ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Master Thesis International Economics

The effect of monetary policy shocks on wealth inequality in the Eurozone.

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Abstract

This study examines the impact of expansionary monetary policy shocks on wealth inequality in the Eurozone between 2009 and 2023, focusing on various asset types and overall net wealth. Using local projections, the analysis estimates the effects of both QE and policy rate shocks on the ratio of the top 10% to the bottom 50% wealth group. The findings indicate significant temporary increases in listed shares- and decreases in debt securities wealth inequality due to QE shocks, alongside a temporary decrease in deposits wealth inequality due to policy rate shocks. These effects support the portfolio rebalancing and savings redistribution channels. No proof is found for the housing asset price inflation channel. Only the QE shock leads to a small temporary increase in the net wealth Gini coefficient; no effect is found for the net wealth ratio.

Temporary increases in wealth inequality following monetary policy shocks may not require immediate adjustments by the European Central Bank (ECB) unless they result in negative externalities. Future research could study different asset classes using Gini coefficients instead of tail ratios to get more comprehensive results on wealth inequality effects.

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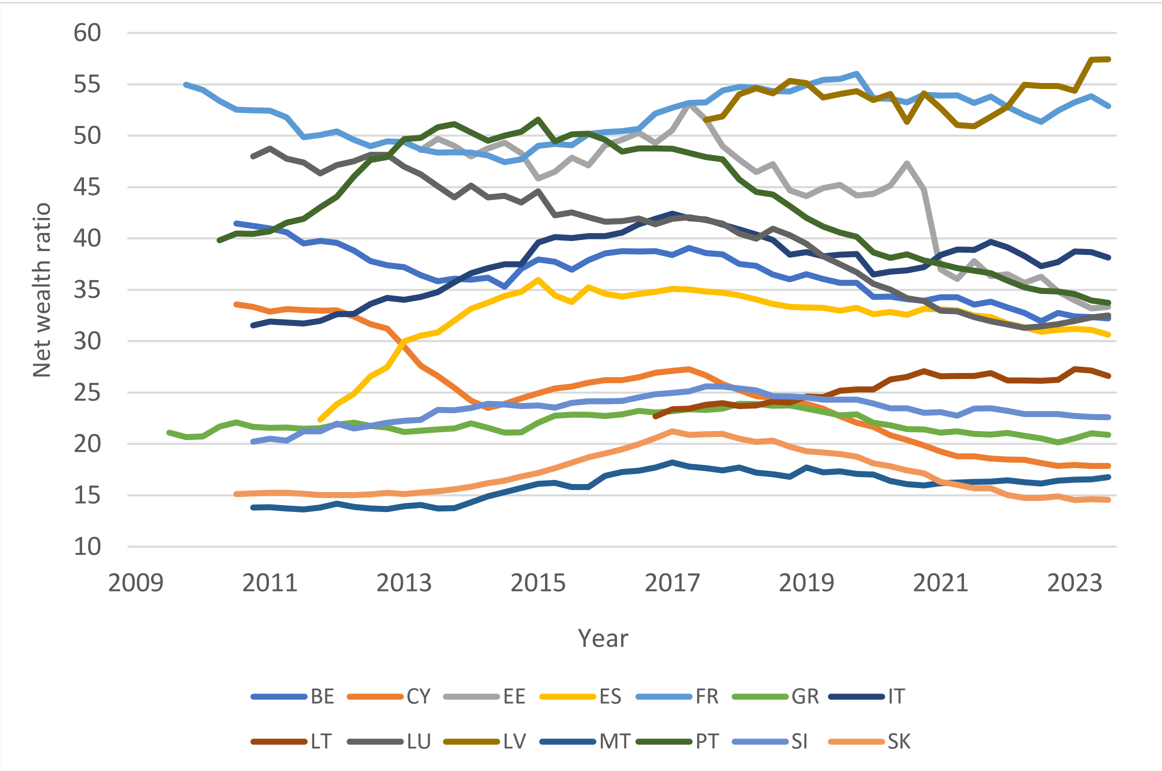
1. Introduction

The two most important causes of inequality during economic cycles are high inflation and unemployment, which disproportionately affect the most vulnerable. Therefore, looking at the ECB's mandate, namely keeping inflation steady and thereby limiting economic and financial instability, monetary policy should reduce economic inequality (Bank for International Settlements, 2021). While this is true for labour income inequality, its impact on wealth inequality is still debated (European Central Bank, 2021).

Wealth inequality has significant implications. It leads to less economic freedom (Islam, 2018), reduces social mobility (Fisher et al., 2016), and is negatively associated with economic growth (Islam and McGillivray, 2020). Contrary to assumptions that wealth inequality is limited in Eurozone countries due to their welfare and tax systems, Figure 1 illustrates clear disparities in average net household wealth across most Eurozone countries. As can be seen, for most countries households in the top 10% of the wealth distribution own on average 15 to 55 times more net wealth than those in the bottom 50%. These ratios have remained persistently high over the past 15 years.

Figure 1: Net wealth ratios in the Eurozone



Net average household wealth in euros of top 10% / bottom 50% wealth groups. Country abbreviations, left to right: Belgium, Cyprus, Estonia, Spain, France, Greece, Italy, Lithuania, Luxembourg, Latvia, Malta, Portugal, Slovenia, Slovakia. Countries not included due to higher order of magnitude: Austria, Germany, Finland, Ireland, The Netherlands. Croatia was not included because in only uses the euro since 2023.

In recent years, policymakers' interest in the effect of monetary policy on inequality has risen. This can be seen in the steady rise of the mention of "inequality" in central bankers' speeches (Bank for International Settlements & Carstens, 2021). Citing Isabel Schnabel, member of the Executive Board of the ECB: "there is a risk that monetary policy may disproportionally benefit those in the higher ranks of the wealth distribution. Central banks therefore have a duty to integrate such considerations (…) that ensures their mandate is fulfilled while minimizing the potential distributional effects of monetary policy." (ECB, 2021). Citing her again in another, more recent speech: "Surging asset prices do not only pose risks to financial stability but may also exacerbate wealth inequality. While monetary policy always has distributional effects, portfolio rebalancing as part of QE may amplify these effects." (ECB, 2024).

During and after economically challenging times like the Great Financial Crisis, the Eurozone debt crisis and the COVID crisis, conventional monetary policy tools alone were not enough to avoid or mitigate recessions and low inflation. This led to the adoption of unconventional measures like quantitative easing (QE). Looking at the literature on the effects of expansionary conventional and unconventional monetary policy on wealth inequality, you find mixed findings but consistent transmission channels. Colciago et al. (2019) review the effects of both expansionary conventional and unconventional monetary policies, and name three main channels. They find that the portfolio composition channel typically increases wealth for asset owners via higher asset prices or long-term restructuring of their portfolio. The savings redistribution channel benefits indebted households through lower interest payments, and the unexpected inflation channel favours borrowers by reducing the real value of debt.

Adding to this, Domanski et al. (2016) find that unconventional monetary policy (UMP) may increase wealth inequality through portfolio rebalancing and housing price inflation. Comparative studies like Hohberger et al. (2019) show short-term inequality increases through asset price increases, followed by medium-term reductions in inequality through lower income inequality via lower unemployment. While UMP has significant immediate effects on wealth inequality through asset price increases, the overall impact depends on the distribution of housing and equity ownership. The varying effects underscore the complexity of the effect of expansionary monetary policy shocks on wealth inequality.

This study aims to address gaps in the literature regarding the effect of ECB expansionary monetary policy shocks on wealth inequality across households in the Eurozone. Using data from the Distributional Wealth Accounts (DWA) database by the ECB (*DWA | ECB Data Portal*, 2024), I examine how different types of monetary policy shocks influence wealth distribution among wealth groups and asset types in 19 Eurozone countries (all but Croatia). Using local projections, I estimate the effects of monetary policy shocks on wealth ratios across six different asset types and two net wealth measures. Wealth inequality is measured using ratios of the average household wealth of the top 10% and the bottom 50% of the wealth distribution and a Gini coefficient. I include four different monetary policy shock measures: one QE shock and three different policy rate shocks. I use robustness checks to ensure the validity of the results, including controlling for country outliers and the unique economic conditions during the COVID crisis.

My research adds to the existent literature in several ways:

(1) I study the effect of QE shocks on household wealth data from the DWA database, the use of which I have not seen yet.
(2) Unlike previous studies that mainly cover data up to 2018, my study extends to 2023. This way I can cover shocks during the COVID-19 crisis and compare data with and without the COVID crisis.
(3) While most studies focus on equity and housing assets only, I also include the effects on wealth inequality within deposits and debt securities.

Summarizing, my research aims to answer the following question:

"*How did ECB expansionary monetary policy shocks affect wealth inequality across households in the Eurozone*?";

by answering the sub-questions:

1. How do expansionary monetary policy shocks affect wealth inequality via different asset types?

2. How do expansionary monetary policy shocks affect net wealth inequality?

3. How do expansionary policy rate shocks and QE shocks differently affect net wealth and its components?

2. Literature review

2.1 ECB monetary policy

Conventional Monetary Policy

Up to the Great Financial Crisis (GFC) in 2008, the ECB primarily implemented Conventional Monetary Policy (CMP) through its main refinancing operations. By adjusting liquidity conditions, the European Central Bank (ECB) aimed to influence short-term interest rates and maintain price stability (Kakes et al., 2022). The ECB managed market interest rates within a range defined by the deposit facility rate (paid on overnight deposits at the ECB) and the marginal lending facility rate (charged on overnight loans to banks).

Asset purchase programs before QE

Following the GFC (2007-2008) and during the European sovereign debt crisis (2010-2012), the ECB implemented its first asset purchase programs to enhance monetary transmission. These included the purchase of covered bonds to stabilize bank funding, as well as the Securities Markets Programme (SMP), which involved purchasing government bonds from member countries severely impacted by the Eurozone debt crisis (Kakes et al.).

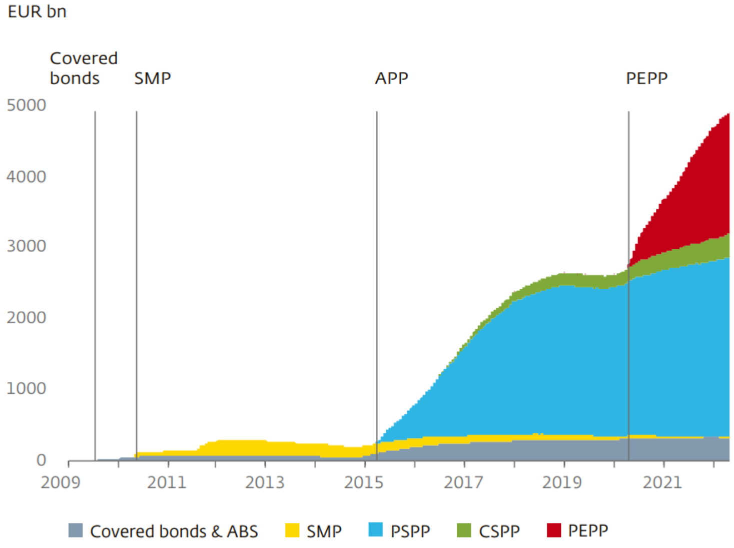
Quantitative Easing

From 2015 onward, amid low inflation and already low interest rates, the ECB implemented multiple large-scale asset purchase programs, which are known as Quantitative Easing (QE) and fall under Unconventional Monetary Policy (UMP). These were intended to directly influence the monetary policy stance rather than just transmission channels. As shown in Figure 1, the Asset Purchase Programme (APP) largely consisted of the Public Sector Purchase Programme (PSPP), which mainly consisted of government bonds. Following the severe economic conditions from the COVID crisis in 2020, the ECB launched the Pandemic Emergency Purchase Programme (PEPP), which aimed to counter the low inflation due to the crisis and secure good financing conditions (Kakes et al.).

Recent developments

Since 2022 up to September 2023, the ECB has progressively increased the policy rate to fight high inflation levels. The first policy rate decrease since 2019 was in June 2024, indicating success of (expected) lower levels of inflation (European Central Bank, 2024).

Figure 2: ECB asset purchase programs in cumulative net purchases



Source: De Nederlandsche Bank, 2022

2.2 Transmission channels to wealth inequality

In their study, Colciago et al. (2019) provide an overview of existent literature on the effect of conventional as well as unconventional monetary policy on wealth inequality, together with the transmission channels through which these effects take place. They summarize them into three main redistribution channels, which are studied for both CMP and UMP: (1) the portfolio composition channel; (2) the savings redistribution channel; (3) the unexpected inflation channel.

In the portfolio composition channel, Colciago et al. include the effect on financial assets as well as on housing assets. Due to expansionary monetary policy decreasing interest rates, certain asset prices increase, which increases wealth for those whose wealth largely consists of these assets. For financial assets, this is mostly people on the higher end of the wealth distribution, thus increasing wealth inequality. For housing wealth, home ownership varies greatly between countries, therefore the effect on wealth inequality depends on the distribution of housing wealth between different wealth groups.

Via the savings redistribution channel, a lower policy rate leads to lower interest rates on loans, decreasing interest payments for indebted households and thus increasing their net wealth. Vice versa, the higher a household's savings, the lower returns on savings and therefore the lower their wealth. Both effects of this channel generally benefit the less wealthy, more indebted households and disadvantage the richer households that have more savings.

The unexpected inflation channel has similar effects as the savings redistribution channel, but this reduces the real value of debt. This benefits borrowers, but disadvantages lenders of these loans

(Evgenidis and Fasianos, 2021).

Considering CMP, Domanski et al. (2016) add that lower short-term interest rates can also lead to higher household liabilities due to lower cost of lending and thus a higher demand for loans. They may also cause higher savings to offset the lower rate of return on savings.

Domanski et al. give an overview of literature on the effect on wealth inequality of UMP specifically. They summarize the transmission into four channels: (1) the portfolio rebalancing channel; (2) the housing asset price inflation channel, and as mentioned before: (3) the savings redistribution channel and (4) the unexpected inflation channel.

The portfolio rebalancing channel is similar to the portfolio composition channel, but refers to short-term changes in portfolios after a shock. It is one of the most important transmission channels of UMP. Generally, when the ECB purchases large amounts of assets, often government bonds, this reduces their supply and thus increases their prices and decreases their yields. This causes investors to switch to higher yield assets like shares. Similarly for CMP, a decrease in interest rates may lead people to switch from low-yielding assets like deposits to higher-yielding assets.

As for the housing asset price inflation channel, Adam and Tzamourani (2016) describe how expansionary UMP increases housing prices. This therefore benefits housing owners, as mentioned before. However, Evgenidis and Fasianos (2021) add to this that the housing asset price channel may also work in another, more redistributive way. In purchasing programs in which mortgage-backed securities (MBS) are purchased, their increased price lowers the yield, leading to lower mortgage interest rates. This leads to a higher increase of net wealth of households with a high mortgage, which are often households that had lower wealth in the first place.

