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## **“One Size Fits All”? Monetary Policy, Inequality and Core-Periphery Divide in the Euro Area**

Guilherme Amaral Ricardo

Master in Economics

Supervisor;  
PhD, Sofia de Sousa Vale, Associate Professor (with  
Aggregation),  
Department of Economics at Iscte Business School

September, 2025



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Department of Economics

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*Dedicated to my parents.*



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## **Abstract**

This dissertation examines how the European Central Bank's (ECB) single monetary policy asymmetrically affects income inequality in core and peripheral euro area countries. Using quarterly data from 2002 to 2022, we estimate several Panel Vector Autoregression (PVAR) specifications that combine three policy instruments – interest rates, the Wu and Xia shadow rate, and quantitative easing – with three inequality metrics: the Gini coefficient, the Bottom 50% income share, and the Top 1% income share. The analysis distinguishes between direct transmission effects and indirect effects via the financial and labor market channels, presenting results separately for core and periphery.

A key distinction is made between the full-sample interest rate model (2002Q1–2022Q4) and a post-crisis version (2012Q1–2022Q2). The former provides a long-run perspective, while the latter aligns with the ECB's zero lower bound environment and enables comparison with unconventional monetary policy tools.

The findings reveal clear regional heterogeneity. In the full-sample model, monetary tightening reduces inequality in the core but increases it in the periphery through indirect channels. In the post-crisis model, this pattern reverses, with rate hikes widening inequality in the core and narrowing it in the periphery. Shadow rate shocks show weaker, mostly indirect effects, with opposite signs across regions. Quantitative easing strongly reduces inequality in the periphery but widens it in the core, with gains concentrated at the top.

Overall, the results show that a “one size fits all” monetary policy produces markedly different – and often opposing – distributional outcomes, underscoring the need for region-specific fiscal policies.

## **Keywords**

Inequality; Monetary Policy; European Central Bank; Core–Periphery; Unconventional Policy

## **JEL Codes**

E52; E58

## **Resumo**

Esta dissertação analisa como a política monetária única do Banco Central Europeu (BCE) afeta de forma assimétrica a desigualdade de rendimentos entre países centrais (core) e periféricos da área do euro. Com dados trimestrais de 2002 a 2022, estimam-se várias especificações de Panel Vector Autoregression (PVAR) que combinam três instrumentos de política – taxas de juro, a shadow rate de Wu e Xia e o Quantitative Easing – com três métricas de desigualdade: o coeficiente de Gini, a quota dos 50% mais baixos e a do 1% do topo. A análise distingue efeitos diretos e indiretos, através dos canais financeiro e laboral, apresentando resultados separadamente para core e periferia.

Uma distinção central é feita entre o modelo de taxas de juro da amostra completa (2002Q1–2022Q4) e uma versão pós-crise (2012Q1–2022Q2). O primeiro fornece uma perspetiva de longo prazo, enquanto o segundo permite comparação com políticas não convencionais.

Os resultados mostram heterogeneidade regional. No modelo completo, o aperto monetário reduz a desigualdade no core, mas aumenta-a na periferia. No pós-crise, o padrão inverte-se: subidas das taxas ampliam a desigualdade no core e reduzem-na na periferia. Os choques da shadow rate têm efeitos fracos e sobretudo indiretos, com sinais opostos entre regiões. Já o Quantitative Easing reduz a desigualdade na periferia, mas alarga-a no core, beneficiando o topo da distribuição.

Conclui-se que a política monetária de “one size fits all” gera resultados distintos – e por vezes opostos – reforçando a necessidade de políticas fiscais adaptadas às condições de cada região.

### **Palavras-chave**

Desigualdade; Política Monetária; Banco Central Europeu; Core-Periferia; Política Monetária Não Convencional

### **JEL Codes**

E52; E58

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## 1. Introduction

*“One size fits all!” (Issing, 2005). But does it really?* This study investigates that question in the context of the euro area’s single monetary policy and its distributional consequences. Inequality has become an increasingly prominent topic in advanced economies, as its persistent rise threatens both economic performance and social stability. The euro area presents a particularly revealing case. When the European Monetary Union was created, policymakers anticipated convergence among its members. Yet, as Popovic (2024) observes, this convergence has not materialized. Instead, structural differences have often deepened, and the single monetary policy may have amplified existing asymmetries between countries. In fact, the euro area’s single monetary policy may have reinforced such asymmetries, not only at the macroeconomic level but also in terms of income distribution. Monetary policy can shape inequality both directly – by altering interest rates – and indirectly, through channels such as labor markets, financial asset prices, and savings behavior (Colciago et al., 2019; McKay & Wolf, 2023).

While much research has examined the euro area’s macroeconomic performance, less attention has been paid to how monetary policy affects inequality across its structurally diverse member states. Previous studies, such as Wortmann and Stahl (2016), have explored how the ECB’s single policy interacts with the core-periphery divide, but most have not focused on the distributional effects or integrated detailed income metrics with multiple transmission channels. This thesis addresses that gap by combining a core-periphery framework with both conventional and unconventional monetary policy measures, multiple indicators of inequality, and an explicit focus on the financial market, labor market, and savings redistribution channels.

Using quarterly data from 2002 to 2022, we estimate 24 Panel Vector Autoregression (PVAR) specifications covering three policy types – interest rates, the Wu and Xia shadow rate, and quantitative easing—while incorporating both the Gini coefficient and Piketty’s (2014) income percentiles. Importantly, the analysis distinguishes between the full sample (2002Q1–2022Q4) and the post-crisis period (2012Q1–2022Q2), the latter aligning with the ECB’s zero lower bound environment and the introduction of unconventional policy tools. By explicitly modelling the financial market and labor market channels alongside direct effects, the analysis provides a richer and more systematic assessment of monetary policy’s asymmetric distributional impact in the euro area.

This work contributes to the literature by examining the distributional effects of monetary policy in the euro area through a core-periphery framework, which remains relatively underexplored. In contrast to most previous studies, it considers both conventional and unconventional instruments, distinguishes between pre- and post-crisis periods, and uses multiple measures of inequality –

including the Gini coefficient and Piketty’s income percentiles. By incorporating both direct and indirect transmission channels, the analysis offers a broader perspective on how monetary policy affects income distribution across heterogeneous member states. In doing so, it adds empirical evidence to the debate on whether the ECB’s single monetary policy can deliver uniform outcomes across structurally diverse economies.

At a glance, the results reveal that monetary policy’s effects are far from uniform. Interest rate hikes reduce inequality in the core but increase it in the periphery when considering the full sample, yet this pattern reverses in the post-crisis period. Shadow rate shocks show weaker, mainly indirect effects, with opposite signs across regions. Quantitative easing strongly reduces inequality in the periphery but widens it in the core. Across all models, the balance between direct and indirect channels emerges as a central driver of these differences. This divergence underscores the broader argument of the thesis: in the euro area, one size does not fit all. These findings are not only of academic interest but also carry direct policy relevance, as they highlight the need for complementary fiscal strategies tailored to each country’s structural conditions in order to counteract the uneven distributional effects of a single monetary policy.

The work is then divided as follows: Chapter 2 reviews the literature on monetary policy and inequality, focusing on the euro area’s structural asymmetries and the relevance of the core–periphery divide. It also discusses the main theoretical transmission channels – both direct and indirect – through which monetary policy can affect income distribution. Chapter 3 outlines the empirical strategy, describing the PVAR methodology, the data and variables employed, the classification of countries into core and periphery, and the distinction between conventional and unconventional policy periods. Chapter 4 presents the results for each of the three policy instruments – interest rates, shadow rates, and quantitative easing – across all inequality measures, emphasizing regional differences in the magnitude and direction of effects. Finally, Chapter 5 summarizes the main findings, draws the policy implications, and offers suggestions for future research.

## 2. Literature Review

In this chapter we will present an overview of the literature made until this point, firstly on the effects of different types of monetary policy on inequality and later the asymmetric effects of monetary policy within the Eurozone.

### 2.1 Monetary policy and Inequality

Inequality has been an economic concern for decades. Kuznets (1955) defined it through the Kuznets curve, arguing that inequality follows a U-shaped pattern, suggesting that income inequality initially rises during economic development before declining as economies mature. More recent empirical studies, however, challenge this assumption. Piketty and Saez (2006) found that rather than declining naturally, inequality in advanced economies has followed a persistent upward trend, largely due to the concentration of wealth among the top earners. Moreover, Piketty (2014) argued that economic forces favor capital accumulation over wage growth, leading to a continuous rise in inequality unless countered by strong fiscal policy.

Monetary policy, which is mainly used as a tool to control and stabilize prices, can also affect inequality and, as some authors argue, can have a direct impact on it. (Coibion et al., 2017; Samarina & Nguyen 2024; Guerello, 2018). Monetary policy can affect inequality both through conventional policy – short-term interest rate fluctuations – or unconventional policy – usually associated with quantitative easing (Lenza & Slacalek, 2024 and Bivens, 2015) or shadow rates (Wu & Xia, 2017).

Policy makers are becoming more aware of the importance of finding the right policy (e.g., Draghi 2015), however, there is no consensus in the literature on the effects of monetary policy on inequality, with some authors finding that, for instance, contractionary monetary policy increases inequality (Coibion et al., 2017; Guerello, 2018; Mumtaz & Theophilopoulou, 2017), while others find the opposite trend (Inui et al., 2017 and Cloyne et al., 2020).

Contractionary monetary policy, which is usually related to the raising of interest rates, is found, in many studies, that leads to an increase in income and earnings inequality (Colciago et al, 2019; Mumtaz & Theophilopoulou, 2017; Guerello, 2018 and Samarina & Nguyen, 2024). An increase in interest rates slows the economy, increases unemployment, and leads to lower wages. Since low-income households often rely more heavily on wages for their income, they are disproportionately impacted by these policy shifts. On the other hand, higher-income households, which typically have greater savings rates, tend to benefit from the increased interest earnings. With both effects happening simultaneously, the income gap between households will widen. (Coibion et al., 2017).

Samarina and Nguyen (2024), studying the Euro Area, highlight in their research that expansionary monetary policy shocks generally lead to lower income inequality by stimulating economic activity, reducing unemployment, and boosting wages, which predominantly benefit poorer households without significantly impacting richer ones. However, when considering the financial assets channel, expansionary policies tend to increase asset prices, disproportionately benefiting households in the upper income percentiles who have greater access to financial markets (McKay & Wolf, 2023). If we also consider labor market rigidities or the delayed response of wages to these policies (Inui et al., 2017), expansionary monetary policies might paradoxically increase inequalities, as observed also in the UK and the US (Cloyne et al., 2020).

Unconventional monetary policy, in the form of Quantitative Easing (QE), also has its place in the literature. Bivens (2015) concludes that QE strongly reduces inequality, by studying the effect of Fed’s policy after 2008. The author states that a more expansionary policy will lead to less inequality than a lesser expansionary policy, because it pushes the economy closer to full employment, benefiting the lower to moderate wage workers. Lenza and Slacalek (2024) also demonstrate that QE reduces income inequality, not only on the earning heterogeneity channel, but also on the portfolio composition channel, whose increase in stock prices is balanced by the increased housing wealth.

Beyond this debate, the distributional consequences of monetary policy depend on how different economic groups interact with financial markets and labor structures. Monetary policy, while applied uniformly within a country, has different effects on different households, given their different relationships with financial assets, real estate, or labor markets. As McKay and Wolf (2023) point out, this uniform application can lead to heterogeneous effects within the same economic region.

Colciago et al. (2019) state that monetary policy is transmitted to households in three main effects – the income effect, the wealth effect and the substitution effect. The income effect relates to how changes in interest rates affect savers and borrowers, while the wealth effect is related to the fluctuation in the value of financial assets or real estate because of changes in interest rates. The choice between saving or borrowing/investing money is part of the substitution effect, where lower interest rates typically encourage households to shift from saving towards borrowing or investing, as the opportunity cost of holding savings decreases and credit becomes more accessible.

These effects are then applied through a variety of transmission channels – expansionary monetary policy will accelerate the economy, as stated before, and lead to higher wages for workers, benefiting those with higher labor income (McKay & Wolf, 2023).

At the same time, expansionary monetary policy will, through the financial assets and portfolio composition channel, raise financial asset values, favoring households that hold more financial assets

– usually higher income percentile households (Samarina & Nguyen, 2024; Lenza & Slacalek, 2024). Again, showing that the same monetary policy can have different effects on inequality.

The savings redistribution channel adds to the difficulty of determining whether monetary policy reduces or increases inequality. Expansionary policies, such as low interest rates, reduce borrowing costs and increase access to credit, benefiting indebted households. (Amaral, 2017) However, they also reduce the returns to saving, disadvantaging income groups with higher savings accounts and reducing incentives to save (Schnabel, 2021). In contrast, contractionary policies that raise interest rates benefit savers by increasing returns on deposits and bonds, but make borrowing more expensive, disproportionately burdening low-income households with higher levels of debt (Doepke & Schneider, 2006 and Coibion et al., 2017).

Auclert (2019) examines the interest rate channel and finds that borrowers with long-term liabilities, such as mortgages, benefit from lower interest rates, as this reduces their debt costs and can increase the value of their assets. On the other hand, savers who hold short-term investments, such as savings accounts, short-term bonds, or certificates of deposit, receive lower returns on their savings. This results in a redistribution of wealth from short-term savers to long-term borrowers.

## 2.2 Fundamental Asymmetries in the Euro area

Even before the formation of the European Monetary Union (EMU), Bayoumi and Eichengreen (1993) identified that there was fundamentally an asymmetric pattern between the countries.

