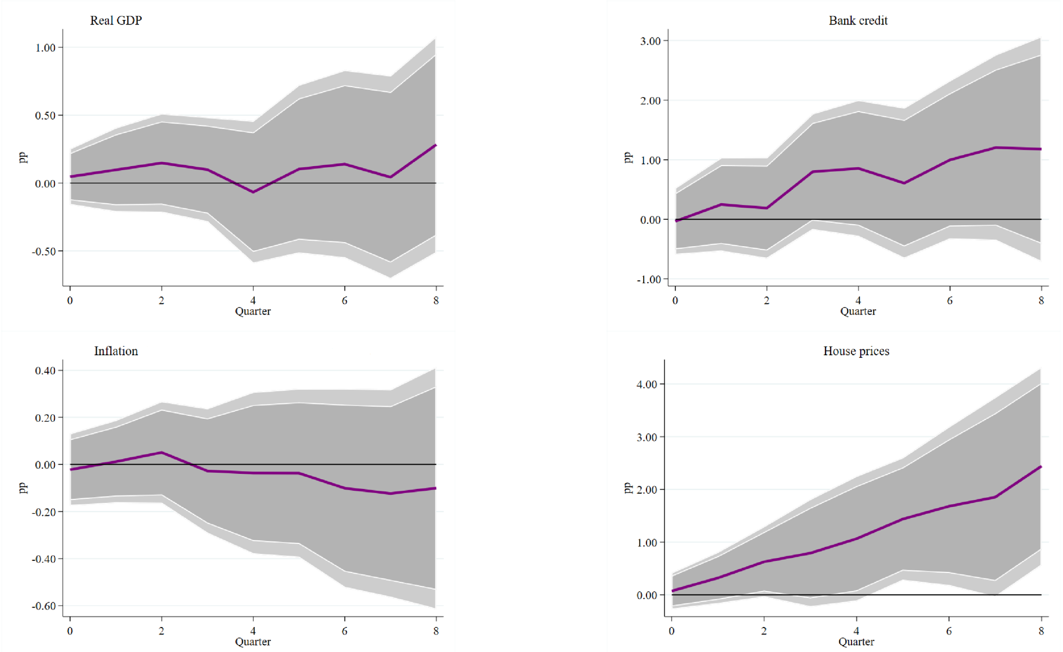
Notes: $\{\delta^h\}_{h=0}^{8}$ estimates with bank credit house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors. The UK dropped from the sample, reflecting the results of EU27 countries.

shocks with up to 2.4pp at peak in a two-year horizon. The positive interactions are even more pronounced for non-EA EU countries, with effects of limits on large exposures having an even greater offsetting effect on bank credit (13 - Column (3)) and house prices (13 - Column (7)), suggesting that limits on large exposures and concentration are prudential tools that can be used against UK monetary policy spillovers. The empirical studies on the effects of large exposures are currently limited, with studies such as Batiz-Zuk et al. (2016) showing the benefits of tighter limits on interbank exposures in reducing contagion risk.

4.2.4 Limits on credit growth

Similar to findings in Section 4.1.3 for US monetary policy spillovers, limits on credit growth prove effective at offsetting UK monetary policy spillovers, especially for bank credit. Figure 11 and Table 6 - Column (4) depict a positive estimate for bank credit across all horizons, offsetting UK monetary policy shocks with up to 2.9pp at peak, while the same effect cannot be significantly observed in the other channels.

Figure 10: Interaction of UK monetary policy spillovers with limits on large exposures and concentration in recipient EU countries

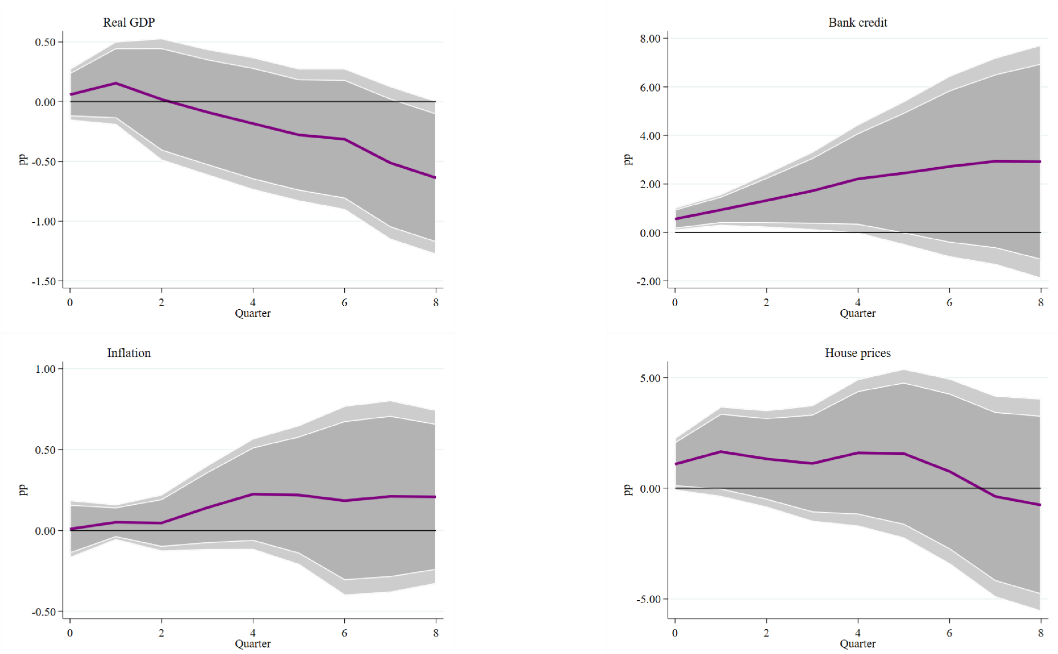


Notes: $\{\delta^h\}_{h=0}^{8}$ estimates with bank credit and house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors. The UK dropped from the sample, reflecting the results of EU27 countries.

4.3 Interaction with EA Monetary Policy spillovers

The third study explores the interaction of EA monetary policy with various specific measures of EU prudential policy using regression (2). In this section, the results show that policies with a predominantly microprudential nature such as limits on large exposure and concentration, minimum capital requirements, but also capital buffers, lead to smaller spillover effects of EA monetary policies to EU countries, albeit the interaction results are not positive. The interaction effects of policies of microprudential nature can be observed mostly for bank credit and house prices, while the same effect cannot be observed for macro variables such as real GDP and inflation. This is in line with related literature such as Fernandez-Gallardo and Paya (2020) who also finds no overall effects on price stability coming from interactions between monetary policy and prudential policy and Svensson (2018) that shows macropudential policy has a small effect on inflation. With regards to the interaction between the two policies, this paper adds to findings such as Budnik (2020) that illustrate that the coordination between monetary policy and prudential policy in EU countries had been effective and can enhance the policy

Figure 11: Interaction of UK monetary policy spillovers with limits on credit growth in recipient EU countries



Notes: $\{\delta^h\}_{h=0}^{8}$ estimates with bank credit and house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors. The UK dropped from the sample, reflecting the results of EU27 countries.

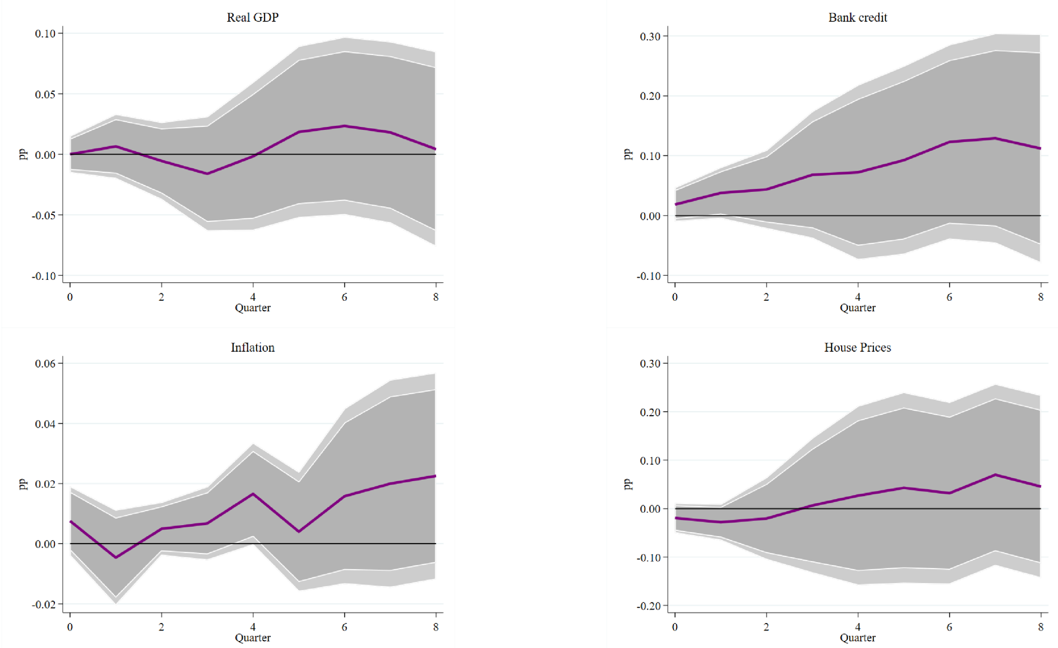
mix, while empirical studies from Maddaloni and Peydró (2013) show the two types of policies can reinforce each other in the EA.

4.3.1 Limits on large exposure and concentration

Similar to results in Section 4.2.3 showing the interactions with UK monetary policy, the two years cumulated limits on large exposure and concentration estimates in (2) prove marginally effective at offsetting EA monetary policy spillovers, albeit to bank credit.

Figure 12 and Table 7 show that estimates bank credit (Column 1) are positive at all horizons, while results from EA are positive and significant across all horizons (14 - Column (1)). The measure also proves effective against EA monetary policy shocks having a positive interaction with house prices coming from non-EA non EU countries (15 - Column (4)). The measures of limits on large exposure and concentration, which have a microprudential nature aimed at curbing excessive exposure and concentration in EU countries, prove effective at diminishing spillovers that arise from EA monetary policy to other EU countries. However, their positive

Figure 12: Interaction of EA monetary policy spillovers with limits on large exposure and concentration in recipient EU countries for bank credit and house prices



Notes: $\{\delta^h\}_{h=0}^8$ estimates with bank credit and house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors.

effects are subdued and not statistically significant, reflecting the heterogeneity in EU countries. The evidence of the effectiveness of these measures is so far limited in the literature, with Cerutti et al. (2017b) looking at the impact of limits on interconnectedness and concentration, and Budnik (2020) finding that large exposure limits increase the growth rate of total credit.