2.3 Evidence on redistribution

Comparing CMP and UMP

Hohberger et al. (2019) compare the effect of expansionary CMP and QE on wealth and income inequality with a two household model of those who have liquidity constraints and those who don't. Their results show that both expansionary CMP and QE increase wealth inequality in the short term, but mitigate wealth inequality in the medium term. This decrease in the medium term happens because expansionary monetary policy increases employment rates, leading to less income inequality, which reduces wealth inequality in the longer term.

Domanski et al. (2016) examine the effect of both expansionary CMP and UMP on wealth inequality in France, Germany, Italy, Spain, the U.K., and the U.S. since the GFC. They state that expansionary CMP has small distributional effects that fade out over the business cycle, while UMP had a larger effect on wealth inequality via the portfolio rebalancing and the housing price channel. For the former, UMP had strong and immediate effects on equity prices and thus on portfolio rebalancing as described before. Increasing equity prices led to the fastest growth of net wealth of the richest since 2010. For the latter, the contraction of housing markets during the GFC led to higher wealth inequality, while the recovery afterward reduced inequality. The net effect of these two channels depends on the distribution of ownership of equity and housing. They also mention the savings redistribution channel, but conclude that even though borrowing costs were lower, higher household leverage has decreased the net wealth of poorer households and thus increased wealth inequality.

O'Farrell et al. (2019) investigate the effect of expansionary monetary policy on the U.K., the U.S., Canada and five Eurozone countries. They conclude that increased housing asset prices reduce wealth inequality and vice versa for equity and bond prices. However, the net effect on total wealth inequality is ambiguous. Their findings show that MP affects wealth most in countries that have large shares of MP-responsive assets in their total wealth, like equity, bonds and housing.

Unconventional Monetary Policy

Albert et al. (2019) study the relation between UMP and wealth inequality for the U.S. and the Eurozone. While they do find increased wealth inequality for the U.S. via the portfolio rebalancing channel, they don't find an effect for the Eurozone.

Casiraghi et al. (2018) do find redistribution effects, but in contrary directions. They examine the effect of UMP on income and wealth inequality in Italy and find that the effect is U-shaped for wealth inequality, indicating wealth increases for the poorest and the richest. People at the lower part of the wealth distribution benefit from lower borrowing costs because they have more leverage, while those at the higher part benefit from increased value of their financial assets. In short, they find that UMP affects wealth inequality through the portfolio rebalancing and savings redistribution channel.

Adam and Tzamourani (2016) also study the effect of UMP via asset price inflation in the Euro Area and find corresponding results for the portfolio rebalancing channel. Their research shows that an increase in equity prices leads to a higher net wealth Gini coefficient, because the top 5% of the income distribution experience substantial wealth gains, while the median household does not benefit at all. They don't find any effects of bond price increases on wealth inequality. Adding to this, they study housing price increases. These results show a hump shaped pattern in which the median household benefits, but the top and the bottom of the wealth distribution do not. Thus, this effect is contrary to the U-shape effect Casiraghi et al. find for the savings redistribution channel. However, it very much depends on how housing wealth is distributed between wealth groups, which varies greatly within the Eurozone.

Results of Evgenidis and Fasianos (2021) show an increasing effect of expansionary unconventional monetary policy via both the portfolio rebalancing and housing price inflation channels, which they study for Great Britain between 2006 and 2016. They use impulse responses and use the Gini coefficient as wealth inequality measure, and a reduction in the shadow rate as the monetary policy shock. The shadow rate is an estimated measure of what the central bank's policy interest rate would be if it could go below zero, since the rate was around the Zero Lower Bound at the time. Their results show that the rise in wealth inequality occurs through the portfolio rebalancing channel and house price effects. They are counterbalanced by the savings redistribution and inflation channels, but these are outweighed by the first two channels.

Blot et al. (2020) also study the effect of several types of expansionary UMP on stock prices and house prices in the Eurozone between 2008 and 2019. Their results show that monetary policy causes imbalances in stock prices but not in house prices. What’s more, the imbalances are mainly due to central bank information shocks and not by pure monetary policy stance shocks.

Quantitative Easing

De Luigi et al. (2023) use local projections to examine the effect of QE shocks specifically on household wealth distribution through housing and risky financial assets in nine Euro Area countries. Their results show that expansionary QE shocks via housing prices induce a rise in wealth inequality when comparing the tails of the wealth distribution. Contrarily, the net wealth Gini coefficient decreases when housing wealth increases. Rises in risky financial assets wealth increase the Gini coefficient, because these are mainly owned by the wealthiest households. Evidently, wealth of one third of households is not at all affected by QE, since they don’t own risky financial assets nor housing assets. Overall, in most countries the decreasing effect of higher housing wealth outweighs the increasing effect of higher risky asset wealth, leading to a small decrease in the Gini coefficient.

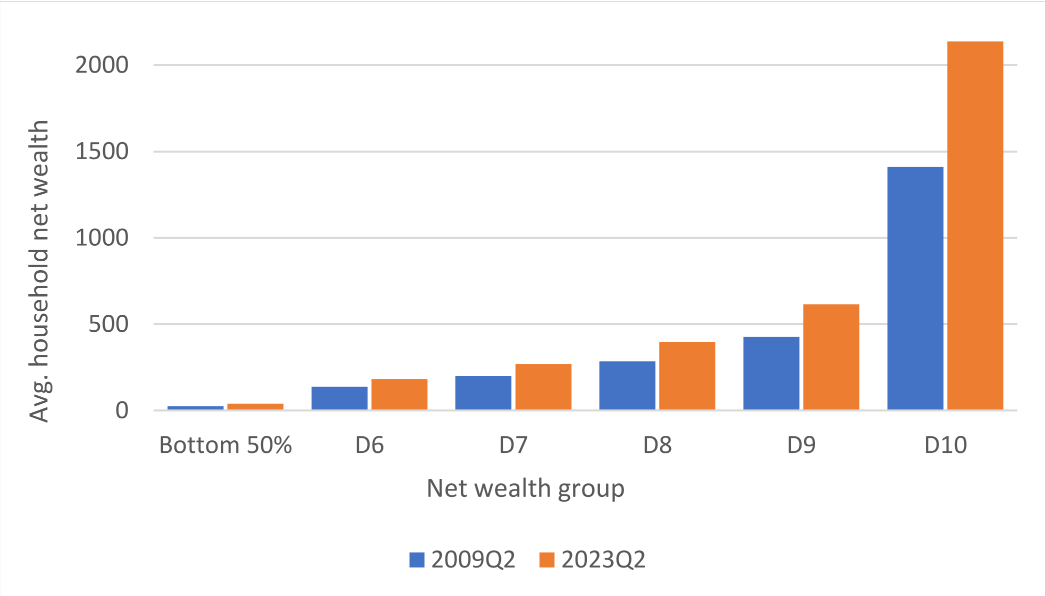
A study by Lenza and Slacalek (2018) finds similar effects of QE on wealth inequality, which they study for France, Germany, Italy, and Spain using impulse responses. They find negligible effects of QE on wealth inequality, which they measure using the Gini coefficient. Their results show that the effect of QE on net wealth is primarily through housing wealth, which is relatively equally distributed across the wealth distribution and composes a large share of the overall wealth. They do find that QE increases the value of stocks temporarily and that this leads to a wealth increase at the top of the wealth distribution. They explain this with the fact that wealthy households own relatively more stocks and also trade more, thus are able to rebalance their portfolio better. However, since stocks compose a relatively small amount of the total wealth, these temporary effects are negligible.

3. Data

Distributional Wealth Accounts

For the dependent variables, I use data from the Distributional Wealth Accounts (DWA) database by the ECB (*DWA | ECB Data Portal*, 2024). The database gives an overview of how wealth is distributed across different wealth groups and asset types in the euro area, and provides data on all 20 Eurozone countries. I don't include Croatia, since it adopted the euro only in 2023. To construct my wealth inequality measures, I take the average household wealth of two wealth groups in euros, of six different asset classes of each of the other 19 Eurozone countries. The wealth groups I use are the least wealthy 50% (B50) of the wealth distribution and the richest 10% (D10). Comparing the tails of the wealth distribution is a commonly used measure for inequality. I choose the bottom 50% because the dataset does not include decile 1 to 5 separately. Figure 3 provides an overview of the average net household wealth for the available wealth groups at the start and end of the dataset.

Figure 3: Average net household wealth in the Eurozone per wealth group



Average household net wealth in thousands of euros

The six asset types I use are the following: deposits, debt securities, listed shares, unlisted shares and other equity, investment fund shares/units and housing wealth. Additionally, I use the ratio of net wealth as well as the net wealth Gini coefficient. This adds up to eight dependent variables. The data I use is quarterly and ranges from 2009Q3 to 2023Q2 for most countries, resulting in 27 to 56 datapoints per country depending on data availability. Derived from the same database, I calculate the division of wealth within each wealth group and within each asset type. The values can be seen in Table 1.1 and 1.2. As Table 1.1 shows, the asset types I use do not make up for the entire wealth of both wealth groups; it does not include life insurance and annuity entitlements nor loans.

Table 1.1: Wealth division per wealth group in different asset types

Asset type	Bottom 50%	Top 10%
Deposits	23.5%	10.8%
Debt securities	0.2%	2.7%
Listed shares	0.4%	2.8%
Unlisted shares and other equity	0.9%	10.2%
Investment fund shares/units	1.1%	5.5%
Housing wealth	64.1%	46.6%
Total	90.2%	78.6%

Percentages are the average share over the dataset 2009Q3-2023Q2.

Table 1.2: Share of wealth groups in each asset type

Asset type	Bottom 50%	Top 10%
Deposits	14.7%	42.1%
Debt securities	1.1%	84.1%
Listed shares	2.1%	83.7%
Unlisted shares and other equity	1.3%	90.5%
Investment fund shares/units	2.7%	78.6%
Housing wealth	9.4%	42.5%
Net wealth	4.9%	56.1%

Percentages are the average share over the dataset 2009Q3-2023Q2.

Monetary policy shocks

I use four different monetary policy shock measures as the independent variables:

(1) a QE shock by Altavilla et al. (2019) which measures a QE surprise,

and three shocks that measure a surprise in the policy rate:

(2) a Target shock by Altavilla et al.;

(3) a Monetary Policy 'pm' shock by Jarociński and Karadi (2020), later called 'MP';

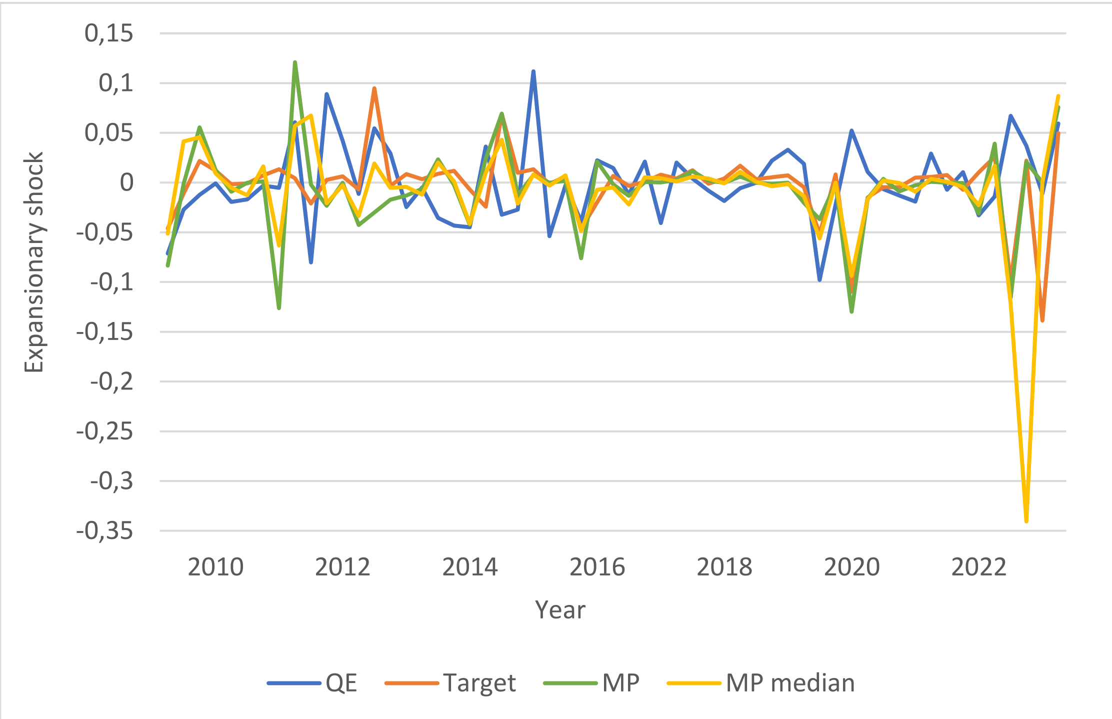
(4) a Monetary Policy 'median' shock by Jarociński and Karadi, later called 'MP median'.

All four monetary policy shocks are calculated with changes in yields of risk-free rates at different maturities shortly after monetary policy announcements by the ECB, but with different factor loadings and calculation methods. Altavilla et al. define their QE shock as a shock that lowers the long-term euro area safe rate and is associated with the non-standard monetary policy measures implemented by the ECB. The shock reflects the effect of announcements of Quantitative Easing.

The Target shock captures the immediate reaction to changes in the policy stance. The MP shock by Jarociński and Karadi, which they call MP pm, is calculated using a simplified method of so-called poor man's sign restrictions. This means that they classify each shock as being purely a central bank information shock, or purely a monetary policy shock; it cannot be both. The central bank information shock is the shock due to the signal that the ECB gives when setting the policy rate. If the rate setting is lower than expected, this indicates that the ECB finds the inflation (expectations) lower than the markets expected, often indicating a (expected) worsening economy. If the surprise has a contrary sign to the shock, e.g. an expansionary shock lowers interest rates, it is classified a monetary policy shock, and captured in the MP shock. Their MP median shock does not have poor man's sign restrictions and therefore gives a more balanced estimate, in which each announcement can have both policy rate and central bank information shocks. It represents the central tendency of the responses of various assets after a monetary policy shock.

The Target shock by Altavilla et al. and both Jarociński and Karadi shocks are all measurements of shocks concerning the policy rate, therefore I use all three to measure policy rate surprises. Even though the three policy rate shocks were calculated to measure similar effects, their differences in calculation do give them different estimations, as can be seen in Figure 4 and Table 1.3. What strikes is the deep trough of the MP median shock at 2022Q4. This could be explained by the fact that the ECB increased the policy rate twice in that quarter; from 1.5% to 2.0% and again to 2.5%. Apparently the rate increases were higher than expected, or the ECB's signaling about the economic outlook was worse than expected. The latter is likely, since at their December press conference, they stressed significant tightening remained ahead (Reuters, 2022).

