Leverage, Financial Openness, and the Transmission of Monetary Policy: Empirical Insights from the Euro Area

Sven Schnellbacher*[a]

[a]Karlsruhe University of Applied Sciences, Germany

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Abstract

We use a PCHVAR model to examine the importance of bank risk-taking, household indebtedness and financial globalization for monetary policy transmission across twelve euro area countries using quarterly data ranging from 1999Q2 to 2018Q4. Our results suggest that the decrease of real housing prices after a contractionary monetary policy shock is larger when the leverage levels of the banking and the household sector are high. Further, a higher level of financial openness leads to a stronger contraction in real GDP and a larger fall in real housing prices after a positive monetary policy shock. Moreover, an average of 66% of the decline in the growth rate of real GDP and 51% of the fall in real housing prices is attributable to cross-country differences in the degree of financial openness. Household indebtedness accounts for 33% of the decline in real GDP growth and 44% of the fall in real housing prices. The risk-taking channel of monetary policy transmission explains an average of 60% of the decline in the growth rate of real GDP and 55% of the fall in real housing prices in the euro area, highlighting the importance of this channel for the transmission of monetary policy to housing markets.

Keywords: Monetary policy transmission, Panel VAR, Bank leverage, Household leverage, Financial openness, Asymmetries

JEL Classification: C33, E44, E52, F45, F62

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1 Introduction

Understanding the transmission of monetary policy shocks to the real and financial side of the economy is one of the most important fields in monetary economics. While the early empirical literature on monetary policy transmission used a single-country setup and often focused solely on the US economy (see e.g. Christiano et al. 1999), latter studies such as Mihov (2001), Dedola and Lippi (2005) and Ciccarelli and Rebucci (2006) have undertaken a cross-country comparison of estimated single-country vector autoregressions. As pointed out by Peersman (2004), such comparisons are not always straightforward as the size of the monetary policy shocks and the reaction function of the monetary authority differ across countries.

The development of more appropriate vectorautoregressions facilitated a better understanding of the determinants of the monetary policy transmission mechanism by exploiting the cross-country dimension. This has led to further and more robust insights on the transmission mechanism in general, at the expense of cross-country insights, however. For instance, Assenmacher-Wesche and Gerlach (2008) use a panel vector autoregressive model estimated with data from seventeen advanced economies to study the role of financial structure, measured by indicators such as the level of the mortgage-debt-to-GDP ratio or the securitization of mortgages, in the transmission of monetary policy to output, inflation and asset prices. The findings reveal significant asymmetries in the transmission process between country-groups separated according to the above mentioned financial characteristics.

Recent studies, such as Georgiadis (2013) and Georgiadis (2015), have employed a cross-country setting to gain further insights into the transmission of monetary policy shocks. While focusing the empirical analysis on the euro area economies, they find significant asymmetries in the monetary policy transmission mechanism. These asymmetries arise because of cross-country differences in the composition of the manufacturing sector and the structure of the financial system. Short run effects are driven by sectoral characteristics, whereas in the medium run labor market rigidities and financial structure seem to play a bigger role (Georgiadis 2013).

Extensive research, e.g. by the European Central Bank, has highlighted the relative importance of the interest rate channel and the bank lending channel for the transmission of monetary policy shocks (Angeloni et al. 2002; Clements et al. 2001; Kashyap and

Stein 1994). The relevance of the interest rate channel and the bank lending channel for the transmission mechanism depends on several characteristics underlying the economy. If interest sensitive sectors contribute a higher share to domestic GDP output and price dynamics seem to be shaped by the interest rate channel (Sala 2002). The significance of the bank lending channel is determined by the relative importance of bank funding compared to funding through capital markets (Bernanke and Gertler 1995).

By contrast, Borio and Zhu (2012) have highlighted the importance of the "risk-taking channel" of monetary policy transmission whereafter monetary policy affects the perceptions of risk and the resulting risk-taking behavior of financial intermediaries leading to fluctuations in the provision of liquidity. Bekaert et al. (2013) documents also the link between monetary policy and market risk measured by the VIX index. Adrian and Shin (2010) provide a possible explanation for the mechanism underlying the link between liquidity and market risk. Accordingly, changes in market risk are related to balance sheet adjustments by financial intermediaries which are due to changes in equity triggered by fluctuations in asset prices. In this sense, variations in financial leverage are procyclical. The risk-taking channel is not limited to the domestic economy, however. As argued by Bruno and Shin (2015) as well as Lee and Bowdler (2020), fluctuations in the leverage of financial intermediaries and the resulting variation in cross-border capital flows are central for spillovers of monetary policy shocks.

In the present paper, we use the panel conditionally homogenous vector autoregressive (PCHVAR) model from Georgiadis (2012) in order to contribute to recent findings. We condition the monetary policy transmission mechanism on the level of bank leverage, the level of household leverage and the degree of financial openness in order to study the significance of the risk-taking channel, the relevance of household indebtedness and the importance of cross-border capital flows in the transmission of monetary policy shocks to output and housing prices.

The remainder of this paper is organized as follows: Section 2 gives a brief overview on the choice of the conditioning variables. Section 3 outlines the methodological framework. Section 4 presents the empirical results along with several robustness checks. Finally, section 5 concludes.

2 On the Choice of the Conditioning Variables

Our choice of the conditioning variables is based on recent trends regarding structural changes of financial systems. The rise in cross-border capital flows observable over recent years has led to an increased interconnectedness of the economies around the world. As shown by Milesi-Ferretti and Tille (2011), such financial globalization is to a major extent driven by a rise in international bank flows between advanced economies, both through a rise in cross-border bank lending as well as through lending by foreign subsidiaries. This positive trend in financial integration was especially observable in the period preceding the global financial crisis as European banks channeled liquidity to U.S. asset markets leading to the build-up of vulnerabilities in the real estate sector (Shin 2012). During the global financial crisis, the decline in gross capital flows was primarily driven by a reduction in cross-border bank flows. The intensity of the decline in capital inflows can be linked to macroeconomic factors such as the growth in the credit to GDP ratio and the level of gross external debt before the crisis (Eichengreen and Gupta 2017; Milesi-Ferretti and Tille 2011).

The high financial sector leverage experienced in recent decades is a possible threat for the stability of the macroeconomy. The evidence points to an increased importance of credit cycles for financial stability and an increasing role of credit in shaping the dynamics of the business cycle not only temporarily but as a recurrent phenomenon (Jordà et al. 2013; Schularick and Taylor 2012). Accordingly, the expansion in credit and the resulting rise in financial leverage results in a greater susceptibility of the financial system to shocks with severe negative implications for the real economy, such as a decline in output and investment, once financial instabilities unfold (Schularick and Taylor 2012). As shown by Jordá et al. (2013) the intensity of the credit expansion determines the severity of the contraction in output.

Regarding the composition of credit aggregates, it is observed that the importance of mortgage credit compared to business credit has risen over recent decades (Bezemer et al. 2016). This rise in the share of mortgage lending by financial intermediaries has led to a change in the composition of bank balance sheets and facilitated a change in banking practices (Jordà et al. 2016). The positive trend in mortgage lending was accompanied by rising household debt levels that exceeded the rise in asset values during the same time span leading to rising household leverage ratios (Jordà et al. 2017).

The expansion of household indebtedness and the rise of household leverage ratios have been a remarkable feature in most industrialized countries over the past decades (Zinman 2015). The rise in household debt poses several challenges for financial stability, however. First, if household debt exceeds sustainable levels, the risk of default after a negative income shock increases. Second, a negative shock to housing prices increases the fragility of the household sector as collateral values decline. Lastly, given the growing share of mortgages issued to private households on bank balance sheets, an increased fragility of the household sector diminishes the resilience of the banking sector, as the quality of bank balance sheets declines (Jordà et al. 2016; Kuhn et al. 2020).

The left hand panel in the first row of figure 1 reveals considerable heterogeneities underlying the twelve euro area countries included in our empirical analysis with a decoupling of bank leverage in Ireland surrounding the financial crisis episode. A similar pattern is observable in the right hand panel of figure 1 which displays the level of household leverage in the twelve euro area countries. With Austria and Germany as an exception, it further shows a positive trend in household leverage until the beginning of the euro crisis. In addition to the high level regarding financial openness in the euro area, the panel in the second row of figure 1 shows a positive trend in financial globalization for the majority of the euro area countries until the start of the financial crisis period. Given these heterogeneities in the structural characteristics and their increasing role for the stability of the macroeconomy we expect significant asymmetries in the transmission of monetary policy shocks across the individual euro area countries.