When it was formed, the EMU was expected to contribute to a convergence between its members although as seen in the current literature, the opposite effect ended up happening (Popovic, 2024). Popovic (2024) stated that a single monetary policy cannot accommodate the fundamentally different needs of the heterogeneous economies in the EMU, leading to economic polarization rather than convergence.

Cesaroni et al. (2019) support the hypothesis of a pronounced core-periphery dualism within the euro area. They argue that this division goes beyond mere economic stability and affects how countries in each group interact with European integration, globalization, and other economic dynamics. For example, the impact of GDP growth on income inequality differs significantly between these groups: in core countries, GDP growth was negatively correlated with inequality, suggesting that economic expansion helps reduce inequality. Conversely, in the peripheral economies, GDP growth was positively correlated with inequality.

However, the size and composition of these groups vary depending on the variables considered (Vale, 2024; Campos & Macchiarelli, 2021). While most authors divide the EMU into the two aforementioned groups, Campos and Macchiarelli (2021) introduce a new framework using the NORD method. This method asserts that countries can be divided into three groups – Hard Core, Intermediate Group and Extended Periphery – and that the probability of a country belonging to a particular group evolves over time. In this framework, the higher the NORD level, the more peripheral the country is considered. The NORD index is measured by the percentage of rejections of the underlying structural macroeconomic AD-AS (Aggregate Demand-Aggregate Supply) model, i.e. the more often this model is rejected, the less symmetric, and thus the more peripheral, the country is.

There have always been concerns about the structural complexity of the EMU and the fact that a single monetary policy would need to be a positive fit for all its members. In his 2005 speech, Otmar Issing confidently asserted, "Today, in light of the evidence gathered so far in the euro area, I am more confident in saying: 'One size does fit all!'" (Issing, 2005)

The “One size does fit all” statement ended up being present in the literature about the unique ECB’s monetary policy, sparking some debate among authors. Wortmann and Stahl (2016) started their analysis by noting that it would be impossible to fit a single monetary policy smoothly in a group with such a specific core-periphery framework. The authors make a clear distinction between the GIIPS

(Greece, Italy, Ireland, Portugal, and Spain) and the core members (such as Germany, Austria, France, and the Netherlands), even stating that countries with a higher deficit, such as Greece, affect the efficiency and stability of the monetary union (Wortmann & Stahl, 2016), emphasizing that the exit of such countries could ultimately improve the overall functionality of the EMU.

Wortmann & Stahl (2016) finally conclude that the unique currency can positively affect some countries while negatively affecting others, or in other words – one size fits only some.

### **2.3 Monetary Policy and Asymmetries in the Euro Area**

The asymmetric effects of monetary policy and the relationship between inequality and monetary policy - in the euro area – are two issues that have grown in importance in recent decades and have attracted the attention of economists around the world.

These issues have been approached in different ways. Some authors look directly for convergence among EMU members (Popovic, 2024 and Vale, 2024). Popovic (2024) examines inflation convergence within the euro area and finds little to no convergence in this regard. Vale (2024), on the other hand, also found that countries do not converge on any inequality indicator except for the richest 1%, also concluding that the core-periphery framework may not fully capture the EMU dualism.

Samarina and Nguyen (2024) study both conventional and unconventional monetary policies, including a shadow interest rate in their exploration of unconventional policies. Choosing the labor market and financial asset channels as the transmission channels of monetary policy, the authors find that expansionary policies reduce income inequality in the EMU, especially in peripheral countries. Similarly, Lenza and Slacalek (2024), using a Bayesian VAR model and household simulations, find that QE – a form of unconventional monetary policy mainly used in the US and the UK – has heterogeneous effects across the EMU, operating through channels such as income composition, portfolio composition and income heterogeneity.

Cesaroni et al. (2019) also find asymmetries, with financial integration having a negative effect on inequality in core countries but a positive effect in periphery countries.

However, the existing literature lacks a detailed analysis of the asymmetric effects of the euro area's single monetary policy on inequality, notably through the portfolio composition, income composition, savings redistribution, and labor market channels, using the income percentage indicators outlined by Piketty (2014).

Moreover, the specific effects of unconventional monetary policies, such as quantitative easing and the use of shadow rates (Wu & Xia, 2017), remain underexplored, especially in the context of the core-periphery dynamics of the Economic and Monetary Union (EMU), which calls for further research in this regard.

### **3. Empirical strategy and methodology**

#### **3.1 Data**

To study the dynamics of asymmetric monetary policy effects across the Euro Area, we selected a sample of 11 countries. This includes 10 of the original 11 founding members of the Economic and Monetary Union (EMU) – Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, and Spain – excluding Luxembourg due to its small size and unique economic characteristics. Greece was also included, reflecting its long-standing membership and relevance to euro area macroeconomic dynamics.

The classification of countries into core and periphery groups is based on their average Gini coefficient over the period 2002–2022. Countries with an average Gini value below 30 are categorized as core, while those above 30 are classified as periphery. This yielded the following division: for the core (from lowest to highest Gini), Finland, Belgium, the Netherlands, Austria, Germany, and France; and for the periphery, Ireland, Portugal, Spain, Greece, and Italy.

This classification is broadly consistent with established approaches in the literature (Wortmann & Stahl, 2016), where core countries are typically associated with lower levels of inequality, reflecting their greater macroeconomic stability, stronger institutional quality, and more resilient labor markets. These features often translate into more equitable income distribution, as stable labor markets provide better employment opportunities and social safety nets, while institutional strength supports progressive taxation and redistributive policies.

In contrast, peripheral countries – often referred to as GIIPS (Greece, Italy, Ireland, Portugal, and Spain) – tend to exhibit higher levels of inequality, linked to weaker labor market structures, higher unemployment, and greater exposure to external shocks. These vulnerabilities, especially in the aftermath of the 2008 financial crisis, have constrained their capacity to shield lower-income groups from economic downturns, amplifying disparities in income and wealth (Wortmann & Stahl, 2016).

The full dataset covers the period from 2002Q1 to 2022Q4 and is constructed at a quarterly frequency. This time frequency is widely adopted in the literature on monetary policy transmission, as it allows capturing the short- to medium-term effects of ECB decisions more accurately. Due to data availability limitations, inequality measures were originally available only at an annual frequency. In such cases, linear interpolation is applied to convert them into quarterly series, ensuring consistency across the panel structure.

To study the effects of monetary policy on income inequality, the model includes the Gini coefficients sourced from the Standardized World Income Inequality Database (SWIID) – as the primary

inequality indicator. We also include two alternative measures of inequality from the World Inequality Database (WID): the income share of the top 1%, and the income share of the bottom 50%. These additional indicators allow us to better capture changes across the income distribution and assess whether the effects of monetary policy differ across its extremes. For conventional monetary policy, the deposit facility rate (sourced from the ECB) is used as a proxy for the interest rate, based on quarterly averages. Unconventional monetary policy is captured through two complementary variables: the total size of the European Central Bank’s balance sheet (to proxy for quantitative easing), and the shadow interest rate developed by Wu and Xia (2017), which extends the concept of interest rates into the negative lower bound period.

To control for the macroeconomic conjuncture, the unemployment rate, from the Eurostat database, is included, as it is both a policy target and a key transmission channel. Additionally, national stock market indices are incorporated to capture financial asset price effects and to assess the indirect transmission channel of monetary policy through financial markets. These indices include: the ATX (Austria), BEL 20 (Belgium), OMX 30 (Finland), CAC 40 (France), DAX (Germany), ATHEX (Greece), ISEQ (Ireland), FTSE MIB (Italy), AEX (Netherlands), PSI 20 (Portugal), and IBEX 35 (Spain).

### **3.2 Methodology**

We explore how monetary policy affects inequality by distinguishing between direct and indirect channels of transmission. The direct channels refer to cases where monetary policy impacts the Gini index directly – through changes in interest rates (in both the interest rate and shadow rate models) or via quantitative easing, captured by movements in the ECB’s balance sheet. Indirect channels, on the other hand, involve variables that are influenced by monetary policy and subsequently affect inequality. We capture these by including financial indexes to represent the asset price channel, and the unemployment rate to represent the labor market channel.

The asset price channel has been shown to transmit monetary shocks unequally through financial markets, particularly benefiting asset holders and higher-income households (Ampudia et al., 2018; Coibion et al., 2017).

The labor market channel, in turn, captures the impact of monetary policy on employment and wages – two key determinants of household income. Unemployment shocks are especially relevant for lower-income groups, making this a central mechanism through which inequality responds to policy changes (Furceri et al., 2018; Draghi, 2016).

Since this study aims to assess the effects of three distinct forms of monetary policy – interest rates, shadow rates, and quantitative easing (QE) – on income inequality, a separate PVAR model is estimated for each policy type. For interest rates, two variants are considered: a full-sample model covering 2002Q1 to 2022Q4, and a post-crisis model covering 2012Q1 to 2022Q2, the latter matching the time horizon of the unconventional monetary policy specifications. To account for regional heterogeneity within the Euro Area, all models are estimated separately for core and periphery countries. In addition, inequality is measured using three indicators: the Gini index, the Bottom 50% income share, and the Top 1% income share. This yields a total of 24 model specifications, reflecting the combination of four monetary policy model variants (full-sample interest rates, post-crisis interest rates, shadow rates, QE), three inequality measures, and two country groups. For each of these specifications, all relevant statistical procedures – including the selection of optimal lag length, tests for stationarity, and model stability diagnostics – are performed individually to ensure the accuracy and robustness of the analysis.

The estimation periods differ according to the institutional and economic context in which each monetary policy tool became relevant within the Euro Area. The interest rate model is estimated from 2002Q1 to 2022Q4, encompassing the full period in which conventional interest rate policy served as the ECB’s primary monetary instrument. This includes both the pre-crisis and post-crisis phases, allowing for an analysis of the impact of standard monetary tightening or easing measures on inequality across the Euro Area.

To complement the full-sample interest rate specification, we also estimate a post-crisis variant covering the period from 2012Q1 to 2022Q2. This restricted horizon matches that of the unconventional monetary policy models, enabling a direct comparison of the distributional effects of all three instruments within the same economic environment. The starting point of 2012 coincides with the onset of the zero lower bound in the euro area, when the ECB’s deposit facility rate approached or entered negative territory and the effectiveness of conventional policy tools was increasingly constrained. By isolating this period, the model captures potential changes in the transmission of interest rate policy under conditions where non-standard measures played a central role.

In contrast, both the shadow rate and quantitative easing (QE) models are estimated from 2012Q1 to 2022Q4. This choice reflects the ECB’s transition into a period of unconventional monetary policy. Around 2012, nominal interest rates in the euro area approached zero, rendering traditional rate-based instruments increasingly ineffective – a condition often described as the zero lower bound (ZLB). In response, the ECB began adopting more accommodative tools, including forward guidance and liquidity provision, which were not fully captured by nominal rates. The shadow rate, developed by Wu and Xia

(2016), provides a theoretically consistent measure of the stance of monetary policy during this time by incorporating the effects of such non-standard measures. As interest rates moved into negative territory and diverged from the actual deposit facility rate, the shadow rate became a more informative proxy for monetary accommodation. Thus, beginning the estimation of the shadow rate model in 2012Q1 allows us to align the analysis with the period when shadow rates started to meaningfully reflect policy conditions under the ZLB regime (Wu & Xia, 2017).

Similarly, the QE model also starts in 2012Q1 to capture the early stages of the ECB’s balance sheet expansion, even before the official announcement of the Asset Purchase Programme (APP) in January 2015. Although large-scale asset purchases formally began in March 2015, the ECB had already introduced preparatory and complementary non-standard measures between 2012 and 2014, such as the Securities Markets Programme (SMP) and Long-Term Refinancing Operations (LTROs). These interventions began to significantly influence the size and composition of the ECB’s balance sheet and, by extension, the financial and macroeconomic environment (ECB, 2015). By including this earlier phase, the model accounts not only for the formal QE operations, but also for anticipatory effects and transitional dynamics that may have impacted inequality.

<b>Models</b>	<b>Time horizon</b>
Interest Rates – Full sample	2002q1 to 2022q4
Interest Rate – Post-crisis	2012q1 to 2022q2
Shadow Rates	2012q1 to 2022q2
Quantitative Easing (QE)	2012q1 to 2022q2

To capture the dynamic relationships between variables while accounting for heterogeneity across countries, we employ the Panel Vector Autoregression (PVAR) methodology developed by Abrigo and Love (2016). The optimal lag length was determined using standard information criteria – MBIC, MAIC, and MQIC – by identifying the specification that minimized each criterion. In cases where the criteria pointed to different optimal lags (e.g., MBIC suggesting lag 1 while MAIC and MQIC pointed to lags 2 or 3), preference was generally given to the lower lag, particularly when it yields more stable and interpretable results. Beyond the information criteria, the quality of the impulse response functions (IRFs) – including the clarity of dynamic patterns and the tightness of confidence intervals – was also considered in selecting the lag length. While a lag length of one is optimal in most model specifications, some models require higher lags to adequately capture the underlying dynamics. The final lag choices thus reflect a balance between statistical criteria and the empirical performance of the models. Details of the selected lag lengths across models can be found in Tables A 1 to A 6 of the Appendix. The PVAR framework is especially well-suited for this analysis, as it enables the modeling of feedback effects and interdependencies among macroeconomic and inequality-related variables over time, while

accommodating cross-country heterogeneity. Additionally, its flexible structure facilitates the comparison between core and periphery countries, a central aim of this study. The baseline PVAR model is specified as:

$$Y_{i,t} = A_1 Y_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

where  $Y_{i,t}$  is a vector of endogenous variables for country  $i$  at time  $t$ , including the the monetary policy variable (which differs across models: interest rates, shadow rates, or ECB asset holdings), the financial assets prices, and the unemployment rate and the inequality variable (which also differs across model variants: Gini index, Bottom 50% income share and Top 1% income share). The ordering of variables is determined based on their expected reaction speed to monetary policy shocks. The monetary policy variable is placed first, as it is assumed to be the exogenous driver of the system. Next is the financial index, which tends to respond almost immediately to changes in monetary policy. This is followed by the unemployment rate, reflecting the slower adjustment of labor market conditions. Finally, the inequality variable is ordered last, under the assumption that distributional outcomes respond with the longest lag to macroeconomic shocks.