Figure 4: Monetary policy shocks



A peak above zero indicates an expansionary shock; vice versa for a trough. Shocks are measured in percentage points. 'QE' and 'Target' denote the Altavilla et al. shocks; 'MP' and 'MP median' denote the Jarociński and Karadi shocks.

The correlation between the shocks can be seen in Table 1.3, which shows that QE has very little correlation with the other shocks. The other three shocks do have correlation between each other of 0.48, 0.26 and 0.43.

Table 1.3: Correlation matrix of monetary policy shocks and DFR

Variables	QE	Target	MP	MP median
QE	1.000			
Target	0.049	1.000		
MP	0.055	0.477	1.000	
MP median	-0.104	0.260	0.431	1.000
DFR	0.185	-0.083	0.241	-0.025
DFR 1 lag	0.177	0.049	0.245	0.213
DFR 2 lags	0.175	0.220	0.175	0.304
DFR 3 lags	0.083	0.301	0.029	0.224

'QE' and 'Target' denote the Altavilla et al. shocks; 'MP' and 'MP median' denote the Jarociński and Karadi shocks; DFR denotes the ECB Deposit Facility Rate level and its lags

Control variables

I use three country-specific variables to control for the economic cycle: the GDP growth rate, the Harmonized Index of Consumer Prices (HICP) and the unemployment rate. I use the EuroStoxx 50 returns in euros to control for financial market movements, and the Deposit Facility Rate (DFR) to control for interest rates. It may seem double to include the DFR, since it is already partly captured in the shock measures. However, the DFR helps to capture the broader effect of the monetary policy level on economic conditions, rather than just the direct impact of monetary policy shocks on markets. I calculated the correlation between the different shocks and the different lags of the DFR to check for multicollinearity. As shown in Table 1.3, correlation doesn't exceed 0.3, thus there seem to be no multicollinearity issues.

4. Methodology

Local projections

For the methodology, I use local projections by Jordà et al. (2005). Using this method I can estimate the effect of expansionary monetary policy surprises on wealth ratios of different asset types. A local projection runs several short regressions to estimate the effect on each period of interest, in my case after a monetary policy shock. It then shows the average movement of each of these regressions in an Impulse Response Function (IRF). This way, one can see the response to the impulse at different horizons. Thus, the IRF at horizon *t+1* shows the average effect of the shock one period after it occurred. I use the default IRF with a confidence interval of 95%. Using the different monetary policy shocks as independent variable and the wealth inequality measures as the dependent variable, I get the following equation:

$$Y_{it} = \alpha_i + \beta\epsilon_t + \sum_{j=1}^{n} \gamma_j Y_{i(t-j)} + \delta Z_{it} + \zeta X_t + \varepsilon_{it}$$

Y_{it} represents the dependent variable, which is the inequality measure for different asset types, for country *i* at time *t*.

α_i is the country-specific intercept that captures the unobserved heterogeneity across countries.

ϵ_t is the expansionary monetary policy shock at time t, which is one of the four shocks as mentioned in the data.

Y_{it-n} is the vector of lags of the dependent variable.

Z_{it} is the vector of country-specific control variables for country *i* at time t.

X_t represents the vector of non-country-specific control variables at time t.

ε_{it} is the error term, capturing unobserved factors or random variation in the dependent variable that is not explained by the independent variables in the model.

To select the best fitting model, I use the Akaike Information Criterion (AIC) test for each of my local projections. This way I determine the optimal amount of lags per control variable and for my dependent variable, which varies from zero to four lags.

Variable transformation

For my dependent variable, I transform the wealth measures of each of the six different assets and the net wealth into ratios. For example, my inequality measure for housing wealth will be the ratio of the average household wealth of the top 10% wealth group divided by that of the bottom 50% wealth group. I call this the D10/B50 ratio.

To avoid spurious regression, I check for stationarity in each dependent and control variable using the Augmented Dickey-Fuller (ADF) test. For those that are not, I transform them until they are stationary. This results in taking the cyclical component of the logarithm of my wealth inequality measures, and taking the cyclical component of each of the control variables except the DFR. The cyclical components are taken with the Hodrick-Prescott (HP) filter. Because the Altavilla et al. shocks are measured after each governing council, which are more frequent than quarterly, I sum these shocks for each quarter.

Panel data and country fixed effects

I panel the data cross-country for the inequality variable. By doing so, I can measure the movement of each of the country's time series over the time period, and capture the average effect in one Impulse Response Function. I therefore assume that the wealth inequality of each of the assets behaves comparably in each country. This way I can get more robust results than when I run separate regressions on each country's wealth measure, for which the time series are rather short and thus prone to high variability and less reliable. I include country-fixed effects to control for unobserved heterogeneity across countries, ensuring that country-specific characteristics that do not vary over time are accounted for.

Robustness checks

To avoid heteroskedasticity or autocorrelation, I use Newey-West standard errors in each of my local projections. As mentioned in the data, I use three different measures of the policy rate shock. By doing so, I can see whether their effect on the inequality measure is consistent. When the three shocks show similar results, this decreases the possibility of potential biases associated with a single measure, such as measurement error. For the QE shock, I use data from 2015Q1 to 2023Q2, since QE started from March 2015. For the policy rate shocks, I use the whole sample.

To check if my results are resistant to outliers, I run each of the local projections again for a country sample that excludes the biggest outliers. After transforming my dependent variables but before paneling them, I graph the inequality measures in one figure. I then drop the country ratios or coefficients of which the movement is notably divergent from that of the rest of the countries. The outliers I have excluded for each of the asset types are listed in appendix A. Lastly, I also control for the COVID crisis, during which economies, financial markets and monetary policy shocks moved with greater shocks and therefore different from 'normal'. I do this by running each local projections for the time sample without the time sample of the COVID crisis, namely 2020Q1 until 2021Q3.

5. Results

5.1 Deposits

Both the QE and the Target shock do not significantly affect the wealth ratio (Figure 1.1, 1.2). However, the Jarociński and Karadi shocks do show significant declines in the ratio of around 0.05pp for almost all specifications (appendix B.1).

Redistribution channels

The effect of the Jarociński and Karadi shocks aligns with Casiraghi et al. (2018), who find evidence for the savings redistribution channel. The poorer, often indebted households benefit from lower borrowing costs, which they can add to their savings instead. Another possible explanation is the remark by Domanski et al. (2016), who propose that lower interest rates may induce higher savings for the poorest to compensate the lower return on savings. The effects could also partially be explained by the portfolio rebalancing or portfolio composition channel that Evgenidis and Fasianos (2021) find. The rich, contrary to the poor, are liquid enough to move their money from low-yielding deposits to other assets, decreasing their deposit wealth. All three channels work via lower interest rates, which are affected directly by a policy rate shock and indirectly via a QE shock. This explains the higher and more significant effect of the rate shocks.

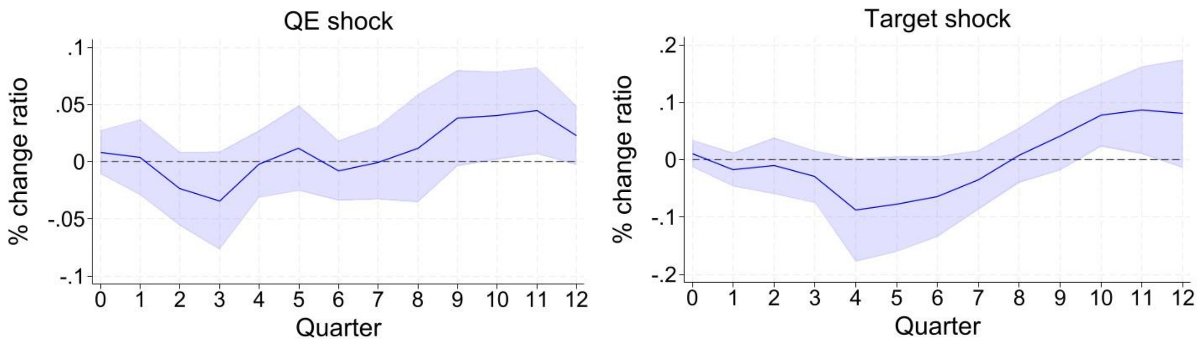


Figure 1.1 (left): IRF of D10/B50 wealth ratio of Deposits to expansionary Altavilla et al. QE shock in pp.
Figure 1.2 (right): IRF of D10/B50 wealth ratio of Deposits to expansionary Altavilla et al. Target in pp.
Bands denote the 95% confidence interval.

Table 1: IRF peaks and throughs of D10/B50 wealth ratio for Deposits

Expansionary shock	All countries	Without outliers
QE all dates	-0.0340 (3)	-0.0186 (3)
QE no COVID	-0.0592 (3) **	-0.0191 (3)
Target all dates	-0.0877 (4)	-0.0390 (4)
MP all dates	-0.0406 (5) **	-0.0613 (5)**
MP median all dates	-0.0731 (5) **	-0.0639 (5)**
Target no COVID	-0.0891 (4)	0.0340 (2)
MP no COVID	-0.0289 (6) **	-0.0477 (5)**
MP median no COVID	-0.0693 (5) **	-0.0356 (5)

*IRF peaks and troughs of the D10/B50 wealth ratio for Deposits, using Altavilla et al. QE and Target shocks, and Jarociński and Karadi Monetary Policy (MP) and MP median shocks. Values are percentage point (pp) changes due to a 1 pp increase in the shock, with corresponding quarter in parentheses. ** denotes significance at 5%.*

5.2 Debt securities

The QE shock induces an initial insignificant increase in the wealth ratio, followed by a significant decrease of 0.4pp after one quarter (Table 2). The results are similar for the robustness checks.

The Target shock causes an insignificant decline in the ratio of 0.8pp after a year. For the Jarociński and Karadi shocks, the decrease is significant around 0.6pp.

Redistribution channels

QE programs consisted largely of purchases of corporate and public sector bonds (Figure 2), which are by definition debt securities. QE shocks initially lead to higher demand, prices and wealth for the top 10% who own these debt securities, but also lower their yield. Therefore, investors switch to other higher yielding assets, decreasing their debt securities wealth via the portfolio rebalancing channel. The policy rate shocks work in a similar way, but via lower borrowing costs that lower yields for bonds and thus make investors move away from debt securities as well. Since the QE shock targets debt securities more specifically and more directly, the decrease in the debt securities ratio is quicker for the QE shock.

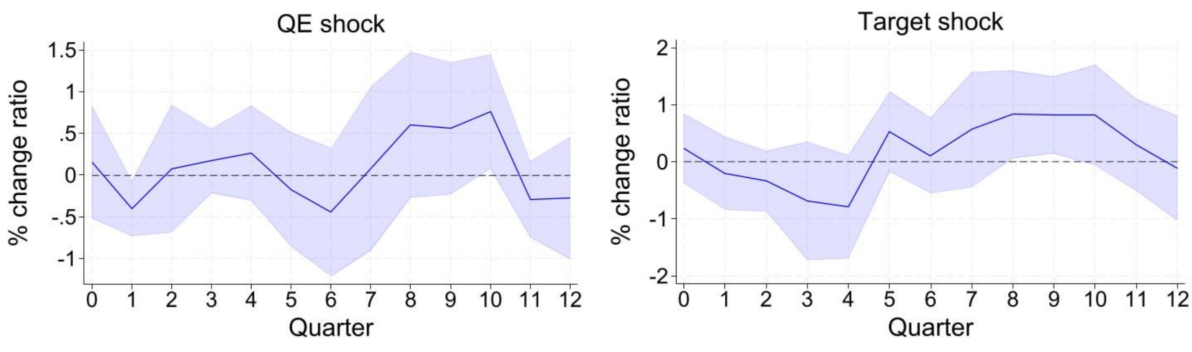


Figure 2.1 (left): IRF of D10/B50 wealth ratio of Debt securities to expansionary Altavilla et al. QE shock in pp.
Figure 2.2 (right): IRF of D10/B50 wealth ratio of Debt securities to expansionary Altavilla et al. Target shock in pp. Bands denote the 95% confidence interval.

Table 2: IRF peaks and throughs of D10/B50 wealth ratio for Debt securities

Expansionary shock	All countries	Without outliers
QE all dates	-0.3992 (1)**	-0.5542 (1)**
QE no COVID	-0.4752 (1)**	-0.6356 (1)**
Target all dates	-0.7890 (4)	-0.4327 (4)
MP all dates	-0.5929 (4)**	-0.2516 (4)
MP median all dates	-1.1327 (4)**	-0.6333 (4)**
Target no COVID	-0.7882 (3)	-0.4944 (4)**
MP no COVID	-0.5561 (4)**	-0.3416 (4)**
MP median no COVID	-0.9541 (4)**	-0.5218 (4)**

*IRF peaks and troughs of the D10/B50 wealth ratio for Debt securities, using Altavilla et al. QE and Target shocks, and Jarociński and Karadi Monetary Policy (MP) and MP median shocks. Values are percentage point (pp) changes due to a 1 pp increase in the shock, with corresponding quarter in parentheses. ** denotes significance at 5%.*