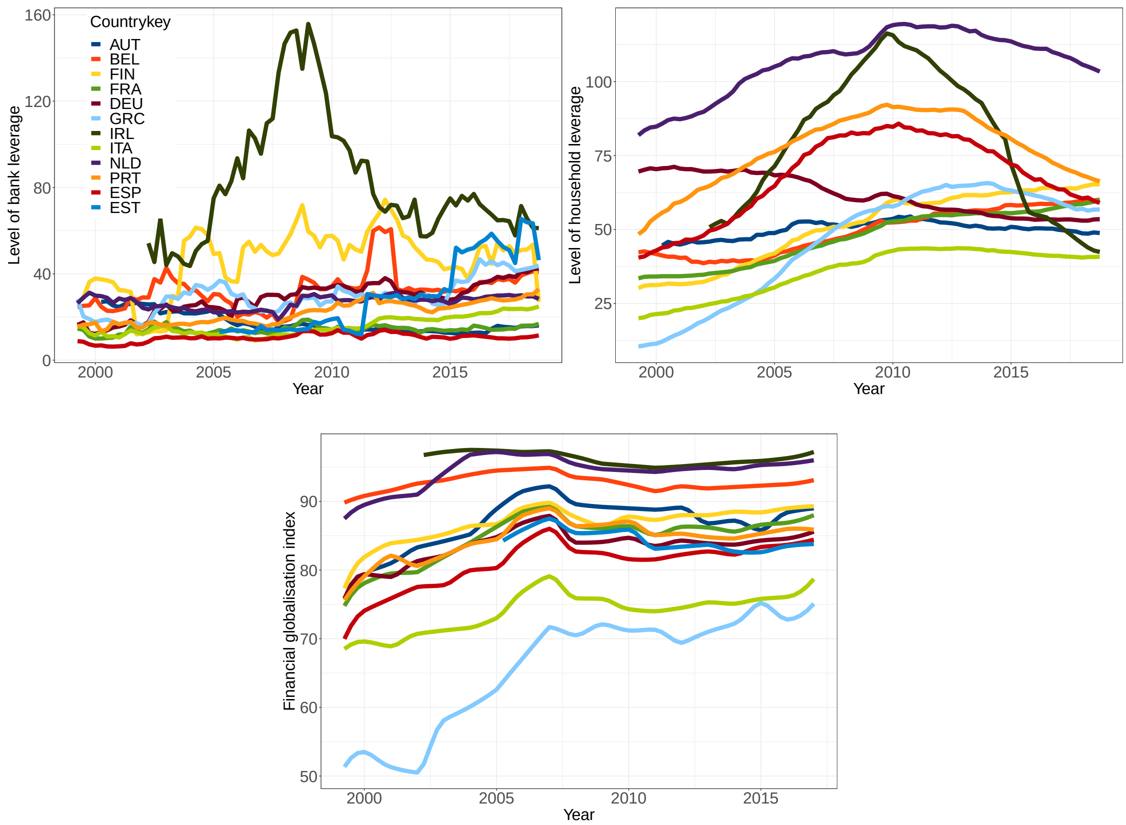

Figure 1: The left hand panel in row one plots the level of bank leverage measured as the ratio of financial assets over equity of monetary financial institutions in the twelve euro area countries included in the empirical analysis. The right hand panel in row one plots the level of household leverage measured as credit to households and non-profit institutions serving households to domestic GDP. The panel in row two plots the level of the KOF financial globalisation index.

3 Data and Methodology

3.1 Data Description

The data consists of quarterly time series of twelve euro area countries ranging from 1999Q2-2018Q4 which together account for 97% of euro area GDP. Bank leverage is defined as the ratio of financial assets over equity of monetary financial institutions (MFI). Financial assets include currency and deposits, debt securities and loans (Lequiller and Blades 2014). We follow Jordà et al. (2017) and measure household leverage as the ratio of private credit to GDP. Hence, household leverage is measured by total credit to households and non-profit institutions serving households in relation to domestic GDP.

According to the general convention in the literature, leverage and credit are endogenous. As we want to measure structural changes of the financial system, we need exogenous measures of bank leverage and the household credit-to-GDP ratio. In order to obtain weakly exogenous conditioning variables, we extract the trend component of the bank leverage and household credit-to-GDP time series by means of the Hodrick-Prescott (HP) filter. The underlying idea is that the trend component of the HP-Filter operates under a different frequency than the cyclical component. We assume that GDP and housing prices operate under the business cycle frequency. As we have quarterly time series, we choose a smoothing parameter of 1600. The resulting trend component of the bank leverage and household leverage time series should be roughly uncorrelated with the GDP growth and housing prices time series.

Financial openness is measured with the financial globalization subindex of the KOF Globalisation Index. The KOF financial globalization index is available for a wide range of economies. It covers a long time span ranging from 1970 to 2017 and is updated on a yearly basis. The subindex measures de facto financial globalization covering a wide range of capital flow categories. Specifically, the index comprises foreign direct investment, portfolio investment and debt flows as well as reserves and primary income payments (Gygli et al. 2019). The index is interpolated from yearly to quarterly frequency. The VIX index of the Chicago Board Options Exchange is included as a common exogenous variable and serves as a proxy for the degree of global risk aversion.

The real GDP and real housing prices series are measured in quarter-to-quarter percentage changes. Outliers larger than three times the interquartile range are replaced by the median value of the respective time series. The VIX index is in logs. The short-term interest rate, MFI leverage, household leverage and the KOF financial globalization index are in levels.

Table (1) summarizes the variables and their transformations. The augmented Dickey-Fuller, Philips-Perron and Kwiatkowski-Philips-Schmidt-Shin test results regarding the stationarity of the real GDP and real housing prices series are mixed. To keep interpretation simple, first differences are taken.

Table 1: Variables and transformations

Endogenous Variables	log	First Difference	Source
Real GDP	•	•	OECD
Real housing prices	•	•	OECD
Short-term interest rate			OECD
Conditioning Variables			
MFI leverage			ECB
KOF financial globalization index			KOF
Household credit-to-GDP ratio			BIS
Common Exogenous Variable			
VIX	•		CBOE

3.2 Country-Specific SVAR Models

As the first step of the empirical analysis we examine the dynamics of the short-term interest rate, real housing prices and real GDP in country-specific structural vector autoregressive (SVAR) models of the following form

$$\mathsf{A}y_t = \mathsf{A}c + \mathsf{A}_1^* y_{it-1} + \mathsf{A}_q^* y_{t-q} + \nu_t \tag{1}$$

where y_t is a $(K \times 1)$ vector of endogenous variables, c a $(K \times 1)$ vector of constants, A is a $(K \times K)$ lower–triangular matrix, $\mathsf{A}_j^* = \mathsf{A}\alpha_j$ for $j = 1, \ldots, q$ and $\nu_t = \mathsf{A}\varepsilon_t \sim (0, \Sigma_\nu = \mathsf{A}\Sigma_\nu \mathsf{A}')$ where ε_t for $t = 1, \ldots, t$ is a $(K \times 1)$ vector of white noise with $\varepsilon_t \sim (0, \Sigma_\varepsilon)$ a $(K \times K)$ positive definite matrix. The contemporaneous relationships between the endogenous variables are described by the matrix A. The shocks are recursively identified. Hence, the A-Matrix is constructed so that the first variable has a contemporaneous effect on the other variables, the second variable has a contemporaneous effect on all other variables except variable one, and so on. Thus, the following A-Matrix is prepared:

$$\mathsf{A} = \begin{pmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{pmatrix}$$

As we assume that real GDP is a slow moving variable, reacting to changes in real housing prices and the short-term interest rate with a time lag, we order it first. The short-term interest rate is ordered last as it is assumed that it reacts contemporaneously to real GDP and real housing prices. Hence, the monetary authority observes real output and real housing prices before setting the interest rate (Christiano et al. 1999). Thus, the order of the endogenous variables in the country-specific SVAR models is as follows: (1) real GDP, (2) real housing prices, (3) short-term interest rate.

The decision on the optimal lag length is based on the Akaike information criterion, the Hannan-Quinn and the Bayesian information criterion. The information criteria suggest different lag lengths for each country. In theory, the optimal lag length should be chosen so that the residuals are white noise. To test the normality of the residuals we consider the Jarque-Bera Test. The test results reveal that the distribution of the residuals can hardly be considered as normal. As the sample size is rather small, we use the adjusted Portmanteau and the Breusch-Godfrey LM tests to assess whether the residuals are autocorrelated. The tests report mixed results for some countries in the panel. As the test results depend on the lag length of the SVAR models we choose the optimal lag length in order to minimize the remaining autocorrelation in the residuals. Finally, we consider a lag length of two for every country-specific SVAR model except for Ireland where a lag length of one is chosen.

