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Modelling Economic Policy Issues

House prices and credit as transmission channels from monetary policy to inequality: Evidence from OECD countries

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ABSTRACT

Using a panel vector autoregressive model, this paper assesses the impact of monetary policy on the Gini coefficient of disposable income for 30 OECD countries between 1995Q1 and 2019Q4. We assume house prices and household credit as transmission channels, representing households' financial balance. To capture the effect of the financial crisis, the analysis further distinguishes the period that started in 2008Q4. We find that a contractionary monetary policy increases the Gini coefficient in a moderate way. For the entire period, house prices are an effective transmission channel, a positive shock decreasing inequality, while credit is not statistically significant. Following the crisis credit stands out as the transmission mechanism, a positive credit shock reducing the Gini coefficient, while house prices lose relevance. These results are robust to different model specifications.

1. Introduction

Since the 1980s, there has been an unprecedented widening of inequality in the distribution of income and wealth (Piketty, 2014), a trend that has been accentuated by both the 2008 economic and financial crisis (Saez, 2018) and the recent Covid-19 crisis (World Bank, 2021). While the relative share appropriated by the richest 1 % and 0.1 % has increased, the fraction of the population living below poverty has remained high. Traditionally, monetary policy interventions are not aimed at changing the distribution of income and wealth, but the dominant role they have progressively assumed, becoming the main instrument of macroeconomic stabilization, has led central bank governors to reveal a growing concern about their relationship with rising inequality (Bullard, 2014; Draghi, 2016; Schnabel, 2021).

The central goals of monetary policy are to keep inflation around an inflation target and close the output gap or control unemployment, with redistribution of income and wealth as a secondary issue (Hansen et al., 2020). However, when impacting economic activity, monetary policy tools such as the policy rate or asset purchasing programs can modify household income and the distribution of wealth (e.g. Colciago et al., 2019). Contractionary measures that reduce labor earnings increase inequality in income by affecting the poorer, who tend to depend solely on wages (Coibion et al. 2017; Guerello 2018), whereas non-standard monetary policy measures that raise asset prices widen inequality by benefiting the richer, those more engaged with financial markets (Saiki and Frost 2014). The impact of monetary policy decisions on inequality depends on the combined effect of different transmission channels, making it important to distinguish direct channels that mainly influence household savings from indirect channels that affect unemployment and income (Ampudia et al., 2018).

The literature has sought to disentangle the effect of each of the transmission channels of monetary policy on inequality but paid

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less attention to those that affect the financial balance of households. Households are exposed to the combined effect of changes in monetary policy on both their assets and liabilities. The price of housing, the main asset of households, responds to conventional and unconventional monetary policy, affecting household wealth and income (Rosenberg, 2019). As real estate ownership is not enjoyed by the entire population, its appreciation benefits only the fraction of households owning it, which, depending on their distribution in the population, may accentuate or attenuate inequality. Thus, heterogeneity across households influences the transmission of monetary policy to inequality (Lenza and Slacaleck, 2018; Auclert, 2019; Cloyne et al., 2019). In its turn, credit, which is an instrument to offset inequality for low-income households (Barba and Pivetti, 2009), when used in excess, can cause financial distress and trigger an economic crisis, thereby increasing inequality (Bazillier and Hericourt, 2017). House prices and credit are mutually reinforcing, an increase in the former driving an expansion of the latter, which itself exerts upward pressure on prices (Anundsen and Jansen, 2013). This market feature cannot be excluded from the analysis, and the interaction of prices and credit determines their roles as transmission channels to inequality. Jointly, house prices and credit determine the financial position of households, a crucial factor for monetary and financial stability (Zabai, 2017), both of which affect the ability of monetary policy to control inflation, the output gap, and inequality.

We discuss the role played by house prices and household credit as transmission channels of monetary policy to inequality. Whereas the literature has used survey data to calculate household balance sheets from their distributions of assets and liabilities (e.g. Mumtaz and Theophiopoulou, 2017; Lenza and Slacaleck, 2018), the current analysis focuses on aggregate data. For this purpose, a Panel Vector Autoregression (PVAR) methodology is applied to quarterly data for 30 OECD countries from 1995Q1 to 2019Q4. The empirical model relates the Gini coefficient of disposable income to household credit, nominal house prices, GDP, and the short-term interest rate representing the monetary policy stance. The link between financial crises and inequality is an ongoing debate, the possibility of bidirectionality between the two is not ruled out, as income disparity can generate economic crises that can generate inequality by slowing economic growth (Bodea et al., 2021). The time series under analysis was split into a shorter, post-financial crisis period to capture any structural disruption that resulted from the financial crisis that may have affected inequality.

The empirical results indicate a contractionary monetary policy having negative but mildly distributional effects, namely an unanticipated interest rate increase of 100 basis points increases the Gini coefficient of disposable income by about 0.5 % after 18 months. A rise in either house prices or household credit leads to a fall in inequality, but the relative strength depends on the period under analysis. For the whole period, a positive shock to house prices reduces the Gini coefficient, and credit is not statistically significant. In the post-crisis period, the Gini coefficient falls after a positive shock to credit, and house prices lose statistical significance.

The rest of the paper is structured as follows. Section 2 addresses the relationship between monetary policy and inequality that is found in the literature. Section 3 presents the model data and the panel VAR methodology. Section 4 displays and discusses the empirical results for different estimates, and Section 5 concludes.

2. Literature review

The extent to which the sharp rise in inequality of income distribution that has occurred since the 1980s is related to the stabilization policy of central banks has caught the attention of economists. So far, the opinion most agreed upon in the empirical literature is that monetary policy affects inequality through both direct and indirect channels, although with moderate and short-lived effects (Colciago et al., 2019). Monetary policy is transmitted to inequality through channels such as income composition, financial segmentation, portfolio composition, savings redistribution, income heterogeneity, and their different combinations (Coibion et al., 2017). These channels often have opposite effects on income distribution, and thus the effect of monetary policy on inequality is ambiguous. Coibion et al. (2017) triggered this discussion while showing that between 1980 and 2008 expansionary monetary policy shocks in the US had equalizing effects on both consumption and income, and that labor income, income composition, and portfolio composition were the decisive transmission channels of monetary policy to income inequality.

Emphasizing the role of financial channels as transmission mechanisms, O'Farrell et al. (2016) claimed that monetary policy affects income and net wealth inequality, but its redistributive effects tend to be small. Inequality responds to changes in asset prices, weakening with rising house prices but strengthening with rising bond and equity prices. Additionally, by stabilizing the economy, monetary policy reduces cyclical variation in inequality. For the UK, Mumtaz and Theophiopoulou (2017) demonstrated that inequality in earnings, income, and consumption increased or showed greater fluctuations following a contractionary monetary policy. They emphasized the role of the income composition channel, differentiating households belonging to the upper end of the wage and income distribution from those at the lower end to show that tight monetary policy affects households asymmetrically, reducing wages and income of low-income households and those that consume the least while affecting less those at the top of the distribution. Nevertheless, they distinguish the period of quantitative easing that led to an increase in income inequality, since households that held financial assets, the high-income group, profited from their price appreciation while poorer households had less access to financial markets.

In the same line, Casiraghi et al. (2018) concluded that an expansionary monetary policy moderately reduced inequality among Italian households, as its indirect effects on employment and wages benefited households at the bottom of the income scale, outweighing the direct effects on financial wealth, a consequence of poorer households' labor income being more sensitive to the business cycle. Contradicting Mumtaz and Theophiopoulou (2017), these authors reported negligible effects of the ECB's unconventional monetary policy on inequality.