All variables are treated as endogenous within the system and fixed effects are removed through forward orthogonal deviations (FOD) as proposed by Arellano and Bover (1995). This estimator effectively addresses concerns related to endogeneity and unobserved heterogeneity across countries while preserving the time-series properties of the data.

We assess the stationarity of the variables using both first-generation and second-generation unit root tests (Appendix – Table A 7 to A 10). The results confirm that all variables used in the models are stationary across the two different time horizons, ensuring the validity of the panel VAR specifications. Specifically, the Gini index, Bottom 50%, and Top 1% income shares are stationary in levels; the interest rates, shadow rates, and unemployment rate are stationary in first differences; and both the ECB’s asset holdings (used in the QE model) and the financial asset price index are stationary in log-first differences. These findings support the overall stability and robustness of the model estimates.

We now proceed to detail each of the three main variants of the baseline model – namely, the interest rate model, the shadow rate model, and the quantitative easing (QE) model. For each specification, we assess the validity of the estimation by evaluating model stability to ensure the robustness of the results.

### **3.2.1 Interest rates model – Full Sample**

The first model, which serves as the baseline specification, estimates the effect of conventional monetary policy on inequality. This model includes the ECB’s deposit facility rate as the monetary policy variable. Income inequality is measured using the Gini coefficient, the Top 1% income share, and the Bottom 50% income share. Each inequality measure is estimated in a separate regression to isolate its individual response to monetary policy shocks, as these measures reflect distinct aspects of the income distribution. Additional control variables include a financial index, capturing asset market behavior, and the unemployment rate, which serves as a proxy for labor market dynamics. These variables represent the indirect transmission channels of monetary policy – namely, the financial market and labor market channels – through which policy changes may influence income inequality. The model is estimated over the full sample period, from the first quarter of 2002 to the fourth quarter of 2022.

The vector of endogenous variables includes the first-differenced ECB deposit rate, the log-differenced financial index, the first-differenced unemployment rate and the differenced Gini index (or alternatively, the Top 1% or Bottom 50% income share).

The stability of the models was also verified by checking that all eigenvalues lie strictly within the unit circle, confirming the model’s (and its variants) dynamic consistency.

### **3.2.2 Interest rates model – Post-crisis**

In addition to the full-sample interest rates model, a second specification is estimated for the post-crisis period, from 2012Q1 to 2022Q2. This shorter time horizon is chosen to match the estimation periods of the shadow rate and QE models, allowing for a direct comparison of results across all three monetary policy tools within the same economic and institutional context. The starting point of 2012 coincides with the euro area’s entry into a prolonged low interest rate environment, where the ECB’s deposit facility rate approached the zero lower bound and unconventional measures became increasingly important in the monetary policy toolkit.

The structure of the post-crisis model is identical to the baseline interest rates specification. The ECB’s deposit facility rate is used as the monetary policy variable, inequality is measured alternately by the Gini coefficient, the Bottom 50% income share, and the Top 1% income share, and the unemployment rate and national stock market indices are included to capture the indirect labor market and financial market channels. The ordering of variables, transformations, and estimation procedures remain unchanged.

As in the other specifications, optimal lag length selection, unit root tests, and stability diagnostics are performed separately for this sample period to account for any changes in the statistical properties of the variables. The model is estimated separately for core and periphery countries, and the results are presented alongside those from the full-sample interest rates model, the shadow rate model, and the QE model. This makes it possible to assess whether the role of conventional monetary policy in shaping income inequality changes when its operation is constrained by the lower bound environment.

### **3.2.3 Shadow rates model**

The second model focuses on unconventional monetary policy by incorporating the shadow short rate developed by Wu and Xia (2016) as the monetary policy instrument. This specification captures the ECB’s monetary stance during the zero lower bound (ZLB) period, when conventional interest rate tools became ineffective. The shadow rate provides a continuous and theoretically grounded estimate of policy accommodation, even in environments where nominal rates are constrained near or below zero. In the context of the Euro Area, the zero lower bound (ZLB) became a practical constraint around 2012, as official interest rates approached zero and lost effectiveness as a policy tool. During this period, the shadow rate began to meaningfully diverge from the official policy rate, reflecting the ECB’s shift toward negative rates and more accommodative measures (Wu & Xia, 2017). The model is therefore estimated over the 2012Q1 to 2022Q2 period to align with the timeline of unconventional policy activity.

The model retains the structure and control variables of the baseline interest rate model, differing only in the monetary policy proxy. Specifically, the vector of endogenous variables includes the shadow short rate, the financial index, the unemployment rate and the Gini index (or alternatively, the Top 1% or Bottom 50% income share)

As with the baseline model, the shadow rate specification is estimated separately for core and periphery countries, enabling a comparative analysis of how unconventional monetary policy transmits across different regional structures. Model’s stability (and its variants) was verified by confirming that all eigenvalues fall strictly within the unit circle, indicating dynamically stable VAR systems across both regional panels and for all the inequality variants.

### **3.2.4 Quantitative Easing model**

The third model assesses the impact of quantitative easing (QE) as an unconventional monetary policy instrument on income inequality in the euro area. In this specification, the ECB’s total assets are used as a proxy for balance sheet expansion under the central bank’s asset purchase programmes. While the ECB had already introduced several non-standard measures before 2015, such as the ECB’s Securities Markets Programme (SMP) and the Long-Term Refinancing Operations (LTROs), large-scale asset purchases under the Asset Purchase Programme (APP) were formally announced in January 2015 and initiated in March of that year (ECB, 2015). Nevertheless, the model’s estimation window begins in 2012Q1 to account for the anticipatory effects and preparatory interventions that began to influence the ECB’s balance sheet prior to the formal implementation of the APP.

As in the other two model specifications, this QE model retains the same set of inequality and control variables, altering only the monetary policy proxy. The Gini coefficient, Top 1%, Bottom 50%, unemployment rate, and financial index are included with the same transformations and stationarity tests as in the baseline.

The model is estimated separately for core and periphery countries, enabling an analysis of regional heterogeneity in the effects of quantitative easing. Model stability is also confirmed by verifying that all eigenvalues lie strictly within the unit circle, ensuring the dynamic stability of the estimated VAR systems in both regional panels.

### **3.3 Results estimation process**

To conclude the methodological framework, we complement the panel VAR estimations with three diagnostic and interpretative tools: Granger causality tests, impulse response functions (IRFs), and forecast error variance decompositions (FEVDs). Granger causality tests are conducted using Wald tests to evaluate whether lagged values of one variable significantly explain movements in another within the panel context. This allows us to formally identify directional dependencies between monetary policy variables and inequality outcomes across both core and periphery country groups.

Next, impulse response functions are used to trace the dynamic effects of a one-unit orthogonalized shock to a given variable – such as the monetary policy variables, the financial index variables or the unemployment rate – on the inequality indicators. These IRFs are estimated using 200 Monte Carlo simulations, which provide bootstrapped confidence intervals for statistical inference. In line with Abrigo and Love (2016), the 95% confidence intervals allow us to assess the precision and

significance of the estimated responses over a 10-quarter forecast horizon, offering a robust understanding of short- and medium-term dynamics in response to policy shocks.

Finally, forecast error variance decomposition (FEVD) is applied to quantify the proportion of the forecast error variance in the inequality measures that can be attributed to each explanatory variable. This decomposition helps assess the relative contribution of monetary policy and indirect channels – such as labor market and financial market conditions – to changes in income inequality. The FEVD thus complements the IRFs by identifying which variables are most influential in explaining inequality dynamics, offering an additional layer of interpretability across models and country groupings.

Together, these tools provide a comprehensive and empirically grounded assessment of the mechanisms through which monetary policy – both conventional and unconventional – affects income inequality across the euro area.

## **4. Results**

The results section is divided into four parts – one for the Interest Rates Model (full sample), one for the Interest Rates Model – Post-Crisis, one for the Shadow Rates Model, and one for the Quantitative Easing (QE) Model. These models are used to examine how different types of ECB monetary policy – one conventional (in two time horizons) and two unconventional – affect income inequality across core and peripheral Euro Area countries. Inequality is measured using the Gini index, complemented by the income shares of the Top 1% and the Bottom 50%. Following the methodology of Abrigo and Love (2016), each subsection presents: Granger causality tests; Impulse Response Functions (IRFs) to analyze the effects of monetary policy shocks; and Forecast Error Variance Decompositions (FEVDs) to evaluate the relative contribution of each variable to inequality dynamics. For the full-sample interest rate model, the estimation period is 2002Q1 to 2022Q4, while the post-crisis interest rate model covers 2012Q1 to 2022Q2, matching the time horizons of the unconventional monetary policy specifications.

### **4.1 Interest Rates Model – Full Sample**

We begin the analysis with the interest rates model, covering the period from 2002Q1 to 2022Q4. This model examines how changes in the ECB’s deposit facility rate affect income inequality in both core and periphery Eurozone countries. The Granger causality tests (Table 4.1) already reveal notable differences between the two groups: in core countries, interest rates Granger-cause inequality, suggesting a direct relationship. In contrast, in the periphery, inequality is Granger-caused only by the two indirect channel variables – financial indexes and the unemployment rate. These initial results already point to heterogeneity in how monetary policy operates across the two regions.

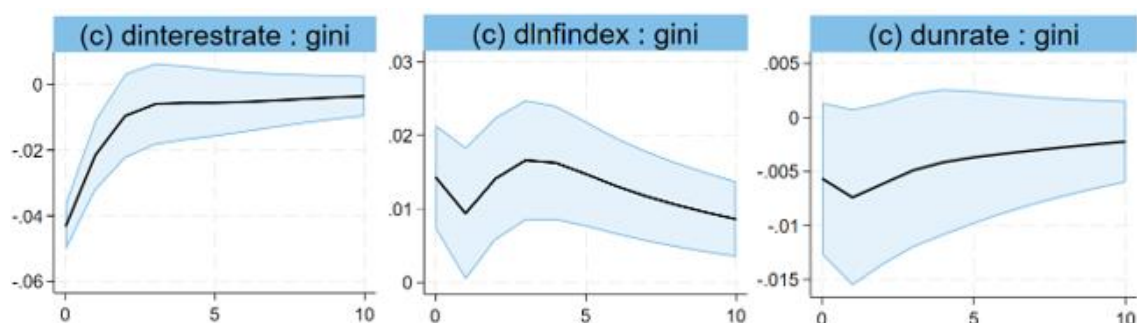
**Table 4.1 - Granger causality Wald test (Interest rates model)**

GINI			
CORE	p-value	PERIPHERY	p-value
Interest Rate	0.002*	Interest Rate	0.811
Financial Indexes	0.428	Financial Indexes	0.000*
Unemployment Rate	0.403	Unemployment Rate	0.000*
BOTTOM 50%			
CORE	p-value	PERIPHERY	p-value
Interest Rate	0.000*	Interest Rate	0.135
Financial Indexes	0.017*	Financial Indexes	0.005*
Unemployment Rate	0.872	Unemployment Rate	0.057**
TOP 1%			
CORE	p-value	PERIPHERY	p-value
Interest Rate	0.000*	Interest Rate	0.859
Financial Indexes	0.005*	Financial Indexes	0.000*
Unemployment Rate	0.019*	Unemployment Rate	0.115

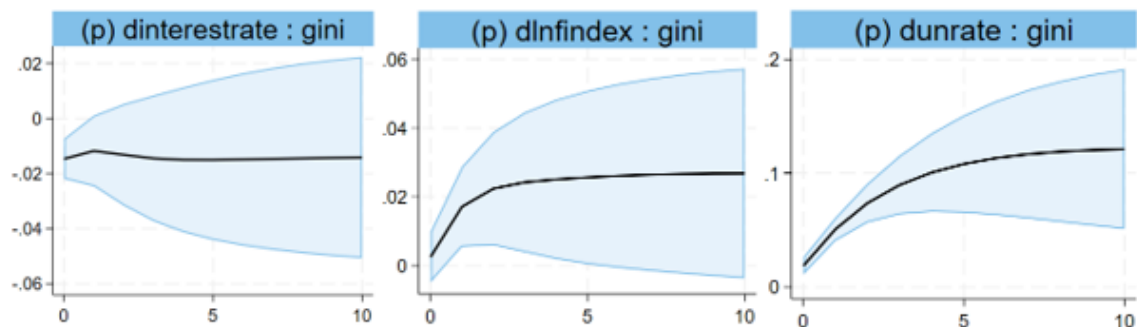
Notes: \*p-values below 0.05 \*\*p-values between 0.05 and 0.10

The impulse response functions (IRFs) offer further support for the asymmetric distributional effects of monetary policy across Euro Area regions (Figure 4.1). In core countries, a contractionary monetary shock – represented by an interest rate hike – leads to an immediate decline in the Gini coefficient, with the effect dissipating by period 4. This short-term reduction in inequality reflects a relatively stronger and earlier increase in the income share of the Bottom 50% compared to the Top 1% (Figure 4.3), suggesting a temporary narrowing of the income distribution. In contrast, periphery countries do not exhibit a significant Gini response to interest rate shocks. Instead, inequality in these regions is more sensitive to labor market dynamics, as evidenced by a stronger response to unemployment shocks (Figure 4.2). Financial market shocks also contribute modestly to inequality in the periphery, highlighting the greater importance of indirect transmission channels in these regions.