3.3 The PCHVAR Model

The methodological framework of the panel conditionally homogenous vector autoregressive (PCHVAR) model developed by Georgiadis (2012) allows the estimated reduced form coefficients to differ according to unit-specific properties. The model can be written in the following form

$$y_{it} = c_i + \Phi_p(\mathsf{z_{it}})y_{it-p} + \beta_q v_{t-q} + \varepsilon_{it} \tag{2}$$

where y_{it} is a $(K \times 1)$ vector of endogenous variables, Φ_i is a $(K \times K)$ matrix of coefficients, v_t a $(K \times 1)$ vector of common exogenous variables and ε_{it} a $(K \times 1)$ vector of white noise with $\varepsilon_{it} \sim (0, \Sigma_\varepsilon)$ a $(K \times K)$ positive definite matrix. The coefficient matrices Φ_p depend on the unit-specific vector $\mathsf{z_{it}}$. The coefficients $\phi_{j,nm}(\mathsf{z_{it}})$ with $j = 1, \ldots, p$, $n = 1, \ldots, K$ and $m = 1, \ldots, K$ in Φ_p are approximated by the following functional form

$$\phi_{j,nm}(\mathsf{z_{it}}) \simeq \pi(\mathsf{z_{it}})\gamma_{j,nm} \tag{3}$$

with $\pi(\mathsf{z_{it}}) = [\pi_1(\mathsf{z_{it}}), \pi_2(\mathsf{z_{it}}), \ldots, \pi_\tau(\mathsf{z_{it}})]$ being a $1 \times \tau$ vector of polynomials and $\gamma_{j,nm} = (\gamma_{j,nm1}, \gamma_{j,nm2}, \ldots, \gamma_{j,nm\tau})'$ a $\tau \times 1$ vector of polynomial coefficients.

The polynomial $\pi(\mathsf{z_{it}})$ is obtained by the following equation

$$\pi(\mathsf{z_{it}})\gamma_{j,nm} = [1, \pi_1(\mathsf{z_{1i,t-1}}), \pi_2(\mathsf{z_{2i,t-1}})] \times \gamma_{j,nm} \tag{4}$$

The coefficients in Φ_i are replaced by the polynomial approximations in equation (3).

$$\begin{aligned}
\Phi_i(\mathsf{z_{it}}) &= \begin{pmatrix} \pi(\mathsf{z_{it}})\gamma_{j,11} & \cdots & \pi(\mathsf{z_{it}})\gamma_{j,1K} \\ \vdots & \ddots & \vdots \\ \pi(\mathsf{z_{it}})\gamma_{j,K1} & \cdots & \pi(\mathsf{z_{it}})\gamma_{j,KK} \end{pmatrix} \\
&= \begin{pmatrix} \gamma'_{j,11} & \gamma'_{j,12} & \cdots & \gamma'_{j,1K} \\ \vdots & \vdots & \ddots & \vdots \\ \gamma'_{j,K1} & \gamma'_{j,K2} & \cdots & \gamma'_{j,KK} \end{pmatrix} \times [I_K \otimes \pi'(\mathsf{z_{it}})] \\
&= \Gamma \times [I_K \otimes \pi'(\mathsf{z_{it}})]
\end{aligned}$$

Equation (2) can be rewritten as follows

$$
\begin{aligned}
y_{it} &= c_i + \sum_{j=1}^{p} \Gamma_j \times [I_K \otimes \pi'(\mathsf{z_{it}})] y_{i,t-j} + \sum_{q=1}^{l} B_q \times v_{t-q} + \varepsilon_{it} \\
&= c_i + \sum_{j=1}^{p} \Gamma_j \times x_{i,t-j} + \sum_{q=1}^{l} B_q \times v_{t-q} + \varepsilon_{it} \\
&= c_i + \Gamma_j \times X_{i,t-j} + B_q \times V_{t-q} + \varepsilon_{it}
\end{aligned} \tag{5}
$$

with $X_{i,t-j} = (x'_{i,t-1}, x'_{i,t-2}, \ldots, x'_{i,t-j})'$, $\Gamma = (\Gamma_1, \Gamma_2, \ldots, \Gamma_j)$, $B = (B_1, B_2, \ldots, B_q)$ and $V_{t-q} = (v_{t-1}, v_{t-2}, \ldots, v_{t-q})$.

The estimation of the model in equation (5) occurs via ordinary least squares.

To compute the impulse responses, we start by writing the model in equation (2) in canonical form

$$
\begin{bmatrix} y_{it} \\ y_{it-1} \\ \vdots \\ y_{it-p} \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_N \end{bmatrix} \times \begin{bmatrix} \Phi_1(\mathsf{z_{it}}) & \Phi_2(\mathsf{z_{it}}) & \cdots & \Phi_p(\mathsf{z_{it}}) \\ I_k & 0 & \cdots & 0 \\ \vdots & I_k & & \vdots \\ 0 & \cdots & \cdots & 0 \end{bmatrix} \times \begin{bmatrix} y_{it-1} \\ y_{it-2} \\ \vdots \\ y_{it-p} \end{bmatrix} + \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_q \end{bmatrix}' \times \begin{bmatrix} v_{t-1} \\ v_{t-2} \\ \vdots \\ v_{t-q} \end{bmatrix} + \begin{bmatrix} \varepsilon_{it} \\ 0 \\ \vdots \\ 0 \end{bmatrix}
$$

$$
Y_{it} = C_i + \Phi(\mathsf{z_{it}}) Y_{it-1} + BV_{t-1} + \Upsilon_{it}
$$

through recursive substitution we obtain

$$
\begin{aligned}
Y_{it} &= C_i + \Phi(\mathsf{z_{it}}) Y_{it-1} + BV_{t-1} + \Upsilon_{it} \\
&= C_i + \Phi(\mathsf{z_{it}}) \Phi(\mathsf{z_{it-2}}) Y_{it-2} + \Phi(\mathsf{z_{it}}) BV_{t-2} + \Phi(\mathsf{z_{it}}) \Upsilon_{it-1} + \Upsilon_{it} \\
&= C_i + \left[\prod_{j=1}^{s} \Phi(\mathsf{z_{it-j}}) \right] Y_{it-s} + \sum_{j=0}^{s} \left[\prod_{q=1}^{j} \Phi(\mathsf{z_{it-q}}) \right] BV_{t-j} + \sum_{j=0}^{s} \left[\prod_{k=1}^{j} \Phi(\mathsf{z_{it-k}}) \right] \Upsilon_{it-j}
\end{aligned}
$$

By premultiplying the above equation by the matrix J = $[I_k, 0, \ldots, 0]$ we get

$$JY_{it} = JC_i + J\left[\prod_{j=1}^{s}\Phi(\mathsf{z_{it-j}})\right]Y_{it-s} + J\sum_{j=0}^{s}\left[\prod_{q=1}^{j}\Phi(\mathsf{z_{it-q}})\right]BV_{t-j} + J\sum_{j=0}^{s}\left[\prod_{k=1}^{j}\Phi(\mathsf{z_{it-k}})\right]J'J\Upsilon_{it-j}$$

$$y_{it} = c_i + \eta_s y_{it-s} + \sum_{j=0}^{s}\alpha_j(\mathsf{z_{it-j}})\beta_j v_{t-j} + \sum_{j=0}^{s}\psi_j(\mathsf{z_{it-j}})\varepsilon_{it-j}$$

Finally, we obtain the impulse response coefficients from the matrices

$$\sum_{j=0}^{s}\psi_j(\mathsf{z_{it-j}}) \tag{6}$$

4 Econometric Results

4.1 Impulse Response Functions of the PCHVAR Model

Figure 2 displays the real GDP responses for different conditioning variables resulting from the PCHVAR estimation. The results reveal a positive relationship between the extent of the contraction in real GDP and the degree of financial openness, the level of bank leverage and the level of household leverage. Consequently, a higher degree of financial openness, a higher level of bank leverage and a higher level of household leverage seem to intensify the contraction in real GDP after a positive monetary policy shock.

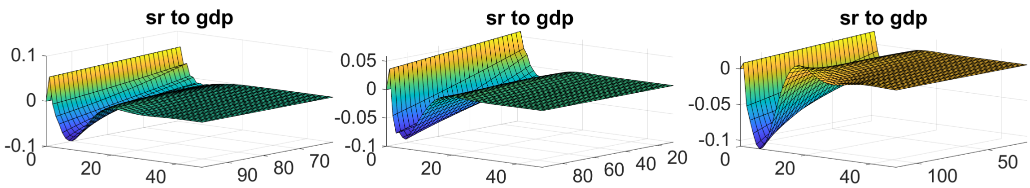

Figure 2: The figure shows the orthogonalized impulse response functions of real GDP to a shock in the short-term interest rate generated by the PCHVAR model. The left-hand panel plots the impulse responses for varying degrees of financial openness. The middle panel plots the impulse responses for varying levels of bank leverage. The right-hand panel plots the impulse responses for varying levels of household leverage.

The subfigure on the left hand side shows the response of real GDP to a positive one standard deviation monetary policy shock for varying degrees of financial openness. The trough increases from -0.01% at the lowest degree of financial openness to -0.08%

at the highest degree of financial openness. Overall, the degree of financial openness seems to have only a minor impact on the contraction in real GDP as the percentage changes are relatively small.

The subfigure in the middle shows the response of real GDP to a one standard deviation monetary policy shock for varying levels of bank leverage. The trough increases from -0.02% at the lowest level of bank leverage to -0.08% at the highest level of bank leverage. Similar to our results regarding the degree of financial openness, the level of bank leverage has only a minor impact on the contraction in real GDP.