For a cross-section of countries, Furceri et al. (2018) established that contractionary monetary policy shocks increased income inequality, but with asymmetric effects, that is, a policy contraction (tightening) increases inequality more than a policy expansion (easing) reduces it, and these effects depend on the state of the business cycle. Recurring to historical data, Hailemariam et al. (2021)

reported a positive shock to the real interest rate reducing income inequality, while El Herradi and Leroy (2021) concluded that a tightening of monetary policy reduces the national income of the richest 1 % of the population via asset prices, which does not imply a more equal income distribution as a whole.

In contrast to the previous findings, Davtyan (2017) demonstrated that contractionary monetary policy had positive redistributive effects in the US, where income inequality is determined by the change in the top 1 % of the income distribution. A tight policy allows for controlling inflation, which tends to hurt the low-income part of the population, as the financial wealth of low-income households is held mostly in cash. This effect thus results from the portfolio composition channel.

The more or less widespread choice of unconventional monetary policies after the financial crisis led many authors to investigate how these policies affect inequality. With its specific transmission channels contributing to the valuation of financial and real assets, unconventional monetary policy can impact the income distribution by benefiting those who own assets, typically the wealthiest. According to Saiki and Frost (2014), following the global financial crisis in Japan, unconventional monetary policy amplified income inequality through the portfolio channel because, in order to ensure financial stability, the central bank chose unconventional monetary policy instruments such as liquidity provision, which increased the prices of assets above economic fundamentals such as wages and employment, benefiting upper-income households, who hold a larger amount of capital income.

Similarly, Montecino and Epstein (2015) concluded that quantitative easing increased inequality in the US since it had little equalizing effect on employment, and mortgage refinancing compared to the dis-equalizing effects on equity price appreciations. For the eurozone, Guerello (2018) reported cross-country heterogeneity and non-linearities in the relationship between monetary policy and inequality. The increase in the size of the central bank balance sheet affected the distribution of income mainly in countries where households participated more actively in financial markets, producing larger dis-equalizing effects. In these countries, standard expansionary monetary measures tended to reduce inequality in the short run, but expansionary unconventional monetary policies increased the income dispersion. In countries where bank deposits were the largest share of households' portfolios, an expansionary unconventional monetary policy had the same effect as a conventional monetary policy, reducing income dispersion.

For Ampudia et al. (2018), standard and non-standard monetary policy had distributional effects, both a reduction in policy interest rates and the Asset Purchase Program compressing the distribution of income. The authors isolated direct from indirect effects of monetary policy transmission channels, in which direct effects comprise changes in household incentives and net financial income, and indirect effects include the response of prices and wages. In the zero lower bound context, all households gained from indirect effects, while direct effects had a less redistributive impact. Therefore, the new toolkit of unconventional monetary policy contributed to reducing inequality.

Showing that quantitative easing had equalizing effects in the euro area, especially by decreasing unemployment for lower-income households, Lenza and Slacaleck (2018) underscored the role of household heterogeneity in the transmission of monetary policy. According to these authors, the earnings heterogeneity channel was the most important in this relationship.

The impact of monetary policy on household balance sheets and inequality has been less explored. These balance sheets comprise housing, the value of which can be captured by house prices (as its main asset) and household debt, that is, credit (as its main liability). For Auclert (2019) differences between household balance sheets amplify the transmission of monetary policy. Household debt, especially mortgage debt, affects transmission, as homeowners increase their consumption expenditure in response to a fall in interest rates, generating inequality in expenditure, even if the effect is also felt in their disposable income (Cloyne et al., 2019). The role of the credit channel in the transmission of monetary policy is well established in the literature (Bernanke and Gertler, 1995) as is the impact of inequality on increasing recourse to credit and extending credit cycles (Malinen, 2016). These relationships may explain the existence of a bidirectional causality between credit supply and inequality, as pointed out by Bazillier and Hericourt (2017) and Perugini et al. (2016). Additionally, a shock to monetary policy will cause a spike in house prices (Rahal, 2016). As the main form of household wealth, fluctuations in house prices can be a relevant transmission channel from monetary policy to income and inequality (Lenza and Slacalek, 2018). This paper adds to the body of literature by utilizing aggregate data to examine how household credit and housing prices act as transmission channels for the effects of monetary policy on income inequality—a strand that has not been sufficiently studied to date—and by examining how these effects differ over time. These two channels play a pivotal role in determining the relative wealth of households by determining the value of their primary assets and liabilities, thereby conditioning their financial balance.

3. Empirical framework

3.1. Data

Our sample covers 30 OECD countries: Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, the U.K., and the U.S. Data availability and the structural break caused by Covid-19 constrained the period of analysis to the period 1995Q1 to 2019Q4.

The monetary policy instruments should be able to represent both the shocks that characterized the period and the shift to unconventional monetary policy. In the empirical literature the options have been quite diverse, ranging from monetary aggregates to represent unconventional monetary policy (Saiki and Frost, 2014), to the 3-month treasury bill rate (Mumtaz and Theophiopoulou, 2017), to innovations in ECB balance sheets (Guerello, 2018). Following Krippner (2014) and Wu and Xia (2016), a shadow rate is also often considered in estimations. In this study, centered on households, we favored the short-term interest rate (the call money/interbank rate) for two reasons: because households respond to changes in the interest rate since they affect their borrowing costs; and, despite the common monetary policy, the rate differs across the Eurozone countries, which account for much of the sample. Long-term (10-year) government bond yields were also collected to perform robustness tests. Both variables were taken from the OECD database.

To capture inequality in a way that allows relating 30 different countries, we selected the Gini coefficient, retrieved from the Standardized World Inequality Database (SWIID) by Solt (2016). The SWIID is standardized by the Luxembourg Income Study and has the advantage of providing comparable estimates of income inequality. The Gini coefficient takes values between 0, representing an equal distribution of income, and 1, implying a completely unequal distribution, and is a measure of inequality for the total population, not focusing on a specific group. Since the model's variables are available with quarterly frequency and the Gini coefficient is available on an annual basis, following Creel and El-Herradi (2022) the original data were linearly interpolated using the Chow and Lin (1971) methodology, making the best use of available data. Higher frequency data provides more observations, improving the fit and explanatory power of the estimates. Additionally, it enables the evaluation of the effects of monetary policy adjustments, which take place frequently, on income inequality. The preference for linear interpolation is justified by the fact that this indicator is persistent and not subject to significant fluctuations.

Two monetary variables were added as the transmission channels in the model – nominal house prices and household credit. Nominal house prices are a seasonally adjusted index taking 2015 as base year, the source of which is the OECD Quarterly National Accounts analytical house prices indicators. The preference for nominal prices is justified given their direct relationship to instantaneous household perceptions (Campbell and Cocco, 2007) and because the immediate impact of monetary policy is on nominal variables. As a measure of household credit, we obtained the percentage of household credit to GDP from the Bank for International Settlements (BIS). This measure represents a stock of liabilities and tends to be related to house prices, the main asset of households, nevertheless, their correlation is not very high, which guarantees these variables independence from one another (see Table 2). Then, we multiplied it by real GDP collected from the OECD database to calculate the volume of household credit. Finally, we also include real GDP as control variable.