5.3 Financial equity

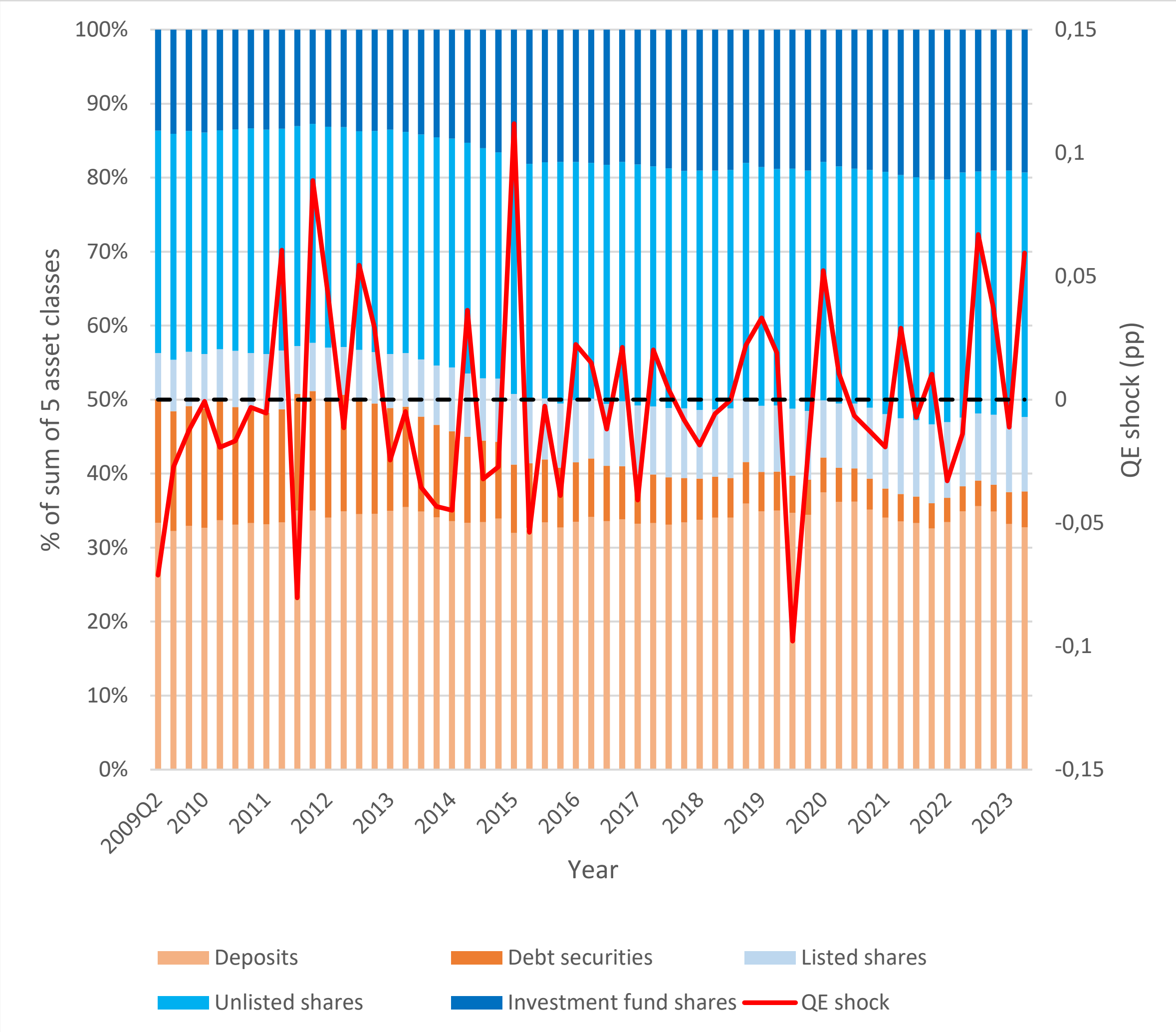
Redistribution channels of the QE shock

For listed shares, unlisted shares and other equity, and investment fund shares/units, IRFs move similarly (Figures 3.1-5.2). A QE shock leads to an increase in the ratio at the short term and a decrease at the medium term. This aligns with the portfolio rebalancing channel, where investors initially move from lower-yield assets like deposits or debt securities to higher-yield assets like stocks. Consequently, people in the top 10% wealth group increase their equity holdings. Conversely, people in the bottom 50% wealth group, who are less liquid, cannot as easily exchange their deposits for listed shares.

However, the effect is only significant for the listed shares ratio. This is likely because listed shares are publicly traded and highly liquid, making them more sensitive to shocks. Another possible reason is that stock values increase the most, leading investors to buy more shares compared to other asset classes. The medium-term decrease could be due to the same rebalancing channel working in reverse; as the increased demand for risky assets drives up prices and reduces yields, investors shift back to higher-yielding assets, normalizing the market.

Figure 5 shows the wealth of the top 10% wealth group of the Eurozone in the five asset classes that are most involved in portfolio rebalancing, as share of their sum. According to the portfolio rebalancing channel, an expansionary (positive) QE shock should lead to a decrease in the share of deposits and/or debt securities and an increase in the share of financial equity. This should happen after 1-3 quarters, according to Figure 1.1, 2.1, 3.1 and 4.1. This does seem fairly true when looking at Figure 5. Large positive shocks at 2011Q4, 2012Q3, 2014Q2, 2020Q1 and 2022Q2 are followed by a relative increase of equity wealth, while negative shocks at 2015Q2, 2015Q4, 2019Q3 and 2022Q1 are followed by a relative increase of deposits and debt securities wealth. However, it doesn't hold for all shocks.

Figure 5: Eurozone top 10% wealth group: division between 5 asset classes



These results confirm findings by Lenza and Slacalek (2018) and Adam and Tzamourani (2016), who observed increased wealth inequality via the portfolio rebalancing channel. However, the listed shares ratio only measures wealth in listed shares. Therefore it can only account for increases in the *amount* and not for increases in the *value* of stocks, which are also part of the portfolio rebalancing channel. If stock values rise, this impacts both poor and rich groups holding shares, potentially leaving the ratio unchanged. Possible stock value increases will be discussed in Chapter 5.5.

Redistribution channels of the policy rate shocks

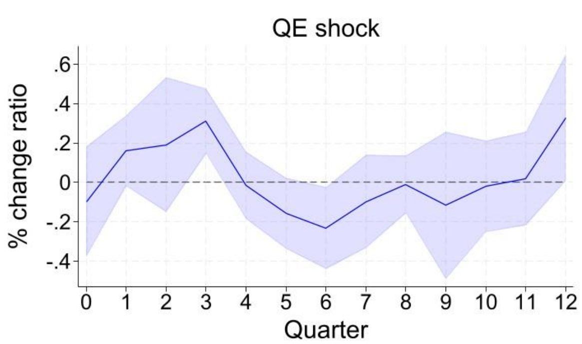
At the short term, policy rate shocks only significantly increase the listed shares ratio; again indicating the portfolio rebalancing channel. The other two asset class ratios show different but insignificant results. At the medium term, all three asset classes show a decrease in the ratio, indicating a market adjustment. However, this again is only significant for the listed shares ratio.

The following three sub chapters shortly describe the exact effects of the shocks on each of the three equity asset ratios separately.

Listed shares

The QE shock increases the listed shares wealth ratio with a peak of around 0.3pp after 3 quarters, followed by a decrease of around 0.2pp after 1.5 years. Both are significant and robust.

After half a year, the Target shock shows a robust and significant increase of 0.3pp, followed by a decrease after 7 quarters of 0.4pp. The Jarociński and Karadi shocks are partly significant.



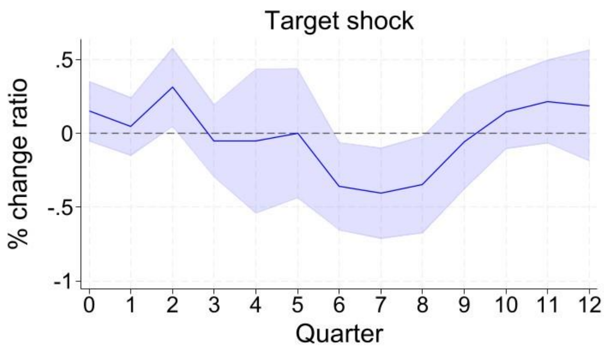


Figure 3.1 (left): IRF of D10/B50 wealth ratio of Listed shares to expansionary Altavilla et al. QE shock in pp. Figure 3.2 (right): IRF of D10/B50 wealth ratio of Listed shares to expansionary Altavilla et al. Target shock in pp. Bands denote the 95% confidence interval.

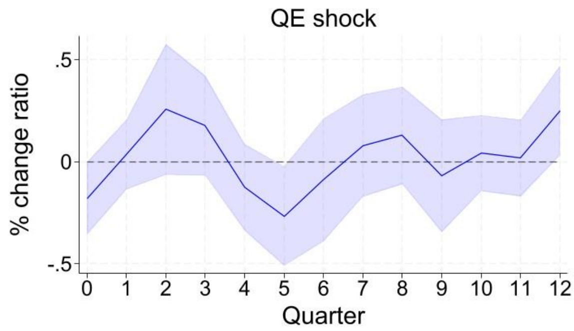
Table 3: IRF peaks and throughs of D10/B50 wealth ratio for Listed shares

	Short term effect		Medium term effect	
Expansionary shock	**All countries**	**Without outliers**	**All countries**	**Without outliers**
QE all dates	0.3113 (3)**	0.3160 (3)**	-0.2318 (6)**	-0.2090 (6)
QE no COVID	0.3216 (3)**	0.3214 (3)**	-0.4347 (6)**	-0.3644 (6)**
Target all dates	0.3140 (2)**	0.3596 (2)**	-0.4047 (7)**	-0.4350 (7)**
MP all dates	0.1389 (2)	0.1869 (2)	-0.2832 (7)**	-0.2335 (7)**
MP median all dates	-0.2469 (2)**	-0.2093 (2)**	-0.5783 (7)**	-0.5099 (7)**
Target no COVID	0.2907 (2)**	0.3552 (2)**	-0.5420 (7)**	-0.6985 (8)**
MP no COVID	0.0419 (3)	0.1410 (3)	-0.3196 (7)**	-0.2379 (8)
MP median no COVID	-0.3247 (2)**	-0.2752 (2)**	-0.6611 (7)**	-0.5574 (7)**

*IRF peaks and troughs of the D10/B50 wealth ratio for Listed shares, using Altavilla et al. QE and Target shocks, and Jarociński and Karadi Monetary Policy (MP) and MP median shocks. Values are percentage point (pp) changes due to a 1 pp increase in the shock, with corresponding quarter in parentheses. ** denotes significance at 5%.*

Unlisted shares and other equity

The short-term effect of both the QE and Target shocks to the unlisted shares and other equity wealth ratio are insignificant. At the medium term, both shocks significantly decrease the ratio with about 0.3pp, but these results are not robust (Table 4).



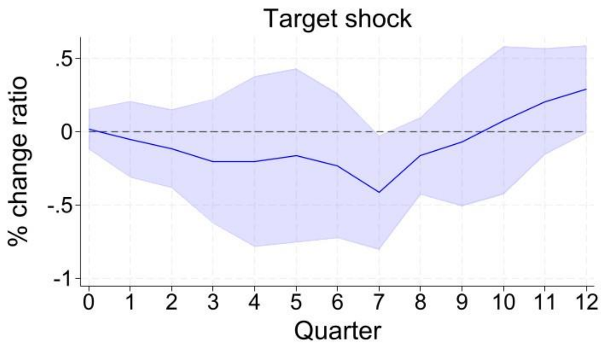


Figure 2.1 (left): IRF of D10/B50 wealth ratio of Unlisted shares and other equity to expansionary Altavilla et al. QE shock in pp.
Figure 2.2 (right): IRF of D10/B50 wealth ratio of Unlisted shares and other equity to expansionary Altavilla et al. Target shock in pp. Bands denote the 95% confidence interval.

Table 4: IRF peaks and throughs of D10/B50 wealth ratio for Unlisted shares and other equity

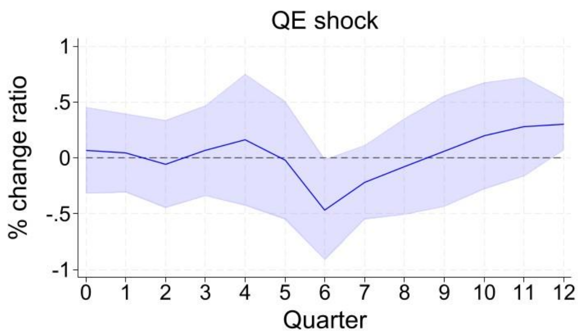
	Short term effect		Medium term effect	
Expansionary shock	**All countries**	**Without outliers**	**All countries**	**Without outliers**
QE all dates	0.2572 (2)	0.2434 (2)	-0.2654 (5)**	-0.1842 (5)**
QE no COVID	0.2032 (2)	0.2767 (2)	-0.2497 (5)	-0.1163 (5)
Target all dates	-0.2022 (3)	-0.2066 (3)**	-0.4162 (7)**	-0.1638 (7)
MP all dates	-	-	-0.2916 (7)	-0.1214 (5)
MP median all dates	-	-	-0.3890 (7)	-0.1316 (7)
Target no COVID	-0.1808 (3)	-0.1808 (3)	-0.4580 (7)	-0.2377 (6)
MP no COVID	-	-	-0.3208 (6)	-0.1781 (7)
MP median no COVID	-	-	-0.4065 (7)	-0.1156 (5)

*IRF peaks and troughs of the D10/B50 wealth ratio for Unlisted shares and other equity, using Altavilla et al. QE and Target shocks, and Jarociński and Karadi Monetary Policy (MP) and MP median shocks. Values are percentage point (pp) changes due to a 1 pp increase in the shock, with corresponding quarter in parentheses. ** denotes significance at 5%.*

Investment fund shares/units

Both the QE shock and the Target shock don't significantly affect the wealth ratio in the short term.

At the medium term, only the QE shock significantly decreases the ratio.



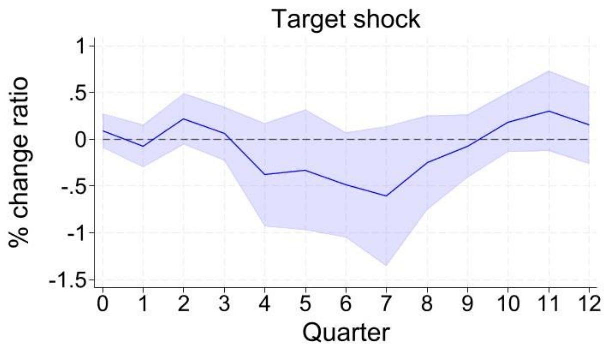


Figure 5.1 (left): IRF of D10/B50 wealth ratio of Investment fund shares/units to expansionary Altavilla et al. QE shock in pp.
Figure 5.2 (right): IRF of D10/B50 wealth ratio of Investment fund shares/units to expansionary Altavilla et al. Target shock in pp. Bands denote the 95% confidence interval.

Table 5: IRF peaks and throughs of D10/B50 wealth ratio for Investment fund shares/units

	Short term effect		Medium term effect	
Expansionary shock	**All countries**	**Without outliers**	**All countries**	**Without outliers**
QE all dates	0.1629 (4)	0.2058 (3)	-0.4639 (6)**	-0.2360 (6)
QE no COVID	0.1665 (2)	0.0784 (3)	-0.7520 (6) **	-0.4477 (6) **
Target all dates	0.2160 (2)	0.1767 (2)	-0.4880 (6)	-0.3998 (7) **
MP all dates	0.1478 (3)	-0.2226 (4)	-0.3479 (6)	-0.2564 (8)
MP median all dates	-0.4959 (4)**	-0.3724 (4)	-0.6671 (7) **	-0.5600 (8) **
Target no COVID	0.1079 (2)	0.2079 (2) **	-0.4621 (7)	-0.4359 (7) **
MP no COVID	-0.2305 (4)	-0.1631 (0)	-0.2000 (6)	-0.1375 (7)
MP median no COVID	-0.2968 (4)	-0.2017 (2)	-0.5187 (7)	-0.4601 (7) **

*IRF peaks and troughs of the D10/B50 wealth ratio for Investment fund shares/units, using Altavilla et al. QE and Target shocks, and Jarociński and Karadi Monetary Policy (MP) and MP median shocks. Values are percentage point (pp) changes due to a 1 pp increase in the shock, with corresponding quarter in parentheses. ** denotes significance at 5%.*

5.4 Housing wealth

The housing wealth ratio is not significantly affected by the QE shock or the Target shock (Figure 6.1, 6.2). The Jarociński and Karadi shocks do show significant increases after 5 quarters, but these are not robust without COVID. The IRFs do show a significant trough after 2.5 years for some specifications, but inferences on the effects of monetary policy shocks after such a long period are hard to make, since there could be many other factors influencing housing wealth at the longer term.