**Figure 4.1 - Effect of interest rate, financial asset prices and unemployment rate shocks on Gini coefficient (Core countries “c”)**



**Figure 4.2 - Effect of interest rate, financial asset prices and unemployment rate shocks on Gini coefficient (Periphery countries "p")**



The 10-step forecast error variance decomposition (FEVD) offers additional insights into these dynamics (Table 4.2 and Table 4.3). In core economies, the Gini coefficient remains largely self-driven (accounting for 84.37% of its own variation), with interest rates contributing 8.9% – a modest but meaningful share compared to financial indexes (0.6%) and unemployment (0.07%). This supports the interpretation that monetary policy plays a direct role in shaping inequality in core countries.

In the periphery, FEVD results differ markedly. The unemployment rate is the dominant external predictor of Gini fluctuations, explaining 63.08% of its variance – far exceeding all other channels. Financial indexes explain a modest 3.7%, while interest rates contribute almost nothing (1.37%), reinforcing the earlier IRF results that the direct effect of interest rates on inequality in the periphery is negligible, and that the labor market is the key transmission channel.

**Table 4.2 - Forecast-error variance decomposition (Core countries) – 10 quarters horizon**

	<i>Own variance</i>	<i>Interest Rate</i>	<i>Financial Assets</i>	<i>Unemployment Rate</i>
<i>Gini</i>	.8436662	.0890259	.0600507	.0072572
<i>Bottom 50%</i>	.8622756	.0714854	.0642047	.0020343
<i>Top 1%</i>	.6955625	.2683182	.0322188	.0039004

**Table 4.3 - Forecast-error variance decomposition (Periphery countries) – 10 quarters horizon**

	<i>Own variance</i>	<i>Interest Rate</i>	<i>Financial Assets</i>	<i>Unemployment Rate</i>
<i>Gini</i>	.3182124	.0137015	.0372011	.630885
<i>Bottom 50%</i>	.7876308	.0581819	.0912153	.062972
<i>Top 1%</i>	.8913584	.0007951	.1061675	.001679

To complement this analysis, we examine the responses of the Bottom 50% and Top 1% income shares to conventional monetary policy in both core and periphery countries. These disaggregated

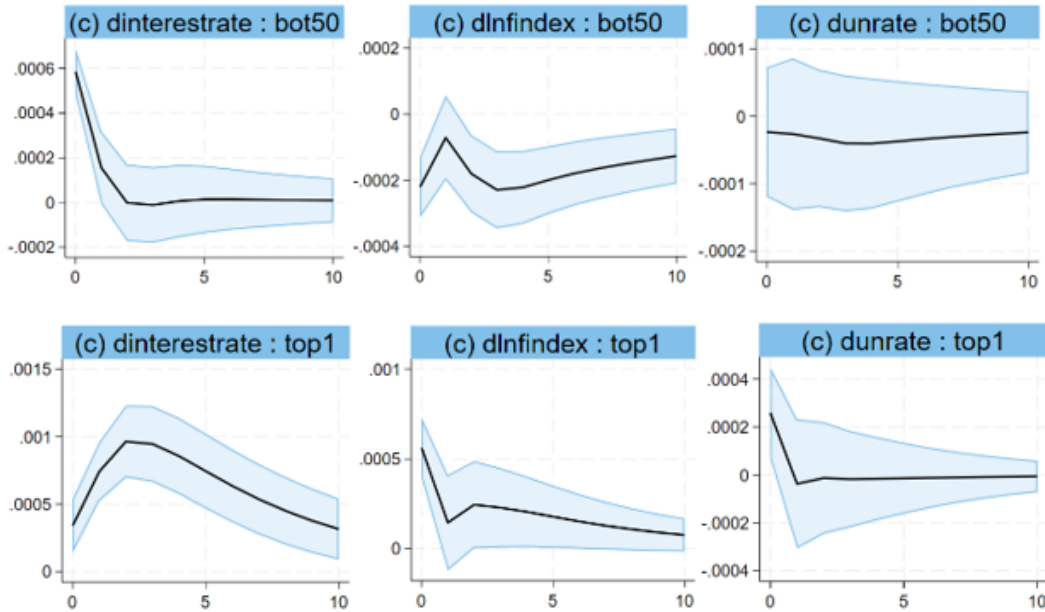
metrics provide a clearer picture of distributional asymmetries, especially in the presence of ambiguous Gini responses.

In core countries, following an interest rate hike, the income shares of both the Bottom 50% and the Top 1% increase. However, the timing and magnitude of these gains differ (Figure 1). The rise in the Bottom 50%'s income share is more pronounced in the short term - particularly within the first three periods - relative to that of the Top 1%. This is consistent with the observed decline in the Gini coefficient during the same horizon, indicating a temporary reduction in overall income inequality. Forecast error variance decomposition results (Table 4.2) further reinforce this interpretation, showing that interest rate shocks are the primary drivers of income share fluctuations for both groups. Together, these findings suggest that monetary policy has a direct and distributionally significant impact on income dynamics in core economies.

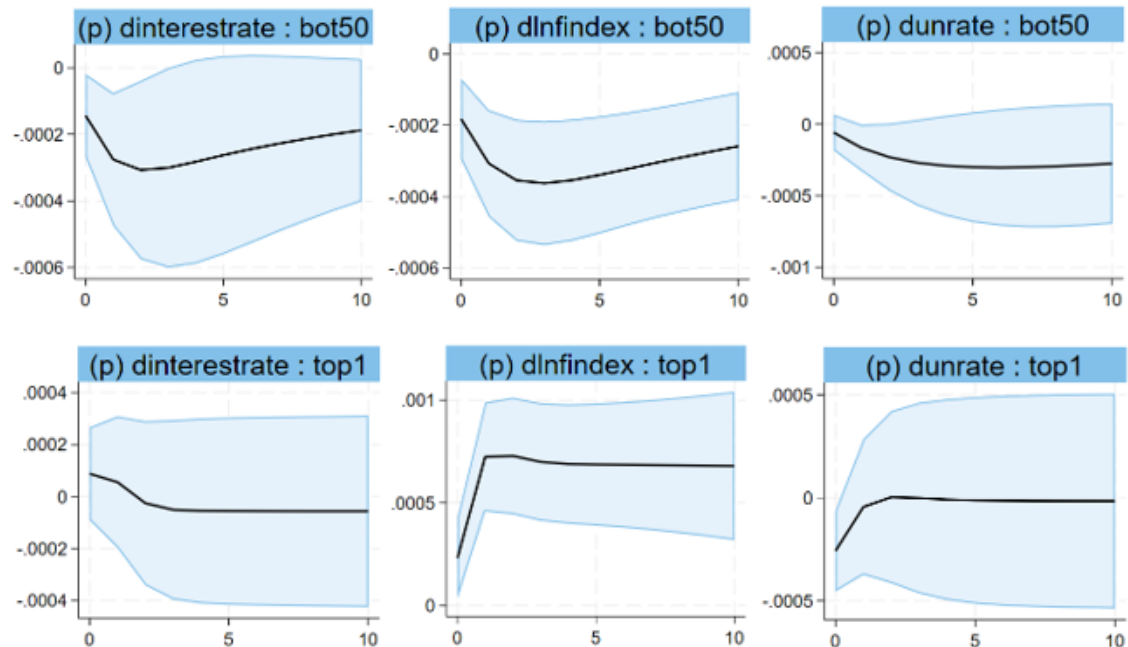
In the periphery, the Top 1% and Bottom 50% are less affected by interest rates directly. Instead, unemployment shocks explain the bulk of income share fluctuations, again highlighting that the periphery experiences the effects of monetary policy primarily through labor market channels, rather than through direct financial or interest rate mechanisms.

In periphery countries, once more, the impact works mainly through indirect channels. Financial market shocks benefit households with greater exposure to financial assets - typically the Top 1% - while reducing the income share of asset-poor households. This is consistent with findings in Ampudia et al. (2018), who show that wealth composition strongly influences how households respond to financial shocks. Our impulse response functions (IRFs) reveal that financial index shocks increase the Top 1% share and decrease the Bottom 50% share (Figure 4.3 and Figure 4.4). Additionally, unemployment shocks appear to disproportionately affect the Bottom 50%, whose incomes depend more heavily on labor earnings. Their income shares decline following a rise in unemployment, reflecting their vulnerability to labor market fluctuations. Interestingly, the Top 1% also experiences a temporary decline in income in the first two periods, which then stabilizes around zero – potentially due to the resilience of capital income or a delayed adjustment in high-income returns. (Mumtaz & Theophilopoulou, 2017).

**Figure 4.3 - Effect of interest rate, financial asset prices and unemployment rate shocks on Bottom 50% and Top 1% percentiles (Core countries "c")**



**Figure 4.4 - Effect of interest rate, financial asset prices and unemployment rate shocks on Bottom 50% and Top 1% percentiles (Periphery countries "p")**



Overall, the findings from the interest rate model highlight the asymmetric effects of conventional monetary policy across Euro Area regions. In core countries, monetary tightening is associated with a temporary reduction in income inequality, as reflected by a decline in the Gini coefficient following

interest rate shocks. This appears to be driven by a relatively stronger short-term increase in the income share of the Bottom 50% compared to the Top 1%, particularly within the first three periods. Both groups ultimately benefit, but the Bottom 50% experiences earlier and more substantial gains. Forecast error variance decomposition (FEVD) results confirm that interest rate shocks are the most influential drivers of income share fluctuations in both groups, underscoring the direct role of monetary policy in shaping income distribution. These findings emphasize the value of using disaggregated income metrics alongside summary indicators like the Gini coefficient, which may obscure important dynamics, particularly in the tails of the distribution.

In contrast, periphery countries experience inequality changes mainly through indirect channels – particularly labor market shocks – which disproportionately affect lower-income households dependent on wages as stated by Samarina and Nguyen (2024). Financial markets also contribute modestly to inequality in these regions, reinforcing the role of structural differences in shaping policy transmission.

These findings emphasize the importance of regional and distributional heterogeneity when assessing the effects of monetary policy in the Euro Area. They suggest that interest rate tools may yield uneven results depending on national economic structures and household profiles. This reinforces the need to explore how unconventional monetary policy - through shadow rates or quantitative easing - affects inequality in the evolving low-interest rate environment.

#### **4.2 Interest Rates Model – Post-crisis**

We now turn to the post-crisis interest rates model, estimated over the 2012Q1–2022Q2 period to match the time horizon of the unconventional monetary policy specifications. This period corresponds to the euro area’s prolonged low interest rate environment, in which the ECB’s deposit facility rate approached or entered negative territory and unconventional measures became an increasingly important part of the policy mix.

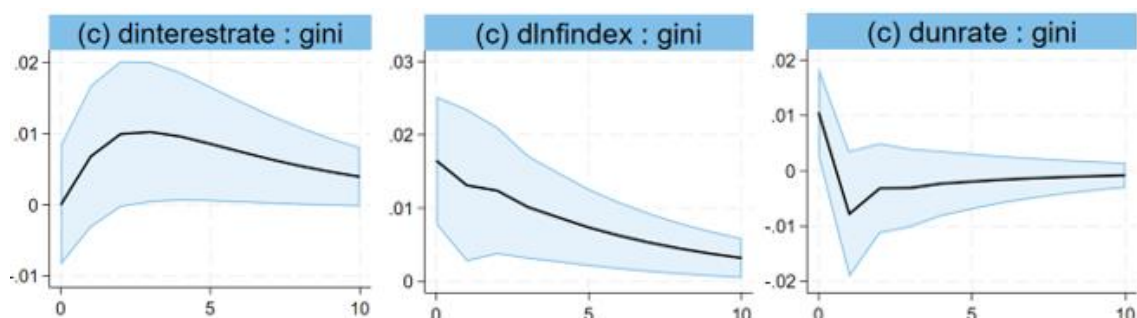
**Table 4.4 - Granger causality Wald test (Interest rates model – Post-crisis)**

GINI			
CORE	p-value	PERIPHERY	p-value
Interest Rate	0.073**	Interest Rate	0.000*
Financial Indexes	0.236	Financial Indexes	0.014*
Unemployment Rate	0.000*	Unemployment Rate	0.882
BOTTOM 50%			
CORE	p-value	PERIPHERY	p-value
Interest Rate	0.000*	Interest Rate	0.022*
Financial Indexes	0.278	Financial Indexes	0.012*
Unemployment Rate	0.159	Unemployment Rate	0.332
TOP 1%			
CORE	p-value	PERIPHERY	p-value
Interest Rate	0.000*	Interest Rate	0.253
Financial Indexes	0.724	Financial Indexes	0.657
Unemployment Rate	0.052**	Unemployment Rate	0.446

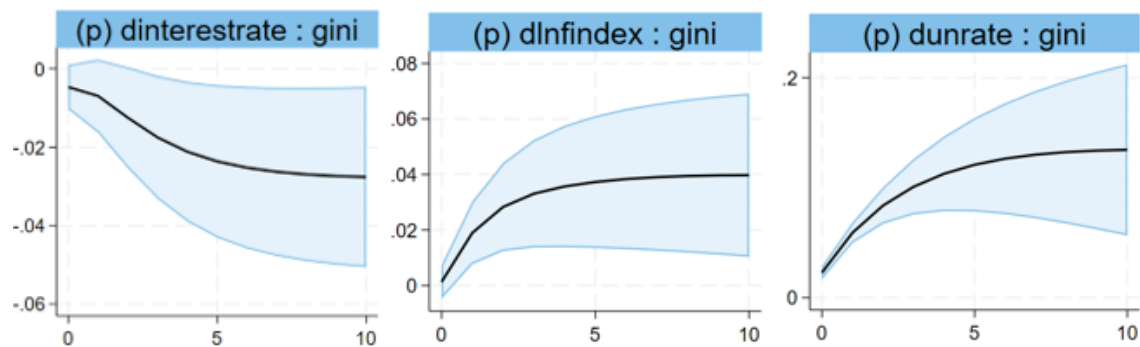
Notes: \*p-values below 0.05 \*\*p-values between 0.05 and 0.10

The Granger causality tests (Table 4.4) reveal that in both core and periphery countries, interest rates are a statistically significant predictor of inequality. In the core, the deposit facility rate Granger-causes the Gini coefficient at the 10% level ( $p = 0.073$ ), while in the periphery the relationship is highly significant ( $p = 0.000$ ). In addition, unemployment shows a strong link with inequality in the core ( $p = 0.000$ ) but remains insignificant in the periphery, whereas financial indexes are significant in the periphery ( $p = 0.014$ ) but not in the core. These results already suggest a shift in the transmission channels compared to the full-sample model.