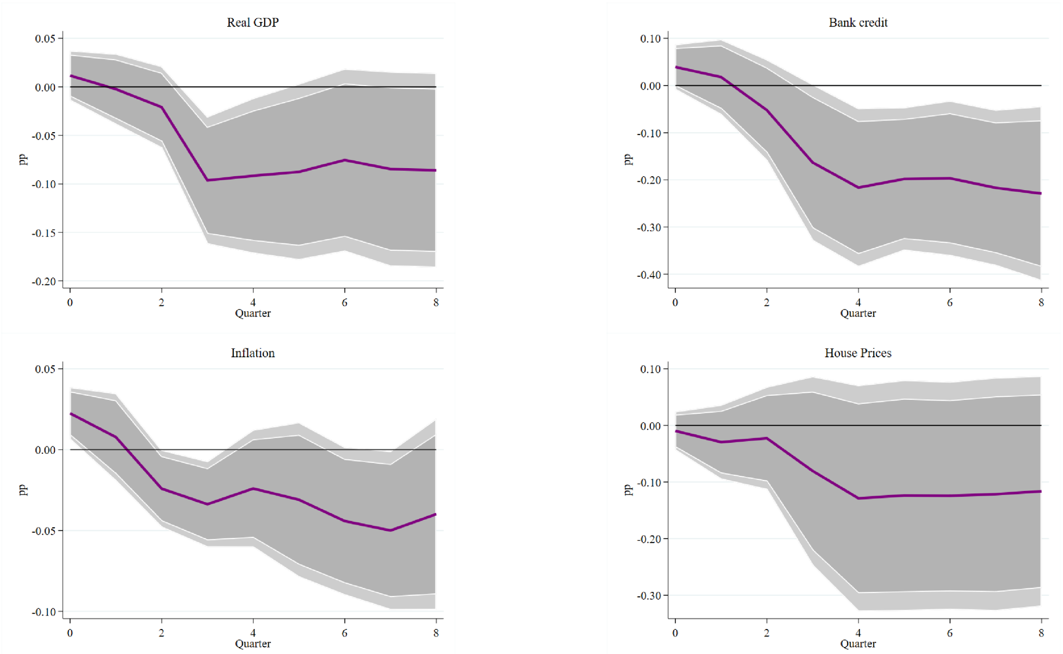
4.3.2 Minimum capital requirements

In line with findings from Section 4.2.2 for UK monetary policy spillovers, minimum capital requirements reduce the spillovers effects of EA monetary policy spillovers - as seen in Table 7 Columns (2)-(4), however, such measures do not have an offsetting effect against EA monetary policy spillovers. As shown in Figure 13, the interaction effects are not positive, making minimum capital requirements marginally effective tools against EA monetary policy spillovers.

4.3.3 Capital buffers

Similar to the findings in Section 4.3.2, figure 14 shows that capital buffers do not have an offsetting effect against EA monetary policy shocks, as shown by the negative interaction esti-

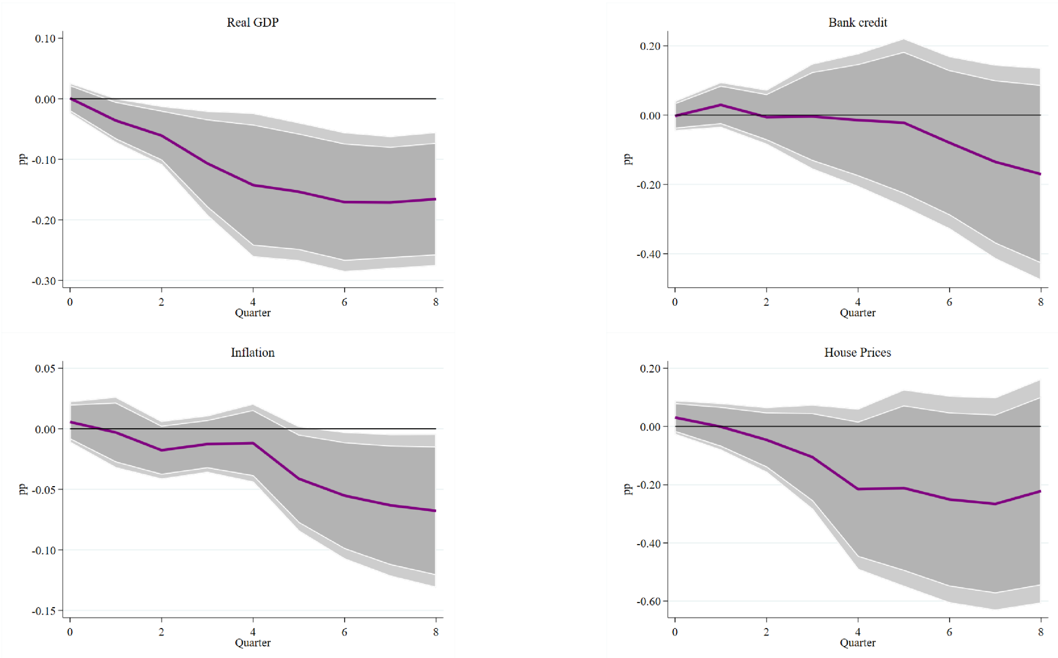
Figure 13: Interaction of EA monetary policy spillovers with minimum capital requirements in recipient EU countries for real GDP, inflation, bank credit and house prices



Notes: $\{\delta^h\}_{h=0}^8$ estimates with bank credit and house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors.

mates. Table 7 - Columns (5) and (6) show negative, though statistically significant, interactions of EA monetary policy with EU countries' capital buffers for real GDP and inflation. The results can be interpreted as EU countries that have tighter capital buffers before an EA monetary policy shock experience smaller spillover effects on real GDP and inflation, although the same offsetting effect which we saw in Section 4.1.1 against US spillovers is not observed.

Figure 14: Interaction of EA monetary policy spillovers with capital buffers in recipient EU countries for bank credit and house prices



Notes: $\{\delta^h\}_{h=0}^{8}$ estimates with bank credit and house prices for 28 EU countries as dependent variable in regression (2). The grey shaded areas denote 90% and 95% confidence intervals around point estimates, constructed from Driscoll and Kraay (1998) standard errors.

5 Conclusion

This paper aims to present empirical evidence about the role of prudential policies in reducing the macro-financial spillover effects of US, UK and EA monetary policy shocks to EU countries. The main findings show how different measures can partially offset the negative spillover effects, especially coming from US monetary policy. Having tighter prudential measures can dampen a country's exposure to the associated global credit cycle, as well as monetary policy shocks from within the EU, the paper identifies which instruments prove to be effective tools in the face of spillovers. The results show that, domestically, prudential policies are an effective response to the externalises created by foreign monetary policy shocks and they can increase the resilience of domestic markets to external vulnerabilities.

The use of the MaPPED database contributes to the discussion on the effectiveness of different prudential instruments, especially in offsetting monetary policy spillovers. The empirical specification in this paper allows us to estimate cross-border monetary and prudential policy interactions. However, common to the majority of prudential related literature, some limitations remain in the analysis. The prudential policy dataset measures policy actions used in this paper do not capture the intensity of policy changes, and future research will, no doubt, benefit from such analysis given the data coverage and granularity of the MaPPED database.

The findings have important implications, suggesting that macroprudential policies can effectively reduce the spillover effects of US monetary policy shocks, while microprudential policies are effective at reducing spillover effects from within the EU market, namely from the UK and EA monetary policy shocks. The use of micro and macro prudential instruments is usually aligned in the upswing of the credit cycle, where is a need to strengthen the resilience of individual institutions and the system as a whole. These findings could help policymakers to maintain monetary policy autonomy in the face of spillovers and the global financial cycle, and better decide which measure to activate to safeguard their respective economies.

Appendix

A Data Sources

A.1 Macro-Financial Panel Dataset

The macro-financial data used for this analysis is taken from the European Macroprudential Database (MPDB) by Coman et al. (2019), which is a collection of indicators that regularly support the macroprudential policy analysis conducted by the European System of Central Banks (ESCB), the European Systemic Risk Board (ESRB) and the national authorities of the Single Supervisory Mechanism (SSM). The MPDB indicators cover all 28 EU countries (19 Euro Area[13] and 9 non-Euro Area countries[14]) and is publicly available on the ECB Statistical Data Warehouse (SDW). The dataset ensures cross-country comparability, with data collected according to harmonised reporting requirements across all countries in the sample. The sufficiently long history of the indicators enables time series analysis and prove to have the right characteristics to feed econometric models. Although the MPDB covers a large number of indicators for prudential analysis, for this study four indicators are selected as relevant channels for the analysis and included in Table 1.

[13]The 19 EA countries are: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Italy, Ireland, Latvia, Luxembourg, Lithuania, Malta, The Netherlands, Portugal, Slovakia, Slovenia, Spain

[14]The 9 non-Euro area countries are: Bulgaria, Croatia, Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, The United Kingdom (still an EU member state until January 2020)

Table 1: Macro-financial Data

Indicator	Definition	Dataset in SDW	Other studies using the measure
Bank credit	Bank credit to the private sector(households, non-financial corporations, other financial institutions)	BSI:Balance Sheet Items	Buch et al. (2018a), Budnik (2020),Franch et al. (2021), Poghosyan (2020)
House prices	Residential property prices	RESR: Residential Property Prices	Acharya et al. (2020),Fernandez-Gallardo (2023), Poghosyan (2020), Richter et al. (2018), Rubio and Carrasco-Gallego (2014), Zhang and Zoli (2016)
Real GDP	Gross domestic product at market prices	MNA: National accounts, Main aggregates	Fernandez-Gallardo (2023), Poghosyan (2020)
Inflation	Harmonised consumer price index	ICP : Indices of Consumer prices	Fernandez-Gallardo (2023), Svensson (2018)

A.2 Prudential Policy Data

The Budnik and Kleibl (2018) dataset, *Macroprudential Policies Evaluation Database (MaPPED)*, has been last updated in February 2018 and it includes all policies of a macroprudential nature that were bound to be in force until 2018Q3. The dataset includes information on the following categories of policy instruments:

1. Minimum capital requirements (*Microprudential*)
    - (a) Capital adequacy ratio (CAR) - *Microprudential*
    - (b) Tier 1 capital ratio - *Microprudential*
    - (c) Common Equity Tier 1 capital ratio (CET1) - *Microprudential*
    - (d) Core Tier 1 capital ratio - *Microprudential*
2. Capital buffers (*Macroprudential*)
    - (a) Countercyclical capital buffer (CCyB) - *Macroprudential*
    - (b) Capital conservation buffer - *Macroprudential*
    - (c) Systemic risk buffer - *Macroprudential*
    - (d) G-SII capital buffer - *Macroprudential*
    - (e) O-SII capital buffer - *Macroprudential*
    - (f) Other capital requirements targeting most important institutions - *Macroprudential*
    - (g) Other capital surcharges and own funds requirements - *Macroprudential*
    - (h) Profit distribution restrictions - *Macroprudential*

3. Risk weights (*Macroprudential, Microprudential*)
    (a) Risk weights for loans backed by residential property - *Macroprudential, Microprudential*
    (b) Risk weights for loans backed by commercial property - *Macroprudential, Microprudential*
    (c) Other sectoral risk weights - *Macroprudential, Microprudential*
4. Leverage ratio (*Macroprudential, Microprudential*)
5. Loan-loss provisioning (*Macroprudential, Microprudential*)
    (a) Loan classification rules - *Macroprudential, Microprudential*
    (b) Minimum specific provisioning - *Macroprudential, Microprudential*
    (c) General provisioning - *Macroprudential, Microprudential*
    (d) Capital treatment of loan loss reserve - *Macroprudential, Microprudential*
6. Lending standards restrictions (*Macroprudential*)
    (a) Loan-to-value (LTV) limits - *Macroprudential*
    (b) Loan-to-income (LTI) limits - *Macroprudential*
    (c) Debt-to-income (DTI) limits - *Macroprudential*
    (d) Debt-service-to-income (DSTI) limits - *Macroprudential*
    (e) Limits on interest rates on loans - *Macroprudential*
    (f) Maturity and amortisation restrictions - *Macroprudential*
    (g) Other income requirements for loan eligibility - *Macroprudential*
    (h) Limits on the volume of personal loans - *Macroprudential*
    (i) Other restrictions on lending standards - *Macroprudential*
7. Limits on credit growth and volume - *Macroprudential*
    (a) Reserve requirements related to banks' liabilities - - *Macroprudential*
    (b) Asset-based reserve requirements - *Macroprudential*
8. Levies/taxes on financial institutions (*Microprudential*)
    (a) Tax on assets / liabilities - *Microprudential*
    (b) Tax on financial activities - *Microprudential*
9. Limits on large exposures and concentration (*Microprudential*)
    (a) single client exposure limits - *Microprudential*
    (b) Intragroup exposure limits - *Microprudential*
    (c) Sector and market segment exposure limits - *Microprudential*
    (d) Funding concentration limits - *Microprudential*
    (e) Limits on qualified holdings outside financial-sector - *Microprudential*