Table 1 reports descriptive statistics for the variables used in the models and Table 2 reports the correlation matrix for the model variables.

3.2. Data inspection

The variables' degree of integration was assessed by applying Maddala and Wu's (1999) panel unit root tests. The tests indicated that the interest rate and government bond yields are stationary. We then conducted tests on the seasonal first differences of the other variables and found that they are integrated of order 1. Table 3 displays the unit root tests for the interest rate and the yields in levels and for the first differences of the remaining variables.

Figs. 1–3 present scatter plots of the relationship between the Gini coefficient and respectively the interest rate, credit, and house prices, all variables calculated as an average for each country, and distinguishing the whole period (panel a) from the post-crisis period (panel b). Except for the interest rate, the variables are shown in their first differences. Fig. 1 shows a negative correlation between the interest rate and the Gini coefficient, supporting research findings indicating that an expansionary monetary policy has an uneven effect on the distribution of income. House prices and credit are also negatively associated with the Gini coefficient, as seen in Figs. 2 and 3 (the negative relationship being less pronounced for house prices). After the crisis, the sharp falls in interest rates and credit are visible, as is the weaker correlation between the Gini coefficient and house prices. This empirical evidence indicates that it makes sense to investigate if there is a qualitative change in the relationships between these variables following 2008Q4 and compare them to the total period.

3.3. Econometric methodology

The estimates use a Panel Vector Auto-Regression (panel VAR) methodology that has the advantage of treating all variables of interest as endogenous while using a panel data framework (Love and Zicchino, 2006) and that has been employed by the literature that studies the impact of monetary policy shocks (e.g., Dwyer et al. 2023; Prabheesh et al., 2024). Given the panel structure, it is possible to control for unobserved individual heterogeneity. The panel VAR can be written as:

$$X_{i,t} = A(L)X_{i,t} + v_i + \varepsilon_{i,t},\ i = 1,\ldots,N,\ t = 1,\ldots,\ T \quad (1)$$

where $X_{i,t}$ is a vector of up to five endogenous variables (the interest rate, household credit, nominal house prices, real GDP, and the

Table 1
Summary statistics.

Variable	#Obs	Mean	Std. Dev.	Min	Max
Gini coefficient	2972	31.26924	5.805087	21.98056	50.8
Short-run interest rate	2860	4.289542	8.969946	−2	183.2
Bond yields	2716	4.169254	2.469479	−0.7763333	25.4
Nominal house prices	2664	85.73311	29.19073	22.41578	175.0906
Household credit	2913	12.67838	1.503063	8.590425	16.61125
GDP	2996	13.40789	1.224766	10.30612	16.81638

Note: the variables cover 30 countries between 1995Q1 and 2019Q4; household credit and GDP are in logarithms.

Table 2
Correlation matrix.

	Gini coefficient	Short-run interest rate	Bond yields	Nominal house prices	Household credit	GDP
Gini coefficient	1					
Short-run interest rate	−0.045**	1				
Bond yields	−0.0312	0.6756***	1			
Nominal house prices	−0.0813***	0.028	−0.1854***	1		
Household credit	−0.0484***	0.1466***	0.181***	0.2826***	1	
GDP	−0.0377**	0.0573***	−0.0163	0.2868***	0.4049***	1

Note: *** and ** indicate significance at the 1 % and 5 % level respectively.

Table 3
Panel unit root tests.

Test	Interest rate	Yields	House prices*	Credit*	GDP*	Gini*
ADF-Fisher						
Chi-square	119.6983	95.1226	113.3543	267.1136	305.6533	129.0790
p-value	0.0000	0.0015	0.0000	0.0000	0.0000	0.0000
PP-Fisher						
Chi-square	192.4611	147.3042	579.9604	1214.5961	1273.9018	107.1180
p-value	0.0000	0.0015	0.0000	0.0000	0.0000	0.0003

Note: *indicates seasonal first differences.

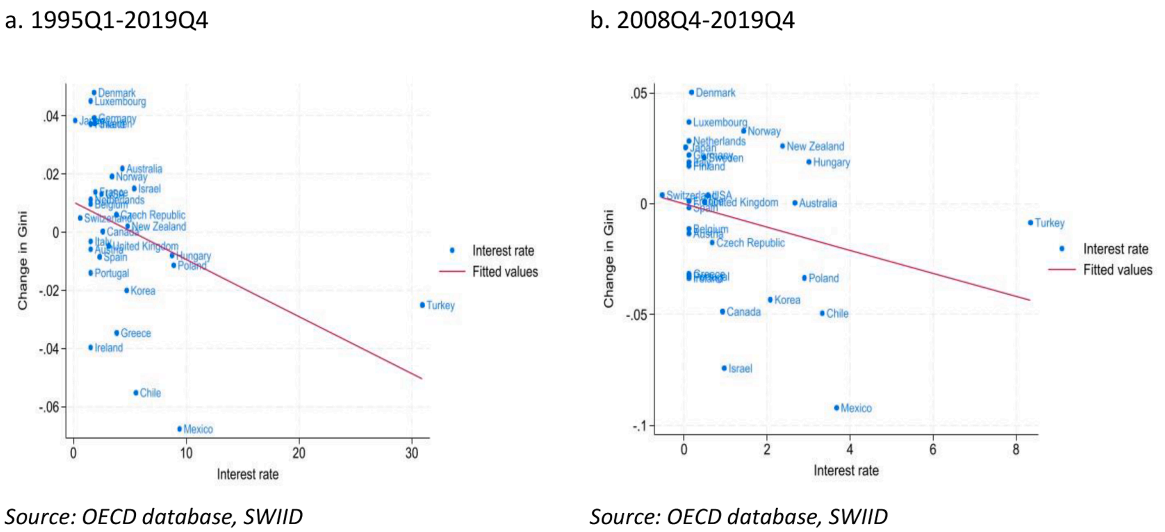

Fig. 1. Correlation between the interest rate and the change in the Gini coefficient of disposable income, averages by country.

Gini coefficient of disposable income), L is the lag operator, $A(.)$ is a polynomial matrix in the lag operator, υ_i are time-invariant country-specific effects, and $\varepsilon_{i,t}$ is a vector of independently and identically distributed error terms. Since this sample is relatively heterogeneous, panel VAR has the advantage of including fixed effects, allowing each country to have its specific level and time-invariant factors. However, since the model includes lags of the variables, specific factors lead to fixed effects being correlated with the regressors. By applying the Helmert procedure, a transformed panel VAR is estimated in which the forward mean of the variables in the VAR is removed (see Arellano and Bover, 1995). With this transformation, the lagged original variables are orthogonal to the transformed variables and can be used as instruments, and the model coefficients are estimated by system GMM. Thus, all models were estimated using GMM-style instruments following Holtz-Eakin et al. (1988).