Redistribution channels

The insignificant results show no proof of the housing asset price inflation channel as described by Domanski et al. (2016). They contradict those of De Luigi et al. (2023), who find that expansionary QE shocks via housing prices lead to an increase in wealth inequality when comparing the tails of the wealth distribution. Though both insignificant, the increases of the wealth ratio are larger for the policy rate shocks than for the QE shock. This is because housing price inflation works through a lower interest rate, which is affected directly by the policy rate shock and indirectly via asset purchases.

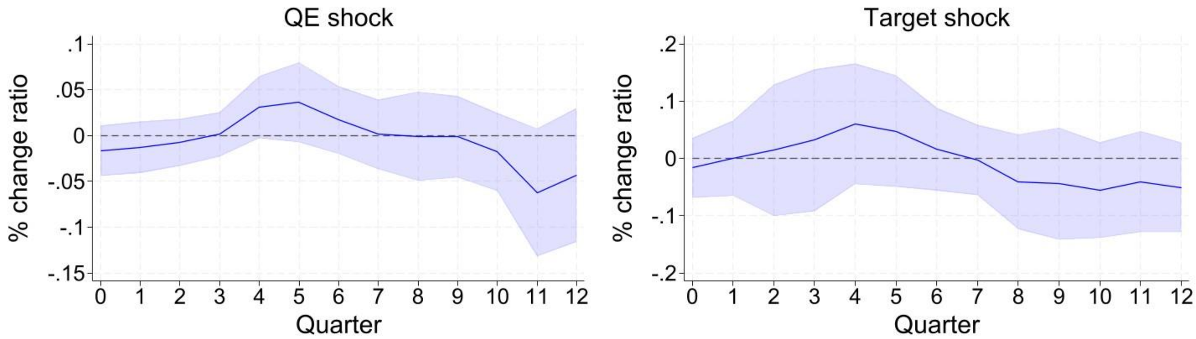


Figure 6.1 (left): IRF of D10/B50 wealth ratio of Housing wealth to expansionary Altavilla et al. QE shock in pp. Figure 6.2 (right): IRF of D10/B50 wealth ratio of Housing wealth to expansionary Altavilla et al. Target shock. Bands denote the 95% confidence interval.

Table 6: IRF peaks and throughs of D10/B50 wealth ratio for Housing wealth

Expansionary shock	All countries	Without outliers
QE all dates	0.0363 (5)	0.0252 (4) **
QE no COVID	0.0526 (5)	0.0344 (4)
Target all dates	0.0607 (4)	0.0205 (3)
MP all dates	0.0929 (5) **	0.0690 (5) **
MP median all dates	0.1221 (4) **	0.0810 (5) **
Target no COVID	-0.0903 (10) **	-0.0368 (1) **
MP no COVID	-0.0322 (11)	-0.0308 (11)
MP median no COVID	-0.0726 (10)	-0.0513 (10) **

*IRF peaks and troughs of the D10/B50 wealth ratio for Housing wealth, using Altavilla et al. QE and Target shocks, and Jarociński and Karadi Monetary Policy (MP) and MP median shocks. Values are percentage point (pp) changes due to a 1 pp increase in the shock, with corresponding quarter in parentheses. ** denotes significance at 5%.*

5.5 Total wealth

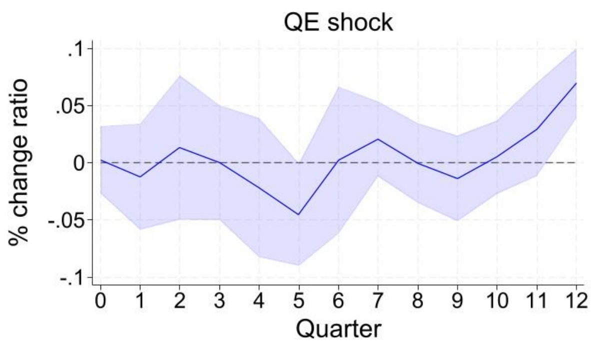
Net wealth

The QE shock only significantly affects the net wealth ratio at the medium term, with a decrease of about 0.05pp. The Target shock doesn't significantly affect the net wealth ratio. The ratio is significantly affected by some of the Jarociński and Karadi shock specifications, but these are not robust for the sample without COVID (Table 7).

Redistribution channels

The net wealth ratio is essentially a sum of all separate asset type ratio movements. Even though the effect of the QE shock is insignificant, the movement above zero up to quarter 3 and under zero around quarter 5, can probably best be explained by the movement of the financial equity ratios. Even though only significant for listed shares, all three assets do show increases at the short term and decreases at the medium term. Even though the effect is insignificant, the movement of the net wealth ratio due to the QE shock seems to be affected via the portfolio rebalancing channel, as explained in section 5.3.

For the policy rate shocks, even though the effect is insignificant, the movements of the net wealth ratio are similar to those of the housing wealth ratio with a peak after a year (Figure 6.2, 7.2; Table 6, 7). This is reasonable, since about half of household total wealth consists of housing wealth (Table 1.1). The insignificant results are consistent with those of O'Farrell et al. (2019) and Albert et al. (2019).



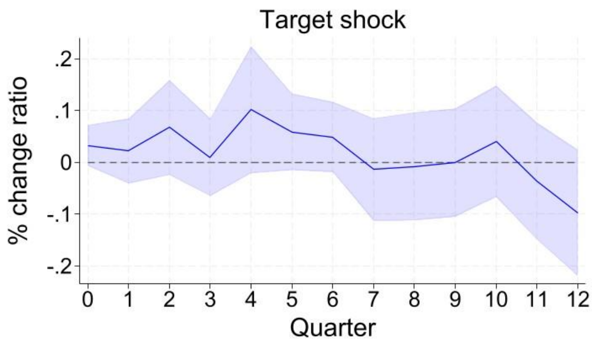


Figure 7.1 (left): IRF of D10/B50 wealth ratio of Net wealth to expansionary Altavilla et al. QE shock in pp.
Figure 7.2 (right): IRF of D10/B50 wealth ratio of Net wealth to expansionary Altavilla et al. Target shock and Jarociński and Karadi shocks in pp. Bands denote the 95% confidence interval.

Table 7: IRF peaks and throughs of D10/B50 wealth ratio for Net wealth

Expansionary shock	All countries	Without outliers	All countries	Without outliers
QE all dates	0.0133 (2)	0.0416 (2)	-0.0452 (5)**	-0.0569 (5)**
QE no COVID	0.0433 (2)	0.0706 (2)**	-0.0134 (5)	-0.0441 (5)**
Target all dates	0.0783 (5)	0.0859 (2)**		
MP all dates	0.0562 (6)**	0.0611 (2)**		
MP median all dates	0.0756 (6)**	0.0605 (6)		
Target no COVID	0.0634 (4)	0.1081 (10)**		
MP no COVID	0.1886 (4)	0.0262 (2)		
MP median no COVID	0.0572 (4)	-0.0315 (1)**		

*IRF peaks and troughs of the D10/B50 wealth ratio for Net wealth, using Altavilla et al. QE and Target shocks, and Jarociński and Karadi Monetary Policy (MP) and MP median shocks. Values are percentage point (pp) changes due to a 1 pp increase in the shock, with corresponding quarter in parentheses. ** denotes significance at 5%.*

Net wealth Gini coefficient

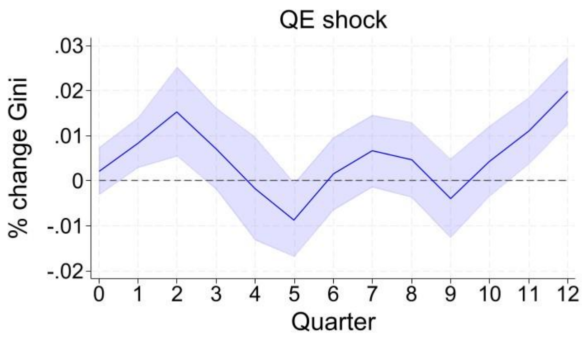
The QE shock causes a small significant increase of around 0.02pp after half a year for all samples, followed by a very small but non-robust decrease after 5 quarters (Table 8). The policy rate shocks show ambiguous results. The Target shock only shows a significant effect after 2.5 years; a term that is too long to make inferences on the shock effect. The Jarociński and Karadi shocks show positive as well as negative effects on the ratio. Thus overall, there is no clear significant effect of the policy rate shocks.

Redistribution channels Gini

The short-term significant increase in the Gini coefficient due to the QE shock reflects the increases in the listed shares ratio. Besides the increase in the relative *amount* of listed shares for higher wealth groups, the net wealth Gini coefficient's rise may also indicate an increase in the *value* of listed shares. This increase in the net wealth Gini reflects a relative growth in total net wealth for wealthier groups, which cannot be attributed only to asset switching since this would not increase total wealth. Therefore, asset classes that form a larger share of the wealth of the richest groups than of the poorest must have increased the most, particularly the three types of equity (Table 1.1).

Since only the listed shares ratio significantly increases, these shares are possibly most desired, possibly experiencing the highest value increase. This aligns with Lenza and Slacalek (2018), who found increased inequality due to rising equity prices. It also confirms Adam and Tzamourani's (2016) study, which found that rising equity prices lead to a higher net wealth Gini coefficient, as the richest experience substantial gains, while median households do not benefit.

The effect on the Gini coefficient is about one-tenth of the equity increases, likely because equity constitutes a small share of total wealth (Table 1.1). However, since my separate asset wealth measures are ratios of the wealth distribution tails, they do not necessarily explain the Gini coefficient's movement. Comparing both inequality measures, I find a significant effect of the QE shock on the net wealth Gini, but not on the net wealth ratio. This contradicts De Luigi et al. (2023), who found a more significant impact of shocks on net wealth when measured with a tail ratio than with the Gini coefficient.



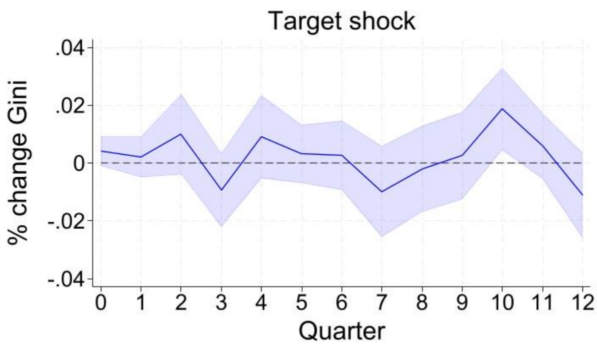


Figure 8.1 (left): IRF of Net wealth Gini coefficient to expansionary Altavilla et al. QE shock in pp.
Figure 8.2 (right): IRF of Net wealth Gini coefficient to expansionary Altavilla et al. Target shock. Bands denote the 95% confidence interval.

Table 8: IRF peaks and throughs of Net wealth Gini coefficient

Expansionary shock	**All countries**	**Without outliers**	**All countries**	**Without outliers**
QE all dates	0.0153 (2) **	0.0208 (2) **	-0.0087 (5) **	-0.0124 (5) **
QE no COVID	0.0179 (2) **	0.0203 (2) **	-0.0017 (5)	-0.0069 (5)
Target all dates	0.0187 (10) **	0.0241 (10) **		
MP all dates	0.0119 (6) **	0.0136 (4) **		
MP median all dates	-0.0118 (2) **	-0.0140 (2) **		
Target no COVID	-0.0270 (3) **	-0.0276 (3) **		
MP no COVID	-0.0058 (1) **	-0.0059 (1) **		
MP median no COVID	-0.0174 (2) **	-0.0161 (2) **		

*IRF peaks and troughs of the Net wealth Gini coefficient, using Altavilla et al. QE and Target shocks, and Jarociński and Karadi Monetary Policy (MP) and MP median shocks. Values are percentage point (pp) changes due to a 1 pp increase in the shock, with corresponding quarter in parentheses. ** denotes significance at 5%.*

6. Discussion

My research does have limitations. The main point concerns my time sample. First, my time sample consists of quarterly data from 2009 to 2023, but is shorter for many of the countries. Therefore, I only have 27 to 56 datapoints for each country. I do panel the data to avoid high variability between countries and use country fixed effects and I do control for business cycles, COVID and outliers. However due to my relatively short time sample, there could still be external factors not included in my controls that affect wealth inequality for many countries, which I miss in my model. Adding to this, the time sample does contain (the aftermath of) three major economic crises: the GFC, the Eurozone debt crisis and the COVID crisis. Therefore, even though I control for business cycles, my research may not be externally valid to periods of economic calmness. Future research should try to find more frequent and more historic data on wealth inequality.

What's more, my wealth inequality measures are limited. Except for the net wealth Gini coefficient, my separate asset ratios only compare the tails of the wealth distribution. Even though this is a fair way of measuring inequality, future research should also use Gini coefficients to give a better overview of the inequality for the entire wealth distribution within an asset class. This way, effects on the middle class can also be examined. Additionally, I don't include all wealth types, which would be good for future studies to get a complete understanding of all the different asset type movements to monetary policy shocks. Adding a last point about my inequality measures, I don't control for tax avoidance or tax evasion, which could induce downwards estimates of my inequality ratios. Future research should control for this. Furthermore, I only use one QE shock, which makes the results very dependent on the validity of the calculation of this shock. Future analysis would be improved if researchers find or construct additional QE shocks. Lastly, because I use cross-country paneled data, the effect within each country is weighted equally, even though population sizes differ greatly across the Eurozone. Therefore, the effects are the average effect per Euro Area country, not necessarily the average for all of the Eurozone. Thus, new studies could give weights to effects of certain countries relative to e.g. their population or economy sizes.

Not necessarily drawing onto limitations of my own research, I do have some extra suggestions for future studies. While I look at within-country inequality ratios, new research could use the DWA data to compare wealth cross-country, which could give more insights into how monetary policy shocks heterogeneously affect each country. Lastly, I only look at wealth inequality that compares the tails of the entire wealth distribution. However, the tails of the top 10% wealth group also often show large inequality. Comparing e.g. the top 1% to the rest of the top 10% could give more insights into the effect on the rich vs. the superrich.

7. Conclusion

This study aimed to investigate how expansionary monetary policy shocks affect wealth inequality in the Eurozone, focusing on different asset types and overall net wealth.