(f) Other exposure and concentration limits - *Microprudential*

10. Liquidity requirements and limits on the currency and maturity mismatch (*Macroprudential, Microprudential*)

    (a) Loan to deposit (LTD) ratios - *Macroprudential*
    (b) Other stable funding rates requirements - *Macroprudential, Microprudential*
    (c) Short-term liquidity coverage ratios - *Macroprudential, Microprudential*
    (d) Liquidity ratios and deposit coverage ratios - *Macroprudential, Microprudential*
    (e) Limits on FX mismatches - *Macroprudential, Microprudential*
    (f) Other liquidity requirements - *Macroprudential, Microprudential*

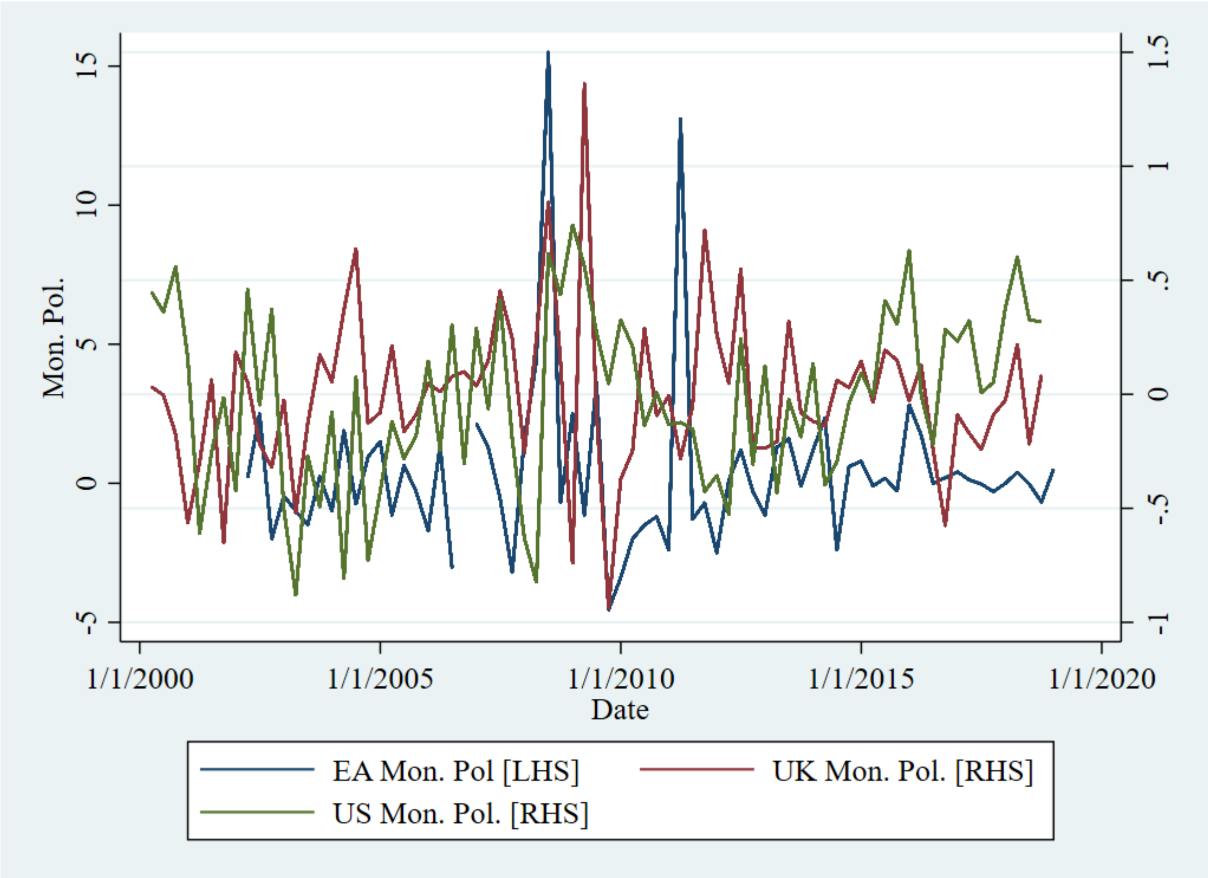
11. Other measures (*Macroprudential, Microprudential*)

    (a) Structural measures - *Macroprudential, Microprudential*
    (b) Margin requirements - *Microprudential*
    (c) Other regulatory restrictions on financial activities - *Macroprudential, Microprudential*
    (d) Limits on deposit rates - *Macroprudential, Microprudential*
    (e) Debt resolution policies - *Macroprudential*
    (f) Crisis management tools - *Macroprudential*
    (g) Changes in regulatory framework - *Microprudential*
    (h) Other - *Microprudential*

A.3 Monetary Policy Shocks

In describing the econometric framework for identifying monetary policy shocks, this paper draws heavily on Gertler and Karadi (2015) (Section II) for US shocks and Gerko and Rey (2017) for UK. For further details about the methodology used for monetary policy shocks for US and UK, refer to Coman and Lloyd (2022) (Section A.3). Monetary Policy shocks for EA are taken from the Euro Area Monetary Policy Event-Study Database (EA-MPD) by Altavilla et al. (2019).

Figure 15: US Monetary Policy Shocks



Notes: Green line - $MP_t^{\$}$ as US monetary policy shocks, based on Gertler and Karadi (2015).
Red line - $MP_t^{\$}$ as UK monetary policy shocks, based on Gerko and Rey (2017).
Blue line - $MP_t^{\$}$ as EA monetary policy shocks, from Altavilla et al. (2019)

A.4 Robustness

A.4.1 Robustness - Spillovers

While the paper focuses on the spillover effects of individual monetary policy shocks, as the main results with the aim of understanding the monetary policy shock effect on different channels, this section includes a robustness discussion on joint monetary policy shocks and their effects on our channels of interest. Table 16 summarises the robustness exercise using a variation of equation (1), where combinations of monetary policy shocks from US, UK and EA are considered simultaneously. The same negative spillover effects observed in the main results of Table 4, are not observed for financial stability indicators such as bank credit (Columns (1) to (3)) and house prices (Columns (4) to (6)), suggesting that a joint specification makes it difficult to understand the effects of foreign monetary policy and their spillovers to bank lending and subsequently to house prices. The negative spillovers of foreign monetary policy are still present in various joint combinations of monetary policy shocks for the GDP (Columns (7) to (9)) and inflation (Column (10) to (12)) channel, suggesting that the real economies in EU countries are having a direct hit of foreign monetary policy, regardless of the source of monetary policy spillovers.

A.4.2 Robustness - Interactions

This section includes a discussion on one of the headline findings of US monetary policy interactions with limits on credit growth and volume. The main reason why this specific prudential measure is used for further robustness is, that it can be compared with similar datasets and studies, reserve requirements being one of the widely used measures, as well as their effects on lending. Table 17 summarises the robustness exercise for (log) bank credit, with column (1) showing the baseline interaction coefficient estimate coming from regression (2).

Cerutti et al Prudential Policy Database The Budnik and Kleibl (2018) (MaPPED) prudential policy dataset is used as baseline regression in column (1), as depicted in Section 4.1. Column (2) shows that our baseline results are robust to the use of an alternative prudential database, namely the prudential policies database by Cerutti et al. (2017b). Using this dataset, an aggregate prudential policy measure of reserve requirement measures is created and then the actions are cumulated over two years, as in our benchmark regression. The interaction coefficient estimates are significantly positive from 4 to 8-quarters-ahead, showing the same positive interactions and offsetting intensity of interaction as in our baseline finding. The IMF Integrated Macroprudential Policy (iMaPP) database by (Alam et al., 2019) was also considered for the robustness check, however at a closer inspection various prudential measures episodes are missing for small Euro Area and other non-Euro Area EU countries, therefore a direct comparison of results would not be possible.

Alternative cumulation of Prudential Policy Measure As described in Section 4, the baseline prudential policy measure is calculated by cumulating actions over two years. Columns (3) and (4) describe coefficient estimates using various alternative summation periods. Column (3) presents estimates using a one-year cumulation period, as seen in Alam et al. (2019) to study the direct effects of macroprudential policy. The estimated interaction coefficients using

Table 2: Summary statistics for dependent variables

Measure	# Obs.	$\overline{y}_i$	$\sigma(y_i)$	$\min(y_i)$	$\max(y_i)$
Bank credit	1,906	11.947	1.740	7.9	15.05
House prices	1,818	4.545	0.263	3.13	5.11
Real GDP s	2,128	11.268	2.013	7.28	16.11
Inflation (CPIP)	2,128	4.479	0.157	3.21	4.6

Note: Summary statistics across 28 EU countries and over the full sample period. Log values of dependent variables are used in the analysis.

the one-year cumulation remain positive at all horizons, albeit not statistically significant when using this cumulation variation. The same positive interaction (at all horizons) is also observed in Column (4) with estimates using a three-year cumulation period.

Column (5) lists interaction coefficients when the prudential policy measures are cumulated from the start of the sample, as used in Takáts and Temesvary (2019). In this cumulation variation, the point estimates remain positive, however are insignificantly different from zero across all horizons. One possible explanation for this insignificant finding could be that, by taking into account all policy actions since the start of the sample, the full-sample cumulated measure does not adequately capture cyclical variation in prudential policy necessary to identify policy interactions in regression (2), same finding as in Coman and Lloyd (2022). A policy action in the year e.g. 2000 may indeed no longer be relevant in the face of a US monetary policy shock in, say, 2016. Therefore, as described in similar studies such as Bussière et al. (2021a) and the references within, this current analysis gives greater weight to results using shorter summation periods.

One additional robustness check depicts the prudential policy indicator with no cumulation over time and addresses the concerns that cumulating prudential policy actions generates serial correlation in the regressor. With coefficient estimates presented in column (6), the interaction coefficients are positive and significantly different from zero across all horizons.

Lagged control variables Two lags of real GDP, inflation and quarterly changes of the dependent variable in our set of control variables $\mathbf{X}_{i,t-1}$ are used in each policy interaction specification, as detailed in Section 2. Column (7) illustrates a further robustness exercise with eight lags of the country-specific control variables to mirror the number of periods over which prudential policy actions are cumulated in the baseline regression. As in the other robustness checks, the point estimates for interaction coefficients remain positive across all horizons.

Table 3: Summary statistics for prudential policy proxies – two-year cumulated period

Prudential Policy Measure	# Obs.	$\overline{Pru}_{i,t}$	$\sigma\left(Pru_{i,t}\right)$	$\min\left(Pru_{i,t}\right)$	$\max\left(Pru_{i,t}\right)$
Capital buffers	2,128	0.334	0.937	−2	8
Lending standards	2,128	0.313	1.271	−4	10
Levies/taxes on financial institutions	2,128	0.082	0.409	−2	4
Limits on credit growth	2,128	0.018	0.941	−5	10
Limits large exposures	2,128	0.196	0.928	−3	5
Liquidity requirements	2,128	0.387	1.012	−2	11
Loan-loss provisioning	2,128	0.234	0.742	−2	5
Minimum capital requirements	2,128	0.570	1.137	−1	7
Other measures	2,128	0.184	1.096	−8	12
Risk weights	2,128	0.183	0.817	−3	5

Note: Each category is the sum of measures from each individual subcategories; see Appendix A.2 for the full list of measures included. Summary statistics across 28 EU countries and over the full sample period.