As in Love and Zicchino (2006), the shocks identification scheme is based on the Cholesky decomposition of the variance-covariance matrix of residuals, with ordering for the complete model interest rate, household credit, house prices, real GDP, and Gini coefficient, from the least to the most endogenous. We follow Creel and El-Herradi (2022) when assuming the ordering for the interest rate, real GDP and inequality, and follow Goodhart and Hoffmann (2008) to order the transmissions channels. By applying the Cholesky decomposition, one can obtain the dynamic response of the model's dependent variables to shocks to each of the variables. The ordering indicates that the shocks originate in the monetary policy, that is, the interest rate. The implicit restrictions behind this ordering imply that household credit and house prices respond contemporaneously to innovations in the short-run interest rate, while

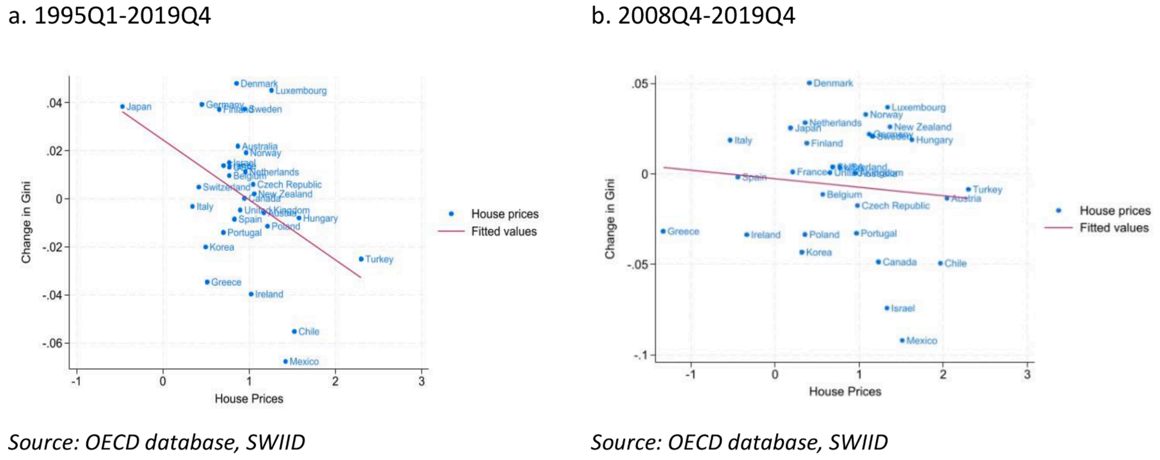

Fig. 2. Correlation between the change in house prices and the change in the Gini coefficient of disposable income, averages by country.

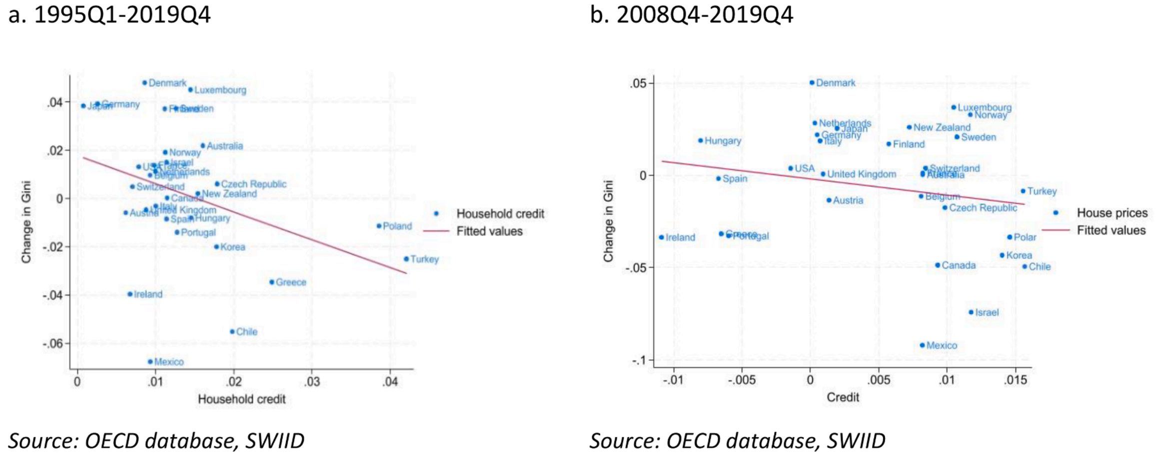

Fig. 3. Correlation between the change in household credit and the change in the Gini coefficient of disposable income, averages by country.

the inequality index does not affect the other variables contemporaneously. Since the joint effect of these mechanisms may differ from their isolated effect, we built additional models in which each channel is treated as unique and the ordering is maintained, and another model without transmission channels to appraise the direct effect of monetary policy on the Gini coefficient.

The model evidence is based on impulse response functions and the analysis of the variance decomposition. The impulse response functions are estimated with a 95 % interval obtained through Monte Carlo simulations with 200 replications. The variance decomposition offers the percentage of change in one dependent variable that is explained by shocks to other variables in the PVAR.

To choose the optimal lag order in PVAR and the moment condition, we applied the three model selection criteria for GMM models of Andrews and Lu (2001) and the overall coefficient of determination to all specifications. These criteria are similar to the Akaike information criteria, the Bayesian information criteria, and the Hannan-Quinn information criteria. For most models, they indicated that the lag length to be considered should be two. All models verified the stability condition of the panel VAR model which requires that the moduli of the eigenvalues of the dynamic matrix lie within the unit circle. The tests, not reported for the sake of space, are available upon request.

4. Empirical evidence and discussion

To test the assumption that monetary policy affects inequality, the analysis starts with the estimation of Eq. (1) for a model with three endogenous variables, relating the short-run interest rate, real GDP, and the Gini coefficient, thus excluding the transmission channels. Next, these channels are introduced into the model separately to finally estimate a model that considers their combined effect. The estimates further distinguish the full period from the moment that follows the 2008 financial crisis. Additionally, estimations for the time leading up to the crisis when monetary policy was not that loose were conducted. Although not a perfect replica, their results resemble those that were discovered for the entire period. In the interest of concision, it was decided not to include them.

Figs. 4–11 plot the simulations of impulse response functions (IRF) that represent the responses of each variable to a one-standard-deviation shock in each variable, whereby the solid line is the point estimate, and the dashed lines represent the 95 % confidence intervals calculated using 200 Monte Carlo draws. Tables 3–11 report the 10 quarters ahead forecast-error variance decompositions (FEVD) that allow inspecting the fraction of the fluctuations in the endogenous variables that is due to a shock in these same variables.

4.1. *Whole period analysis*

Fig. 4 represents the IRF of the tri-variate model without transmission channels. Results indicate a positive interest rate shock increasing the Gini coefficient (although without statistical significance) and a positive shock to the Gini coefficient having no impact on the interest rate. The response of inequality to an increase in GDP is hump-shaped, slightly decreasing in the short run to increase after five quarters.

To assess the role played by house prices and credit as transmission channels of monetary policy, more complete models were estimated. Fig. 5 displays the IRF of a model comprising the former variables and house prices. A tightening of monetary policy has a positive and persistent impact on inequality, a result which is consistent with the literature (see, e.g. Coibbon et al., 2017; Mumtaz and Theophiopoulou, 2017; and Furceri et al., 2018). This effect is small, the Gini coefficient increasing by 0.5 % two-and-a-half years after a positive unexpected shock to the interest rate. An increase in inequality causes the interest rate to rise, indicating possible reverse causality, and the hump-shaped effect on inequality of an increase in GDP is confirmed. As for the transmission channel, a positive house price shock reduces the Gini coefficient by 0.4 % after 18 months, which suggests that this type of wealth effect on households' main asset mitigates income disparities among OECD countries. This suggests that there is a fair distribution of homeownership across households.

Replacing house prices for credit as the transmission channel (Fig. 6) results in a non-statistically significant model, signaling the irrelevance of credit as a transmission mechanism during this period and challenging the literature that defines credit as being used by households as a mean to offset inequality (e.g., Barba and Pivetti, 2009).