For the deposits wealth ratio, I find no significant effects due to the QE or Target shocks. I do find significant and robust effects of the Jarociński and Karadi shocks, which decrease the ratio with 0.06pp after 5 quarters. This mainly supports the savings redistribution channel as well as the portfolio rebalancing channel. This corresponds with Casiraghi et al. (2018)'s study, who also find proof for both channels. Since savings redistribution works via lower interest rates, this explains why two of the policy rate shocks are significant and the QE shock is not.

The QE shock leads to a significant decrease of the debt securities ratio of 0.4pp after one quarter. For the policy rate shocks, the Target shock has no significant effect. The Jarociński and Karadi shocks do significantly decrease the debt securities ratio with around 0.6pp after a year. The effect of the QE shock to debt securities is more immediate than that of the rate shocks since it directly affects the assets. For listed shares, the QE shock and the Target shock lead to a significant increase of 0.3pp at the short-term and a decrease of respectively 0.2pp and 0.4pp at the medium term. The other two equity asset ratios show mostly similar but insignificant movements. The short-term effects to debt securities and listed shares confirm the portfolio rebalancing channel. These results align with those of Adam and Tzamourani (2016), O'Farrell et al. (2019), De Luigi et al. (2023), and Lenza and Slacalek (2018), who find temporary increases in wealth inequality via risky financial assets and the portfolio rebalancing channel. It contrasts Albert et al. (2019), who don't find an effect via the portfolio rebalancing channel for the Eurozone.

For housing wealth, both the QE shock and the policy rate shocks don't significantly affect the ratio. Thus, I don't find proof for the housing asset price inflation channel. This doesn't align with the study by O'Farrell et al. (2019) who find that housing asset price inflation reduces inequality. It also contrasts De Luigi et al. (2023) who find an increase in equality due to housing price inflation when comparing the tails. Even though insignificant, the effect is higher for the policy rate shock because these directly impact the housing assets via lower interest rates, instead of indirectly via asset purchases.

As for the total wealth, there is no significant and robust short-term effect of any of the shocks to the net wealth ratio. To the net wealth Gini coefficient, there is a significant but small increase due to the QE shock of 0.02pp after half a year. This aligns with De Luigi et al. (2023), who also find an increase in the net wealth Gini coefficient via financial equity. The effects of the policy rate shocks to the net wealth Gini coefficient are non-significant or non-robust. The movements of the IRFs of the QE shock to both net wealth measures are best explained by those of the QE shock to the equity ratios, which aligns with the portfolio rebalancing channel. Even though the Target shocks have no significant effects, the movement of the net wealth ratio IRF is best explained by that of the housing wealth ratio. The insignificant or non-robust effects to net wealth align with results of Lenza and Slacalek (2018) and O'Farrell et al. (2019) and Albert et al. (2019), who don't find a significant effect. It contrasts with Evgenidis and Fasianos (2021) who do find a robust increase.

Overall, the policy rate shocks have a more significant impact on the deposits ratio. QE shocks have a more significant impact on equity ratios and the net wealth Gini, and a more immediate impact on debt securities. The distinct effect of both shock types on housing wealth inequality and the net wealth ratio are harder to make due to varying significance and robustness of the results. This supports results of Domanski et al. (2016) who find temporary increases of UMP via portfolio rebalancing, but doesn't support their finding that UMP has a larger effect via the housing price channel. It contrasts findings by Lenza & Slacalek (2018) who find that QE primarily affects net wealth through housing wealth.

Policy implications

To emphasize, all the significant results that I find are temporary. After a certain amount of time following the shock, the inequality measures revert to their standard levels again. Assuming that temporary increases in wealth inequality don't disadvantage the less wealthy, this would indicate that the ECB doesn't have to take wealth inequality implications into account when making their QE or policy rate decisions.

In case temporary wealth inequality increases do have negative external effects, more research should be done into how to mitigate the inequality. However, I can give some very hypothetical ways for how this could be done. One angle would be to give the less wealthy more access to the ways that the richest make use of monetary policy shocks. The most obvious way would be to make the portfolio rebalancing channel more accessible to those who are not very liquid, by improving the liquidity of risky financial assets. However, the less liquid should also be better protected against the negative risks of these assets because they cannot afford to lose their wealth. The other angle would be to limit the benefits that the wealthy get from the shocks. One way is to increase taxes on the value increases in financial equity, which would disproportionately impact those whose equity values rise the most. The yield of these taxes could be redistributed fairly via the state.

To conclude my paper, I will shortly answer my three research sub-questions:

1. How do expansionary monetary policy shocks affect net wealth inequality via different asset types?

Monetary policy shocks temporarily increase inequality ratios for listed shares and the net wealth Gini coefficient, and decrease those for deposits and debt securities. This indicates proof of the portfolio rebalancing channel and the savings redistribution channel. I do not find proof of the housing asset price inflation channel.

2. How do expansionary monetary policy shocks affect net wealth inequality?

Only the net wealth Gini coefficient is slightly but temporarily increased by the QE shock. It is not affected by the Target shock nor is the net wealth ratio by any of the shocks.

3. How do expansionary policy rate shocks and QE shocks differently affect net wealth and its components?

The policy rate shocks have a more significant impact on the deposits. QE shocks have a larger impact on the listed shares ratio and the net wealth Gini coefficient, and a more immediate impact on debt securities. The distinct effect of both shock types on housing wealth inequality and the net wealth Gini are harder to make due to varying significance and robustness of the results.

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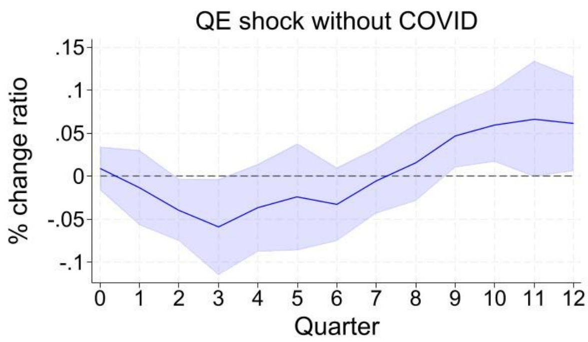
9. Appendix

A. Outliers and missing data per inequality measure

Inequality measure	Missing data	Outliers
Deposits		Cyprus, Estonia, Portugal, Slovenia, Slovakia
Debt securities	Greece, Lithuania, Latvia	Cyprus, Spain, Finland, Slovenia
Listed shares	Greece, Latvia, Slovakia	Finland, Italy, Portugal
		Ireland, Italy, Latvia, Malta, Portugal, Slovakia
Investment fund shares/units	Greece	Cyprys, Estonia, Malta
Housing wealth		Austria, The Netherlands
Net wealth ratio		Cyprus, Ireland, Estonia, The Netherlands
Net wealth Gini coefficient		Cyprus, Spain, Ireland, The Netherlands, Slovenia

B. Impulse Response Functions (IRF) of different asset types

B.1. Deposits



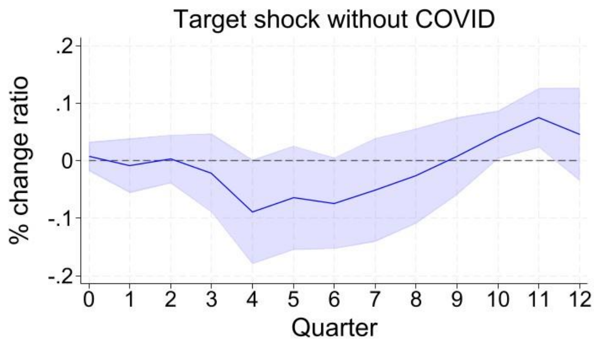
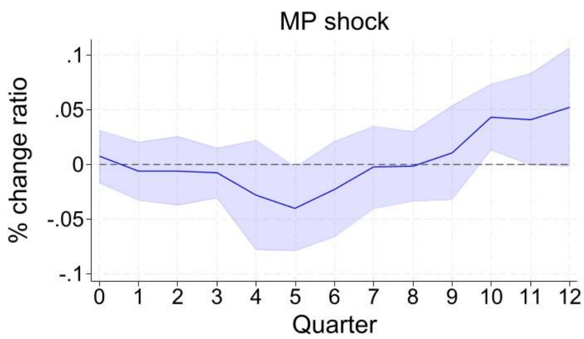


Figure 1.3 (left): IRF of D10/B50 wealth ratio of Deposits to Altavilla et al. QE shock in pp. Sample excludes COVID. Bands denote the 95% confidence interval.
Figure 1.4 (right): same specifications but with Altavilla et al. Target shock.



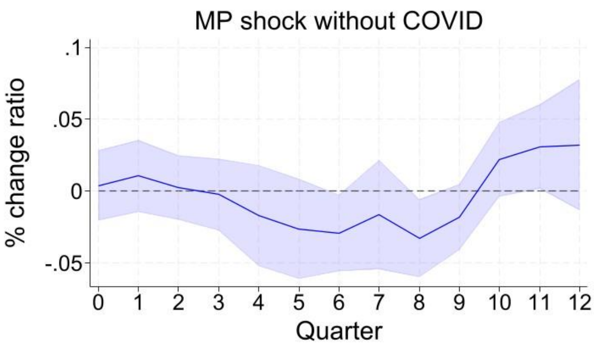
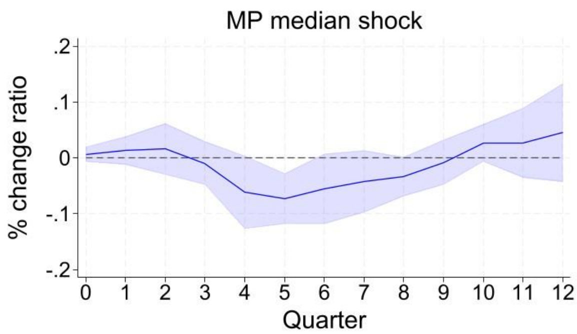


Figure 1.5 (left): IRF of D10/B50 wealth ratio of Deposits to Jarociński and Karadi MP shock in pp. Bands denote the 95% confidence interval.
Figure 1.6 (right): same specifications but without COVID.



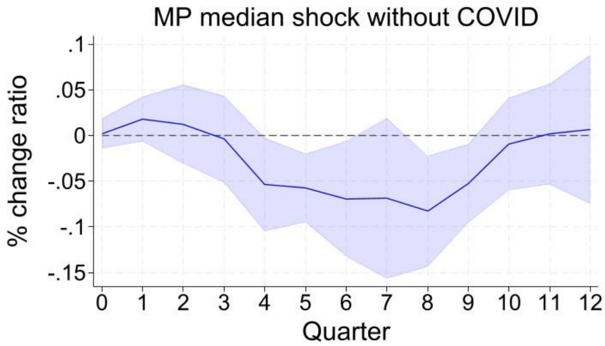
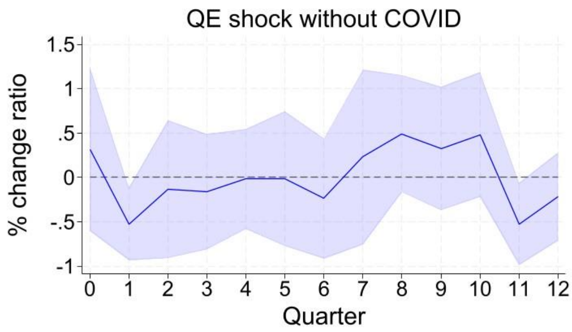


Figure 1.7 (left): IRF of D10/B50 wealth ratio of Deposits to Jarociński and Karadi MP median shock in pp. Bands denote the 95% confidence interval.
Figure 1.8 (right): same specifications but without COVID.

B.2. Debt securities



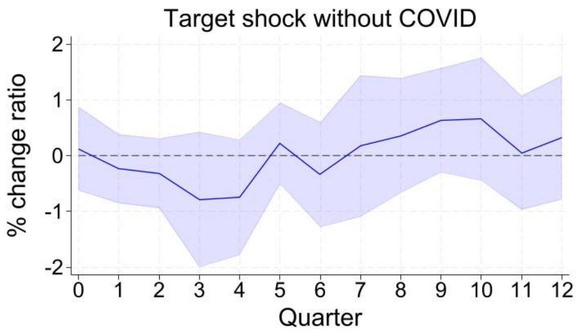
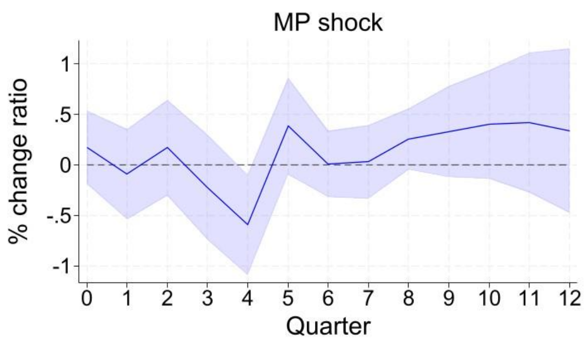


Figure 2.3 (left): IRF of D10/B50 wealth ratio of Debt securities to Altavilla et al. QE shock in pp. Sample excludes COVID. Bands denote the 95% confidence interval.
Figure 2.4 (right): same specifications but with Altavilla et al. Target shock.



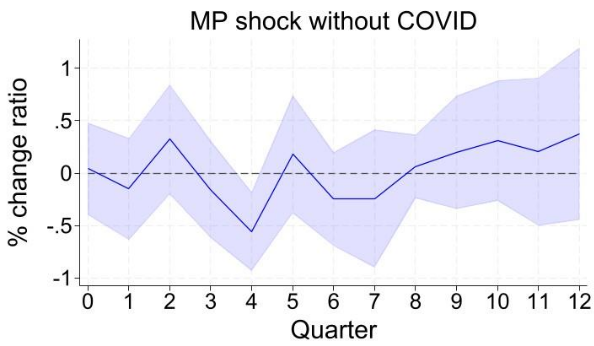
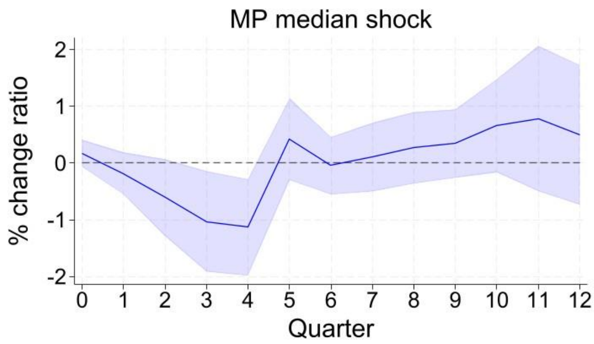


Figure 2.5 (left): IRF of D10/B50 wealth ratio of Debt securities to Jarociński and Karadi MP shock in pp. Bands denote the 95% confidence interval.
Figure 2.6 (right): same specifications but without COVID.