**Figure 4.5 - Effect of interest rate, financial asset prices and unemployment rate shocks on Gini coefficient (Core countries “c”, Post-crisis)**



**Figure 4.6 - Effect of interest rate, financial asset prices and unemployment rate shocks on Gini coefficient (Periphery countries “p”, Post-crisis)**



The impulse response functions (Figure 4.5 and Figure 4.6) highlight a clear reversal in the direction of effects relative to the 2002–2022 estimates. In the core countries, a contractionary monetary shock – represented by an increase in the deposit facility rate – now leads to an immediate and persistent rise in the Gini coefficient, indicating that interest rate hikes have become inequality-widening in this period. By contrast, in the periphery, the same shock produces a sustained decline in the Gini coefficient, pointing to an inequality-reducing effect of monetary tightening. This progressive outcome for the periphery is a notable departure from the full-sample model, where interest rates had no significant direct impact on the Gini index.

The 10-step forecast error variance decomposition (Table 4.5 and Table 4.6) provides additional insights. In the core, the Gini coefficient remains largely self-driven (88.6%), with interest rates explaining 3.8% of its variance, financial indexes 6.2%, and unemployment 1.4%. For the periphery, interest rates explain a slightly larger share of Gini variation (4.2%), with financial indexes contributing 10.5% and unemployment 6.9%. Compared to the full-sample model, the periphery’s direct sensitivity to interest rate shocks has increased, while the relative importance of the unemployment channel has decreased.

**Table 4.5 - Forecast-error variance decomposition (Core countries) - 10 quarters horizon**

	<i>Own variance</i>	<i>Interest Rate</i>	<i>Financial Assets</i>	<i>Unemployment Rate</i>
<i>Gini</i>	.8863308	.0377475	.0619838	.013938
<i>Bottom 50%</i>	.8209024	.0868119	.0170446	.0752411
<i>Top 1%</i>	.8565854	.0422287	.0038271	.0973588

**Table 4.6 - Forecast-error variance decomposition (Periphery countries) - 10 quarters horizon**

	<i>Own variance</i>	<i>Interest Rate</i>	<i>Financial Assets</i>	<i>Unemployment Rate</i>
<i>Gini</i>	.7843294	.0416899	.1049866	.0689941
<i>Bottom 50%</i>	.9319039	.0255498	.0412384	.0013079
<i>Top 1%</i>	.9725639	.0242761	.0002756	.0028844

To complement this analysis, we examine the responses of the Bottom 50% and Top 1% income shares to interest rate shocks in the post-crisis period. These disaggregated measures provide additional insight into the asymmetric distributional effects observed in the Gini responses.

In core countries, the Granger causality tests indicate that interest rates are a highly significant driver of both the Bottom 50% ( $p = 0.000$ ) and the Top 1% ( $p = 0.000$ ) income shares, with unemployment also exerting some influence on the Top 1% ( $p = 0.052$ ). The IRFs show that a contractionary monetary shock leads to a decline in the income share of the Bottom 50% and a simultaneous increase in the share of the Top 1%. These movements reinforce the Gini results for the post-crisis period, confirming that interest rate hikes in the core are now inequality-widening, with gains accruing disproportionately to the highest earners. FEVD results further underscore this dynamic: interest rate shocks account for 8.7% of Bottom 50% variation and 4.2% for the Top 1%, while unemployment explains 7.5% and 9.7%, respectively.

In the periphery, the pattern diverges from the core. Interest rates significantly Granger-cause the Bottom 50% share ( $p = 0.022$ ) but have no significant effect on the Top 1% ( $p = 0.253$ ). The IRFs suggest that an interest rate hike produces a sustained increase in the Bottom 50% share, while the Top 1% experiences a small and short-lived decline. However, these impulse responses display relatively wide confidence intervals, indicating lower statistical precision and making the interpretation of the effects less robust. While the direction of change is consistent with the post-crisis Gini findings for the periphery – where monetary tightening reduces inequality – the strength of the evidence should be treated with caution. The FEVDs show that interest rates explain 2.6% of the variation in the Bottom 50% and 2.4% for the Top 1%, while financial indexes remain more important for the Bottom 50% (4.1%) and have negligible influence on the Top 1%.

Overall, the post-crisis income shares results highlight a sharp contrast between regions: in the core, rate hikes reallocate income upward toward the Top 1%, whereas in the periphery they boost the relative position of the Bottom 50%. This shift in the direction of distributional effects underscores how the same conventional monetary policy instrument can produce opposite equity outcomes depending on regional economic structures and transmission channels.

These results show a clear change in how conventional monetary policy affects inequality in the post-crisis period. In the full-sample model, interest rate hikes had no direct impact on inequality in the periphery and reduced it in the core. In the post-crisis estimates, the pattern is the opposite: higher rates now increase inequality in the core and reduce it in the periphery. This shift may be partly explained by the economic and institutional changes that followed the euro area crisis, which reshaped financial markets, labor conditions, and household finances. In the core, greater reliance on wealth and more divided labor markets may have made rate hikes more regressive. In the periphery, credit conditions had already improved compared to the crisis years due to lower sovereign risk, bank recapitalization, and renewed investor confidence. Against this more stable backdrop, modest rate hikes from very low levels may have helped contain inflation pressures and signaled macroeconomic stability, indirectly supporting the purchasing power of lower-income households. These findings show that the impact of monetary policy on inequality depends heavily on each region’s economic structure – such as its labor markets, wealth distribution, and banking systems – and on the particular pathways through which policy changes affect households. In a period of persistently low interest rates, these differences play an even greater role in shaping outcomes. The next step is to see whether unconventional monetary policy – through shadow rates and quantitative easing – shows similar regional differences or changes the patterns found for conventional policy.

#### **4.3 Shadow Rates Model**

We now turn to the effects of unconventional monetary policy on inequality by examining shocks to the shadow rate, using data from 2012Q1 to 2022Q2. This period matches the time horizon of the post-crisis interest rates model, allowing for a direct comparison between the distributional effects of conventional and unconventional policy within the same macroeconomic environment. Starting in 2012 captures the point at which the euro area entered a prolonged low-interest rate regime, with the deposit facility rate approaching the zero lower bound and traditional policy tools losing traction. In this context, the Wu and Xia (2016) shadow short rate serves as a more comprehensive indicator of the monetary policy stance, incorporating the effects of forward guidance, asset purchases, and other non-standard measures that are not reflected in the nominal policy rate. Examining the shadow rate over this period allows us to assess whether unconventional tools amplify, mitigate, or reverse the regional inequality patterns identified in the post-crisis interest rates model.

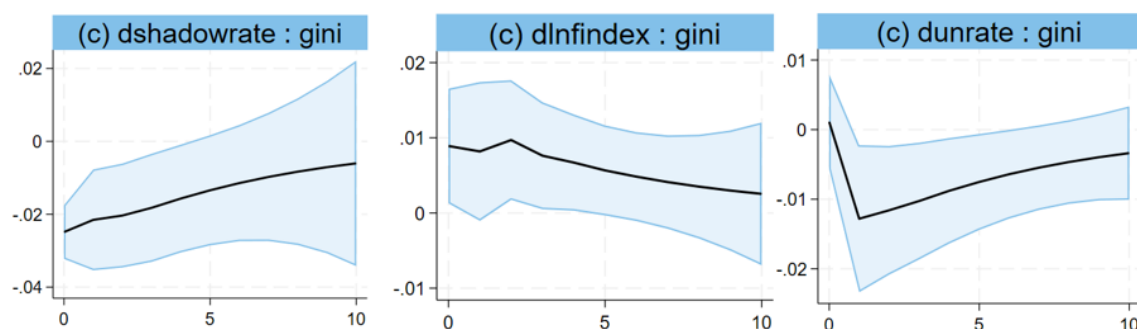
**Table 4.7 - Granger causality Wald test (Shadow rates model)**

GINI			
CORE	p-value	PERIPHERY	p-value
Shadow Rate	0.569	Shadow Rate	0.704
Financial Indexes	0.394	Financial Indexes	0.000*
Unemployment Rate	0.002*	Unemployment Rate	0.000*
BOTTOM 50%			
CORE	p-value	PERIPHERY	p-value
Shadow Rate	0.186	Shadow Rate	0.957
Financial Indexes	0.610	Financial Indexes	0.021*
Unemployment Rate	0.076**	Unemployment Rate	0.037*
TOP 1%			
CORE	p-value	PERIPHERY	p-value
Shadow Rate	0.180	Shadow Rate	0.327
Financial Indexes	0.492	Financial Indexes	0.467
Unemployment Rate	0.213	Unemployment Rate	0.271

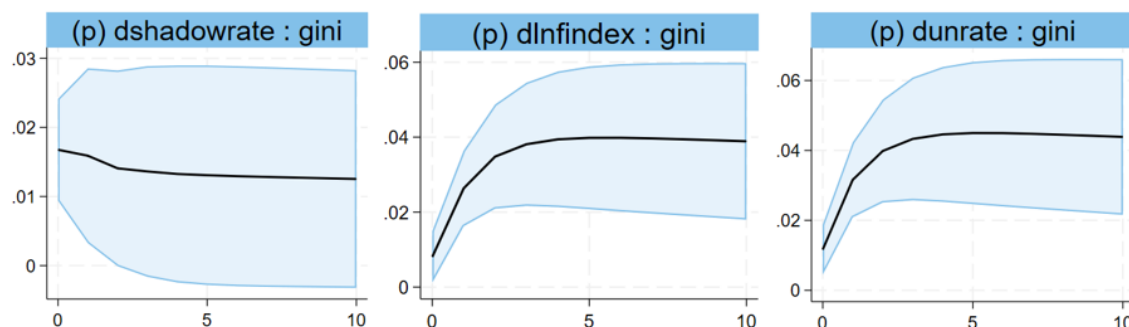
Notes: \*p-values below 0.05 \*\*p-values between 0.05 and 0.10

In both core and peripheral countries, the shadow rate does not Granger-cause movements in the Gini index (Table 4.7), suggesting that the short-term direct transmission channel of unconventional monetary policy remains largely inactive under the ZLB. On the other hand, the indirect transmission channels do Granger-cause Gini in both groups. In the core, it is the labor market channel, through the unemployment rate, that shows Granger causality with inequality. In the periphery, however, both indirect channels - financial assets and the labor market - Granger-cause changes in the Gini index, reinforcing the idea that inequality in these economies responds more strongly to indirect shocks.

**Figure 4.7 - Effect of shadow rate, financial asset prices and unemployment rate shocks on Gini coefficient (Core countries “c”)**



**Figure 4.8 - Effect of interest rate, financial asset prices and unemployment rate shocks on Gini coefficient (Periphery countries “p”)**



The IRFs (Figure 4.7 and Figure 4.8) show that the direct transmission channel - a contractionary shock in the shadow rates, in this case - does have an effect in both core and periphery countries, even if the confidence intervals are relatively wide (especially in the periphery). Nonetheless, there is clear heterogeneity in how the effects play out across the two groups. In the core countries, the graph shows a decline in the Gini index following a shadow rate shock, while in the periphery, the same shock leads to an increase in inequality.