The subfigure on the right hand side displays the response of real GDP to a one standard deviation monetary policy shock for varying levels of household leverage. The trough increases from -0.03% at the lowest level of household leverage to -0.11% at the highest level of household leverage. Hence, the impact of a contractionary monetary policy shock seems to be stronger when households are relatively more indebted. This result is explainable by changes in household liquidity (Cloyne et al. 2019). Accordingly, the contraction in real GDP leads to a decrease of aggregate income. The resulting decrease of aggregate expenditure contributes to the decline in real GDP. The decrease of expenditure is stronger for indebted households as they hold a relatively low amount of liquid wealth constraining the possibility to substitute the decline in income with liquidity. Moreover, a contractionary monetary policy shock depresses inflation leading to a transfer of wealth from debtors to creditors. In other words, the debt burden increases leading to a reduction in expenditures. However, as the monetary policy shock is temporary, the latter effect might only have a minor impact (ibid.). Moreover, as the percentage changes are relatively small, the level of household leverage is only of minor relevance for the contraction in real GDP.

Figure 3 shows the real housing price responses for different conditioning variables resulting from the PCHVAR estimation. The estimation reveals a positive relationship between the extent of the contraction in real housing prices and the degree of financial openness, the level of bank leverage and the level of household leverage after a positive one standard deviation monetary policy shock.

The subfigure on the left hand side shows the response of real housing prices to a one standard deviation monetary policy shock for varying degrees of financial openness. The trough increases from -0.06% at the lowest degree of financial openness to -0.28% at the highest degree of financial openness. The percentage change at a low degree of financial

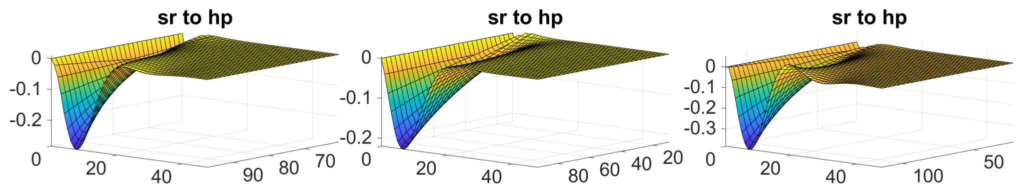

Figure 3: The figure displays the orthogonalized impulse response functions of real housing prices to a shock in the short-term interest rate generated by the PCHVAR model.

openness is relatively small. However, at a high degree of financial openness, the results reveal a more pronounced impact of financial openness on the fall in real housing prices. These findings highlight the amplifying effects of international financial linkages on the fall in real housing prices and demonstrate the importance of cross-border capital flows for the transmission of monetary policy shocks to housing prices. The results can be explained by assuming that a rise in the monetary policy rate leads to a retrenchment of capital invested in the housing market. This process is amplified through the liquidation of foreign investment positions (Sá and Wieladek 2015). One channel through which the retrenchment of cross-border capital flows occurs are cross-border banking flows (Milesi-Ferretti and Tille 2011). As shown by Shin (2012), in the run-up to the financial crises starting in 2007, increasing cross-border banking flows channeled global liquidity to U.S. asset markets. Our estimation results offer insights into the intermediating role of global liquidity after a change in domestic financing conditions. The effects may be intensified through a rise in global risk aversion which leads to a retrenchment of capital flows on an aggregate level (Forbes and Warnock 2012). Overall, the findings suggest that highly volatile capital flows have the potential to affect the transmission of monetary policy with considerable consequences for asset price changes.

The subfigure in the middle shows the response of real housing prices to a one standard deviation monetary policy shock for varying levels of bank leverage. The trough increases from -0.03% at the lowest level of bank leverage to -0.22% at the highest level of bank leverage. Hence, we see a more pronounced impact of the level of bank leverage on the fall in real housing prices after a positive one standard deviation monetary policy shock at high levels of bank leverage. These findings lend support to the assumption that a trend towards more leveraged financial institutions seems to result in an amplification of monetary policy shocks through the banking sector. The change in banking practices is a more important determinant of the negative response of real housing prices. The impact on housing prices demonstrates the potential consequences of an increased importance of real estate lending for the business of financial intermediation. The effects may intensify under the assumption that banks are subject to similar exposures leading to heightened systemic risks (Greenwood et al. 2015).

The subfigure on the right hand side shows the response of real housing prices to a one standard deviation monetary policy shock for varying levels of household leverage. The trough reaches -0.03% at the lowest level of household leverage. It increases to -0.38% at the highest level of household leverage. If we compare the PCHVAR impulse response functions across the different conditioning variables, we notice that the level of household leverage has the highest impact on the fall in real housing prices. Thus, a positive trend in household leverage seems to serve as an important amplifier of monetary policy shocks to the housing market. The finding that the impact of monetary policy shocks is stronger for the response of housing prices suggests that an increasing share of mortgages in the composition of household debt has considerable consequences for the monetary policy transmission mechanism. The findings are in line with research conducted by Iacoviello and Minetti (2003) showing that the impact of monetary policy shocks on housing prices is stronger in financially more liberalized economies. Financial liberalization refers in this context to the relaxation of borrowing constraints such as down-payment requirements or the removal of ceilings on lending rates. In addition, compared to the PCHVAR model in which we restrict the transmission process on the level of bank leverage, the estimation results show that household leverage seems to be the more important determinant of the transmission of monetary policy shocks to housing prices. Hence, whereas the transmission of monetary policy shocks to the housing market is shaped by changes in the leverage positions of the banking and household sectors, a positive trend in household leverage seems to be a more important determinant of the transmission mechanism.

4.2 Comparison of Impulse Response Functions

In this section, we focus on the significance of financial openness, bank risk-taking and household indebtedness in shaping the transmission of monetary policy shocks to output and housing prices. As the variation in the PCHVAR models depends solely on the conditioning variables, we compare the impulse response functions of the country-specific

SVAR models with the impulse response functions of the PCHVAR models in order to examine the extent to which the empirical variation in the country-specific SVAR models might be explainable by the variation in the PCHVAR models. Although the identification schemes of the country-specific SVAR models and the PCHVAR models differ, comparison is still possible as recursively identified shocks are basically equivalent to orthogonalized shocks obtained by applying a cholesky decomposition. The difference is that the recursive structure does not restrict the variance of the disturbances to unity (Lütkepohl 2005).

4.2.1 Graphical Comparison

Figure 4 shows the output responses to a positive one standard deviation monetary policy shock of the country-specific SVAR models together with the responses estimated by the PCHVAR models. The impulse responses of the PCHVAR models are fixed at the average of the respective conditioning variable. Hence, they represent the response of real GDP and real housing prices at the euro area average of the respective conditioning variable. If the impulse responses generated by the PCHVAR models coincide with the impulse responses of the country-specific SVAR models, we conclude that the empirical variation in the country-specific case can be explained by the euro area average of the respective conditioning variable. Hence, the variation in the PCHVAR model which depends on the respective conditioning variable has some explanatory power for the empirical variation in the country-specific SVAR models. However, differences between the country-specific impulse responses and the average PCHVAR impulse responses point to asymmetries in the transmission mechanism across the euro area countries.

The dynamics shown by the impulse response functions of the country-specific SVAR models are in line with standard macroeconomic theory. As expected, an increase in the monetary policy rate leads to a contraction in output. GDP reaches a trough after about ten quarters in almost all countries included in the panel. Exceptions are Greece, Spain and Ireland where output contracts immediately. In general, it takes about twenty to thirty quarters until the shock vanishes. Obviously, in most of the countries, output rises in the first quarter before it contracts showing a puzzling behavior (Uhlig 2005).

The country-specific impulse responses of Germany, France, Italy, Austria and the Netherlands show similarities with the PCHVAR impulse responses at the average of financial openness. Differences with respect to the timing and strength of the trough

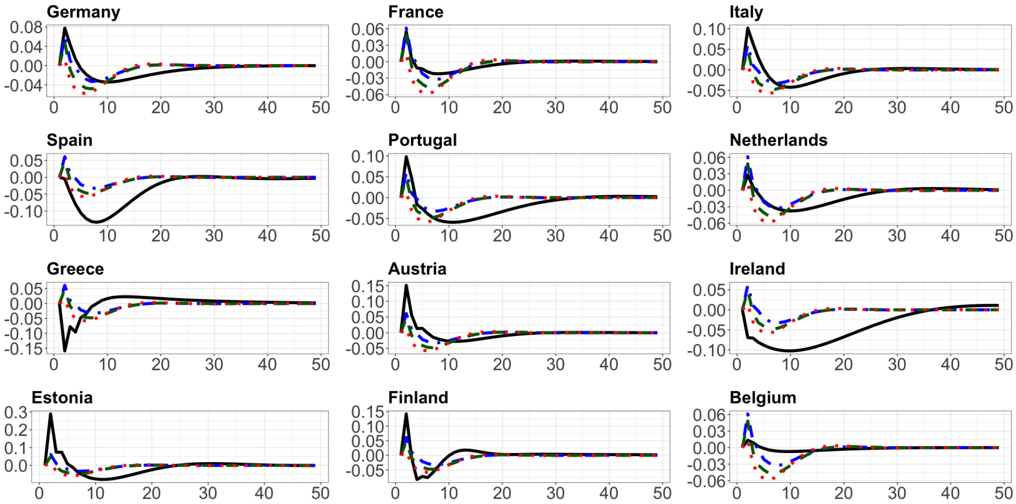

Figure 4: Impulse responses of real GDP to a one standard deviation monetary policy shock generated by the country-specific SVAR models and the PCHVAR model. The blue dash-dotted line refers to the impulse response of the PCHVAR model at the average of financial openness. The green dashed line shows the impulse response at the average of bank leverage and the red dotted line the impulse response at the average of household leverage.

and the return to baseline are observable, though. With Italy as an exception, figure 1 reveals that these countries show a moderate to high degree of financial openness compared to the other euro area countries included in the analysis. Hence, the degree of financial openness has some explanatory power for the contraction in real GDP after a positive one standard deviation monetary policy shock.