Table 4: Estimated coefficients of monetary policy spillovers from regression (1) for GDP, inflation, bank credit and house prices

	Bank credit			House prices		
	(1)	(2)	(3)	(4)	(5)	(6)
	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$
$h = 0$	-0.55	0.40***	-0.03*	-0.67	-0.58	-0.02
	(0.38)	(0.15)	(0.02)	(0.42)	(0.40)	(0.02)
$h = 1$	-1.14***	0.41	-0.08***	-1.61**	-0.97	-0.07**
	(0.40)	(0.25)	(0.03)	(0.64)	(0.61)	(0.03)
$h = 2$	-1.79***	-0.12	-0.23***	-2.40***	-1.48**	-0.19***
	(0.59)	(0.36)	(0.06)	(0.88)	(0.58)	(0.04)
$h = 3$	-2.00***	-0.44	-0.43***	-2.59***	-2.04***	-0.39***
	(0.63)	(0.55)	(0.09)	(0.96)	(0.66)	(0.07)
$h = 4$	-1.36**	0.15	-0.56***	-2.04**	-2.33***	-0.50***
	(0.59)	(0.60)	(0.09)	(0.91)	(0.82)	(0.10)
$h = 5$	-1.22	0.13	-0.63***	-1.59*	-2.35***	-0.53***
	(0.79)	(0.64)	(0.10)	(0.84)	(0.89)	(0.11)
$h = 6$	-0.99	-0.63	-0.71***	-1.76**	-2.76***	-0.49***
	(0.87)	(0.69)	(0.11)	(0.84)	(0.95)	(0.11)
$h = 7$	-0.86	-0.85	-0.80***	-2.53**	-3.18***	-0.47***
	(1.03)	(0.70)	(0.11)	(1.03)	(1.09)	(0.12)
$h = 8$	-1.08	-1.08	-0.83***	-3.42***	-3.77***	-0.49***
	(1.07)	(0.81)	(0.13)	(1.22)	(1.26)	(0.12)
	Real GDP			Inflation		
	(7)	(8)	(9)	(10)	(11)	(12)
	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$
$h = 0$	-0.65***	-0.30**	-0.01	-0.43***	0.10	0.05***
	(0.07)	(0.12)	(0.01)	(0.09)	(0.12)	(0.01)
$h = 1$	-1.11***	-0.27***	-0.04**	-0.92***	-0.14	0.05***
	(0.16)	(0.10)	(0.01)	(0.11)	(0.19)	(0.02)
$h = 2$	-1.55***	-0.85***	-0.14***	-0.96***	-0.45**	-0.03*
	(0.24)	(0.15)	(0.02)	(0.12)	(0.19)	(0.02)
$h = 3$	-1.81***	-1.59***	-0.28***	-0.93***	-0.33	-0.08***
	(0.29)	(0.19)	(0.02)	(0.15)	(0.21)	(0.02)
$h = 4$	-1.38***	-1.92***	-0.33***	-0.91***	-0.16	-0.07***
	(0.29)	(0.23)	(0.03)	(0.21)	(0.29)	(0.02)
$h = 5$	-0.96***	-1.90***	-0.35***	-1.03***	-0.51	-0.07**
	(0.33)	(0.27)	(0.03)	(0.25)	(0.35)	(0.03)
$h = 6$	-1.01***	-2.35***	-0.32***	-0.80***	-0.90***	-0.10***
	(0.35)	(0.31)	(0.03)	(0.24)	(0.35)	(0.03)
$h = 7$	-1.37***	-2.55***	-0.31***	-0.53**	-0.78**	-0.13***
	(0.44)	(0.34)	(0.03)	(0.25)	(0.35)	(0.03)
$h = 8$	-1.66***	-2.64***	-0.30***	-0.37	-0.70*	-0.12***
	(0.46)	(0.41)	(0.04)	(0.29)	(0.42)	(0.03)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	NO	NO	NO	NO	NO	NO

Notes: $\hat{\beta}^h$ for $h = 0, 1, ...8$ coefficient estimates from variation of regression (1) in columns (1) and (12). *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses). UK dropped from the sample for results in Columns (2), (5), (8), (11), reflecting results of EU27 countries.

Table 5: Estimated coefficients of monetary policy and prudential policy interaction from regression (2) for US monetary policy spillovers

	Bank credit			House prices		
	(1) Capital buffers	(2) Lending standards restr.	(3) Limits on credit growth	(4) Capital buffers	(5) Lending standards restr.	(6) Limits on credit growth
$h = 0$	0.07	0.12	0.57	0.27**	-0.31	0.75
	(0.14)	(0.11)	(0.46)	(0.13)	(0.27)	(0.67)
$h = 1$	0.50**	0.20	0.66	0.39	-0.48	1.27
	(0.23)	(0.19)	(0.54)	(0.31)	(0.50)	(1.24)
$h = 2$	0.51	0.08	0.88	0.55	-0.58	1.77
	(0.36)	(0.26)	(0.77)	(0.47)	(0.66)	(1.63)
$h = 3$	0.88*	0.23	0.99	0.57	-0.45	2.21
	(0.49)	(0.29)	(0.84)	(0.57)	(0.59)	(1.98)
$h = 4$	0.99*	0.40	1.44	0.72	-0.28	3.15
	(0.58)	(0.34)	(1.00)	(0.50)	(0.48)	(2.77)
$h = 5$	1.51**	0.74*	1.45*	1.13**	0.11	3.88
	(0.59)	(0.43)	(0.85)	(0.51)	(0.48)	(3.39)
$h = 6$	1.66**	0.71	1.63*	1.34**	0.37	4.50
	(0.67)	(0.54)	(0.96)	(0.58)	(0.54)	(3.66)
$h = 7$	1.93***	0.80	1.36*	1.30**	0.43	4.78
	(0.74)	(0.59)	(0.72)	(0.65)	(0.60)	(3.70)
$h = 8$	1.76**	0.66	1.45**	1.30*	0.51	4.98
	(0.89)	(0.73)	(0.68)	(0.77)	(0.63)	(3.81)
	Real GDP			Inflation		
	(7) Capital buffers	(8) Lending standards restr.	(9) Limits on credit growth	(10) Capital buffers	(11) Lending standards restr.	(12) Limits on credit growth
$h = 0$	-0.05	-0.16**	0.00	0.02	-0.12**	-0.01
	(0.08)	(0.08)	(0.17)	(0.06)	(0.05)	(0.07)
$h = 1$	-0.02	-0.35***	-0.10	0.07	-0.16*	-0.09
	(0.14)	(0.13)	(0.32)	(0.12)	(0.09)	(0.10)
$h = 2$	0.07	-0.44***	-0.15	0.00	-0.25**	-0.12
	(0.26)	(0.16)	(0.41)	(0.12)	(0.11)	(0.09)
$h = 3$	0.11	-0.48***	-0.02	-0.04	-0.20*	-0.04
	(0.30)	(0.18)	(0.51)	(0.12)	(0.11)	(0.10)
$h = 4$	0.21	-0.50**	0.16	0.06	-0.26	-0.05
	(0.28)	(0.20)	(0.48)	(0.16)	(0.16)	(0.12)
$h = 5$	0.39	-0.44*	0.23	0.12	-0.25	-0.05
	(0.30)	(0.22)	(0.52)	(0.20)	(0.17)	(0.17)
$h = 6$	0.48	-0.36	0.31	0.13	-0.24	-0.09
	(0.33)	(0.24)	(0.54)	(0.20)	(0.16)	(0.15)
$h = 7$	0.51	-0.42	0.34	0.16	-0.15	0.01
	(0.34)	(0.27)	(0.62)	(0.20)	(0.14)	(0.18)
$h = 8$	0.38	-0.37	0.29	0.33	-0.13	-0.03
	(0.30)	(0.35)	(0.61)	(0.26)	(0.15)	(0.15)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Notes: $\{\delta^h\}$ for $h = 0, 1, ...8$ coefficient estimates from regression (2) - interactions with US monetary policy spillovers. *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses).

Table 6: Estimated coefficients of monetary policy and prudential policy interaction from regression (2) for UK monetary policy spillovers

	Bank credit				House prices			
	(1) Risk weights	(2) Min. cap. req.	(3) Lim. on l. exp.	(4) Lim. on cred. gr.	(5) Risk weights	(6) Min. cap. req.	(7) Lim. on l. exp.	(8) Lim. on cred. gr.
$h = 0$	0.45*	0.06	-0.03	0.55**	0.39	-0.05	0.07	1.09*
	(0.26)	(0.24)	(0.29)	(0.24)	(0.29)	(0.26)	(0.18)	(0.60)
$h = 1$	0.81**	0.60**	0.25	0.93***	0.61**	-0.15	0.32	1.65
	(0.37)	(0.25)	(0.40)	(0.33)	(0.30)	(0.37)	(0.25)	(1.04)
$h = 2$	0.58	0.45	0.19	1.31**	0.60*	-0.08	0.63*	1.33
	(0.38)	(0.28)	(0.43)	(0.57)	(0.36)	(0.41)	(0.34)	(1.12)
$h = 3$	0.29	0.27	0.80	1.71**	0.76	-0.58	0.79	1.12
	(0.46)	(0.36)	(0.50)	(0.82)	(0.52)	(0.45)	(0.52)	(1.34)
$h = 4$	0.71	0.44	0.85	2.20*	1.38*	-0.78	1.07*	1.60
	(0.56)	(0.44)	(0.59)	(1.15)	(0.72)	(0.58)	(0.61)	(1.70)
$h = 5$	0.79	0.40	0.61	2.44	1.55**	-0.82	1.44**	1.57
	(0.67)	(0.51)	(0.65)	(1.51)	(0.79)	(0.61)	(0.60)	(1.95)
$h = 6$	0.61	0.29	1.00	2.72	1.47*	-0.91	1.68**	0.76
	(0.73)	(0.56)	(0.68)	(1.91)	(0.77)	(0.67)	(0.77)	(2.14)
$h = 7$	0.63	0.34	1.20	2.93	1.48	-1.02	1.85*	-0.37
	(0.88)	(0.56)	(0.80)	(2.18)	(0.90)	(0.68)	(0.97)	(2.32)
$h = 8$	0.65	0.37	1.18	2.91	1.59	-1.09	2.44**	-0.76
	(0.95)	(0.67)	(0.97)	(2.46)	(1.04)	(0.83)	(0.96)	(2.45)
	Real GDP				Inflation			
	(7) Risk weights	(8) Min. cap. req.	(9) Lim. on l. exp.	(10) Lim. on cred. gr.	(11) Risk weights	(12) Min. cap. req.	(13) Lim. on l. exp.	(14) Lim. on cred. gr.
$h = 0$	-0.18	-0.03	0.05	0.06	0.06	0.10	-0.04	0.01
	(0.28)	(0.09)	(0.11)	(0.11)	(0.08)	(0.10)	(0.08)	(0.09)
$h = 1$	-0.14	0.18	0.10	0.15	0.14*	0.07	-0.08	0.05
	(0.34)	(0.14)	(0.16)	(0.18)	(0.09)	(0.16)	(0.16)	(0.06)
$h = 2$	-0.18	-0.04	0.15	0.02	0.05	0.03	-0.06	0.05
	(0.29)	(0.12)	(0.19)	(0.26)	(0.08)	(0.13)	(0.17)	(0.09)
$h = 3$	-0.23	-0.25*	0.10	-0.09	0.08	0.02	-0.09	0.14
	(0.27)	(0.15)	(0.20)	(0.27)	(0.10)	(0.18)	(0.20)	(0.13)
$h = 4$	-0.28	-0.37**	-0.07	-0.18	0.16	0.06	-0.06	0.23
	(0.39)	(0.18)	(0.27)	(0.28)	(0.13)	(0.24)	(0.24)	(0.18)
$h = 5$	-0.13	-0.43**	0.10	-0.28	0.18	-0.05	-0.25	0.22
	(0.47)	(0.22)	(0.32)	(0.28)	(0.14)	(0.27)	(0.29)	(0.22)
$h = 6$	-0.13	-0.53**	0.14	-0.31	0.15	-0.11	-0.23	0.18
	(0.50)	(0.27)	(0.35)	(0.30)	(0.17)	(0.27)	(0.28)	(0.30)
$h = 7$	-0.20	-0.71**	0.04	-0.51	0.16	-0.02	-0.18	0.21
	(0.51)	(0.32)	(0.38)	(0.33)	(0.19)	(0.29)	(0.29)	(0.30)
$h = 8$	-0.17	-0.76**	0.28	-0.64*	0.12	0.00	-0.12	0.21
	(0.53)	(0.34)	(0.41)	(0.33)	(0.21)	(0.36)	(0.32)	(0.27)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: $\{\delta^h\}$ for $h = 0, 1, ...8$ coefficient estimates from regression (2) - interactions with UK monetary policy spillovers. *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses). UK dropped from the sample, reflects results of EU27 countries