Finally, we re-estimate the model comprising the two transmission channels to capture their potential mutual reinforcement and joint effect on inequality. The IRFs (Fig. 7) confirm our previous results on the impact of a contractionary monetary policy on the Gini coefficient and are quantitatively similar: after 10 quarters of a positive shock to the interest rate the Gini coefficient increases by 0.5 %. As mentioned above, these outcomes are in line with Coibion et al. (2017) and Guerello (2018), who reported a tightening of monetary policy moderately exacerbating inequality. The Gini coefficient falls after a positive shock to house prices, but the impact starts to level off after six quarters, while the credit shock is not statistically significant. Again, the idea that credit is used to lessen income inequality (e.g., Perugini et al., 2016, Bazillier and Hericourt, 2017) is not supported by the estimations that cover the whole period.

Figs. A1 to A4 in the Appendix show robustness checks on these models, consisting of representing the monetary policy stance by the long-term (10-year) government bond yields that were maintained in levels. The main results from the baseline models prevail: a

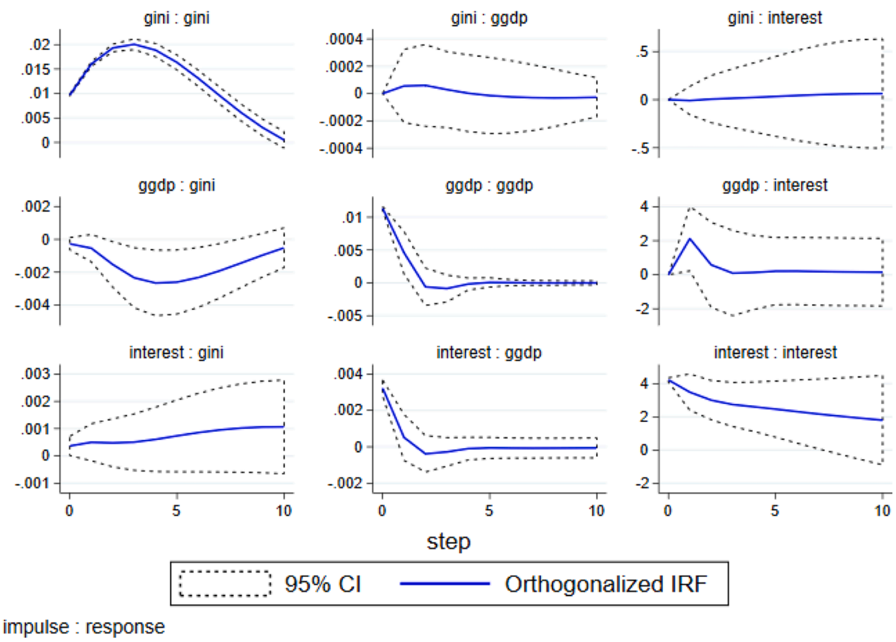

Fig. 4. Impulse-response functions, simpler model, 1995Q1-2019Q4.
Notes: impulse-response are represented by solid lines. The dashed lines in each graph represent the standard-error 95 % confidence bands generated through Monte Carlo simulations with 200 repetitions, 10 quarters horizon.

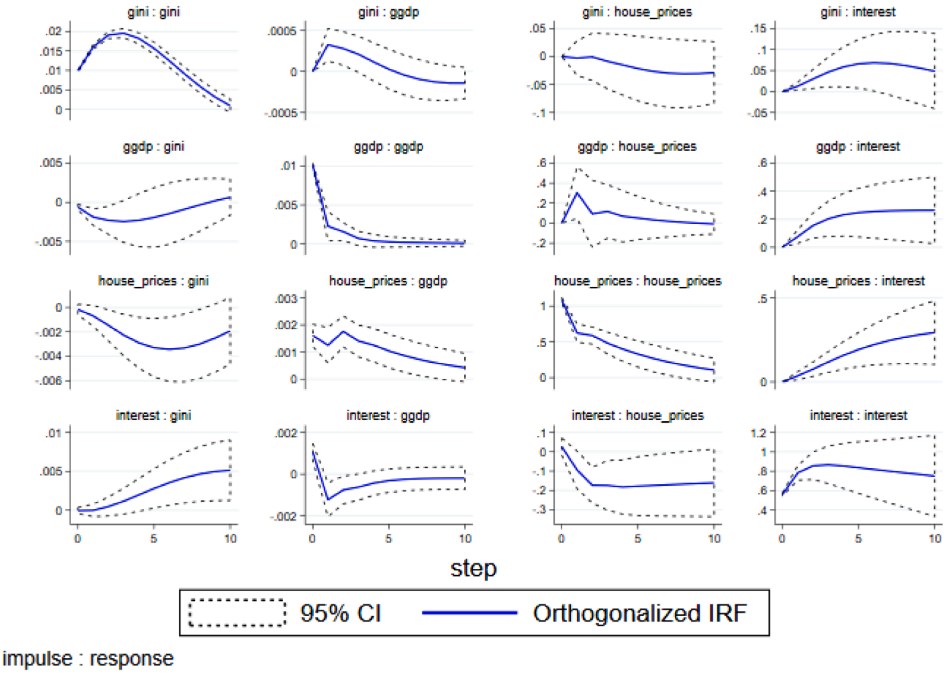

Fig. 5. Impulse-response functions, house prices as transmission channel, 1995Q1-2019Q4.
Notes: impulse-responses are represented by solid lines. The dashed lines in each graph represent the standard-error 95 % confidence bands generated through Monte Carlo simulations with 200 repetitions, 10 quarters horizon.

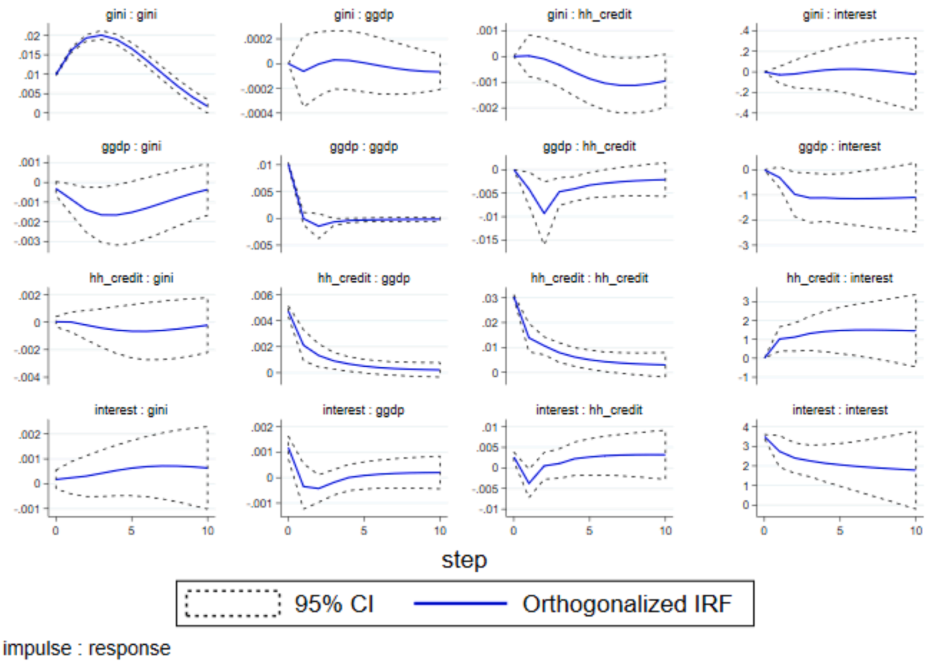

Fig. 6. Impulse-response functions, household credit as transmission channel, 1995Q1-2019Q4.
Notes: impulse-responses are represented by solid lines. The dashed lines in each graph represent the standard-error 95 % confidence bands generated through Monte Carlo simulations with 200 repetitions, 10 quarters horizon.