**Table 4.8 - Forecast-error variance decomposition (Core countries) - 10 quarters horizon**

	<i>Own variance</i>	<i>Shadow Rate</i>	<i>Financial Assets</i>	<i>Unemployment Rate</i>
<i>Gini</i>	.7451458	.1798039	.0303012	.0447491
<i>Bottom 50%</i>	.9206057	.0248492	.0252688	.0292764
<i>Top 1%</i>	.8892617	.0456455	.0334478	.0316449

**Table 4.9 - Forecast-error variance decomposition (Periphery countries) - 10 quarters horizon**

	<i>Own variance</i>	<i>Shadow Rate</i>	<i>Financial Assets</i>	<i>Unemployment Rate</i>
<i>Gini</i>	.4058444	.0364247	.2432661	.3144647
<i>Bottom 50%</i>	.9273666	.0058328	.0443744	.0224263
<i>Top 1%</i>	.9713815	.0246223	.0008975	.0030987

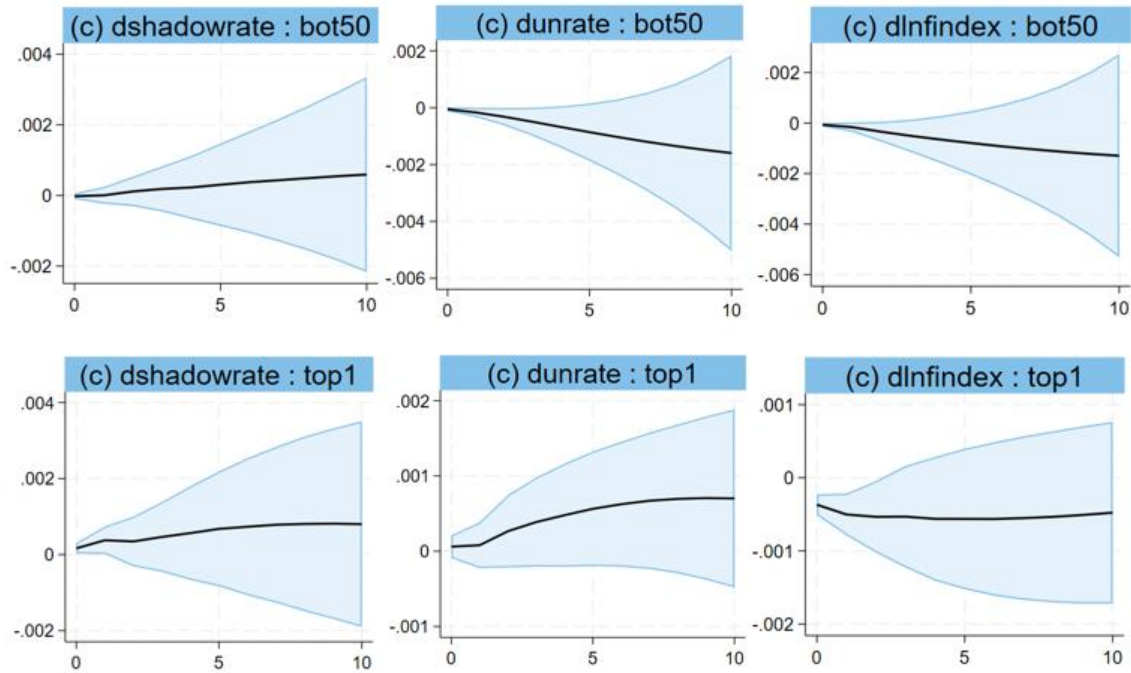
However, the forecast error variance decomposition (FEVD) paints a more nuanced picture. In the core (Table 4.8), despite weak contemporaneous responses, the shadow rate accounts for a non-negligible 17.98% of the Gini's forecast variance over a 10-period horizon – a substantially higher proportion compared to both financial markets (3%) and unemployment (4.47%). This suggests that although the immediate impact of unconventional monetary policy appears limited, its overall influence becomes more important over time. This may reflect gradual effects that work through more

complex or delayed transmission mechanisms, which are not fully visible in the short-term impulse responses.

The picture in periphery countries is considerably different. Here, the indirect transmission channels – namely financial market conditions and the labor market – exert a much stronger influence on inequality than the shadow rate itself. Impulse response functions (Figure 4.8) show that positive shocks to both the financial index and unemployment rate lead to significant increases in the Gini coefficient, consistent with the idea that these economies are more vulnerable to inequality through indirect pathways. These results suggest that, at least through the lens of shadow rates, unconventional monetary tightening exhibits limited direct distributional effects in the periphery – motivating further investigation into whether other non-standard tools, such as quantitative easing, may yield different outcomes.

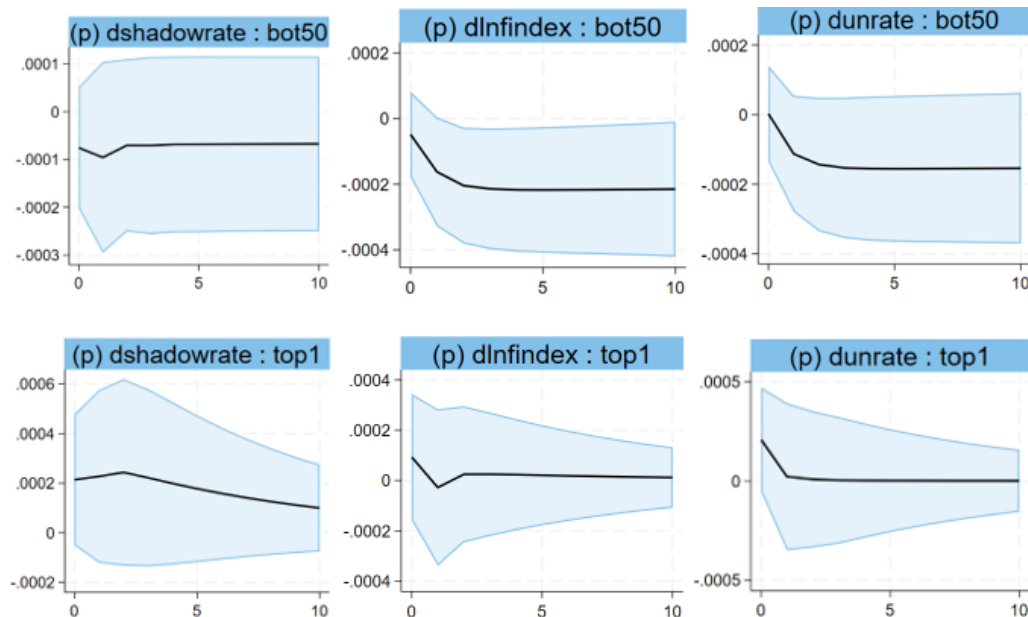
However, the forecast error variance decomposition (Table 4.9) reveals a more nuanced story. At the 10-step horizon, unemployment shocks account for 31.4% of Gini variance, and financial index shocks explain 24.3%, confirming their dominance as transmission mechanisms. Interestingly, the shadow rate accounts for a modest but non-trivial 3.6%, suggesting that although its immediate and direct impact on inequality is weak, it may still contribute to long-run dynamics. This influence is likely indirect, operating through its effects on labor market conditions and asset prices rather than directly on income distribution itself. These results underscore the importance of structural labor market and financial vulnerabilities in shaping the distributional effects of monetary policy in the periphery, even under unconventional regimes. Overall, this indicates that unconventional monetary tightening has limited direct distributional impact in the periphery.

**Figure 4.9 - Effect of direct and indirect shocks on income percentiles (Core countries "c")**



As for interest rates, we also examine how the Bottom 50% and Top 1% income shares respond to shadow rate shocks (Figure 4.9). In the core countries, the results generally align with expectations: a positive unemployment shock reduces the income share of the Bottom 50%, while the Top 1% sees a slight increase. Regarding the other indirect channel - financial assets -shocks lead to a decline in the income share for both the Bottom 50% and the Top 1%. Interestingly, the shadow rate itself appears to have a direct marginally positive effect on both percentiles.

**Figure 4.10 - Effect of direct and indirect shocks on income percentiles (Periphery countries "p")**



In the periphery (Figure 4.10), the influence of the indirect channels is more substantial than in the core. Both unemployment and financial index shocks reduce the income share of the Bottom 50%, underscoring the vulnerability of lower-income households to labor and financial market fluctuations. Interestingly, the Top 1% income share also slightly declines in response to these shocks, though to a lesser extent and with lower statistical significance. This asymmetry suggests that inequality rises not because the top earners benefit, but because the economic conditions disproportionately harm lower-income groups. (Ampudia et al.,2018)

In summary, the analysis of the shadow rates reveals that unconventional monetary policy, as captured by the shadow rate proxy, has a weak direct effect on inequality in both core and peripheral Euro Area countries. Although the direction of the effect differs – showing a decline in the Gini index in core countries and an increase in the periphery – the overall impact remains heterogeneous. In the core, the influence becomes more pronounced over the medium term, as confirmed by the FEVD results. In contrast, the periphery is significantly more affected by indirect transmission channels, particularly through financial markets and the labor market. Shocks to these variables tend to increase inequality, primarily due to a decline in the income share of the Bottom 50%, who are disproportionately impacted compared to the Top 1%.

While shadow rates provide valuable insights into the effects of monetary accommodation under the zero lower bound, they may not fully capture the broader transmission mechanisms of non-standard monetary policy. We therefore turn next to the analysis of the ECB’s balance sheet expansions under quantitative easing, to explore whether direct asset purchases and liquidity injections have had a more pronounced impact on inequality across the Euro Area.

#### **4.4 Quantitative Easing (QE) Model**

We now turn to the distributional effects of unconventional monetary policy (UMP), focusing on Quantitative Easing (QE) over the period 2012Q1–2022Q2. In this specification, QE is proxied by the log-differenced ECB total assets, which serves as a measure of balance sheet expansion under the central bank’s asset purchase programmes. While the ECB had already deployed several non-standard measures prior to 2015 – such as the Securities Markets Programme (SMP) and the Long-Term Refinancing Operations (LTROs) – large-scale purchases under the Asset Purchase Programme (APP) were only formally announced in January 2015 and implemented from March of that year (ECB, 2015).

The choice of 2012Q1 as the starting point reflects the need to capture not only the formal implementation phase of QE but also the anticipatory effects and preparatory policy interventions that began influencing the ECB’s balance sheet in the years leading up to the APP.

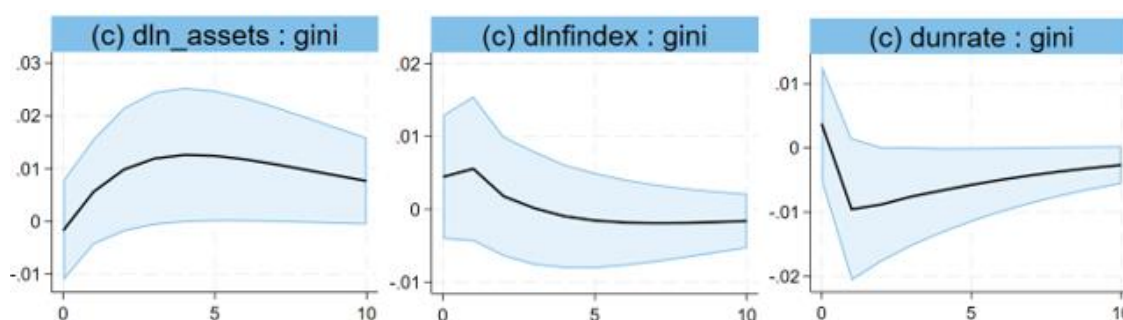
**Table 4.10 - Granger causality Wald test (QE model)**

GINI			
CORE	p-value	PERIPHERY	p-value
ECB Assets (QE)	0.031*	ECB Assets (QE)	0.000*
Financial Indexes	0.274	Financial Indexes	0.068**
Unemployment Rate	0.004*	Unemployment Rate	0.109
BOTTOM 50%			
CORE	p-value	PERIPHERY	p-value
ECB Assets (QE)	0.624	ECB Assets (QE)	0.000*
Financial Indexes	0.249	Financial Indexes	0.453
Unemployment Rate	0.270	Unemployment Rate	0.353
TOP 1%			
CORE	p-value	PERIPHERY	p-value
ECB Assets (QE)	0.397	ECB Assets (QE)	0.233
Financial Indexes	0.789	Financial Indexes	0.667
Unemployment Rate	0.089**	Unemployment Rate	0.974

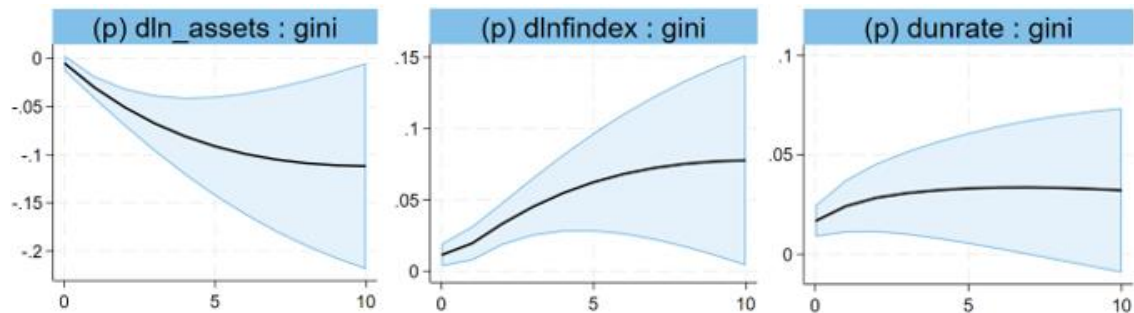
Notes: \*p-values below 0.05 \*\*p-values between 0.05 and 0.10

The Granger causality tests (Table 4.10) indicate that expansion of the ECB’s balance sheet Granger-causes movements in the Gini index in both core and periphery countries. This suggests that the direct transmission channel of QE has relevance across the Euro Area. However, regional differences emerge in the role of secondary channels: in core economies, unemployment also Granger-causes inequality, highlighting the labor market’s added importance. In the periphery, financial market shocks are the sole additional driver, indicating that asset price dynamics are more salient there than labor-based transmission.

**Figure 4.11 - Effect of QE, financial asset prices and unemployment rate shocks on Gini coefficient (Core countries “c”)**



**Figure 4.12 - Effect of QE, financial asset prices and unemployment rate shocks on Gini coefficient (Periphery countries “p”)**



In Figures 4.11 and 4.12, the impulse response functions (IRFs) reinforce this divergence, revealing a clear asymmetry in how QE impacts income inequality. In core countries, an expansionary QE shock leads to an increase in the Gini coefficient, pointing to a rise in inequality. In contrast, in periphery countries, the same monetary stimulus results in a statistically significant decrease in the Gini coefficient, indicating a reduction in inequality. This stark asymmetry underscores that the distributive effects of QE are not uniform, but rather strongly region dependent. While core countries experience inequality-widening effects, peripheral economies see the opposite outcome – an increase in inequality in response to the same policy intervention.