Table 7: Estimated coefficients of monetary policy and prudential policy interaction from regression (2) for EA monetary policy spillovers

	Bank credit			House prices		
	(1) Lim. of large exp.	(2) Min. cap. req.	(3) Capital buffers	(4) Lim. of large exp.	(5) Min. cap. req.	(6) Capital buffers
$h = 0$	0.02	0.04	0.00	-0.02	-0.01	0.03
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
$h = 1$	0.04*	0.02	0.03	-0.03	-0.03	0.00
	(0.02)	(0.04)	(0.03)	(0.02)	(0.03)	(0.04)
$h = 2$	0.04	-0.05	-0.01	-0.02	-0.02	-0.05
	(0.03)	(0.05)	(0.04)	(0.04)	(0.05)	(0.06)
$h = 3$	0.07	-0.16*	0.00	0.01	-0.08	-0.11
	(0.05)	(0.08)	(0.08)	(0.07)	(0.09)	(0.09)
$h = 4$	0.07	-0.22**	0.01	0.03	-0.13	-0.22
	(0.07)	(0.09)	(0.10)	(0.09)	(0.10)	(0.14)
$h = 5$	0.09	-0.20**	-0.02	0.04	-0.12	-0.21
	(0.08)	(0.08)	(0.12)	(0.10)	(0.10)	(0.17)
$h = 6$	0.12	-0.20**	-0.08	0.03	-0.12	-0.25
	(0.08)	(0.08)	(0.13)	(0.10)	(0.10)	(0.18)
$h = 7$	0.13	-0.22**	-0.14	0.07	-0.12	-0.27
	(0.09)	(0.08)	(0.14)	(0.10)	(0.11)	(0.19)
$h = 8$	0.11	-0.23**	-0.17	0.05	-0.12	-0.22
	(0.10)	(0.09)	(0.16)	(0.10)	(0.10)	(0.20)
	Real GDP			Inflation		
	(7) Lim. of large exp.	(8) Min. cap. req.	(9) Capital buffers	(10) Lim. of large exp.	(11) Min. cap. req.	(12) Capital buffers
$h = 0$	-0.11	0.01	0.00	0.01	0.02***	0.01
	(0.09)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$h = 1$	-0.23	0.00	-0.04*	0.00	0.01	0.00
	(0.17)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
$h = 2$	-0.24	-0.02	-0.06**	0.00	-0.02**	-0.02
	(0.23)	(0.02)	(0.02)	(0.00)	(0.01)	(0.01)
$h = 3$	-0.38	-0.10***	-0.11**	0.01	-0.03**	-0.01
	(0.29)	(0.03)	(0.04)	(0.01)	(0.01)	(0.01)
$h = 4$	-0.33	-0.09**	-0.14**	0.02*	-0.02	-0.01
	(0.29)	(0.04)	(0.06)	(0.01)	(0.02)	(0.03)
$h = 5$	-0.29	-0.09*	-0.15***	0.00	-0.03	-0.04*
	(0.29)	(0.05)	(0.06)	(0.01)	(0.02)	(0.02)
$h = 6$	-0.26	-0.08	-0.17***	0.02	-0.04*	-0.06**
	(0.32)	(0.05)	(0.06)	(0.01)	(0.02)	(0.03)
$h = 7$	-0.37	-0.08*	-0.17***	0.02	-0.05**	-0.06**
	(0.38)	(0.05)	(0.06)	(0.02)	(0.03)	(0.03)
$h = 8$	-0.24	-0.09*	-0.17***	0.02	-0.04	-0.07**
	(0.41)	(0.05)	(0.06)	(0.02)	(0.03)	(0.03)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Notes: $\{\delta^h\}$ for $h = 0, 1, ...8$ coefficient estimates from regression (2) - interaction with EA Monetary Policy. *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses).

Table 8: Estimated coefficients of monetary policy spillovers from regression (1) for GDP, inflation, bank credit and house prices - Euro Area countries

	Bank credit			House prices		
	(1)	(2)	(3)	(4)	(5)	(6)
	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$
$h=0$	-0.85	0.30**	-0.01	-0.23	-0.30	-0.04
	(0.58)	(0.13)	(0.02)	(0.28)	(0.21)	(0.02)
$h=1$	-1.15**	0.12	-0.04	-0.86**	-0.33	-0.04
	(0.54)	(0.28)	(0.03)	(0.41)	(0.23)	(0.03)
$h=2$	-1.72**	-0.28	-0.11*	-1.28**	-0.90***	-0.10**
	(0.86)	(0.40)	(0.06)	(0.51)	(0.35)	(0.05)
$h=3$	-2.13**	-0.43	-0.23***	-1.61***	-1.44***	-0.22***
	(0.87)	(0.69)	(0.09)	(0.57)	(0.48)	(0.07)
$h=4$	-1.84**	0.04	-0.32***	-1.55**	-1.73***	-0.29***
	(0.79)	(0.47)	(0.09)	(0.60)	(0.59)	(0.09)
$h=5$	-2.19**	0.16	-0.38***	-1.44**	-1.96***	-0.32***
	(0.98)	(0.50)	(0.10)	(0.58)	(0.72)	(0.10)
$h=6$	-2.14*	-0.35	-0.47***	-1.71***	-2.40***	-0.29***
	(1.16)	(0.62)	(0.13)	(0.64)	(0.87)	(0.11)
$h=7$	-2.22*	-0.13	-0.55***	-2.13***	-2.93***	-0.27**
	(1.34)	(0.59)	(0.14)	(0.78)	(1.01)	(0.11)
$h=8$	-2.28	-0.24	-0.53***	-2.97***	-3.15***	-0.31***
	(1.47)	(0.68)	(0.15)	(0.90)	(1.13)	(0.12)
	Real GDP			Inflation		
	(7)	(8)	(9)	(10)	(11)	(12)
	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$
$h=0$	-0.57***	-0.31**	0.00	-0.43***	0.18*	0.18**
	(0.09)	(0.12)	(0.01)	(0.08)	(0.09)	(0.09)
$h=1$	-0.83***	-0.27**	-0.03*	-0.95***	0.00	0.00
	(0.15)	(0.12)	(0.01)	(0.08)	(0.13)	(0.13)
$h=2$	-1.11***	-0.80***	-0.12***	-0.96***	-0.33***	-0.33***
	(0.25)	(0.18)	(0.02)	(0.09)	(0.13)	(0.13)
$h=3$	-1.26***	-1.46***	-0.23***	-0.97***	-0.21	-0.21
	(0.22)	(0.24)	(0.03)	(0.11)	(0.14)	(0.14)
$h=4$	-0.74***	-1.67***	-0.25***	-0.87***	0.02	0.02
	(0.19)	(0.28)	(0.02)	(0.16)	(0.20)	(0.20)
$h=5$	-0.20	-1.17***	-0.26***	-1.07***	-0.25	-0.25
	(0.17)	(0.37)	(0.03)	(0.19)	(0.24)	(0.24)
$h=6$	-0.26	-2.08***	-0.23***	-0.88***	-0.68***	-0.68***
	(0.20)	(0.41)	(0.03)	(0.18)	(0.24)	(0.24)
$h=7$	-0.38	-1.98***	-0.21***	-0.79***	-0.62**	-0.62**
	(0.26)	(0.37)	(0.02)	(0.20)	(0.26)	(0.26)
$h=8$	-0.67*	-1.89***	-0.20***	-0.69***	-0.49*	-0.49*
	(0.35)	(0.39)	(0.03)	(0.22)	(0.28)	(0.28)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	NO	NO	NO	NO	NO	NO

Notes: $\hat{\beta}^h$ for $h = 0, 1, ...8$ coefficient estimates from regression (1) in columns (1) and (12). *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses). Results reflect the 19 EA countries, at the time the sample ended.

Table 9: Estimated coefficients of monetary policy spillovers from regression (1) for GDP, inflation, bank credit and house prices - Non-Euro Area EU countries

	Bank credit			House prices		
	(1)	(2)	(3)	(4)	(5)	(6)
	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$
$h=0$	-0.18	0.51	-0.06**	-1.51	-1.20	0.01
	(0.29)	(0.42)	(0.03)	(1.01)	(1.09)	(0.04)
$h=1$	-1.17**	0.94	-0.17***	-2.90*	-2.25	-0.11**
	(0.60)	(0.59)	(0.05)	(1.50)	(1.67)	(0.05)
$h=2$	-0.20***	0.18	-0.46***	-4.25*	-2.22	-0.28***
	(0.68)	(0.83)	(0.09)	(2.24)	(1.41)	(0.07)
$h=3$	-1.95**	-0.39	-0.77***	-4.04	-2.21*	-0.58***
	(0.82)	(1.10)	(0.12)	(2.50)	(1.34)	(0.12)
$h=4$	-0.76	0.52	-0.96***	-2.46	-1.86	-0.71***
	(0.89)	(1.54)	(0.13)	(2.27)	(1.70)	(0.16)
$h=5$	0.08	0.27	-1.03***	-1.29	-0.86	-0.71***
	(1.23)	(1.70)	(0.14)	(2.04)	(1.74)	(0.18)
$h=6$	0.53	-0.85	-0.19***	-1.21	-0.66	-0.61***
	(1.29)	(1.70)	(0.15)	(2.10)	(1.58)	(0.19)
$h=7$	0.94	-1.73	-1.18***	-2.48	-0.37	-0.56***
	(1.53)	(1.73)	(0.17)	(2.42)	(1.80)	(0.20)
$h=8$	0.33	-2.15	-1.27***	-3.30	-1.34	-0.51***
	(1.50)	(2.06)	(0.22)	(2.88)	(2.30)	(0.19)
	Real GDP			Inflation		
	(7)	(8)	(9)	(10)	(11)	(12)
	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$	US $MP_t^{\$}$	UK $MP_t^{\$}$	EA $MP_t^{\$}$
$h=0$	-0.74***	-0.26	-0.02	-0.41**	0.07	0.04***
	(0.15)	(0.22)	(0.01)	(0.16)	(0.21)	(0.01)
$h=1$	-1.42***	-0.20	-0.07***	-0.88***	-0.21	0.03
	(0.28)	(0.23)	(0.02)	(0.18)	(0.32)	(0.02)
$h=2$	-2.03***	-0.80***	-0.17***	-0.94***	-0.47	-0.06**
	(0.42)	(0.28)	(0.02)	(0.21)	(0.34)	(0.03)
$h=3$	-2.40***	-1.62***	-0.35***	-0.87***	-0.30	-0.10***
	(0.54)	(0.34)	(0.04)	(0.27)	(0.39)	(0.03)
$h=4$	-2.06***	-2.07***	-0.43***	-0.92***	-0.16	-0.10**
	(0.53)	(0.37)	(0.06)	(0.35)	(0.51)	(0.04)
$h=5$	-1.75***	-1.94***	-0.47***	-0.96**	-0.57	-0.12**
	(0.58)	(0.43)	(0.06)	(0.41)	(0.65)	(0.05)
$h=6$	-1.80***	-2.42***	-0.43***	-0.69*	-0.88	-0.17***
	(0.64)	(0.49)	(0.06)	(0.38)	(0.63)	(0.06)
$h=7$	-2.42***	-2.97***	-0.42***	-0.23	-0.67	-0.21***
	(0.76)	(0.57)	(0.07)	(0.40)	(0.62)	(0.06)
$h=8$	-2.72***	-3.27***	-0.41***	0.01	-0.62	-0.21***
	(0.79)	(0.72)	(0.08)	(0.46)	(0.77)	(0.06)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	NO	NO	NO	NO	NO	NO

Notes: $\hat{\beta}^h$ for $h = 0, 1, ...8$ coefficient estimates from regression (1) in columns (1) and (12). *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses). UK dropped from the sample in estimates from Columns (2), (5), (8) and (11), reflecting results of EU27 countries.