On the contrary, the country-specific real GDP impulse responses of Spain and Finland show similarities with the PCHVAR impulse response at the average of household leverage. Although there are differences with respect to the strength and timing of the trough and the return to baseline, the shape of the country-specific real GDP response of Spain is similar to the PCHVAR impulse response at the average of household leverage. Figure 1 indicates that Spain and Finland show a moderate to high level of household leverage compared to the other euro area countries included in the panel. These observations lead us to conclude that the level of household leverage offers some explanatory power for the contraction in real GDP after a positive monetary policy shock. However, as already noted, the percentage changes of real GDP are relatively small suggesting a minor impact of the conditioning variables on the contraction in real GDP.

Figure 5 shows the housing price responses to a positive one standard deviation monetary policy shock of the country-specific SVAR models together with the responses estimated by the PCHVAR models. Regarding the impulse responses of the country-specific SVAR models, we see a contraction of housing prices in almost all countries. Differences with respect to the timing of the trough are observable, though. In some countries the fall in housing prices occurs shortly after the shock has hit the economy indicating a higher sensitivity. In general, the trough is reached in the first fifteen quarters.

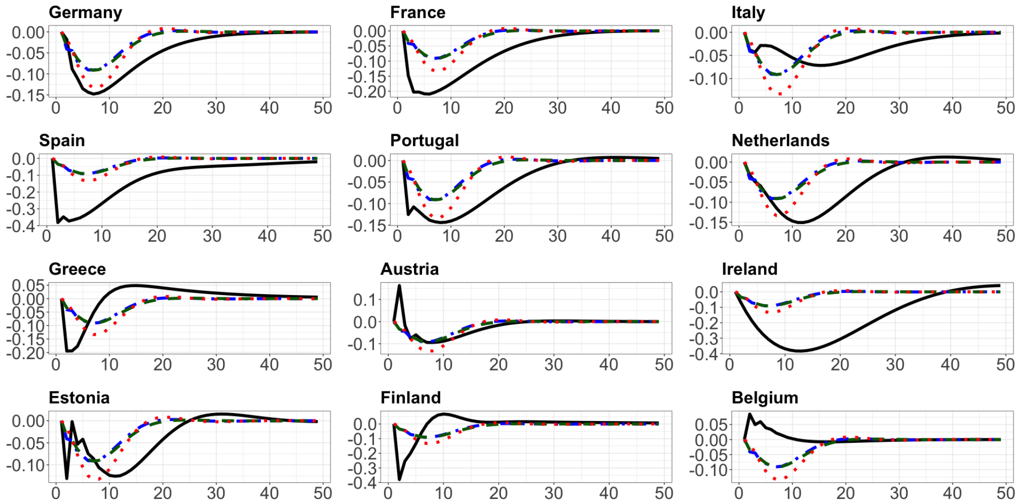

Figure 5: Impulse responses of real housing prices to a one standard deviation monetary policy shock generated by the country-specific SVAR models and the PCHVAR model. The blue dash-dotted line refers to the impulse response of the PCHVAR model at the average of financial openness. The green dashed line shows the response at the average of bank leverage and the red dotted line the response at the average of household leverage.

The impulse response functions for Austria and Belgium increase on impact showing signs of a puzzle similar to the "price puzzle" (Eichenbaum 1992, p. 1002). The price puzzle refers to increases in inflation after a positive monetary policy shock. Following Sim's (1992) explanation, it might be caused by anticipated inflationary pressures due to a rise in commodity prices. The monetary contraction then has a dampening effect on the rise in inflation. However, as we are dealing with real housing prices, the occurrence of the puzzle appears to be surprising as it implies that either nominal housing prices rise higher than goods prices do or that housing prices decrease less than goods prices do. Nevertheless, the rise in housing prices might be due to what is thought to be a positive innovation in monetary policy.[1] Indeed, Miranda-Agrippino and Ricco (2019) point to frictions due to asymmetric information between economic agents and the monetary authority that are likely responsible for the puzzling responses after a monetary policy shock. Accordingly, a rise in the policy rate is interpreted either as an unexpected monetary policy innovation or an endogenous response of the monetary authority to improved economic fundamentals. In the presence of informational frictions, agents confuse the monetary policy shock with an aggregate demand shock to which the monetary authority endogenously responds leading to the puzzling behavior of output and prices.

If we compare the country-specific impulse response functions with the impulse response functions generated by the PCHVAR model, we see that the country-specific responses of Germany and France show similarities with the PCHVAR impulse responses at the average of household leverage. Again, differences with respect to the timing and strength of the trough and the return to baseline are observable. These obsevations apply to Spain and Ireland as well. The deeper trough observable in Spain and Ireland points to further empirical factors not included in the PCHVAR models but relevant for the transmission of monetary policy shocks. With the exception of Germany and France, figure 1 reveals that the level of household leverage is on a moderate to high level compared to the other countries included in the panel. Based on these observations, we notice that the level of household leverage has some explanatory power for the fall in real housing prices after a positive one standard deviation monetary policy shock.

The graphical comparison conducted in this subsection is more speculative in nature. In the following section we use further econometric methods to sharpen our understanding of the importance of financial openness, bank-risk taking and household indebtedness for the monetary policy transmission mechanism.

4.2.2 Polynomial Regression Analysis

After a graphical comparison of the impulse response functions, we proceed with a quantitative examination and regress the impulse responses of the country-specific SVAR models on the PCHVAR impulse responses at the average of the respective conditioning variables. Provided that the estimated coefficients are significant we take this as

[1] We deal with this pattern in the section on robustness checks. Specifically, we estimate the country-specific SVAR models including the quarterly growth rate of the consumer price index as an endogenous variable. This specification is motivated by the assumption that the rise in housing prices might be caused by inflationary pressures associated with a rise in rent prices.

evidence that the empirical variation in the country-specific SVAR models can be explained by the structural characteristics included in the PCHVAR models.

The polynomial regression equation for real GDP and real housing prices respectively, looks as follows

$$IR_i^{SVAR} = c_i + \beta_1 IR_j^{PCHVAR} + \beta_2 (IR_j^{PCHVAR})^2 + \varepsilon_i \tag{7}$$

where $i = (1, 2, \ldots, N)$ indexes countries and $j = (1, 2, \ldots, l)$ indexes the computed average responses of the PCHVAR models[2].

Table (2) shows the adjusted R^2 for each country-specific polynomial regression. Choosing France as an example, about 92% of the empirical variation in the GDP response can be explained by the degree of financial openness. Additionally, the level of bank leverage explains about 89% of the variation in the GDP response. However, taking Ireland as an example, the results show a weaker link between the responses of real GDP and real housing prices and the degree of financial openness and the level of bank leverage. Obviously, most of the empirical variation in the country-specific real GDP responses is attributable to differences in the degree of financial openness. For the majority of countries, financial openness and bank leverage seem to be more important for variations in the GDP impulse responses. On the contrary, household leverage seems to be more important for variations in the housing price impulse responses. Compared to the degree of financial openness and the level of household leverage, bank risk-taking seems to be the more important determinant for the transmission of monetary policy shocks to housing prices. This result is at odds with our PCHVAR estimation results as they lead us to conclude that household leverage is a more important determinant of the transmission of monetary policy shocks to housing prices. However, the difference in the results may be due to the averaging of the PCHVAR impulse responses.

After calculation of the average adjusted R^2 over each column in Table (2) we claim that 66% of the decline in the growth rate of real GDP and 51% of the fall in real housing prices is attributable to cross-country differences in the degree of financial openness. Bank risk-taking explains on average 60% of the decline in the growth rate of real GDP and 55% of the fall in real housing prices. Household indebtedness accounts for 33% of

[2]Note that in order to improve the significance of the estimated coefficients, we drop the quadratic term for some country-specific regression equations. Please refer to the appendix for detailed regression results.

the decline in the growth rate of real GDP and 44% of the fall in real housing prices.