contractionary monetary policy shock slightly increases the Gini coefficient, whereas both the negative impact of house prices and the statistically insignificant effect of credit on inequality are reaffirmed. All in all, if the set of estimations reveal that a tight monetary policy increases inequality when monetary policy is represented by yields, they also point to the possibility that increased inequality

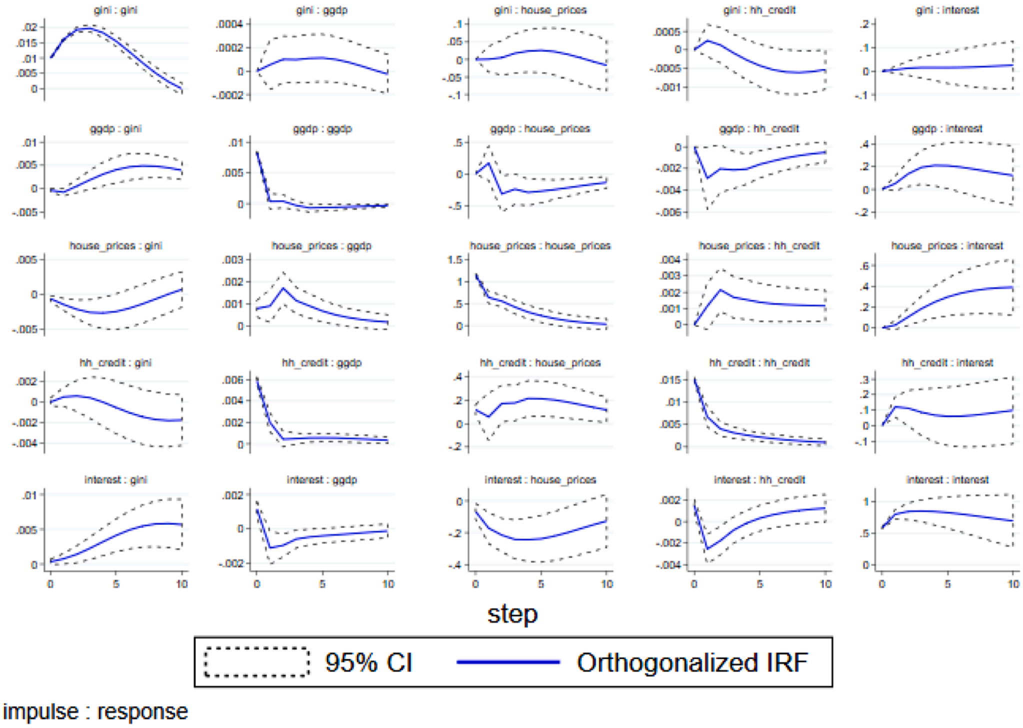

Fig. 7. Impulse-response functions, complete model, 1995Q1-2019Q4.
Notes: impulse-responses are represented by solid lines. The dashed lines in each graph represent the standard-error 95 % confidence bands generated through Monte Carlo simulations with 200 repetitions, 10 quarters horizon.

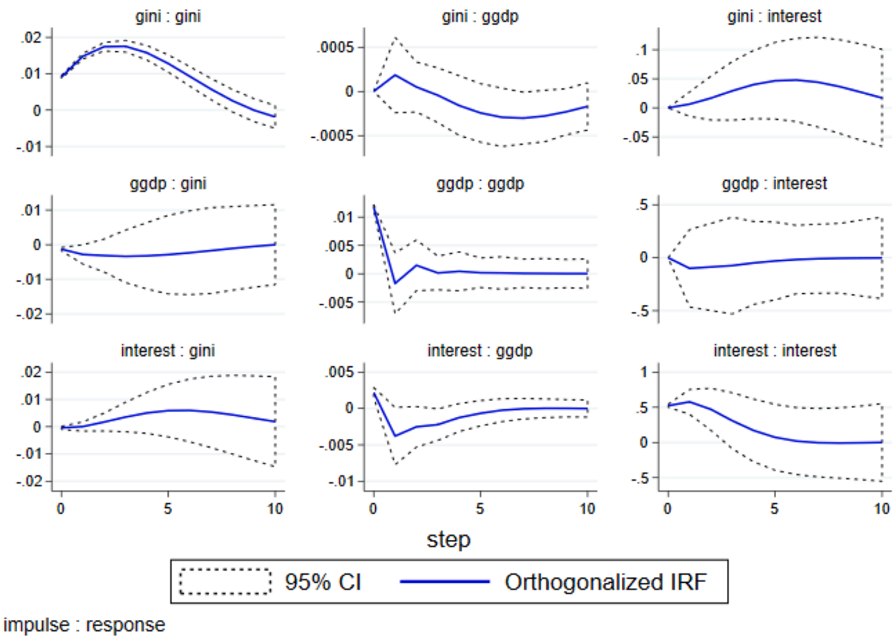

Fig. 8. Impulse-response functions, simpler model, 2008Q4-2019Q4.
Notes: impulse-responses are represented by solid lines. The dashed lines in each graph represent the standard-error 95 % confidence bands generated through Monte Carlo simulations with 200 repetitions, 10 quarters horizon.

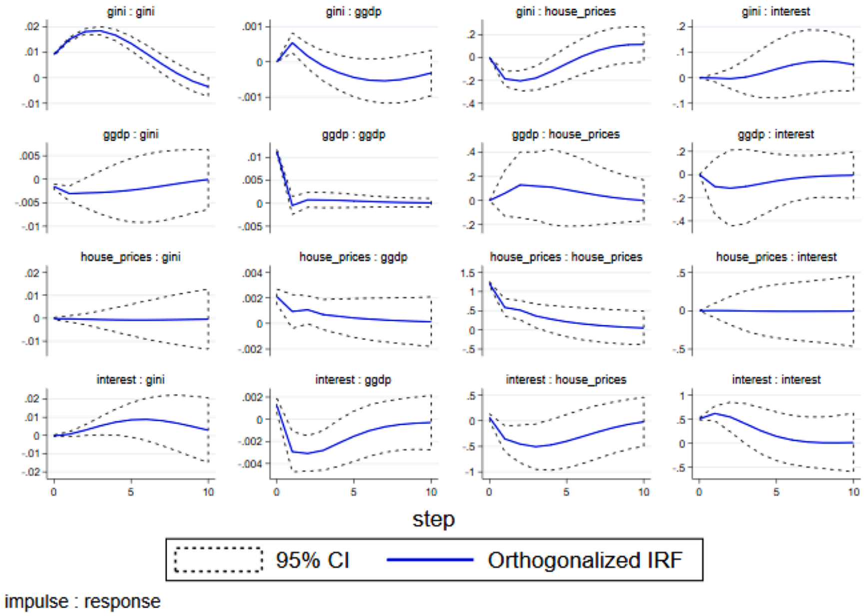

Fig. 9. Impulse-response functions, house prices as transmission channel, 2008Q4-2019Q4.
Notes: impulse-responses are represented by solid lines. The dashed lines in each graph represent the standard-error 95 % confidence bands generated through Monte Carlo simulations with 200 repetitions, 10 quarters horizon.