Table 10: Estimated coefficients of monetary policy and prudential policy interaction from regression (2) for US monetary policy spillovers - Euro Area Countries

	Bank credit			House prices		
	(1) Capital buffers	(2) Lending standards restr.	(3) Limits on credit growth	(4) Capital buffers	(5) Lending standards restr.	(6) Limits on credit growth
$h = 0$	0.03	0.05	0.94	0.55*	-0.10	-1.02
	(0.22)	(0.13)	(0.95)	(0.31)	(0.15)	(0.89)
$h = 1$	0.51	0.04	0.99	0.90**	-0.16	-1.54
	(0.36)	(0.25)	(1.60)	(0.44)	(0.22)	(0.96)
$h = 2$	0.52	-0.10	1.24	1.21*	-0.08	-1.33
	(0.54)	(0.30)	(2.51)	(0.65)	(0.37)	(1.05)
$h = 3$	0.98	-0.08	0.57	1.53*	0.01	-1.64
	(0.71)	(0.38)	(2.53)	(0.79)	(0.49)	(1.60)
$h = 4$	1.22	-0.17	1.58	1.79*	-0.10	-2.20
	(0.78)	(0.47)	(3.93)	(0.96)	(0.63)	(2.12)
$h = 5$	1.59*	-0.28	1.36	2.25**	0.01	-2.33
	(0.86)	(0.53)	(4.34)	(1.04)	(0.79)	(2.27)
$h = 6$	1.51	-0.49	2.04	2.51**	0.17	-1.68
	(0.96)	(0.71)	(5.60)	(1.15)	(0.90)	(2.18)
$h = 7$	1.69	-0.46	1.41	2.47**	0.30	-1.69
	(1.14)	(0.78)	(5.34)	(1.16)	(0.98)	(2.19)
$h = 8$	1.66	-0.70	1.92	2.64**	0.15	-1.95
	(1.33)	(0.96)	(5.71)	(1.27)	(1.12)	(2.36)

	Real GDP			Inflation		
	(7) Capital buffers	(8) Lending standards restr.	(9) Limits on credit growth	(10) Capital buffers	(11) Lending standards restr.	(12) Limits on credit growth
$h = 0$	0.08	-0.08	-0.26	-0.02	-0.11	0.26
	(0.12)	(0.06)	(0.25)	(0.07)	(0.08)	(0.22)
$h = 1$	0.17	-0.22	-0.52**	0.09	-0.05	0.26
	(0.21)	(0.14)	(0.23)	(0.11)	(0.06)	(0.43)
$h = 2$	0.37	-0.31	-1.16***	-0.01	-0.10	0.40
	(0.40)	(0.20)	(0.31)	(0.11)	(0.08)	(0.30)
$h = 3$	0.47	-0.31	-1.26***	-0.16	-0.08	0.70
	(0.44)	(0.22)	(0.36)	(0.14)	(0.06)	(0.43)
$h = 4$	0.46	-0.32*	-1.18*	-0.21	-0.19	0.87
	(0.43)	(0.19)	(0.63)	(0.17)	(0.12)	(0.66)
$h = 5$	0.60	-0.17	-1.68**	-0.13	-0.16	0.89
	(0.48)	(0.27)	(0.81)	(0.20)	(0.11)	(0.74)
$h = 6$	0.69	-0.04	-2.20***	-0.14	-0.17	0.75
	(0.54)	(0.39)	(0.44)	(0.21)	(0.13)	(0.56)
$h = 7$	0.78	0.03	-2.76***	-0.20	-0.19	0.97
	(0.59)	(0.48)	(0.66)	(0.24)	(0.13)	(0.69)
$h = 8$	0.60	0.28	-3.49***	-0.15	-0.23	0.81
	(0.50)	(0.62)	(0.70)	(0.26)	(0.18)	(0.69)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Notes: $\{\delta^h\}$ for $h = 0, 1, ...8$ coefficient estimates from regression (2) - interactions with US monetary policy spillovers. *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses).

Table 11: Estimated coefficients of monetary policy spillovers from regression (1) for GDP, inflation, bank credit and house prices - non-Euro Area EU countries

	Bank credit			House prices		
	(1) Capital buffers	(2) Lending standards restr.	(3) Limits on credit growth	(4) Capital buffers	(5) Lending standards restr.	(6) Limits on credit growth
$h = 0$	0.09	0.14	1.41*	0.16	-0.59	2.15**
	(0.28)	(0.21)	(0.76)	(0.27)	(0.45)	(0.90)
$h = 1$	0.56	0.29	1.68	0.24	-0.89	3.57*
	(0.42)	(0.35)	(1.04)	(0.76)	(0.91)	(1.86)
$h = 2$	0.30	-0.01	2.25	0.26	-1.20	4.60*
	(0.81)	(0.58)	(1.58)	(0.99)	(1.20)	(2.40)
$h = 3$	0.36	0.14	2.71	-0.03	-1.02	5.50*
	(1.12)	(0.61)	(1.92)	(1.34)	(1.10)	(3.04)
$h = 4$	0.15	0.47	3.65	-0.01	-0.62	8.06**
	(1.28)	(0.66)	(2.28)	(1.20)	(0.88)	(3.76)
$h = 5$	0.79	1.14	3.52	0.17	-0.04	9.82**
	(1.33)	(0.70)	(2.18)	(1.24)	(0.81)	(4.34)
$h = 6$	1.13	1.14	3.89	0.04	0.20	10.83**
	(1.55)	(0.88)	(2.44)	(1.55)	(0.89)	(4.57)
$h = 7$	1.29	1.16	3.55*	-0.04	0.18	11.18**
	(1.62)	(0.99)	(2.10)	(1.44)	(0.99)	(4.67)
$h = 8$	0.95	0.97	3.22*	-0.14	0.45	11.35**
	(1.71)	(1.21)	(1.74)	(1.70)	(0.98)	(5.11)
	Real GDP			Inflation		
	(7) Capital buffers	(8) Lending standards restr.	(9) Limits on credit growth	(10) Capital buffers	(11) Lending standards restr.	(12) Limits on credit growth
$h = 0$	-0.24*	-0.19	-0.03	0.04	-0.13**	0.02
	(0.13)	(0.13)	(0.22)	(0.08)	(0.07)	(0.08)
$h = 1$	-0.35	-0.43*	-0.20	-0.03	-0.27**	-0.06
	(0.28)	(0.25)	(0.35)	(0.17)	(0.13)	(0.09)
$h = 2$	-0.43	-0.47	-0.27	-0.02	-0.38**	-0.09
	(0.37)	(0.33)	(0.48)	(0.28)	(0.18)	(0.07)
$h = 3$	-0.50	-0.49	-0.13	0.01	-0.32	0.01
	(0.52)	(0.37)	(0.62)	(0.31)	(0.20)	(0.11)
$h = 4$	-0.18	-0.43	0.05	0.20	-0.35	0.02
	(0.48)	(0.44)	(0.62)	(0.38)	(0.29)	(0.13)
$h = 5$	0.03	-0.40	0.11	0.21	-0.38	0.03
	(0.46)	(0.45)	(0.68)	(0.45)	(0.31)	(0.20)
$h = 6$	0.10	-0.31	0.14	0.27	-0.35	-0.02
	(0.48)	(0.38)	(0.71)	(0.51)	(0.28)	(0.19)
$h = 7$	0.07	-0.42	0.15	0.31	-0.22	0.09
	(0.44)	(0.36)	(0.81)	(0.54)	(0.25)	(0.27)
$h = 8$	0.11	-0.49	0.09	0.49	-0.18	0.07
	(0.50)	(0.39)	(0.77)	(0.64)	(0.20)	(0.23)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	NO	NO	NO	NO	NO	NO

Notes: $\hat{\beta}^h$ for $h = 0, 1, ...8$ coefficient estimates from regression (1) in columns (1) and (12). *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses). UK dropped from the sample in estimates from Columns (2), (5), (8) and (11), reflecting results of EU27 countries.

Table 12: Estimated coefficients of monetary policy and prudential policy interaction from regression (2) for UK monetary policy spillovers - Euro Area countries

	Bank credit				House prices			
	(1) Risk weights	(2) Min. cap. req.	(3) Lim. on l. exp.	(4) Lim. on cred. gr.	(5) Risk weights	(6) Min. cap. req.	(7) Lim. on l. exp.	(8) Lim. on cred. gr.
$h = 0$	0.06	0.10	-0.11	0.51	-0.11	0.11	-0.11	-0.16
	(0.20)	(0.28)	(0.17)	(0.47)	(0.25)	(0.22)	(0.15)	(0.36)
$h = 1$	0.41	-0.18	0.05	0.67	0.40	0.26	0.09	-0.07
	(0.40)	(0.33)	(0.25)	(1.10)	(0.40)	(0.27)	(0.22)	(0.44)
$h = 2$	0.35	-0.24	0.10	1.32	0.30	0.32	0.21	0.25
	(0.41)	(0.43)	(0.27)	(1.99)	(0.53)	(0.40)	(0.31)	(0.78)
$h = 3$	0.15	-0.16	0.60	0.87	-0.28	0.14	-0.18	-0.87
	(0.52)	(0.73)	(0.45)	(2.01)	(0.70)	(0.47)	(0.36)	(0.81)
$h = 4$	0.24	-0.52	0.58	0.44	-0.45	0.30	-0.16	-0.87
	(0.60)	(0.69)	(0.53)	(2.15)	(0.84)	(0.55)	(0.45)	(0.96)
$h = 5$	0.55	-0.39	-0.01	-0.26	-0.39	0.52	0.46	-1.04
	(0.73)	(0.75)	(0.45)	(2.06)	(0.97)	(0.59)	(0.56)	(0.98)
$h = 6$	0.28	-0.49	0.38	0.54	-0.61	0.53	0.31	-1.40
	(0.76)	(0.87)	(0.45)	(3.03)	(1.02)	(0.66)	(0.53)	(1.05)
$h = 7$	0.17	-0.33	0.45	-0.22	-1.07	0.57	0.06	-1.55
	(0.86)	(1.02)	(0.43)	(2.75)	(1.27)	(0.73)	(0.70)	(1.29)
$h = 8$	0.07	-0.16	0.15	-0.85	-1.33	0.84	0.86	-1.55
	(0.92)	(0.85)	(0.52)	(2.73)	(1.41)	(0.88)	(0.74)	(1.27)
	Real GDP				Inflation			
	(7) Risk weights	(8) Min. cap. req.	(9) Lim. on l. exp.	(10) Lim. on cred. gr.	(11) Risk weights	(12) Min. cap. req.	(13) Lim. on l. exp.	(14) Lim. on cred. gr.
$h = 0$	-0.09	0.02	0.08	-0.18	0.10	-0.05	0.10	0.26
	(0.40)	(0.14)	(0.12)	(0.44)	(0.11)	(0.09)	(0.09)	(0.19)
$h = 1$	-0.15	0.20	0.02	0.17	0.28**	-0.03	0.23*	0.32
	(0.44)	(0.22)	(0.15)	(0.50)	(0.14)	(0.13)	(0.14)	(0.37)
$h = 2$	-0.33	0.00	-0.05	-0.18	0.16	-0.08	0.19	0.41
	(0.43)	(0.20)	(0.14)	(0.49)	(0.10)	(0.12)	(0.12)	(0.56)
$h = 3$	-0.30	-0.04	-0.24	-0.77**	0.06	-0.18	0.13	0.48
	(0.46)	(0.27)	(0.17)	(0.37)	(0.10)	(0.15)	(0.11)	(0.52)
$h = 4$	-0.63	-0.11	-0.46**	-0.95***	0.14	-0.19	0.21	0.62
	(0.64)	(0.27)	(0.23)	(0.31)	(0.14)	(0.19)	(0.15)	(0.66)
$h = 5$	-0.83	-0.31	-0.48**	-1.33***	0.22	-0.20	0.25	0.51
	(0.68)	(0.29)	(0.25)	(0.35)	(0.16)	(0.19)	(0.19)	(0.68)
$h = 6$	-0.87	-0.37	-0.57*	-2.25***	0.17	-0.19	0.14	0.24
	(0.72)	(0.35)	(0.30)	(0.73)	(0.15)	(0.21)	(0.15)	(0.58)
$h = 7$	-0.89	-0.46	-0.56*	-2.71**	0.08	-0.20	0.09	0.30
	(0.74)	(0.39)	(0.29)	(1.31)	(0.19)	(0.23)	(0.12)	(0.57)
$h = 8$	-0.94	-0.55	-0.29	-3.12*	0.02	-0.34	0.14	0.56
	(0.69)	(0.38)	(0.27)	(1.69)	(0.22)	(0.29)	(0.11)	(0.50)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: $\{\delta^h\}$ for $h = 0, 1, ...8$ coefficient estimates from regression (2) - interactions with UK monetary policy spillovers. *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses). UK dropped from the sample, reflects results of EU27 countries