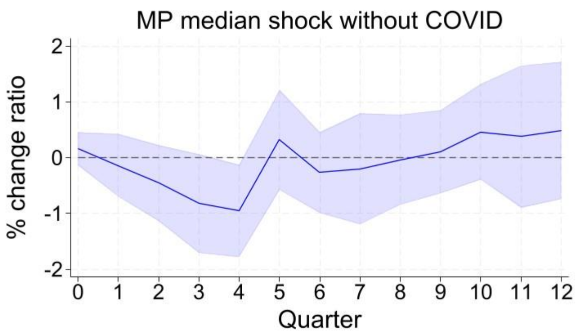
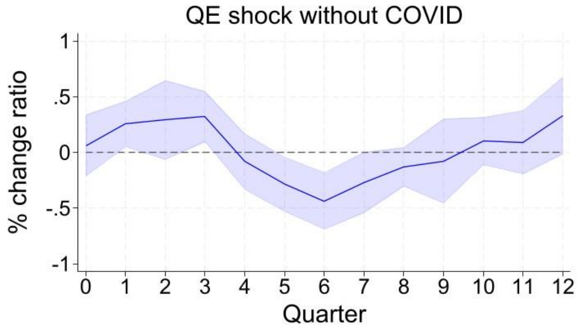


Figure 2.7 (left): IRF of D10/B50 wealth ratio of Debt securities to Jarociński and Karadi MP median shock in pp. Bands denote the 95% confidence interval.
Figure 2.8 (right): same specifications but without COVID.

B.3. Listed shares



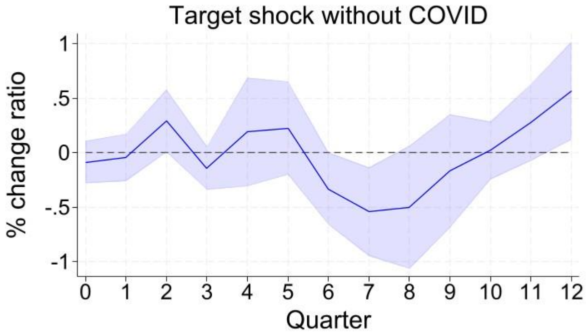
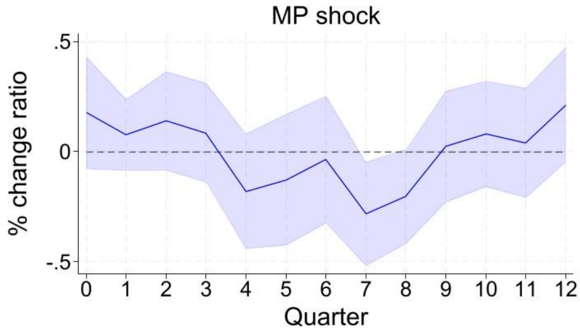


Figure 3.3 (left): IRF of D10/B50 wealth ratio of Listed shares to Altavilla et al. QE shock in pp. Sample excludes COVID. Bands denote the 95% confidence interval.
Figure 3.4 (right): same specifications but with Altavilla et al. Target shock.



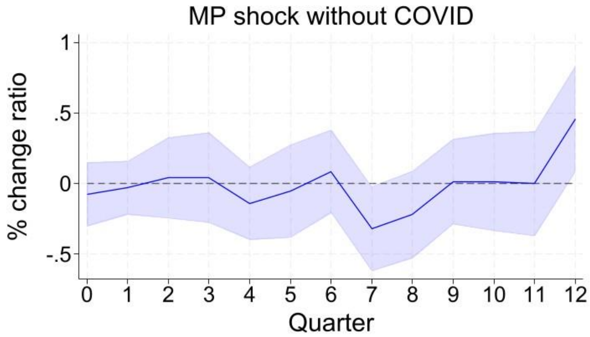
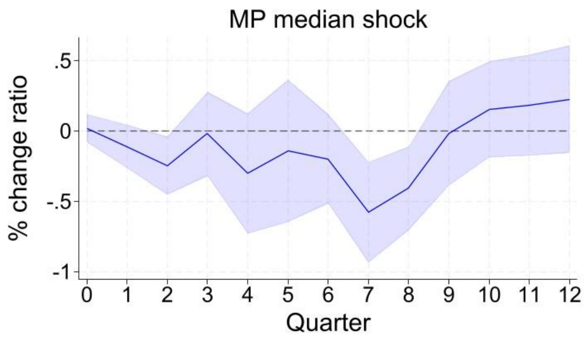


Figure 3.5 (left): IRF of D10/B50 wealth ratio of Listed shares to Jarociński and Karadi MP shock in pp. Bands denote the 95% confidence interval.
Figure 3.6 (right): same specifications but without COVID.



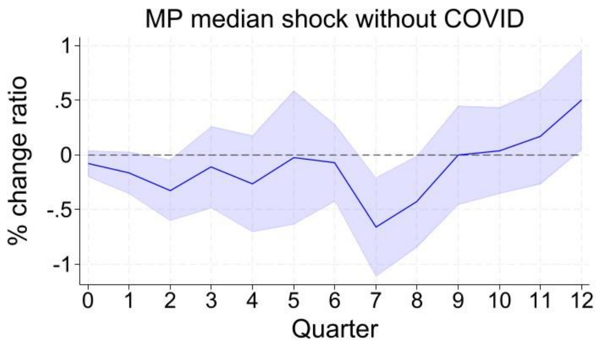
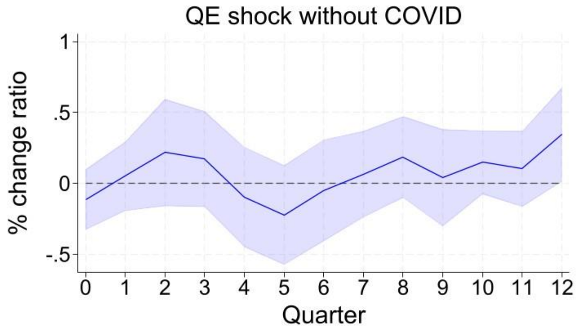


Figure 3.7 (left): IRF of D10/B50 wealth ratio of Listed shares to Jarociński and Karadi MP median shock in pp. Bands denote the 95% confidence interval.
Figure 3.8 (right): same specifications but without COVID.

B.4. Unlisted shares & other equity



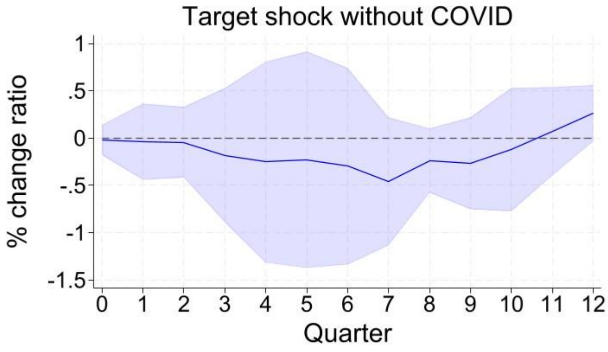
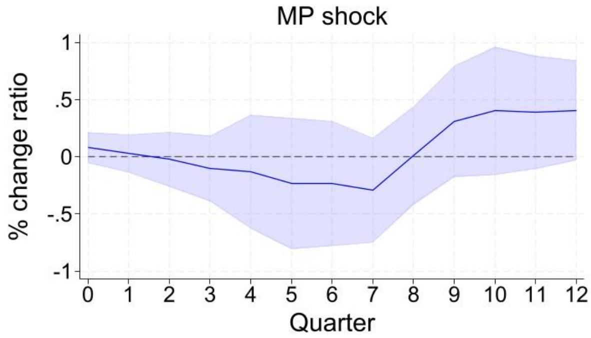


Figure 4.3 (left): IRF of D10/B50 wealth ratio of Unlisted shares & other equity to Altavilla et al. QE shock in pp. Sample excludes COVID. Bands denote the 95% confidence interval.
Figure 4.4 (right): same specifications but with Altavilla et al. Target shock.



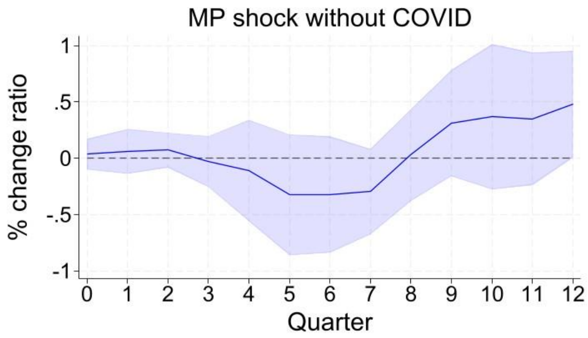
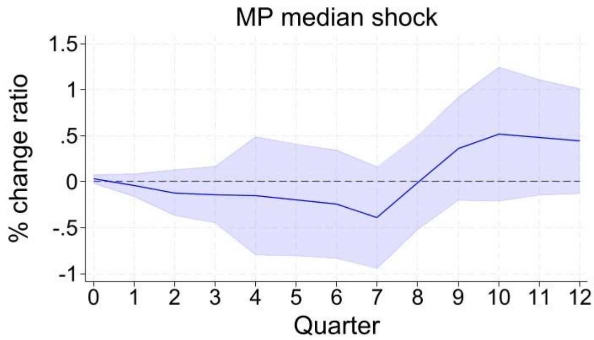


Figure 4.5 (left): IRF of D10/B50 wealth ratio of Unlisted shares & other equity to Jarociński and Karadi MP shock in pp. Bands denote the 95% confidence interval.
Figure 4.6 (right): same specifications but without COVID.



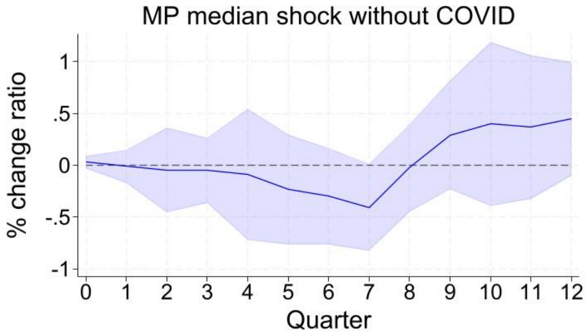
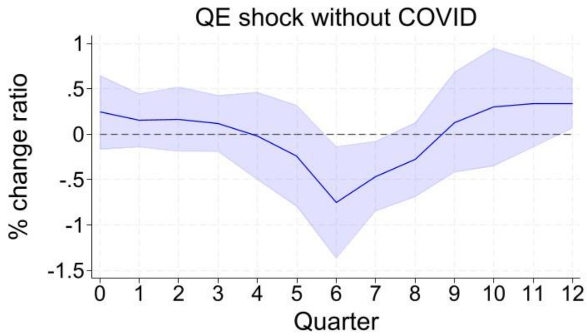


Figure 4.7 (left): IRF of D10/B50 wealth ratio of Unlisted shares & other equity to Jarociński and Karadi MP median shock in pp. Bands denote the 95% confidence interval.
Figure 4.8 (right): same specifications but without COVID.

B.5. Investment fund shares/units



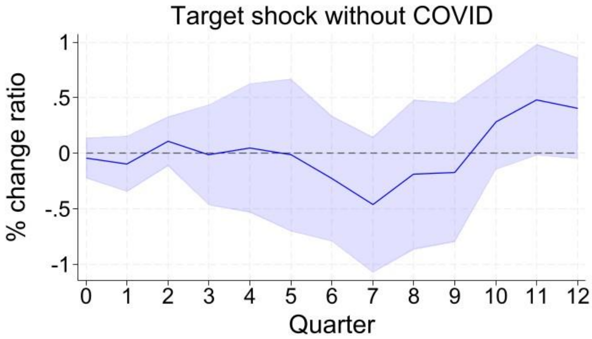
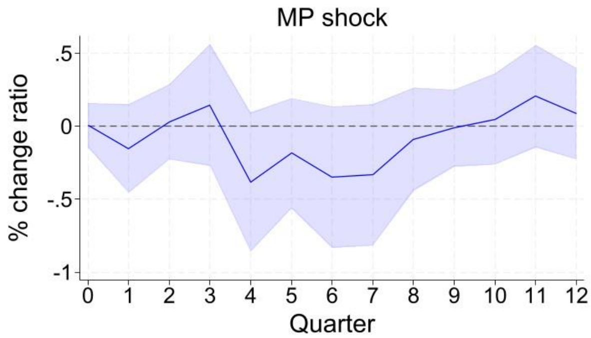


Figure 5.3 (left): IRF of D10/B50 wealth ratio of Investment fund shares/units to Altavilla et al. QE shock in pp. Sample excludes COVID. Bands denote the 95% confidence interval.
Figure 5.4 (right): same specifications but with Altavilla et al. Target shock.



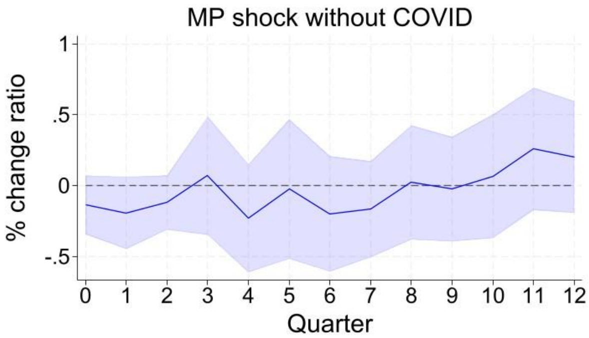
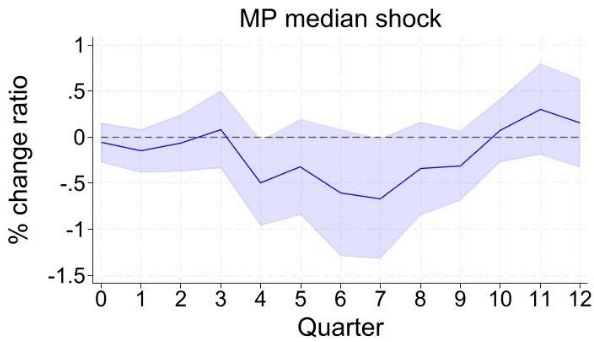


Figure 5.5 (left): IRF of D10/B50 wealth ratio of Investment fund shares/units to Jarociński and Karadi MP shock in pp. Bands denote the 95% confidence interval.
Figure 5.6 (right): same specifications but without COVID.