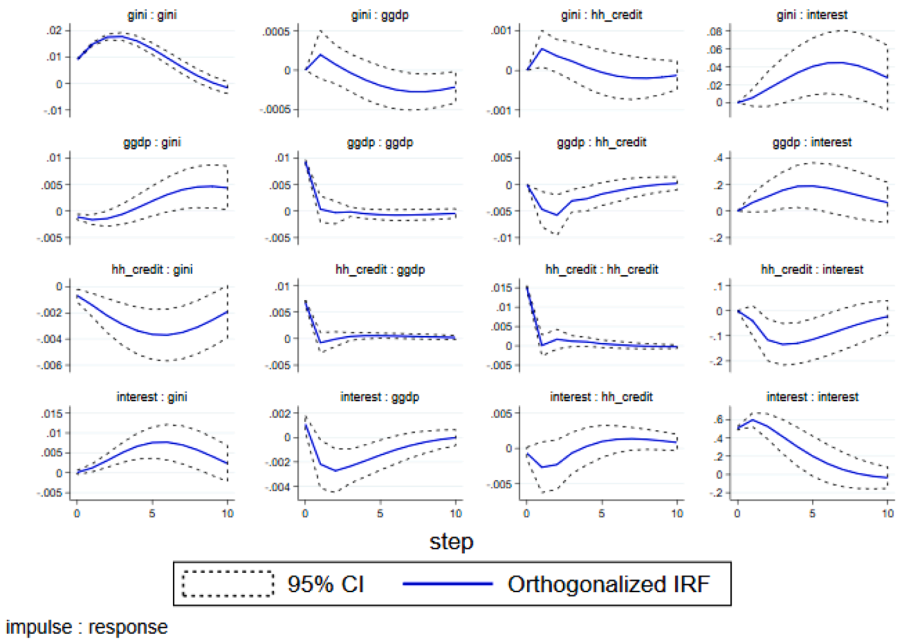

Fig. 10. Impulse-response functions, household credit as transmission channel, 2008Q4-2019Q4.
Notes: impulse-responses are represented by solid lines. The dashed lines in each graph represent the standard-error 95 % confidence bands generated through Monte Carlo simulations with 200 repetitions, 10 quarters horizon.

will trigger a contractionary monetary policy response. This could indicate that the few who concentrate economic power, as occurs in economies with unbalanced income distribution, show a preference for high interest rates and could be related to the richer exerting pressure on monetary authorities to control inflation as it decreases the value of savings in real terms. Thus, it would be an anticipation of the savings redistribution channels.

The models' forecast-error variance decompositions (FEVD) are summarized in Tables 4–7. The cells contain the portion of the

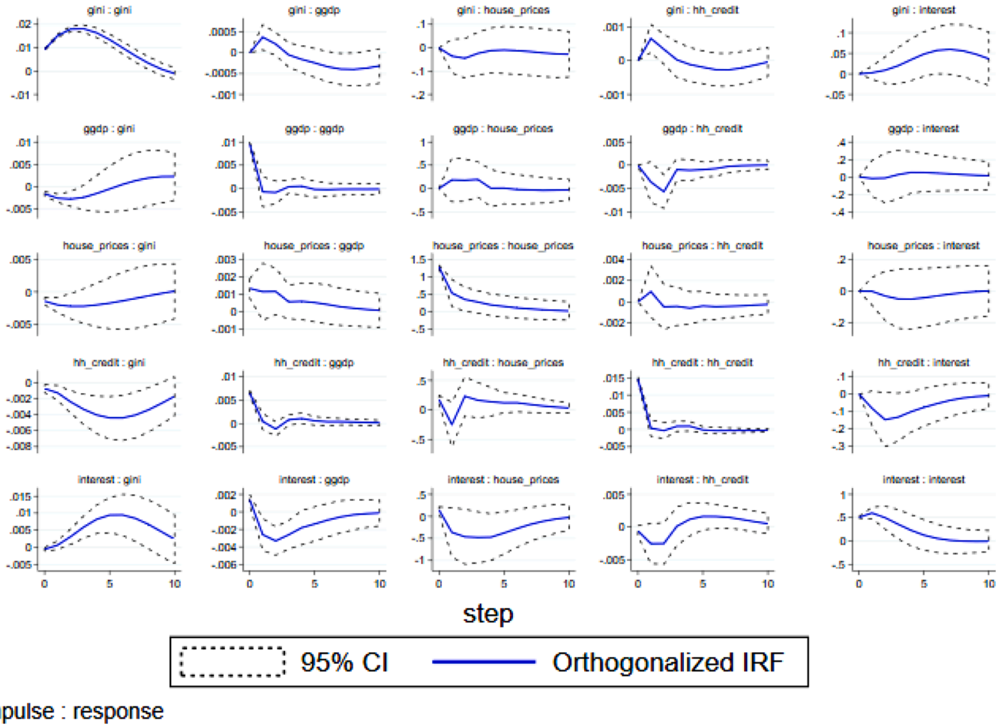

Fig. 11. Impulse-response functions, complete model, 2008Q4-2019Q4.
Notes: impulse-responses are represented by solid lines. The dashed lines in each graph represent the standard-error 95 % confidence bands generated through Monte Carlo simulations with 200 repetitions, 10 quarters horizon.

Table 4
Forecast-error variance decomposition, simpler model.

	Interest	GGDP	Gini
Interest	.9385	.0614	.0002
GGDP	.0676	.9323	.0001
Gini	.0027	.0162	.9812

Share of the variation in the row variable that is explained by the column variable for 10 quarters ahead.

Table 5
Forecast-error variance decomposition, house prices as transmission channel.

	Interest	House prices	GGDP	Gini
Interest	.8851	.0476	.0635	.0038
House prices	.0843	.8722	.0421	.0014
GGDP	.0314	.1075	.8589	.0022
Gini	.0419	.0304	.0127	.9150

Share of the variation in the row variable that is explained by the column variable for 10 quarters ahead.

Table 6
Forecast-error variance decomposition, household credit as transmission channel.

	Interest	Household credit	GGDP	Gini
Interest	.6649	.2116	.1234	.00004
Household credit	.0439	.8452	.1073	.0036
GGDP	.0136	.2216	.7647	.0001
Gini	.0014	.0010	.0067	.9909

Share of the variation in the row variable that is explained by the column variable for 10 quarters ahead.

Table 7
Forecast-error variance decomposition, complete model.

	Interest	Household credit	House prices	GGDP	Gini
Interest	.8529	.0091	.1009	.0367	.0003
Household credit	.0421	.8325	.0496	.0715	.0043
House prices	.1108	.0816	.6683	.1387	.0007
GGDP	.0372	.3261	.0619	.5744	.0005
Gini	.0690	.0046	.0144	.0527	.8594

Share of the variation in the row variable that is explained by the column variable for 10 quarters ahead.

Table 8
Forecast-error variance decomposition, simpler model.

	Interest	GGDP	Gini
Interest	.9617	.0269	.0114
GGDP	.1844	.8132	.0024
Gini	.1008	.0355	.8637

Share of the variation in the row variable that is explained by the column variable for 10 quarters ahead.

