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WHO TAKES THE CAKE? THE HETEROGENEOUS EFFECT OF EUROPEAN CENTRAL BANK ACCOMMODATIVE MONETARY POLICY ACROSS INCOME CLASSES

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This work provides evidence of the heterogeneous effects of the ECB's monetary policy across income classes. In particular, this investigation focuses on the labor market channel. Based on EU-SILC data, we estimate country-specific structural vector autoregressions (SVAR) models to analyze the impact of the expansionary monetary policy shocks over the 2006–2019 period. The results suggest that monetary easing helped decrease unemployment rates for lower- and middle-income classes, to a larger extent for the former. This differential impact is accounted for a stronger improvement in job finding rates for classes located at the bottom of the income distribution. Conversely, the employment status of the upper class remained largely unaffected. The analysis identifies a positive impact of expansionary monetary policy on real labor income, which seems to have mostly benefitted the upper class. Overall, our results suggest that expansionary monetary policy helped decrease labor income inequality by exerting a stronger positive impact on lower-income households.

JEL Codes: D31, E52

Keywords: monetary policy, income inequality, income class, structural vector autoregressions (SVARs), euro area

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1. Introduction

In recent years, there has been a growing concern regarding the status and prospects of the middle class in economically advanced countries. This concern arises from the observation that inequality has increased, and the middle class has lost considerable ground in numerous countries (see, e.g., Cowen, 2013; Vaughan-Whitehead, 2016; Pew Research Center, 2017). This dynamic has placed the question of income distribution at the forefront of economic analysis (see Atkinson, 2015; Deaton, 2013; Galbraith, 2016; Piketty, 2014; Stiglitz, 2012; etc.). Additionally, the emergence of theories challenging the notion that advanced economies inevitably progress towards more egalitarian societies, such as Piketty (2014), which opposes the widely refuted traditional view based on Kuznets (1955), has further fueled this debate. Numerous studies have recently delved into the determinants of income distribution to inform policymaking aimed at promoting equity. The deepening of globalization, skill-biased technological progress, demographic trends, changes in labor market institutions, financialization or the moderate ability of the tax-benefit systems to reduce market income inequality are among the major structural drivers examined in the literature (see e.g., Bourguignon, 2018; Dabla-Norris et al., 2015; OECD, 2011, 2015).

The increasing within-country inequality and the deterioration of the middle class represent long-term trends primarily driven by profound and extensive structural changes. However, the unprecedented conventional and unconventional monetary measures implemented by most major central banks, including the European Central Bank (ECB), since the onset of the Global Financial Crisis (GFC) in 2007–2008 have significantly fueled discussions about the potential distributive implications of monetary policy among academics and policy makers. In fact, while monetary policy primarily targets price stability, its decisions are not neutral for income and wealth inequality.

From an academic standpoint, the distributive effects of monetary policy are not a novelty, and various theoretical channels through which monetary policy can affect income and wealth inequality have been discussed in the literature by several authors (Ampudia et al., 2018; Coibion et al., 2017). The distributive effects of monetary policy have also captured the attention of central bankers, who are concerned about the potential unintended consequences of their unconventional monetary policy decisions, which materialize through changes in the macroeconomic and financial environment (e.g., Bernanke, 2013, 2015; Constâncio, 2017; Draghi, 2016; Yellen, 2014). In advanced economies, the Bank of International Settlements notes a significant increase in the proportion of central bank speeches mentioning inequality since 2014 (Pereira da Silva et al., 2022).

According to Bernanke (2015), monetary policy is not a primary driver of the increase in inequality, as "monetary policy is neutral or nearly so in the longer term, meaning that it has limited long-term effects on *real* outcomes like the distribution of income and wealth". More recently, this traditional view proposing the neutrality of monetary policy over the business cycle is losing ground to the notion that cyclical and trend changes are hardly ever independent. Cyclical increases in inequality during economic downturns tend to be, in absolute terms, larger than the declines prompted by recovery phases. Consequently, by exerting a counter-cyclical effect,

monetary policy might not only limit the short-term deterioration of inequality during recessions but also help reduce subsequent long-lasting scars (see e.g., Pereira da Silva et al., 2022).