**Table 4.11 - Forecast-error variance decomposition (Core countries) - 10 quarters horizon**

	<i>Own variance</i>	<i>QE Shock</i>	<i>Financial Assets</i>	<i>Unemployment Rate</i>
<i>Gini</i>	.9070936	.0639702	.0044955	.0244407
<i>Bottom 50%</i>	.8922225	.0318269	.0625459	.0134047
<i>Top 1%</i>	.8657553	.0112926	.0544921	.0684601

**Table 4.12 - Forecast-error variance decomposition (Periphery countries) - 10 quarters horizon**

	<i>Own variance</i>	<i>QE Shock</i>	<i>Financial Assets</i>	<i>Unemployment Rate</i>
<i>Gini</i>	.147629	.5303392	.2502499	.0717819
<i>Bottom 50%</i>	.4221104	.4574285	.10059	.019871
<i>Top 1%</i>	.9367113	.0238254	.0091889	.0302744

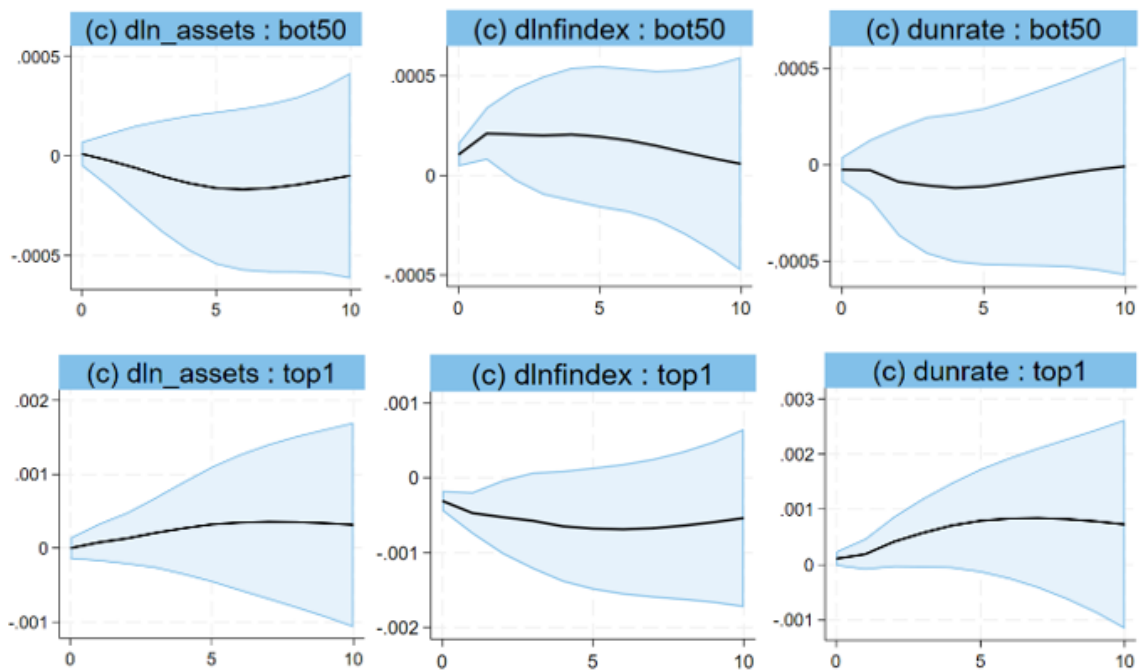
This contrast is further amplified by the forecast error variance decomposition (FEVD) results (Table 4.11 and Table 4.12). In the periphery, the ECB’s balance sheet shocks account for a striking 53% of the Gini’s coefficient variance, even surpassing its own past values (14.7%). In the core, by comparison, QE explains only 6.4% of inequality dynamics – though it remains the most important external driver, followed by unemployment at 2.4%. These results demonstrate that QE plays a central and unequal role across regions, reinforcing the need to account for macroeconomic heterogeneity when evaluating the distributive consequences of unconventional policy tools.

The transmission through indirect channels also varies significantly. In the core countries, the labor market channel yields an unexpected result: a positive shock to unemployment reduces the Gini index slightly, potentially suggesting a compositional effect where job losses are concentrated among higher earners in certain sectors. Meanwhile, in the periphery, the unemployment rate behaves as expected – rising unemployment marginally increases inequality captured through the Gini index, consistent with the view that lower-income households are more vulnerable to labor market shocks.

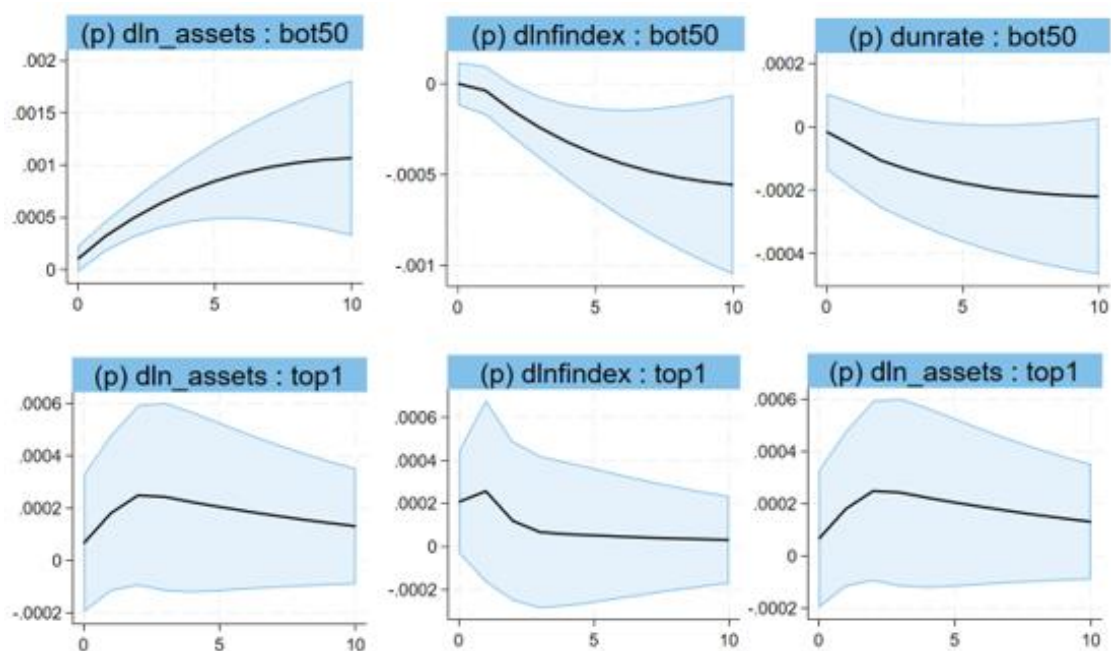
Regarding the financial market channel, financial index shocks have a weak to virtually no discernible effect on inequality in the core. However, in the periphery, rising financial asset prices are associated with an increase in inequality, supporting the notion that wealth is more concentrated and asset ownership less widespread in these economies. Interestingly, although QE typically boosts financial markets, the overall inequality-reducing effect of QE in the periphery suggests that its redistributive gains via employment, credit access, and macroeconomic stabilization dominate the inequality-worsening impact of asset price inflation (Coibion et al., 2017).

In short, QE appears to have progressive effects in the periphery, mitigating inequality by stimulating economic activity and supporting vulnerable households. In the core, however, the distributional consequences are more ambiguous – possibly reflecting a weaker transmission of QE to labor markets and a greater concentration of financial wealth.

**Figure 4.13 - Effect of QE, financial asset prices and unemployment rate shocks on Bottom 50% and Top 1% percentiles (Core countries "c")**



**Figure 4.14 - Effect of QE, financial asset prices and unemployment rate shocks on Bottom 50% and Top 1% percentiles (Periphery countries "p")**



We now turn to the income distribution effects of QE by examining the Bottom 50% and Top 1% income shares. These measures offer a more granular view of how different segments of the population respond to balance sheet expansions. Notably, compared to the Gini index, the impulse response functions (IRFs) for income shares exhibit wider confidence intervals in both the core and periphery, indicating that while the direction of effects is clear, the estimates are somewhat less precise.

In core countries (Figure 4.13), a positive QE shock leads to a decline in the Bottom 50% income share, alongside a slight increase in the Top 1% share. These results suggest that QE may have mild regressive effects in the core, although the magnitude is limited. The forecast error variance decomposition (Table 4.11) confirms this, showing that QE explains only 3.18% of the variation in the Bottom 50% share and 1.13% for the Top 1%, indicating a relatively weak distributional influence of QE in more financially resilient economies.

In sharp contrast, the periphery (Figure 4.14) exhibits a much stronger and more progressive distributional response. QE shocks lead to a statistically significant increase in the Bottom 50% income share, highlighting the effectiveness of balance sheet expansion in easing financial conditions, improving labor market access, and possibly amplifying redistributive fiscal channels in these more vulnerable economies. This is strongly supported by the FEVD (Table 4.12), where QE accounts for 45.7% of the variation in the Bottom 50% share – a dramatic contrast to the core. While the Top 1%

income share in the periphery also rises slightly, QE explains only 2.4% of its variation, suggesting a net equalizing effect of unconventional policy.

Moreover, the financial market channel remains an important indirect pathway in the periphery. A positive shock to the financial index is associated with a decline in the Bottom 50% share, consistent with the idea that asset price inflation disproportionately benefits wealthier households. This channel explains nearly 10% of the variance in the income share of the Bottom 50%, reinforcing the dual nature of monetary transmission in these economies: while QE appears broadly progressive, asset-driven dynamics may offset part of these gains depending on market conditions.

In conclusion, QE exerts more progressive and substantial effects in peripheral Euro Area economies, where it significantly reduces inequality - reflected in both a decline in the Gini coefficient and a steady increase in the income share of the Bottom 50%. These effects likely stem from stronger transmission through labor markets and credit channels, where lower-income households in more vulnerable economies are more responsive to monetary stimulus. The FEVD results confirm this, with QE explaining a large share of variation in the Bottom 50% income in the periphery, highlighting its central role in improving income distribution in those regions.

In sharp contrast, QE shocks in core countries lead to an increase in the Gini coefficient, indicating a rise in overall income inequality. This occurs as the income share of the Bottom 50% declines while the share of the Top 1% rises, reflecting a clear upward redistribution of income. Such effects may stem from QE's limited ability to directly support lower-income households in these economies, combined with gains accruing disproportionately to wealthier groups through asset price channels. The financial market channel itself appears largely neutral in the core, while in the periphery it still contributes negatively by reducing the income of the bottom percentiles when asset prices rise.

Ultimately, these findings underscore a strong asymmetry: QE reduces inequality in the periphery but increases it in the core, illustrating how the same monetary policy can have opposite distributional effects depending on the structural and economic characteristics of each region. This highlights the importance of considering regional heterogeneity in both policy design and evaluation.

## 5. Conclusion

This study investigates how the ECB’s single monetary policy asymmetrically affects inequality in core and peripheral euro area countries. To address this question, we estimate 24 PVAR model specifications, combining three types of monetary policy – interest rates (estimated for the full sample and a post-crisis sub-sample), the Wu and Xia shadow rate, and quantitative easing – with three inequality metrics (Gini coefficient, Bottom 50% income share, and Top 1% income share) across two regional groups: core and periphery.

The results reveal clear asymmetries in the distributional effects of monetary policy. In the full-sample interest rate model, monetary tightening reduces inequality in the core, primarily through direct channels, while in the periphery the direct channel is negligible and both indirect channels – financial asset prices and unemployment – act to increase inequality. In contrast, the post-crisis interest rate model shows not only persistent heterogeneity between regions but also a marked shift relative to the full-sample results: higher interest rates now widen inequality in the core and reduce it in the periphery, effectively reversing the earlier pattern.

We started the unconventional monetary policy analysis by examining the shadow rate model, which serves as a proxy for the ECB’s policy stance during the zero lower bound period. The results show that its direct effect on inequality is relatively weak in both core and peripheral euro area countries, although the direction differs: in the core, shadow rate shocks lead to a gradual decline in the Gini coefficient, while in the periphery they result in a modest increase. In both regions, however, the main drivers of inequality are indirect channels – particularly financial markets and the labor market – which tend to amplify disparities, most notably by reducing the income share of the Bottom 50%. In the core, the influence of the shadow rate becomes more noticeable over the medium term, as indicated by the FEVDs, but it still remains secondary to these indirect effects. Overall, these findings indicate that, unlike in the post-crisis interest rate model where the direct effects on inequality were more pronounced, the shadow rate’s influence is weaker and relies more heavily on indirect transmission mechanisms.

The QE results confirm yet another layer of regional asymmetry. In the periphery, asset purchases and liquidity injections act as a powerful equalizing force, lowering inequality through both a decline in the Gini coefficient and an increase in the Bottom 50% income share, while the Top 1% remains broadly unaffected. In the core, however, the same policy widens inequality, as the Bottom 50% share falls and the Top 1% share rises, pointing to an upward redistribution of income. These patterns suggest that QE transmits primarily through labor market and credit channels in the periphery, benefiting lower-income households, whereas in the core the gains accrue disproportionately to wealthier groups

through asset price channels. This stark contrast reinforces the broader conclusion that the ECB’s single monetary policy can have fundamentally different – and even opposing – distributional consequences across regions.

This work contributes to the literature by examining how three different types of monetary policy affect inequality in a core–periphery framework within the Euro Area. Unconventional monetary policy, which remains relatively underexplored in this setting, is assessed not only through its effects on the Gini coefficient but also using Piketty’s income percentiles, adding robustness and depth to the findings. The results consistently reveal that the distributional effects of monetary policy are heterogeneous across regions, with structural and institutional differences playing a central role. Peripheral countries tend to be more affected by indirect channels – financial markets and the labor market – likely due to their greater dependence on labor income and higher wealth concentration at the top. In contrast, in the core, the direct transmission channel exerts a stronger influence, suggesting that monetary policy impacts these economies more immediately through interest rate changes.