Table 13: Estimated coefficients of monetary policy and prudential policy interaction from regression (2) for UK monetary policy spillovers - Non-Euro Area EU countries

	Bank credit				House prices			
	(1) Risk weights	(2) Min. cap. req.	(3) Lim. on l. exp.	(4) Lim. on cred. gr.	(5) Risk weights	(6) Min. cap. req.	(7) Lim. on l. exp.	(8) Lim. on cred. gr.
$h=0$	0.94**	0.15	0.27	0.72**	0.65**	-0.07	0.53	1.20*
	(0.44)	(0.43)	(0.94)	(0.34)	(0.29)	(0.31)	(0.58)	(0.57)
$h=1$	1.46***	1.23***	1.16	0.97	0.32	-0.25	1.12	2.09
	(0.47)	(0.38)	(1.22)	(0.62)	(0.56)	(0.42)	(1.02)	(1.34)
$h=2$	0.99*	0.91**	1.07	1.14	0.12	-0.15	1.55	1.49
	(0.56)	(0.44)	(1.26)	(0.91)	(0.74)	(0.44)	(1.00)	(1.55)
$h=3$	0.51	0.54	2.09	1.23	0.64	-0.74**	2.44	1.23
	(0.79)	(0.52)	(1.32)	(1.25)	(0.75)	(0.36)	(1.51)	(1.54)
$h=4$	1.28	1.16	2.36	1.39	1.65	-1.11*	3.26*	2.24
	(0.88)	(0.74)	(1.50)	(1.66)	(1.05)	(0.58)	(1.97)	(1.60)
$h=5$	1.31	1.00	2.94	1.67	1.64	-1.19*	3.02	2.32
	(1.08)	(0.79)	(1.80)	(2.12)	(1.25)	(0.63)	(1.86)	(1.85)
$h=6$	1.43	0.87	3.96**	1.79	1.49	-1.18*	4.15*	1.32
	(1.16)	(0.84)	(1.93)	(2.52)	(1.49)	(0.67)	(2.51)	(1.60)
$h=7$	1.54	0.95	4.61**	2.05	1.85	-1.28**	5.30*	-0.20
	(1.43)	(0.86)	(2.06)	(2.71)	(1.62)	(0.64)	(3.14)	(1.58)
$h=8$	1.77	0.88	4.98**	1.78	2.20	-1.43*	5.50	-0.36
	(1.51)	(1.06)	(2.33)	(2.89)	(1.74)	(0.76)	(3.38)	(1.95)
	Real GDP				Inflation			
	(7) Risk weights	(8) Min. cap. req.	(9) Lim. on l. exp.	(10) Lim. on cred. gr.	(11) Risk weights	(12) Min. cap. req.	(13) Lim. on l. exp.	(14) Lim. on cred. gr.
$h=0$	-0.31	-0.04	0.05	0.05	0.05	0.21*	-0.08	-0.05
	(0.30)	(0.16)	(0.20)	(0.10)	(0.10)	(0.12)	(0.17)	(0.11)
$h=1$	-0.15	0.14	0.26	0.16	0.04	0.18	-0.18	0.01
	(0.50)	(0.22)	(0.32)	(0.14)	(0.09)	(0.19)	(0.22)	(0.09)
$h=2$	-0.02	-0.08	0.48	0.04	-0.02	0.14	-0.06	-0.01
	(0.43)	(0.20)	(0.41)	(0.23)	(0.12)	(0.16)	(0.22)	(0.10)
$h=3$	-0.10	-0.38*	0.51	-0.04	0.13	0.19	-0.12	0.08
	(0.31)	(0.23)	(0.42)	(0.21)	(0.15)	(0.21)	(0.26)	(0.13)
$h=4$	0.04	-0.52**	0.44	-0.15	0.23	0.25	-0.13	0.12
	(0.39)	(0.26)	(0.51)	(0.20)	(0.17)	(0.29)	(0.34)	(0.18)
$h=5$	0.46	-0.52	0.85	-0.22	0.25	0.10	-0.14	0.12
	(0.54)	(0.33)	(0.60)	(0.20)	(0.20)	(0.36)	(0.35)	(0.21)
$h=6$	0.50	-0.64	1.04*	-0.19	0.27	0.01	-0.17	0.09
	(0.57)	(0.40)	(0.62)	(0.17)	(0.25)	(0.36)	(0.37)	(0.26)
$h=7$	0.37	-0.87*	0.85	-0.36*	0.36	0.17	-0.13	0.10
	(0.60)	(0.49)	(0.74)	(0.21)	(0.22)	(0.37)	(0.40)	(0.24)
$h=8$	0.47	-0.91*	1.01	-0.45**	0.40*	0.25	-0.07	0.05
	(0.70)	(0.54)	(0.84)	(0.20)	(0.24)	(0.47)	(0.50)	(0.22)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: $\{\delta^h\}$ for $h = 0, 1, ...8$ coefficient estimates from regression (2) - interactions with UK monetary policy spillovers. *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses). UK dropped from the sample, reflects results of EU27 countries

Table 14: Estimated coefficients of monetary policy and prudential policy interaction from regression (2) for EA monetary policy spillovers for Euro Area countries

	Bank credit			House prices		
	(1) Lim. of large exp.	(2) Min. cap. req.	(3) Capital buffers	(4) Lim. of large exp.	(5) Min. cap. req.	(6) Capital buffers
$h = 0$	0.03*	-0.01	-0.01	-0.03	-0.02	0.05
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.04)
$h = 1$	0.06**	-0.07	0.05	-0.07***	-0.06	0.05
	(0.03)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)
$h = 2$	0.07**	-0.02	0.00	-0.10***	0.02	0.02
	(0.03)	(0.07)	(0.05)	(0.03)	(0.06)	(0.06)
$h = 3$	0.10**	-0.05	0.00	-0.13***	0.00	0.00
	(0.04)	(0.08)	(0.11)	(0.04)	(0.12)	(0.08)
$h = 4$	0.11**	-0.06	0.04	-0.15***	-0.03	-0.09
	(0.05)	(0.09)	(0.10)	(0.05)	(0.15)	(0.11)
$h = 5$	0.13**	-0.07	0.03	-0.15***	0.05	-0.07
	(0.06)	(0.10)	(0.14)	(0.05)	(0.15)	(0.14)
$h = 6$	0.14**	-0.02	-0.02	-0.16***	0.04	-0.13
	(0.06)	(0.11)	(0.13)	(0.06)	(0.16)	(0.15)
$h = 7$	0.16**	-0.02	-0.05	-0.12**	0.04	-0.18
	(0.07)	(0.14)	(0.15)	(0.06)	(0.18)	(0.18)
$h = 8$	0.11*	0.00	-0.09	-0.15**	0.07	-0.13
	(0.06)	(0.16)	(0.11)	(0.06)	(0.20)	(0.22)
	Real GDP			Inflation		
	(7) Lim. of large exp.	(8) Min. cap. req.	(9) Capital buffers	(10) Lim. of large exp.	(11) Min. cap. req.	(12) Capital buffers
$h = 0$	0.00	0.02	-0.02	0.02***	0.03*	0.00
	(0.01)	(0.01)	(0.02)	(0.00)	(0.01)	(0.01)
$h = 1$	0.00	0.02	-0.05*	0.01	0.01	0.00
	(0.01)	(0.02)	(0.03)	(0.01)	(0.02)	(0.01)
$h = 2$	-0.01	0.01	-0.06	0.01	-0.02	0.00
	(0.01)	(0.02)	(0.04)	(0.01)	(0.01)	(0.01)
$h = 3$	-0.03**	-0.04	-0.05	0.00	-0.03*	-0.01
	(0.02)	(0.06)	(0.03)	(0.01)	(0.02)	(0.01)
$h = 4$	-0.02	-0.02	-0.09	0.01*	-0.02	-0.01
	(0.02)	(0.07)	(0.05)	(0.01)	(0.02)	(0.02)
$h = 5$	-0.01	0.01	-0.09*	0.00	-0.02	-0.03
	(0.02)	(0.07)	(0.06)	(0.01)	(0.02)	(0.02)
$h = 6$	-0.03	0.01	-0.11	0.00	-0.03	-0.03
	(0.02)	(0.07)	(0.07)	(0.01)	(0.02)	(0.02)
$h = 7$	-0.02	0.02	-0.11	0.00	-0.04***	-0.04
	(0.02)	(0.09)	(0.07)	(0.01)	(0.01)	(0.03)
$h = 8$	-0.03	0.01	-0.07	0.00	-0.02	-0.05
	(0.02)	(0.09)	(0.06)	(0.01)	(0.02)	(0.04)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Notes: $\{\delta^h\}$ for $h = 0, 1, ...8$ coefficient estimates from regression (2) - interaction with EA Monetary Policy. *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses).

Table 15: Estimated coefficients of monetary policy and prudential policy interaction from regression (2) for EA monetary policy spillovers for non-Euro Area EU countries

	Bank credit			House prices		
	(1)	(2)	(3)	(4)	(5)	(6)
	Lim. of large exp.	Min. cap. req.	Capital buffers	Lim. of large exp.	Min. cap. req.	Capital buffers
$h = 0$	0.01	0.06*	0.03	0.03	0.01	0.06
	(0.04)	(0.04)	(0.07)	(0.04)	(0.03)	(0.05)
$h = 1$	0.00	0.05	0.04	0.11*	0.00	0.01
	(0.06)	(0.06)	(0.10)	(0.07)	(0.05)	(0.10)
$h = 2$	-0.03	-0.09	0.05	0.25*	-0.02	-0.02
	(0.10)	(0.10)	(0.15)	(0.15)	(0.08)	(0.11)
$h = 3$	0.03	-0.24*	0.02	0.44*	-0.09	-0.10
	(0.20)	(0.13)	(0.24)	(0.25)	(0.13)	(0.16)
$h = 4$	0.05	-0.30**	-0.12	0.52	-0.13	-0.24
	(0.29)	(0.14)	(0.31)	(0.35)	(0.13)	(0.28)
$h = 5$	0.08	-0.25**	-0.12	0.56	-0.12	-0.26
	(0.32)	(0.11)	(0.36)	(0.38)	(0.13)	(0.38)
$h = 6$	0.17	-0.26**	-0.18	0.54	-0.09	-0.24
	(0.34)	(0.12)	(0.38)	(0.37)	(0.12)	(0.39)
$h = 7$	0.17	-0.26**	-0.30	0.53	-0.05	-0.20
	(0.37)	(0.11)	(0.40)	(0.35)	(0.11)	(0.36)
$h = 8$	0.24	-0.31**	-0.34	0.48*	-0.04	-0.19
	(0.42)	(0.13)	(0.43)	(0.28)	(0.11)	(0.32)
	Real GDP			Inflation		
	(7)	(8)	(9)	(10)	(11)	(12)
	Lim. of large exp.	Min. cap. req.	Capital buffers	Lim. of large exp.	Min. cap. req.	Capital buffers
$h = 0$	0.02	0.01	0.03*	-0.01	0.02**	0.01
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
$h = 1$	0.02	-0.01	-0.03	-0.03	0.00	0.00
	(0.03)	(0.03)	(0.03)	(0.02)	(0.01)	(0.03)
$h = 2$	0.01	-0.03	-0.07**	0.01	-0.03**	-0.02
	(0.05)	(0.03)	(0.03)	(0.02)	(0.01)	(0.02)
$h = 3$	0.04	-0.11***	-0.20**	0.03	-0.03*	-0.01
	(0.09)	(0.04)	(0.09)	(0.02)	(0.02)	(0.03)
$h = 4$	0.07	-0.12**	-0.24**	0.04	-0.03	-0.01
	(0.12)	(0.05)	(0.14)	(0.04)	(0.03)	(0.04)
$h = 5$	0.12	-0.13**	-0.25*	0.05	-0.04	-0.06
	(0.13)	(0.06)	(0.14)	(0.04)	(0.04)	(0.05)
$h = 6$	0.17	-0.11**	-0.26**	0.08	-0.06	-0.09
	(0.12)	(0.06)	(0.12)	(0.06)	(0.04)	(0.05)
$h = 7$	0.15	-0.11*	-0.26**	0.09	-0.06	-0.09
	(0.13)	(0.06)	(0.10)	(0.07)	(0.04)	(0.06)
$h = 8$	0.12	-0.11*	-0.31***	0.09	-0.05	-0.10*
	(0.13)	(0.06)	(0.08)	(0.07)	(0.05)	(0.06)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Notes: $\{\delta^h\}$ for $h = 0, 1, ...8$ coefficient estimates from regression (2) - interaction with EA Monetary Policy. *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses).