Table 2: Polynomial regressions adjusted R^2

	GDP response			HP response		
Country	FINOP	BLev	HLev	FINOP	BLev	HLev
DEU	0.6965	0.5259	0.1788	0,8309	0.8950	0.8382
FRA	0.9220	0.8932	0.5242	0.8813	0.9182	0.7904
ESP	0.7973	0.8016	0.7261	0.8959	0.8863	0.7669
ITA	0.7027	0.5126	0.2038	0.2014	0.3097	0.0913
AUT	0.8218	0.7267	0.2223	0.4166	0.4762	0.5350
BEL	0.6736	0.4835	0.1721	0.3180	0.2528	0.2057
FIN	0.5887	0.7171	0.5341	0.1164	0.1170	0.0711
GRC	0.5318	0.5351	0.2693	0.2627	0.2007	0.1415
IRL	0.3683	0.3595	0.3071	0.2832	0.3774	0.2557
NLD	0.5925	0.4955	0.3407	0.4823	0.5951	0.4335
PRT	0.6335	0.5211	0.2257	0.7938	0.8639	0.6893
EST	0.6309	0.6658	0.2832	0.6433	0.7223	0.5067

Note: The second column shows the adjusted R^2 obtained from regressing the country-specific SVAR real GDP response on the PCHVAR real GDP response at the average of financial openness. The third column refers to the PCHVAR GDP response at the mean of bank leverage. The fourth column to the PCHVAR GDP response at the mean of household leverage. The fifth column refers to the PCHVAR real housing price response at the average of financial openness. The sixth column shows the PCHVAR housing price response at the mean of bank leverage. Finally, column seven displays the PCHVAR housing price response at the average of household leverage.

4.3 Robustness Checks

As there might be exogenous factors not included in the analysis such as global economic activity or the development of commodity prices, we check the robustness of the results generated by the PCHVAR models by repeating the estimation choosing world GDP and oil prices as exogenous variables. The time series are taken from the World Bank World Development Indicators and FRED databases, seasonally adjusted and measured in logs and first differences to obtain percentage changes. The world GDP series is interpolated from yearly to quarterly frequency. The analysis shows that the results of the PCHVAR models are robust with respect to the change of the exogenous variables.

Changing the order of the endogenous variables is a standard way for checking the validity of the estimation results. We reorder the endogenous variables as follows: (1) Real GDP, (2) Short-term interest rate, (3) Real housing prices. The GDP responses of the PCHVAR models and the country-specific SVAR models are robust under this alternative order of the endogenous variables. The impulse responses of housing prices differ in their initial responses. This might be caused by the change in the contemporaneous relation between housing prices and the short-term interest rate. However, as we are foremost interested in the impact of a monetary policy shock, it is reasonable to order the short-term interest rate last and assume that initial changes in GDP and housing prices are included in the reaction function of the monetary authority.

As already mentioned, the dynamics of housing prices might also be driven by changes in consumer prices. To account for this, we include consumer price inflation as additional endogenous variable in the country-specific SVAR models. The time series is taken from the OECD, seasonally adjusted and measured in logs and first differences. We order inflation at an anterior position in the model as we assume that rent prices are sluggish so that variations in inflation due to a change in rent prices occur slowly. The endogenous variables are ordered as follows: (1) Real GDP, (2) CPI, (3) Real housing prices, (4) Short-term interest rate. The resulting impulse response functions are similar to the responses generated by the SVAR models without inflation. The puzzling behavior of the initial housing price and GDP responses could not be eliminated as the price puzzle is visible in Germany, Italy and the Netherlands. Additional output puzzles are visible in Spain and Ireland. However, the initial positive output response for the Netherlands is weaker.

4.3.1 Estimation in levels

As mentioned in section three, the test results regarding the stationarity of the time series are mixed. Hence, the country-specific SVAR models estimated in first differences might be subject to mis-specification. In order to test this possibility, we estimate the country-specific SVAR models in levels and draw a comparison to the country-specific SVAR models in first differences (Georgiadis 2015). The real GDP and real housing price series are measured in logs. Considering the responses of real GDP, the model in levels generates stationary impulse response functions for Italy. For the other countries, estimation in first differences eliminated the explosive behavior of the impulse response functions obtained from the model in levels. Although output puzzles are still visible, the initial positive responses are less pronounced. The responses of housing prices obtained from the model in levels are stationary for France, Spain, Italy and Belgium. Estimation in first differences eliminated the explosive behavior of the housing price impulse responses of the other countries in the panel.[3]

4.3.2 Estimation in fourth differences

The impulse response functions obtained from the country-specific SVAR models in fourth differences are stationary for all countries included in the panel. For some countries, the output and price puzzles could be eliminated. This indicates that the initial increase in output and prices is only of a temporary nature. For Spain, Austria, Belgium and the Netherlands it takes about twenty years till the response of housing prices to a monetary policy shock returns to baseline. The GDP response for Ireland hardly vanishes. Because of non-stationarity of the GDP response obtained from the model in levels, this result must be taken with caution.

5 Conclusion

The econometric results of this article reveal significant asymmetries in the monetary policy transmission mechanism across the euro area. These asymmetries are due to structural characteristics underlying the individual economies. Accordingly, the degree of financial openness, the level of bank leverage and the level of household leverage account for the amplification of contractionary monetary policy shocks to real GDP and real housing prices. A polynomial regression analysis reveals that 66% of the decline in the growth rate of real GDP and 51% of the fall in real housing prices is attributable to cross-country differences in the degree of financial openness. Bank risk-taking explains on average 60% of the decline in the growth rate of real GDP and 55% of the fall in real housing prices. Moreover, household indebtedness accounts for 33% of the decline in real GDP growth and 44% of the fall in real housing prices. Hence, the amplification of monetary policy shocks to real economic activity occurs foremost through a rise in international financial linkages. On the contrary, increasing bank risk-taking is an important determinant of the transmission of monetary policy shocks to the housing market.

[3]The estimated impulse response functions can be found in the appendix.

The asymmetries in the transmission process have significant implications not only for the conduct of monetary policy but also for the process of economic integration in the euro area. If one considers the differences in the member countries' degree of financial openness and the heterogeneity in the banking and household sectors, it is clear that greater harmonization efforts are needed to reduce asymmetric reactions to monetary policy shocks. Thus, our results call for policies to monitor and reduce possible asymmetric reactions among currency union members after a common monetary policy shock.

Against the background of the structural changes considered in this article, future research could gain deeper insights by focusing on the endogenous mechanisms underlying the interaction between monetary policy and the real and financial side of the economy.

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Appendix

Table 3: Countries included and respective time series range

Country	Time series range
Germany	1999Q2:2018Q4
France	1999Q2:2018Q4
Spain	1999Q2:2018Q4
Italy	1999Q2:2018Q4
Austria	2000Q2:2018Q4
Belgium	1999Q2:2018Q4
Finland	1999Q2:2018Q4
Greece	1999Q2:2018Q4
Ireland	2002Q2:2018Q4
Netherlands	1999Q2:2018Q4
Portugal	1999Q2:2018Q4
Estonia	2005Q2:2018Q4

Table 4: Time series

Variable	Unit	Source	Key	S.A.
Real GDP	Index value	OECD	VOBARSA	•
Real housing prices	Index value	OECD	RHP	•
Short-term interest rate	%	OECD	IR3TIB	
Equity held by MFIs	Million Euro	ECB	QSA.Q.N.DE.W0.S12K.S1.N.A.LE.F51._Z._Z.XDC._T.S.V.N._T*	
Loans granted by MFIs	Million Euro	ECB	QSA.Q.N.DE.W0.S12K.S1.N.A.LE.F4.T._Z.XDC._T.S.V.N._T	
Currency and deposits of MFIs	Million Euro	ECB	QSA.Q.N.DE.W0.S12K.S1.N.A.LE.F2.T._Z.XDC._T.S.V.N._T	
Debt securities held by MFIs	Million Euro	ECB	QSA.Q.N.DE.W0.S12K.S1.N.A.LE.F3.T._Z.XDC._T.S.V.N._T	
KOF financial globalization index	Index value	KOF	KOFFiGIdf	
Household credit-to-GDP ratio	% of GDP	BIS	n.a.	
VIX	Index value	CBOE	VIX	
Real GDP World	Trillion USD	World Bank WDI	NY.GDP.MKTP.KD	•
Oil prices	Index value	FRED	POILAPSPINDEXQ	•
Consumer price index	Index value	OECD	IDX2015	•

**Note*: The fourth entry varies across the countries included in the analysis as it refers to the respective country code. DE corresponds to Germany.