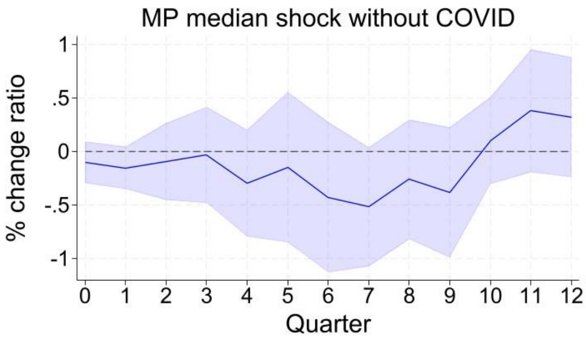
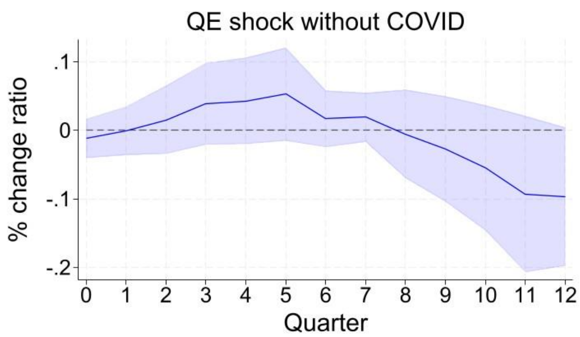


Figure 5.7 (left): IRF of D10/B50 wealth ratio of Investment fund shares/units to Jarociński and Karadi MP median shock in pp. Bands denote the 95% confidence interval.
Figure 5.8 (right): same specifications but without COVID.

B.6. Housing wealth



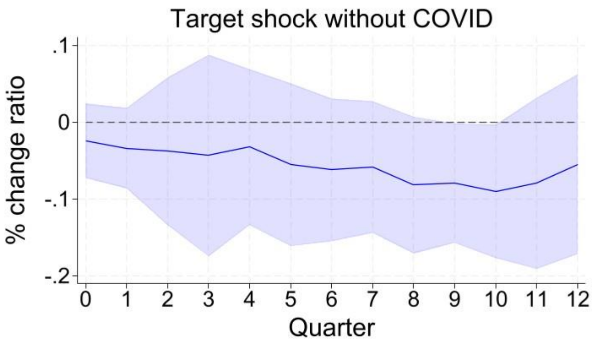
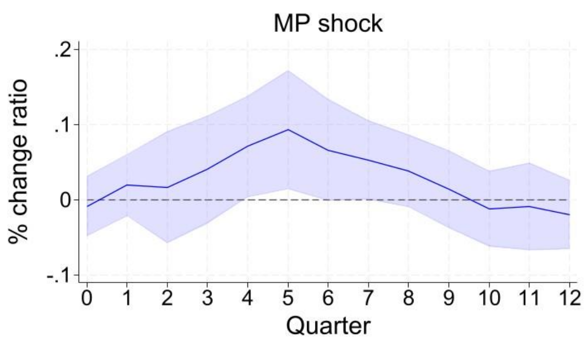


Figure 6.3 (left): IRF of D10/B50 wealth ratio of Housing wealth to Altavilla et al. QE shock in pp. Sample excludes COVID. Bands denote the 95% confidence interval.
Figure 6.4 (right): same specifications but with Altavilla et al. Target shock.



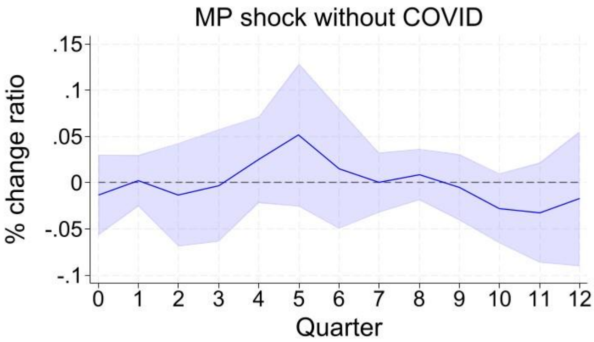
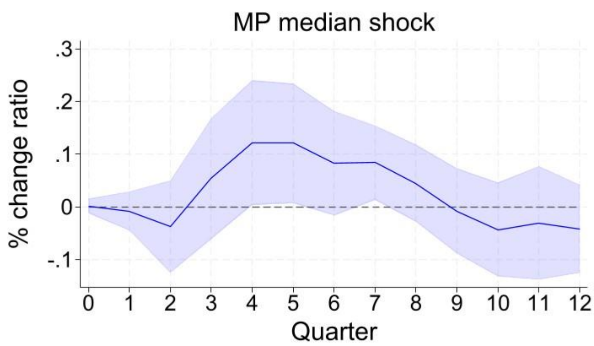


Figure 6.5 (left): IRF of D10/B50 wealth ratio of Housing wealth to Jarociński and Karadi MP shock in pp. Bands denote the 95% confidence interval.
Figure 6.6 (right): same specifications but without COVID.



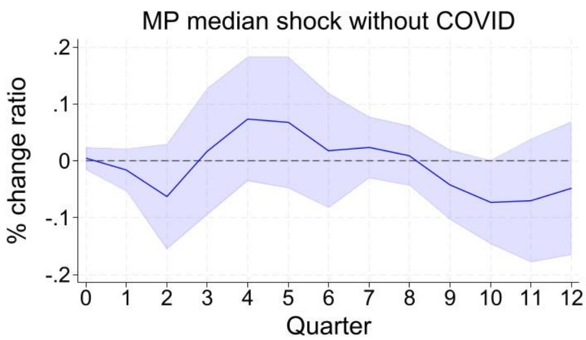
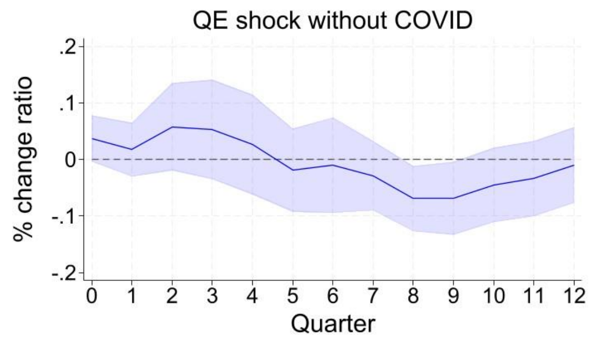


Figure 6.7 (left): IRF of D10/B50 wealth ratio of Housing wealth to Jarociński and Karadi MP median shock in pp. Bands denote the 95% confidence interval.
Figure 6.8 (right): same specifications but without COVID.

B.7. Net wealth



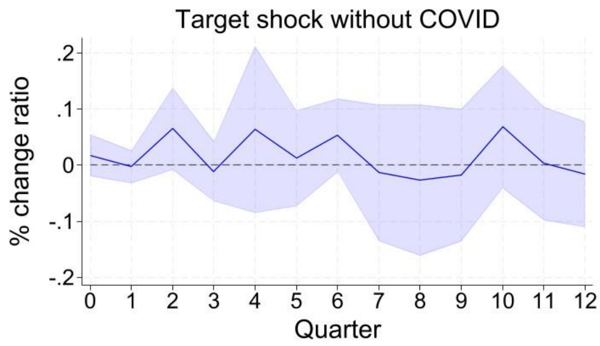
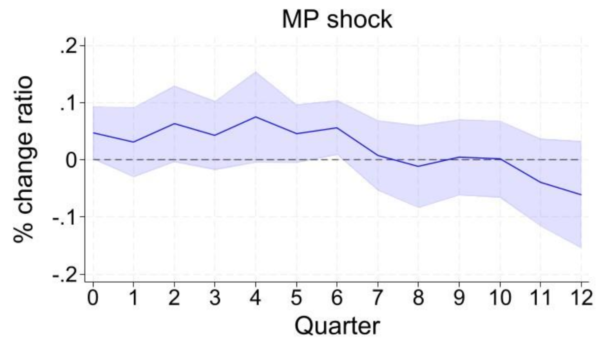


Figure 7.3 (left): IRF of D10/B50 wealth ratio of Net wealth to Altavilla et al. QE shock in pp. Sample excludes COVID. Bands denote the 95% confidence interval.
Figure 7.4 (right): same specifications but with Altavilla et al. Target shock.



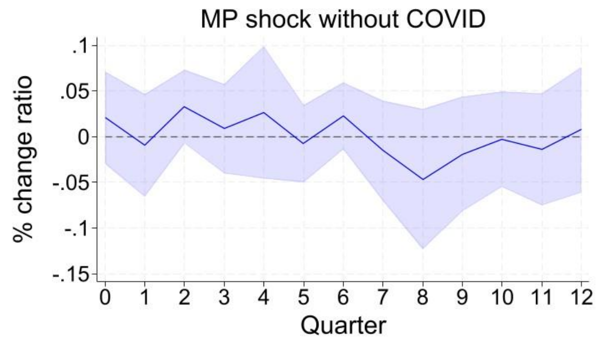
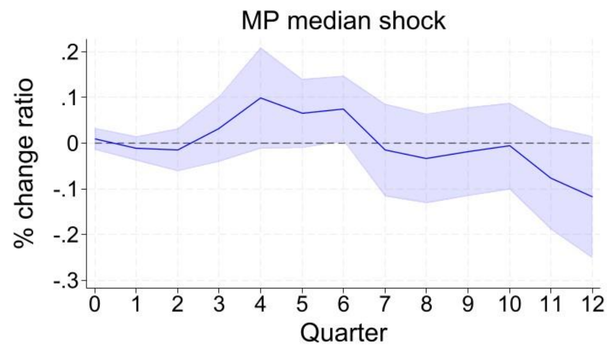


Figure 7.5 (left): IRF of D10/B50 wealth ratio of Net wealth to Jarociński and Karadi MP shock in pp. Bands denote the 95% confidence interval.
Figure 7.6 (right): same specifications but without COVID.



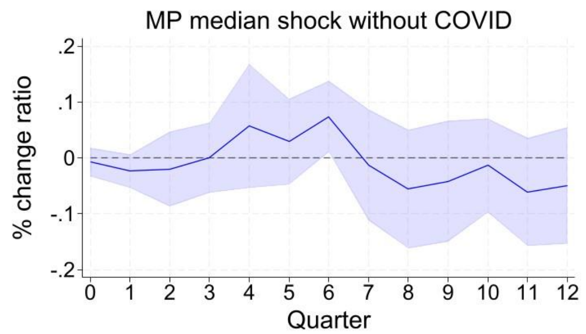
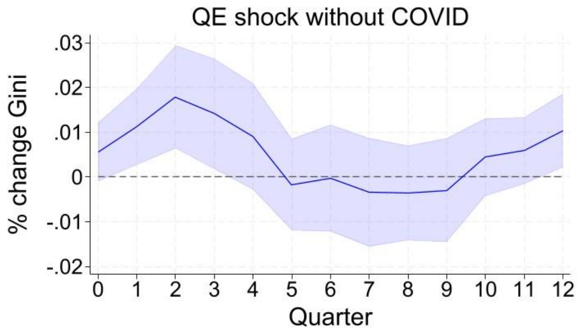


Figure 7.7 (left): IRF of D10/B50 wealth ratio of Net wealth to Jarociński and Karadi MP median shock in pp. Bands denote the 95% confidence interval.
Figure 7.8 (right): same specifications but without COVID.

B.8. Net wealth Gini coefficient



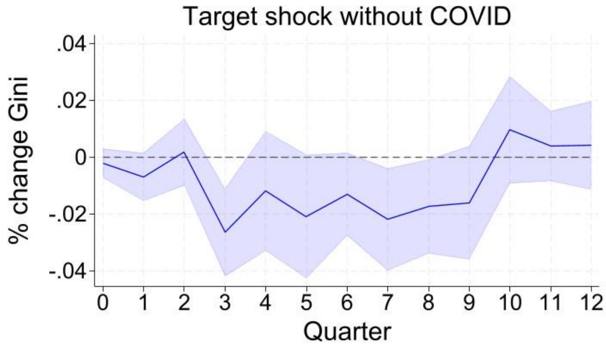
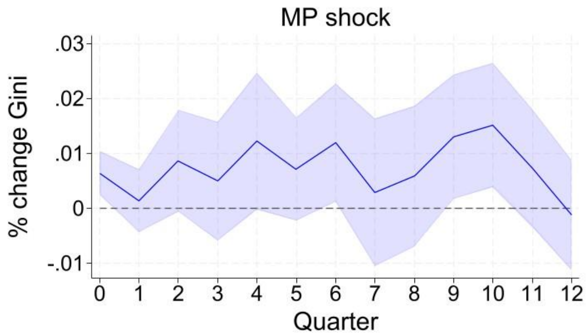


Figure 8.3 (left): IRF of Net wealth Gini coefficient to Altavilla et al. QE shock in pp. Sample excludes COVID. Bands denote the 95% confidence interval.
Figure 8.4 (right): same specifications but with Altavilla et al. Target shock.



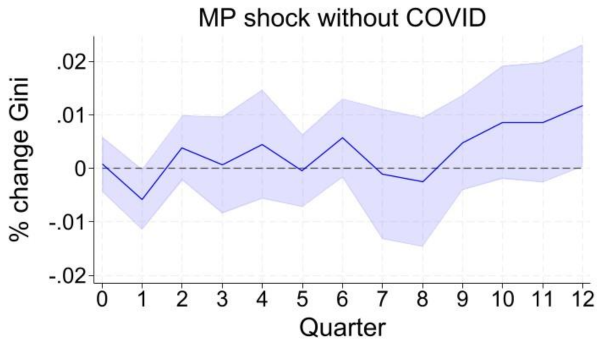
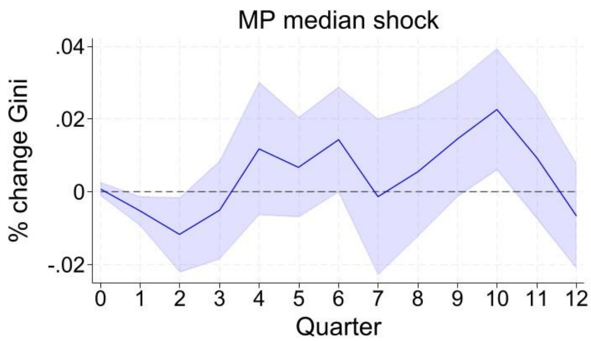


Figure 8.5 (left): IRF of Net wealth Gini coefficient to Jarociński and Karadi MP shock in pp. Bands denote the 95% confidence interval.
Figure 8.6 (right): same specifications but without COVID.



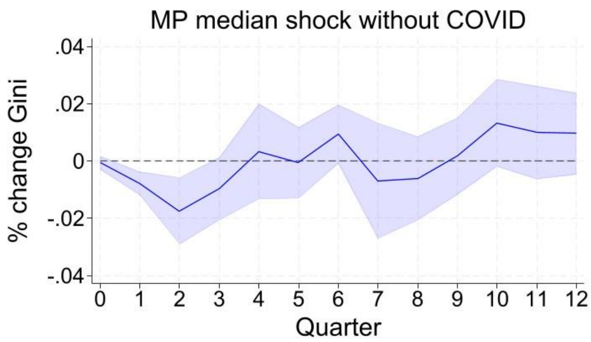


Figure 8.7 (left): IRF of Net wealth Gini coefficient to Jarociński and Karadi MP median shock in pp. Bands denote the 95% confidence interval.
Figure 8.8 (right): same specifications but without COVID.