Table 9
Forecast-error variance decomposition, house prices as transmission channel.

	Interest	House prices	GGDP	Gini
Interest	.9506	.0003	.0367	.0125
House prices	.3067	.6358	.0167	.0408
GGDP	.2081	.0440	.7386	.0093
Gini	.1920	.0018	.0239	.7833

Share of the variation in the row variable that is explained by the column variable for 10 quarters ahead.

Table 10
Forecast-error variance decomposition, credit as transmission channel.

	Interest	Household credit	GGDP	Gini
Interest	.8130	.0549	.1251	.0070
Household credit	.0628	.7029	.2324	.0019
GGDP	.1604	.2904	.5469	.0023
Gini	.1518	.0422	.0403	.7658

Share of the variation in the row variable that is explained by the column variable for 10 quarters ahead.

Table 11
Forecast-error variance decomposition, complete model.

	Interest	Household credit	House prices	GGDP	Gini
Interest	.9118	.0578	.0075	.0090	.0139
Household credit	.0825	.7401	.0083	.1664	.0028
House prices	.2945	.0646	.6102	.0293	.0015
GGDP	.1858	.2606	.0321	.5169	.0046
Gini	.1965	.0488	.0120	.0162	.7265

Share of the variation in the row variable that is explained by the column variable for 10 quarters ahead.

forecast variance of variables displayed in rows that can be attributed to innovations in variables displayed in columns for the forecast horizon of 10 periods (quarters). In general, the FEVDs validate the findings from the IRFs. For the simpler model (Table 4) an unexpected variation in the interest rate explains a negligible portion of the dynamics of the Gini coefficient 10-quarters ahead (<0.3 %), supporting a minor direct effect of monetary policy on inequality, while GDP explains about 1.6 % of the volatility in the Gini coefficient. However, the interest rate is seen to account for a greater share of the variation in inequality in the model with house prices as the transmission mechanism (4 %) and in the complete model (6.9 %), as reported in Tables 5 and 7, respectively.

The results on the transmission channels are corroborated by the FEVDs: a shock to house prices has a greater impact on the change in inequality than an unexpected change in credit (3 % in Table 5 against 0.1 % in Table 6). It is worth noting that the interest rate accounts for 8.4 % to 11.1 % of the dynamics of house prices while it explains just 4.2 % to 4.4 % of the volatility in credit, converting house prices into a more credible transmission channel of monetary policy to inequality during this period.

4.2. Post-financial crisis analysis

Crises reduce economic growth and generate unemployment, thereby compromising workers' bargaining power and acting to reduce wage levels, especially harming the most disadvantaged (Nguyen, 2021 and Bodea et al., 2021). After an economic crisis, the gap between rich and poor is widened. Asset values including house prices are affected, disturbing the balance between the rich and the poor. During the 2008 financial crisis, given the choice of austerity policies (namely expenditure cuts and tax rises to control climbing public debt levels), these effects were accentuated. To explore how this crisis influenced the relationship between monetary policy and inequality, the above models are estimated for the period 2008Q4–2019Q4.

Figs. 8–11 show that a positive shock to the interest rate has an expansionary effect on the Gini coefficient that is more accentuated following the crisis. This may reveal a greater overall dependence of the economy on Central Bank intervention during this period and reveals how monetary policy became a key tool in the response to the financial crisis, accommodating aggregate demand to avoid negative effects on economic activity. In turn, the increase in the Gini coefficient is also causing a stronger effect on the interest rate, confirming the previously detected possibility of reverse causality.

As for the impact of house prices on inequality, in the post-crisis period a rise in this variable has no impact at all on inequality, as seen in Figs. 9 and 11. The IRFs are not statistically significant for either the model with house prices or the complete model. On the other hand, the response to a positive shock on credit becomes negative and persistent following 2008Q4 (Figs. 10 and 11), contrasting with the non-significant results that were found for the entire period. Credit assumes the role that has been claimed in the literature, serving as a way to influence inequality in a recessionary moment. During this period characterized by higher financial instability and monetary dominance, there is a reversal in the role played by each of these transmission channels on inequality, with the influence of house prices fading out and credit gaining prominence.

In the appendix, Figs. A5 to A9 display the IRFs of the models that represent the post-crisis period with the interest rate replaced by government bonds. As for the whole period, in general the estimations verify the earlier results.

The FEVDs that complement this section's estimations are shown in Tables 8–11. A shock to the interest rate explains much of the variation of the Gini coefficient 10-periods ahead, namely from 10.1 % in the simpler model to 19.7 % in the complete one, contrasting the tenuous explanation obtained in the baseline model. Credit accounts for 4.2 % to 4.9 % of the dynamics of the Gini coefficient, whereas house prices assume a residual role. The impact that monetary policy has on these variables is amplified following the financial crisis, the interest rate explaining about 30 % of the variation in house prices against 6 % to 8 % of the variation in credit, in either case implying an increase of its incidence over these transmission channels. The change in the effectiveness of the short-run interest rate in the context of financial instability points to the existence of non-linearities and may affect the behavior of the two transmission channels that are identified in these models.

5. Conclusions

In recent decades monetary policy has become prominent as a vehicle for macroeconomic stabilization, triggering the interest of academics and policy makers in understanding its redistributive effects. This paper provides empirical evidence for the impact of monetary policy on inequality in 30 OECD countries between 1995Q1 and 2019Q4, emphasizing the role that was played by house prices and household credit as transmission channels in this relationship. To capture the disruptions caused by the financial crisis, the study further distinguishes the period between 2008Q4 and 2019Q4. Panel VAR models with quarterly data are estimated to analyze the IRFs and FEVDs for different specifications.

The analysis confirms that a contractionary monetary policy has moderate negative redistributive effects on income, raising the Gini coefficient of disposable income, in line with the literature (e.g., Coibion, 2017; Mumtaz and Theophiopoulou, 2017; Furceri et al., 2018; Guerello, 2018). These findings are robust to different model specifications and are confirmed for the entire period and post-crisis. The impact that transmission channels have on inequality depends on the period under analysis: for the complete time series, house prices reduce the Gini index of disposable income (albeit modestly) while private credit is not relevant; after the crisis, house prices lose statistical significance in their relationship with inequality and private credit has a negative impact on the Gini index. This suggests that the importance of each transmission channel of monetary policy may depend on whether there is a recession and financial instability. It is also possible to conclude that the effect of monetary policy on house prices and household credit is greater during the post-crisis period, which could also be influencing our results.

The present research suggests that central bank policies have redistributive effects from a policy standpoint. Central banks have an impact on income inequality through their use of instruments to increase aggregate demand, prevent downturns, or stabilize inflationary pressures. In particular, during times of economic stability, rising housing costs brought about by an expansionary monetary policy can lessen income inequality by increasing the wealth of middle-class homeowners. Policymakers should monitor and control housing prices to guarantee that home values can serve as a tool to reduce inequality. Also, to prevent financial hardship that can exacerbate inequality during recessions, household credit should be similarly monitored and subject to macroprudential rules. In summary, an increase in the short-term interest rate results in a rise in disposable income as measured by the Gini coefficient. Therefore, when determining the appropriate monetary policy stance, this impact cannot be disregarded if controlling inequality is a concern.

CRediT authorship contribution statement

Sofia Vale: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The author declares no potential conflict of interest.

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Supplementary materials

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