Table 5: polynomial regression results for GDP impulse responses

	GDP response								
		koffgl			nblev			cthgdp	
Country	c	β_1	β_2	c	β_1	β_2	c	β_1	β_2
DEU	-0.0051***	1.0525***	5.9826**	-0.0056***	1.0048***	14.5044***	-0.0052*	1.6514***	28.7209***
	(0.0016)	(0.1123)	(2.6359)	(0.0021)	(0.1352)	(3.3324)	(0.0027)	(0.4957)	(9.9449)
FRA	-0.0014***	0.7637***	2.6776***	-0.0010*	0.7763***	8.0063***	-0.0003	1.3035***	19.0943***
	(0.0005)	(0.0348)	(0.8175)	(0.0006)	(0.0393)	(0.9676)	(0.0012)	(0.2309)	(4.6322)
ESP	-0.0136***	2.8728***	-43.7253***	-0.0129***	1.7917***	-23.4325***	-0.0145***	3.6198***	31.1673**
	(0.0033)	(0.2238)	(5.2540)	(0.0032)	(0.2133)	(5.2574)	(0.0038)	(0.6982)	(14.0095)
ITA	-0.0006	1.4079***	5.8131*	-0.0014	1.2874***	17.5983***	-0.0012	2.2725***	39.7839***
	(0.0021)	(0.1441)	(3.3818)	(0.0027)	(0.1777)	(4.3802)	(0.0034)	(0.6327)	(12.6938)
AUT	-0.0018	1.2200***	22.0645***	-0.0019	1.5385***	32.2711***	0.00004	2.6620***	51.3700
	(0.0017)	(0.1198)	(2.8116)	(0.0022)	(0.1429)	(3.5217)	(0.004)	(0.6710	(13.4700)
BEL	-0.0008**	0.2196***		-0.0011**	0.1882***	2.2703***	-0.0011**	0.3023***	5.0214**
	(0.0003)	(0.0220)		(0.0004)	(0.0276)	(0.6800)	(0.0005)	(0.0973)	(1.9522)
FIN	0.0025	1.5569***	10.3752**	0.0065**	1.8070***	13.8005***	0.0095***	1.2436***	
	(0.0031)	(0.2131)	(5.0012)	(0.0026)	(0.1703)	(4.1959)	(0.0033)	(0.1662)	
GRC	0.0046	-0.7017***	-33.4083***	0.0065*	-1.1515***	-42.8226***	0.0047	-2.3390***	-60.0085***
	(0.0035)	(0.2408)	(5.6519)	(0.0035)	(0.2312)	(5.6969)	(0.0043)	(0.8072)	(16.1952)
IRL	-0.0287***	1.6374***	-36.7050	-0.0286***	0.8182**	-23.7891***	-0.0306***	1.3317***	
	(0.0054)	(0.3677)	(8.6314)	(0.0054)	(0.3568)	(8.7915)	(0.0056)	(0.2822)	
NLD	-0.0050***	0.9161***	-5.4067	-0.0049***	0.6623***		-0.0055***	1.3640***	18.9939**
	(0.0016)	(0.1081)	(2.5384)	(0.0017)	(0.0955)		(0.0020)	(0.3691)	(7.4055)
PRT	-0.0103***	1.7101***		-0.0113***	1.5498***	16.6138***	-0.0108**	2.4858***	38.5973**
	(0.0026)	(0.1866)		(0.0032)	(0.2132)	(5.2533)	(0.0041)	(0.7549)	(15.1459)
EST	0.0041	3.2007***		-0.0050	3.2005***	59.9315***	-0.0017	6.1879***	116.4480***
	(0.0049)	(0.3474)		(-0.0050)	(0.3326)	(8.1970)	(0.0073)	(1.3567)	(27.2213)

*** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level. Standard errors in parentheses. *Note*: Gaps indicate that the coefficients are estimated by dropping the quadratic term in the regression equation.

Table 6: Polynomial regression results for housing price impulse responses

	HP response								
		koffgl			nblev			cthgdp	
Country	c	β_1	β_2	c	β_1	β_2	c	β_1	β_2
DEU	-0.0169***	1.5109***		-0.0131***	2.2630***	9.0630**	-0.0182***	1.6543***	5.2137**
	(0.0035)	(0.0982)		(0.0028)	(0.3088)	(3.8324)	(0.0033)	(0.2738)	(2.3359)
FRA	-0.0228***	4.2494***	25.6920***	-0.0193***	4.4620***	28.0651***	-0.0294***	3.0217***	13.4858***
	(0.0044)	(0.4981)	(6.1866)	(0.0037)	(0.4024)	(4.9940)	(0.0056)	(0.4602)	(3.9266)
ESP	-0.0480***	6.6165***	38.8526***	-0.0444***	6.6408***	39.6031***	-0.0596***	4.7683***	21.5786***
	(0.0065)	(0.7371)	(9.1547)	(0.0069)	(0.7500)	(9.3075)	(0.0094)	(0.7670)	(6.5449)
ITA	-0.0266***	1.4350***	15.4070***	-0.0246***	1.6802***	17.9564***	-0.0286***	0.6713**	4.6065*
	(0.0037)	(0.4162)	(5.1691)	(0.0035)	(0.3766)	(4.6741)	(0.0038)	(0.3087)	(2.6339)
AUT	-0.0022	0.9140		-0.0004	0.9730***		-0.0018	0.7271***	
	(0.0054)	(0.1539)		(0.0052)	(0.1456)		(0.0047)	(0.0970)	
BEL	-0.0022	-0.3480***		-0.0018	-0.3124***		-0.0010	-0.5480**	-3.1822*
	(0.0025)	(0.0720)		(0.0027)	(0.0752)		(0.0027)	(0.2215)	(1.8896)
FIN	0.0126	3.6569**	38.4053**	0.0124	3.8358***	42.5386**	0.0033	2.4150**	19.8392**
	(0.0125)	(1.4225)	(17.6675)	(0.0127)	(1.3842)	(17.1779)	(0.0124)	(1.0141)	(8.6533)
GRC	0.0200**	1.0165***		0.0186**	0.8975***		0.0143	0.5431***	
	(0.0084)	0.2389		(0.0088)	(0.2484)		(0.0089)	(0.1819)	
IRL	-0.1094***	6.7331***	53.2208*	-0.0981***	8.0234***	66.2268**	-0.1217***	1.8271***	
	(0.0219)	(2.4910)	(30.9383)	(0.0208)	(2.2597)	(28.0425)	(0.0213)	(0.4369)	
NLD	-0.0200***	3.4916***	28.5636***	-0.0154**	3.8818***	32.1427***	-0.0243***	1.9636***	9.4903*
	(0.0073)	(0.8281)	(10.2850)	(0.0066)	(0.7129)	(8.8473)	(0.0074)	(0.6023)	(5.1395)
PRT	-0.0158***	3.6577***	26.1925***	-0.0124***	3.8833***	28.4498***	-0.0215***	2.2795***	10.6146***
	(0.0045)	(0.5079)	(6.3075)	(0.0037)	(0.4015)	(4.9830)	(0.0053)	(0.4334)	(3.6982)
EST	-0.0060	3.7170***	32.7029***	-0.0027	3.8165***	33.1264***	-0.0114*	1.9909***	10.6611**
	(0.0051)	(0.5790)	(7.1908)	(0.0046)	(0.4973)	(6.1715)	(0.0058)	(0.4735)	(4.0399)

*** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level. Standard errors in parentheses. *Note*: Gaps indicate that the coefficients are estimated by dropping the quadratic term in the regression equation.

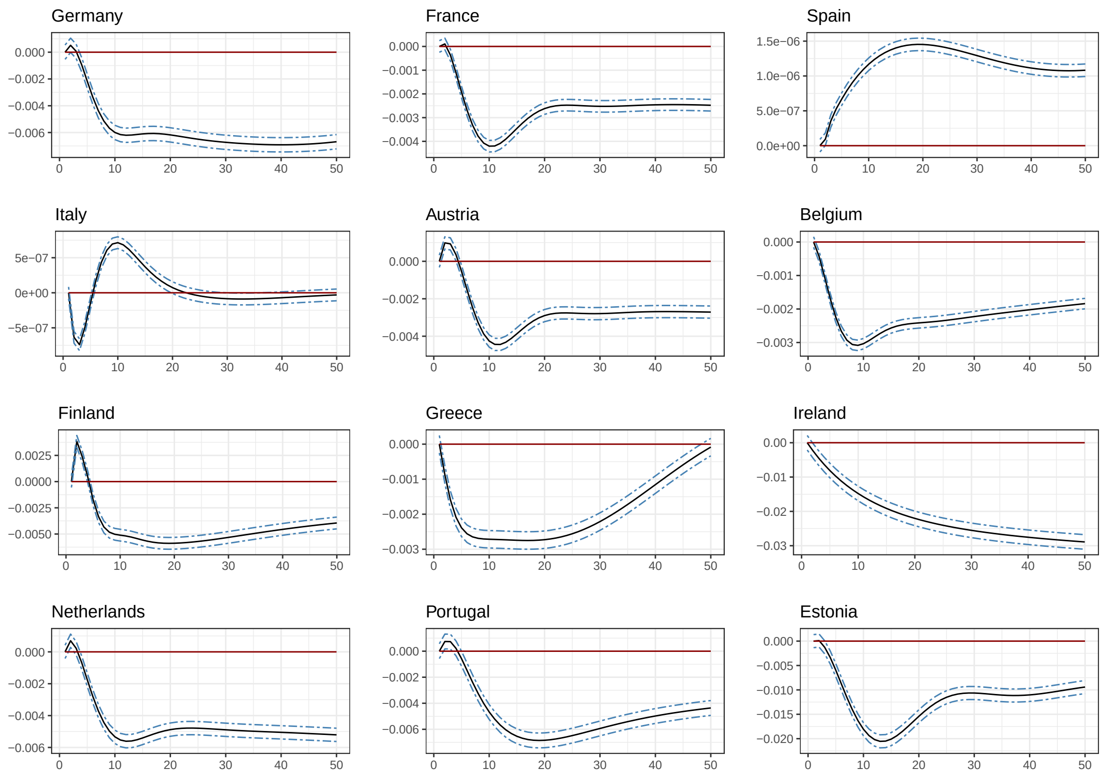

Figure 6: Real GDP responses in levels to a positive one standard deviation monetary policy shock. Dash-dotted lines indicate 95% confidence intervals.