Furthermore, amidst the recent shifts in the macroeconomic environment initiated during the COVID-19 crisis and further exacerbated by the subsequent global supply chain disruptions and the effects of the war in Ukraine, central banks are scaling back previous ultra-accommodative monetary policy stances to curb above-target inflation in advanced economies. The ongoing monetary tightening underscores the necessity of reassessing the impact past monetary easing tools had on inequality to fully comprehend what might be currently at stake and to initiate discussions about whether and how other policy areas (such as fiscal and structural policies) could help address potential forthcoming changes in labor income inequality.

This paper aims to contribute to the debate concerning the potential distributive implications of monetary policy transmission to income through the labor market. This research evaluates how monetary policy affects the different income classes by stimulating economic activity and employment in the set of countries that originated the Economic and Monetary Union (EMU-11). We differentiate between lower, lower-middle, upper-middle, and upper classes and estimate country-specific structural vector autoregression (SVAR) models to assess possible impacts of monetary policy on the different income classes over the period between 2006 and 2019.

Our contribution is twofold. First, our proposal is among the first attempts in the literature (see also Corrado & Fantozzi, 2021, for the case of Italy) to empirically examine the effects of monetary policy using household survey (microlevel) data for the euro area. We generate class-specific labor market metrics and provide a deeper analysis that goes beyond the aggregate measures of inequality usually employed in this literature, which allows us to provide evidence of how both earnings heterogeneity and income composition channels work through the labor market.[1] Most previous studies rely on aggregate inequality measures such as the Gini index or metrics related to the income share of individuals at the top of the distribution compared to those at the bottom. Instead, we use cross-sectional data from EU-SILC and estimate the unequal incidence of monetary policy on employment status (i.e., extensive margin) and labor income (i.e., intensive margin) across income classes. Second, to further elucidate the mechanism behind the effect on the extensive margin, we use longitudinal data from EU-SILC and estimate the impact of expansionary monetary policy shocks on the job loss risk (i.e., job separation rate) and on the likelihood of finding a job (i.e., job finding rate).

Our findings indicate a nonuniform incidence of monetary policy shocks across income classes. On one hand, past accommodative monetary policy appears to have helped reduce unemployment rates for lower- and middle-income classes, while the impact on the upper class is not statistically significant. However, the

[1]Note that the aim of this investigation is to understand the effects that expansionary monetary policy applied since the onset of the GFC may have had in terms of boosting economic activity and thus employment. Therefore, since the focus is on labour market income inequality, other effects related to the potential financial gains stemming from quantitative easing measures are not addressed in this analysis (see e.g., Montecino & Epstein, 2015; Mumtaz & Theophilopoulou, 2017; Saiki & Frost, 2014).

estimated reduction in the unemployment rate appears to be considerably larger for lower-income households, underscoring the substantially greater elasticity of poorer workers' employment status to policy shocks. This differential impact across income classes can be attributed to a significantly stronger improvement in job finding rates for those at the bottom of the income distribution. Conversely, job separation rates have been homogeneously affected across the distribution. On the other hand, we also identify a positive impact on real labor income, which, in this case, seems to have primarily benefitted the upper-income class. This investigation concludes that expansionary monetary policy seems to have helped decrease labor income inequality, as the positive impact via the extensive margin (i.e., improving labor opportunities for the less affluent) has largely offset the comparatively minor increase in inequality driven by the intensive margin (i.e., improving real labor income earned by better-off households).

The remainder of the paper is structured as follows. Section 2 reviews the theoretical channels through which monetary policy affects income and wealth inequality and provides an overview of previous empirical evidence. Section 3 describes the data, while the empirical approach is elaborated in Section 4. Section 5 is dedicated to presenting and discussing the results derived from the analyses. Lastly, Section 6 offers concluding remarks.