Table 16: Robustness of estimated coefficients of variations of monetary policy spillovers from regression (1) for GDP, inflation, bank credit and house prices

	Bank credit			House prices		
	(1)	(2)	(3)	(4)	(5)	(6)
	US*UK*EA	US*UK	UK*EA	US*UK*EA	US*UK	UK*EA
	$MP_t^{\$}$	$MP_t^{\$}$	$MP_t^{\$}$	$MP_t^{\$}$	$MP_t^{\$}$	$MP_t^{\$}$
$h = 0$	0.18***	2.30***	0.07**	0.15	0.34	0.12*
	(0.06)	(0.66)	(0.03)	(0.14)	(0.37)	(0.07)
$h = 1$	0.10	3.02***	0.00	0.18	0.68	0.08
	(0.11)	(1.04)	(0.06)	(0.20)	(0.53)	(0.10)
$h = 2$	-0.17	2.60**	-0.10	0.31	0.10	0.17
	(0.22)	(1.25)	(0.11)	(0.32)	(0.74)	(0.15)
$h = 3$	0.02	3.08*	-0.13	0.25	-0.36	0.17
	(0.24)	(1.61)	(0.14)	(0.33)	(0.95)	(0.19)
$h = 4$	0.55**	4.76**	0.11	1.05**	0.27	0.47**
	(0.28)	(2.03)	(0.14)	(0.46)	(1.29)	(0.23)
$h = 5$	0.77**	4.94***	0.30*	1.78***	1.00	0.92***
	(0.31)	(1.82)	(0.16)	(0.59)	(1.55)	(0.28)
$h = 6$	1.15***	4.71**	0.45**	2.29***	1.69	1.29***
	(0.36)	(1.83)	(0.18)	(0.67)	(1.34)	(0.33)
$h = 7$	1.70***	5.82***	0.74***	2.64***	1.64	1.60***
	(0.42)	(1.89)	(0.21)	(0.71)	(1.46)	(0.39)
$h = 8$	2.23***	7.07***	1.08***	2.93***	2.10	1.81***
	(0.48)	(1.97)	(0.25)	(0.79)	(1.66)	(0.44)
	Real GDP			Inflation		
	(7)	(8)	(9)	(10)	(11)	(12)
	US*UK*EA	US*UK	UK*EA	US*UK*EA	US*UK	UK*EA
	$MP_t^{\$}$	$MP_t^{\$}$	$MP_t^{\$}$	$MP_t^{\$}$	$MP_t^{\$}$	$MP_t^{\$}$
$h = 0$	-0.04	-0.33	-0.06***	-0.04	0.59***	-0.05***
	(0.05)	(0.25)	(0.02)	(0.02)	(0.14)	(0.02)
$h = 1$	-0.09	0.07	-0.12***	-0.20***	-0.06	-0.12***
	(0.06)	(0.27)	(0.03)	(0.04)	(0.18)	(0.03)
$h = 2$	-0.26***	-0.86***	-0.22***	-0.37***	-0.54***	-0.23***
	(0.07)	(0.26)	(0.04)	(0.05)	(0.20)	(0.04)
$h = 3$	-0.34***	-1.31***	-0.31***	-0.28***	-0.22	-0.27***
	(0.12)	(0.39)	(0.07)	(0.05)	(0.20)	(0.03)
$h = 4$	0.18	-0.62	-0.13*	-0.30***	0.19	-0.29***
	(0.12)	(0.45)	(0.07)	(0.06)	(0.25)	(0.04)
$h = 5$	0.50***	-0.55	0.12	-0.38***	0.07	-0.29***
	(0.14)	(0.56)	(0.08)	(0.07)	(0.32)	(0.05)
$h = 6$	0.75***	-0.91	0.31***	-0.30***	-0.42	-0.33***
	(0.18)	(0.56)	(0.10)	(0.07)	(0.29)	(0.05)
$h = 7$	1.00***	-1.27**	0.48***	-0.17***	-0.24	-0.28***
	(0.21)	(0.59)	(0.11)	(0.07)	(0.32)	(0.04)
$h = 8$	1.19***	-1.35**	0.62***	-0.08	0.38	-0.20***
	(0.22)	(0.60)	(0.12)	(0.07)	(0.33)	(0.05)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	NO	NO	NO	NO	NO	NO

Notes: $\hat{\beta}^h$ for $h = 0, 1, ...8$ coefficient estimates from regression (1) in columns (1) and (12). *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses). UK dropped from the sample in estimates from Columns (2), (5), (8) and (11), reflecting results of EU27 countries.

Table 17: Robustness of interaction coefficient estimates $\hat{\delta}^h$ with US Monetary policy from regression (2) for bank credit using limits on credit growth and volume

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				prudential Policy Measure			Control
	Baseline	Cerutti et al database	1-Year Cumulation	3-Year Cumulation	Full Sample cumultation	No cumulation	Eight lags
$h=0$	0.57	0.40**	2.23	0.41	0.06	3.76***	1.85
	(0.46)	(0.20)	(1.55)	(0.33)	(0.08)	(1.12)	(1.29)
$h=1$	0.66	0.53**	2.32	0.47	0.07	6.15***	2.82
	(0.54)	(0.26)	(1.80)	(0.40)	(0.13)	(2.10)	(2.43)
$h=2$	0.88	0.63	2.48	0.53	-0.02	7.39***	3.38
	(0.77)	(0.45)	(2.21)	(0.53)	(0.18)	(2.98)	(3.39)
$h=3$	0.99	0.73	3.19	0.57	0.03	9.38**	5.21
	(0.84)	(0.60)	(2.92)	(0.64)	(0.23)	(4.09)	(4.38)
$h=4$	1.44	1.29*	4.19	0.98	0.15	13.07***	7.48
	(1.00)	(0.67)	(3.56)	(0.89)	(0.26)	(4.93)	(5.11)
$h=5$	1.45*	1.67**	3.74	1.24	0.20	15.28**	8.15
	(0.85)	(0.72)	(4.06)	(0.98)	(0.28)	(6.50)	(6.12)
$h=6$	1.63*	1.94**	3.93	1.40	0.11	16.39**	8.98
	(0.96)	(0.91)	(4.68)	(1.12)	(0.29)	(7.61)	(6.93)
$h=7$	1.36*	1.94*	2.60	1.35	0.10	15.88*	8.29
	(0.72)	(1.07)	(4.82)	(1.04)	(0.35)	(8.49)	(6.84)
$h=8$	1.45**	2.27**	2.47	1.49	0.06	16.05*	7.66
	(0.68)	(1.14)	(4.95)	(0.99)	(0.44)	(9.11)	(6.91)
Country FE	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES

Notes: $\hat{\delta}^h$ for $h = 0, 1, ...8$ coefficient estimates from different specifications in regression (2) in columns (1) and (7). *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses).

Table 18: Estimated coefficients of monetary policy and prudential policy interaction (for capital buffers) from hybrid regression for US monetary policy spillovers

	Bank credit		House prices	
	(1)	(2)	(3)	(4)
	Hybrid	Hybrid	Hybrid	Hybrid
	$MP_t^{\$}$	$MP_t^{\$} \times Pru_{i,t-1}$	$MP_t^{\$}$	$MP_t^{\$} \times Pru_{i,t-1}$
$h = 0$	-0.54	0.00	-0.67*	0.19
	(0.40)	(0.40)	(0.39)	(0.55)
$h = 1$	-1.20***	0.99	-1.56**	0.01
	(0.43)	(0.82)	(0.61)	(1.38)
$h = 2$	-1.85***	1.12	-2.35***	0.11
	(0.62)	(1.10)	(0.83)	(1.90)
$h = 3$	-2.09***	1.62	-2.47***	-0.38
	(0.66)	(1.38)	(0.91)	(2.44)
$h = 4$	-1.36**	1.05	-1.89**	-0.62
	(0.61)	(1.52)	(0.85)	(2.45)
$h = 5$	-1.24	1.61	-1.47*	-0.06
	(0.81)	(1.76)	(0.82)	(2.19)
$h = 6$	-0.92	0.90	-1.69**	0.48
	(0.91)	(2.32)	(0.82)	(2.41)
$h = 7$	-0.80	1.40	-2.52**	1.19
	(1.08)	(2.88)	(1.01)	(2.70)
$h = 8$	-0.98	1.23	-3.44***	1.50
	(1.12)	(3.46)	(1.20)	(3.04)
	Real GDP		Inflation	
	(5)	(6)	(7)	(8)
	Hybrid	Hybrid	Hybrid	Hybrid
	$MP_t^{\$}$	$MP_t^{\$} \times Pru_{i,t-1}$	$MP_t^{\$}$	$MP_t^{\$} \times Pru_{i,t-1}$
$h = 0$	-0.59***	-0.03*	-0.35***	-0.01
	(0.07)	(0.17)	(0.06)	(0.10)
$h = 1$	-1.04***	-0.38	-0.99***	0.17
	(0.15)	(0.43)	(0.08)	(0.20)
$h = 2$	-1.50***	-0.22	-1.04***	0.12
	(0.24)	(0.61)	(0.11)	(0.34)
$h = 3$	-1.74***	-0.32	-0.94***	0.04
	(0.27)	(0.89)	(0.13)	(0.35)
$h = 4$	-1.34***	-0.01	-0.80***	-0.17
	(0.29)	(0.78)	(0.16)	(0.46)
$h = 5$	-0.93***	0.17	-1.03***	-0.29
	(0.32)	(0.85)	(0.18)	(0.51)
$h = 6$	-1.02***	0.53	-0.82***	-0.30
	(0.35)	(0.97)	(0.19)	(0.58)
$h = 7$	-1.41***	0.73	-0.49**	-0.33
	(0.43)	(1.18)	(0.19)	(0.56)
$h = 8$	-1.69***	0.62	-0.26	-0.16
	(0.47)	(1.25)	(0.21)	(0.63)
Country FE	YES	YES	YES	YES
Time FE	NO	NO	NO	NO

Notes: $\{\delta^h\}$ for $h = 0, 1, ...8$ coefficient estimates from hybrid regression (1) and (2). *, ** and *** denote statistically significant coefficient estimates at 10%, 5% and 1% significance levels, respectively, using Driscoll and Kraay (1998) standard errors (reported in parentheses).

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Acknowledgements

I thank an anonymous referee, Andreas Barth, Özlem Dursun-de Neef, Simon Lloyd, Loriana Pelizzon, Mathias Trabandt, participants of International Banking Research Network (IBRN) meetings, and presentation attendees at the European Central Bank and Goethe University: House of Finance for useful comments.

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PDF ISBN 978-92-899-6219-3 ISSN 1725-2806 doi:10.2866/068272 QB-AR-23-091-EN-N