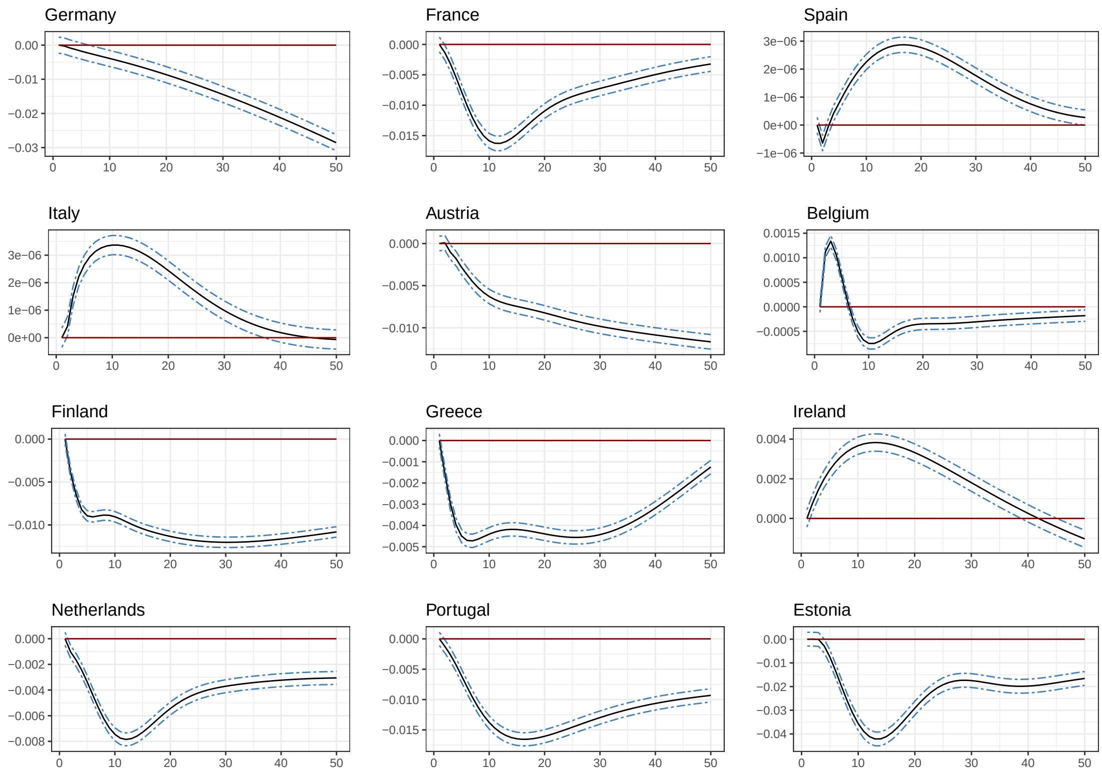

Figure 7: Real housing price responses in levels to a positive one standard deviation monetary policy shock. Dash-dotted lines indicate 95% confidence intervals.

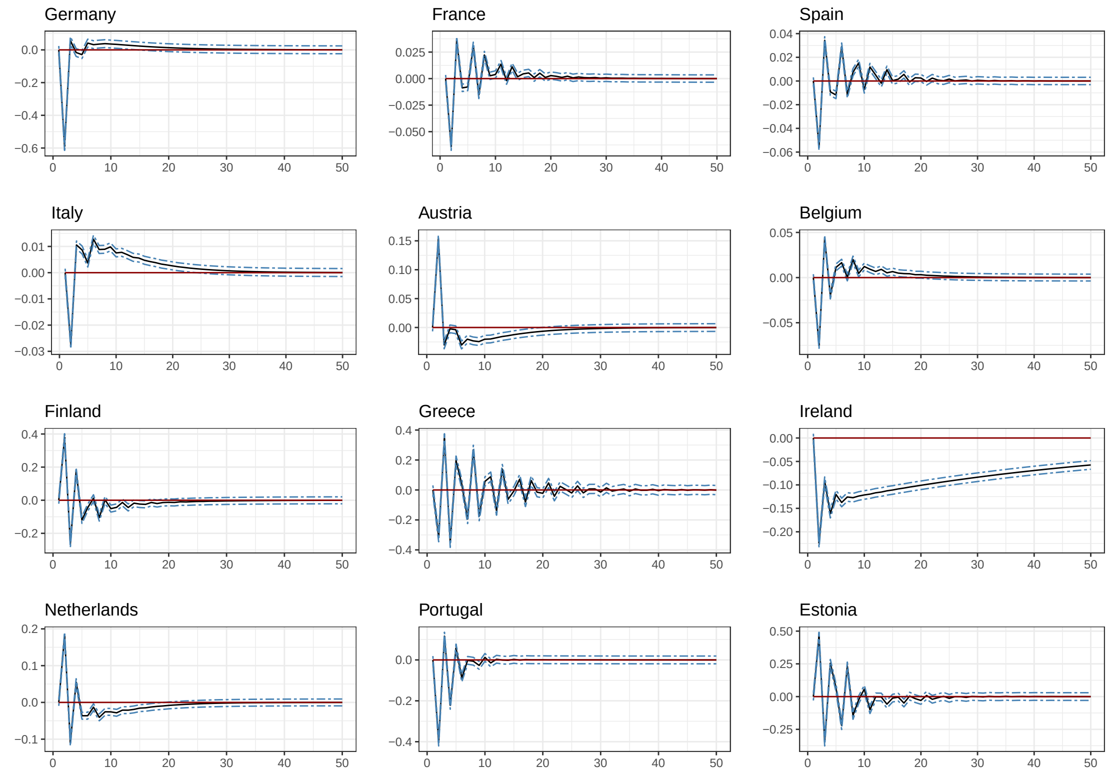

Figure 8: Real GDP responses in fourth differences to a positive one standard deviation monetary policy shock. Dash-dotted lines indicate 95% confidence intervals.

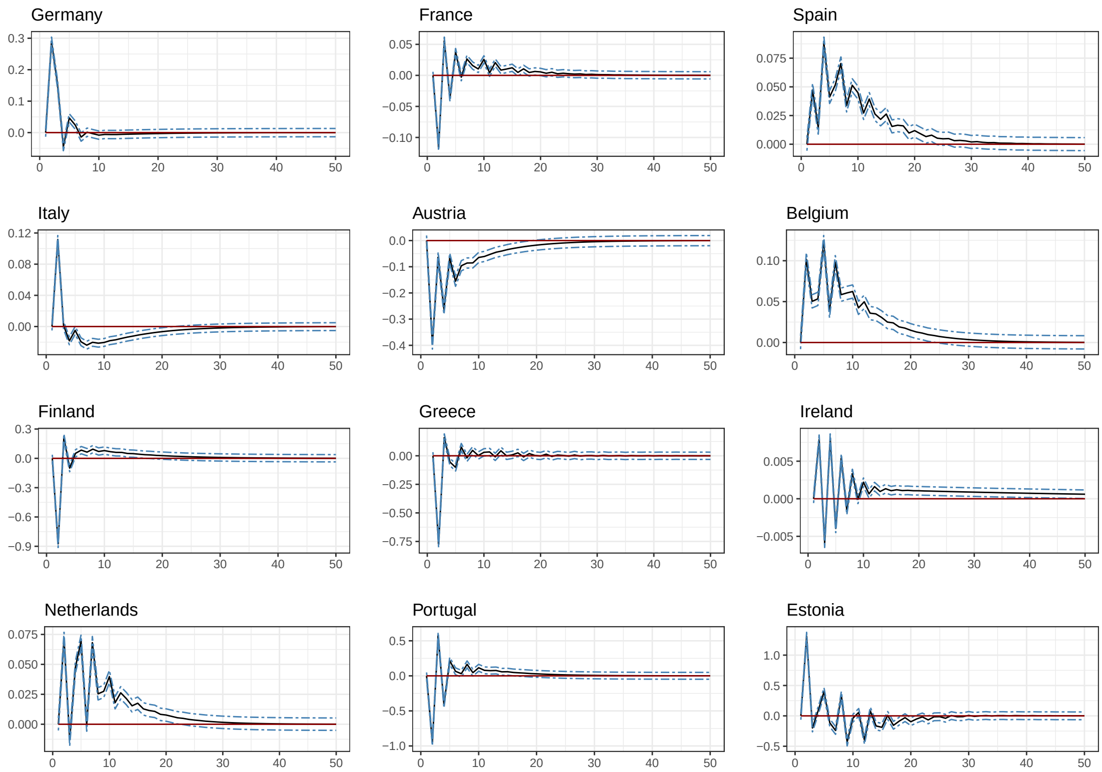

Figure 9: Real housing price responses in fourth differences to a positive one standard deviation monetary policy shock. Dash-dotted lines indicate 95% confidence intervals.