2. Literature Review

2.1. *Theoretical Framework*

Although the literature has traditionally focused more on the distributive effects of inflation than on the direct impacts of monetary policy on income inequality itself (Albanesi, 2007; Galli & von der Hoeven, 2001), specific channels through which monetary policy might influence income and wealth distributions have been clearly identified (see e.g., Amaral, 2017; Coibion et al., 2017). Most of these channels primarily affect wealth distribution, either through inflation, such as the savings redistribution channel or the portfolio channel, or through the transmission process of monetary impulses, such as the interest rates exposure channel or the financial segmentation channel. However, there are two major channels exerting a direct impact on the distribution of income, namely, the income composition channel and the earnings heterogeneity channel.

The income composition channel focuses on the primary sources of household earnings and highlights that an expansionary monetary policy shock may exert a varying pressure on the different sources of earnings, for example, increasing financial asset prices more than salaries. Consequently, its effect on income may differ for agents who receive a larger fraction of their income from wage earnings (often situated at the lower end of the income distribution) compared to those who receive a larger portion of their income from capital returns and business gains (primarily higher-income households). Throughout the paper, we interpret this channel as the intensive margin of the labor market.

Regarding the earnings heterogeneity channel, it emphasizes that the risk of unemployment is unevenly distributed across the population, with the most vulnerable households typically facing higher odds of being or becoming unemployed.

Therefore, monetary policy is expected to affect the employment situation of the different income groups heterogeneously. Specifically, the employment status of households situated in the leftmost part of the income distribution tends to be more sensitive to the economic cycle and might therefore react more significantly to counter-cyclical monetary policy impulses. In this regard, an expansionary monetary policy shock that supports economic activity and employment could disproportionately benefit low- and middle-income classes, thereby reducing labor income inequality. This channel could be understood as the extensive margin of the labor market.

The relationship between monetary policy and inequality is bi-directional. While this research focuses on the potential effects of monetary policy on inequality, it must be noted that the literature is paying growing attention to the opposite causal relationship, namely, how inequality might affect the effectiveness of monetary policy. In this regard, greater income inequality is associated with deeper and longer recessions, while it might also hamper the transmission of monetary policy (Kaplan et al., 2018). Overall, this literature suggests that the effect of monetary stimulus on the bottom part of the income distribution is crucial for the effective transmission of monetary policy, as its impact on aggregate consumption is mainly influenced by the reaction of households with a larger marginal propensity to consume (i.e., "hand-to-mouth" households).

2.2. *Empirical Literature*

From an empirical standpoint, there is a substantial amount of work on the transmission mechanism of monetary policy and income inequality through the labor market (see e.g., Colciago et al., 2019; Kappes, 2023). While earlier studies focused on the impact of the inflation channel on income and wealth distribution (see e.g., Easterly & Fischer, 2001), more recent empirical studies on the redistributive implications of monetary policy shocks primarily focus on the earnings heterogeneity channel and the income composition channel. Some papers suggest that expansionary monetary policy might have helped reduce income inequality in various countries, including the United States (Bivens, 2015; Coibion et al., 2017), the United Kingdom (Mumtaz & Theophilopoulou, 2017), Italy (Casiraghi et al., 2018), Germany (Broer et al., 2022), Denmark (Andersen et al., 2023), Sweden (Amberg et al., 2022), the euro area (Guerello, 2018; Lenza & Slacalek, 2018), and a set of advanced and emerging countries (Furceri et al., 2018). They argue that expansionary monetary policies stimulate economic activity, employment, and wages, particularly benefiting low-income households for which labor earnings constitute the main source of income. In contrast, high-income households are less likely to experience significant changes in employment status throughout the business cycle. In this regard, Heathcote et al. (2010) suggest that earnings at the bottom of the distribution are mainly affected by changes in hours worked and the unemployment rate, while earnings at the top are mostly affected by changes in hourly wages. Focusing on Germany, Broer et al. (2022) observe that job loss is more counter-cyclical for lower-earning households and conclude that expansionary monetary policy helps decrease labor income inequality largely by reducing the job separation rate of the poorer. Similar findings are reported for