The main limitation of this study is the lack of quarterly inequality data, which can reduce the robustness of the results. Future research would benefit from higher-frequency data to better match the timing of monetary policy variables. Further studies could also explore a broader set of income and wealth distribution metrics, investigate other potential transmission channels such as housing markets and fiscal interactions, and assess whether similar patterns emerge in other monetary unions or regions with comparable core–periphery dynamics.

From a policy perspective, the findings highlight that monetary policy alone is unlikely to deliver consistent and equitable outcomes across all regions. Since its distributional effects vary sharply between the core and the periphery, policymakers should consider complementing monetary interventions with targeted fiscal policies tailored to each country’s structural conditions. National fiscal measures – such as progressive taxation or social transfers – could help counteract the regressive effects of monetary tightening in some regions while reinforcing its progressive effects in others. In this sense, the evidence presented here reinforces a simple but important lesson for the Euro Area: when it comes to addressing inequality, one size does *not* fit all.

## 6. Appendix

### 6.1 Optimal Lag Selection

*Lag Selection Criteria: Optimal lags were chosen based on MBIC, MAIC, and MQIC, selecting the specification that minimized each criterion. When criteria diverged, preference was generally given to the lower lag.*

*IRF-Based Validation: Final lag choice also considered IRF quality – favoring specifications with clearer dynamics and narrower confidence intervals for greater interpretability.*

**Table A 1 - Interest rates model - Optimal Var Selection - Core Countries**

<b>GINI</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-168.9658</b>	29.33307	-48.75283	*
<b>2</b>	-130.8281	1.371116	<b>-50.68615</b>	
<b>3</b>	-64.34759	1.752036	-24.2766	
<b>4</b>	-23.42818	<b>-6.903274</b>	-13.41043	
<b>BOTTOM 50</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-152.1372</b>	46.16171	-31.92419	*
<b>2</b>	-144.4285	<b>-12.22925</b>	<b>-64.28652</b>	
<b>3</b>	-77.48823	-11.3886	-37.41724	
<b>4</b>	.	.	.	
<b>TOP 1</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-152.2543</b>	46.04458	-32.04132	*
<b>2</b>	-122.3377	9.86158	<b>-42.19569</b>	
<b>3</b>	-64.04662	<b>2.053</b>	-23.97563	
<b>4</b>	.	.	.	

**Table A 2 - Interest rates model - Optimal Var Selection - Periphery Countries**

<b>GINI</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-197.5291</b>	-9.680941	<b>-84.29583</b>	*
<b>2</b>	-142.0701	-16.83796	-66.58122	
<b>3</b>	-112.7398	<b>-34.46976</b>	-65.55929	
<b>4</b>	-21.51904	-5.865026	-12.08293	
<b>BOTTOM 50</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-161.6626</b>	26.18557	-48.42931	*
<b>2</b>	-126.0913	-0.8592401	<b>-50.6025</b>	
<b>3</b>	-77.35418	<b>-14.748213</b>	-39.60976	
<b>4</b>	.	.	.	
<b>TOP 1</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-139.8916</b>	47.95657	-26.65831	*

<b>2</b>	-138.4685	-13.23643	<b>-62.97969</b>	
<b>3</b>	-81.15372	<b>-18.53768</b>	-43.4093	
<b>4</b>	.	.	.	

**Table A 3 - Interest rates model (Post-crisis) - Optimal Var Selection - Core Countries**

<b>GINI</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-153.8657</b>	9.462846	<b>-56.47904</b>	*
<b>2</b>	-109.4962	-0.61048	-44.57174	
<b>3</b>	-42.42398	12.01885	-9.961774	
<b>4</b>	-21.5541	<b>-7.943388</b>	-13.43855	
<b>BOTTOM 50</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-156.24</b>	7.088464	-58.85342	*
<b>2</b>	-138.1254	<b>-29.23977</b>	<b>-73.20103</b>	
<b>3</b>	-69.6361	-15.1919326	-37.17389	
<b>4</b>	.	.	.	
<b>TOP 1</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-158.5805</b>	4.748055	<b>-61.19383</b>	*
<b>2</b>	-118.9616	-10.07593	-54.03719	
<b>3</b>	-62.64972	-8.206882	-30.18751	
<b>4</b>	.	.	.	

**Table A 4 - Interest rates model (Post-crisis) - Optimal Var Selection - Periphery Countries**

<b>GINI</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-149.756</b>	4.821089	-57.82521	*
<b>2</b>	-121.8589	-18.80749	-60.57168	
<b>3</b>	-103.0836	<b>-38.67649</b>	<b>-64.77912</b>	
<b>4</b>	-40.95373	-15.19088	-25.63193	
<b>BOTTOM 50</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-159.5013</b>	-4.924225	<b>-67.57052</b>	*
<b>2</b>	-126.1032	<b>-23.05185</b>	-64.81605	
<b>3</b>	-73.90166	-22.3759	-43.25807	
<b>4</b>	-20.88142	-7.999995	-13.22052	
<b>TOP 1</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-168.9366</b>	-14.35951	<b>-77.0058</b>	*
<b>2</b>	-131.3323	<b>-28.2809</b>	-70.04509	
<b>3</b>	-74.16092	-22.63523	-43.51732	
<b>4</b>	.	.	.	

**Table A 5 - Shadow rates model - Optimal Var Selection - Core Countries**

<b>GINI</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-170.8791</b>	<b>-8.865708</b>	<b>-74.3195</b>	*
<b>2</b>	-115.1067	-7.097775	-50.73364	
<b>3</b>	-59.22447	-5.220014	-27.03795	
<b>4</b>	.	.	.	
<b>BOTTOM 50</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-149.5894</b>	12.42399	-53.0298	
<b>2</b>	-135.8776	<b>-27.86871</b>	<b>-71.50457</b>	*
<b>3</b>	-69.92111	-15.91666	-37.73459	
<b>4</b>	.	.	.	
<b>TOP 1</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-151.2703</b>	10.74311	-54.71068	
<b>2</b>	-120.7998	<b>-12.79089</b>	<b>-56.42676</b>	*
<b>3</b>	-65.03795	-11.03349	-32.85143	
<b>4</b>	.	.	.	

**Table A 6 - Shadow rates model - Optimal Var Selection - Periphery Countries**

<b>GINI</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-165.3262</b>	-10.74911	<b>-73.3954</b>	*
<b>2</b>	-108.2216	-5.170246	-46.92444	
<b>3</b>	-64.24583	<b>-12.72014</b>	-33.60224	
<b>4</b>	-38.05682	-12.29397	-22.73502	
<b>BOTTOM 50</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-150.9969</b>	3.580159	<b>-59.06614</b>	*
<b>2</b>	-116.1945	-13.1431	-54.9073	
<b>3</b>	-68.80444	<b>-17.27875</b>	-38.16085	
<b>4</b>	-20.87199	-7.990563	-13.21109	
<b>TOP 1</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-149.4647</b>	5.1124	<b>-57.53389</b>	*
<b>2</b>	-114.7926	-11.74123	-53.50543	
<b>3</b>	-71.5909	<b>-20.06521</b>	-50.9473	
<b>4</b>	.	.	.	

**Table A 7 - QE model - Optimal Var Selection - Core Countries**

<b>GINI</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-162.3145</b>	<b>1.014006</b>	<b>-64.92788</b>	*
<b>2</b>	-120.3308	-11.4451	-55.40635	
<b>3</b>	-66.91576	-12.47292	-34.45355	
<b>4</b>	.	.	.	
<b>BOTTOM 50</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-153.229</b>	-10.0995	-55.84239	
<b>2</b>	-143.8451	<b>-34.95944</b>	<b>-78.92069</b>	*
<b>3</b>	-77.19211	-22.74928	-44.7299	
<b>4</b>	.	.	.	
<b>TOP 1</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-153.2869</b>	10.04164	-55.90024	*
<b>2</b>	-126.0118	-17.12611	<b>-61.08737</b>	
<b>3</b>	-72.33344	<b>-17.8906</b>	-39.87123	
<b>4</b>	.	.	.	

**Table A 8 - QE model - Optimal Var Selection - Periphery Countries**

<b>GINI</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-163.4179</b>	-8.840822	<b>-71.48712</b>	*
<b>2</b>	-119.5863	-16.53493	-58.29913	
<b>3</b>	-103.4381	<b>-39.031</b>	-65.13362	
<b>4</b>	-41.29812	-15.53528	-25.97633	
<b>BOTTOM 50</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-156.0717</b>	-1.494595	-64.14089	
<b>2</b>	-135.8379	<b>-32.78651</b>	<b>-74.55071</b>	*
<b>3</b>	-76.81763	-25.29193	-46.17403	
<b>4</b>	-20.88142	-7.999998	-13.22052	
<b>TOP 1</b>				
<b>Lag</b>	<b>MBIC</b>	<b>MAIC</b>	<b>MQIC</b>	<b>Chosen lag?</b>
<b>1</b>	<b>-181.3755</b>	-26.79838	<b>-89.44468</b>	*
<b>2</b>	-137.9734	<b>-34.92205</b>	-76.68625	
<b>3</b>	-77.16244	-25.63675	-46.51885	
<b>4</b>	.	.	.	

## 6.2 Stationarity tests

**Table A 9 - First and second generation stationarity tests (Core countries - 2002q1 to 2022q4)**

Variable	First Generation			Second Generation
	<i>ADF Fisher</i>	<i>Harris-Tzavalis</i>	<i>Levin-Lin-Chu</i>	<i>Pesaran</i>
Interest rates	-8.5561 (0.000)*	-	-	-
Financial Indexes	-13.1737 (0.000)*	-	-	-9.449 (0.000)*
Unemployment Rate	-10.2936 (0.000)*	-	-7.3844 (0.0000)*	-6.555 (0.000)*
Gini	-1.6963 (0.0449)*	-	-3.0062 (0.0013)*	-2.763 (0.003)*
Bottom 50	-2.6535 (0.0040)*	-	-3.1736 (0.0008)*	-1.509 (0.066)*
Top 1	-4.6381 (0.0000)*	-	-4.0226 (0.0000)*	-2.513 (0.006)*

Main statistics are presented in the table, followed the *p*-values in brackets. A variable is considered stationary if the *p*-value of at least one test is lower than 0.10.

\*Variable is stationary

**Table A 10 - First and second generation stationarity tests (Periphery countries - 2002q1 to 2022q4)**

Variable	First Generation			Second Generation
	<i>ADF Fisher</i>	<i>Harris-Tzavalis</i>	<i>Levin-Lin-Chu</i>	<i>Pesaran</i>
Interest rates	-7.8106 (0.000)*	-	-	-
Financial Indexes	-11.1142 (0.000)*	-	-	-9.449 (0.000)*
Unemployment Rate	-5.3560 (0.000)*	-	-4.1008 (0.0000)*	-6.555 (0.000)*
Gini	-1.3638 (0.0863)*	-	-1.6314 (0.0514)*	-2.265 (0.012)*
Bottom 50	-1.4155 (0.0785)*	-	-2.0758 (0.0190)*	-2.169 (0.015)*
Top 1	-1.3149 (0.0943)*	-	-1.3148 (0.0943)*	-1.153 (0.125)

Main statistics are presented in the table, followed the *p*-values in brackets. A variable is considered stationary if the *p*-value of at least one test is lower than 0.10.

\*Variable is stationary

**Table A 11 - First and second generation stationarity tests (Core countries - 2012q1 to 2022q2)**

Variable	First Generation			Second Generation
	<i>ADF Fisher</i>	<i>Harris-Tzavalis</i>	<i>Levin-Lin-Chu</i>	<i>Pesaran</i>
Shadow rates	-	-24.9797 (0.000)*	-	-
ECB's assets	-	-11.0625 (0.000)*	-	-
Interest rates	-	-29.4288 (0.000)*	-	-
Financial Indexes	-9.2973 (0.000)*	-	-5.8852 (0.000)*	-8.211 (0.000)*
Unemployment Rate	-6.8496 (0.000)*	-	-4.6607 (0.000)*	-6.653 (0.000)*
Gini	-0.8687 (0.1925)	-	-2.5664 (0.0051)*	-1.875 (0.030)*
Bottom 50	-2.4398 (0.0073)*	-	-2.6977 (0.0035)*	-1.807 (0.035)*
Top 1	-2.2506 (0.0122)*	-	-2.8269 (0.0024)*	-2.203 (0.014)*

*Main statistics are presented in the table, followed the p-values in brackets. A variable is considered stationary if the p-value of at least one test is lower than 0.10.*

*\*Variable is stationary*

**Table A 12 - Table A 3 - First and second generation stationarity tests (Periphery countries - 2012q1 to 2022q2)**

Variable	First Generation			Second Generation
	<i>ADF Fisher</i>	<i>Harris-Tzavalis</i>	<i>Levin-Lin-Chu</i>	<i>Pesaran</i>
Shadow rates	-	-22.8032 (0.000)*	-	-
ECB's assets	-	-10.0986 (0.000)*	-	-
Interest rates	-	-26.8647 (0.000)*	-	-
Financial Indexes	-7.8704 (0.000)*	-	-6.2431 (0.000)*	-6.598 (0.000)*
Unemployment Rate	-5.7808 (0.000)*	-	-4.7426 (0.000)*	-4.550 (0.000)*
Gini	-0.5541 (0.2898)*	-	-1.7813 (0.0374)*	1.465 (0.929)*
Bottom 50	-0.7665 (0.2217)*	-	-1.8680 (0.0309)*	-2.311 (0.010)*
Top 1	-0.7298 (0.2328)*	-	-1.6195 (0.0527)*	-1.913 (0.028)*

Main statistics are presented in the table, followed the p-values in brackets. A variable is considered stationary if the p-value of at least one test is lower than 0.10.

\*Variable is stationary

## 7. References

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