Denmark and Sweden. For the case of Denmark, Andersen et al. (2023) highlight that gains created by monetary policy through the labor channel are concentrated among relatively low-income workers. In a similar vein, Amberg et al. (2022) study the Swedish economy and conclude that the heterogeneity in the response of labor income across the income distribution is accounted for by the earnings heterogeneity channel, that is, due to a higher sensitivity of labor income to monetary shocks at the bottom than elsewhere in the distribution. Additionally, Lenza & Slacalek (2018) and Furceri et al. (2018), among others, evidence that the incidence of monetary policy on income inequality is asymmetric, with tightening policy raising inequality more than easing policy lowers it.

However, other studies find that expansionary monetary policy is associated with higher income inequality or that its distributive implications may be negligible. For instance, in Japan, Inui et al. (2017) reveal that expansionary monetary policy may disperse wages and increase income inequality due to labor market rigidities and nominal wage stickiness. O'Farrell et al. (2016) conclude that the distributive effects of expansionary monetary policy vary considerably across OECD countries, suggesting that they should be analyzed on a case-by-case basis.

From a somewhat different perspective, Dolado et al. (2021) examine the earnings heterogeneity channel using New Keynesian models, in which they study how capital-skill complementarity interacts with monetary policy in affecting inequality between high- and low-skilled workers. They find that unexpected expansionary monetary policy shocks may increase earnings inequality by lowering the labor share of income received by low-skilled workers and raising it for high-skilled workers, as they increase capital demand, which then amplifies this wage divergence due to skilled workers being more complementary to capital than substitutable unskilled workers are. This way, in contrast to the arguments exposed above, monetary easing may favor the labor share of income received by high-skilled workers over low-skilled ones.

The sometimes-divergent results found in this literature underscore the importance of empirically addressing the impact of monetary policy on inequality in each case, considering sociodemographic, economic, and institutional dynamics that can play a significant role, such as the design of the labor market.

3. Data

3.1. *Microlevel Data from EU-SILC*

To derive class-specific labor market metrics, we use household survey data from the European Statistics on Income and Living Conditions (EU-SILC), which has been conducted since 2004 and serves as the source of reference for comparative statistics on income distribution in Europe (EU-SILC, 2021a, 2021b).[2] The EU-SILC database offers the advantage of gathering detailed information on individual and household income, with data also being comparable across

[2]Missing data on gross employee cash or near cash income for various countries in our sample forces us to shorten the time dimension and consider the period that ranges between 2006 and 2019.

the participating European countries.[3] We use data spanning from 2006 to 2019, encompassing the period from the GFC to the onset of the COVID-19 pandemic.

EU-SILC comprises two datasets: a cross-sectional dataset covering a specific period and a longitudinal dataset enabling the assessment of individual-level changes over time. The longitudinal dataset constitutes a rotational panel covering 4 years for most countries, with certain countries (namely France and Luxembourg) providing data for longer periods. Notably, Germany lacks a longitudinal database. Due to its larger sample size, the cross-sectional dataset is preferred and utilized for Analysis I (outlined in Section 5.1), where we explore the impact of monetary policy on the unemployment rate and annual employee labor income across income classes.[4] For this analysis, we look into a sample composed of the EMU-11 countries, namely Austria, Belgium, Germany, Spain, Finland, France, Ireland, Italy, Luxembourg, the Netherlands, and Portugal. Despite the more sizeable sample of the cross-sectional dataset, we resort to the longitudinal dataset for Analysis II (presented in Section 5.2.) to better understand the impact on unemployment. In particular, we study how monetary policy shocks affect the job separation and the job finding rates, for which we need over-time information on individuals' employment status. As the longitudinal dataset lacks data for Germany, this analysis focuses on the remaining ten countries mentioned above. Additional details regarding the datasets are available in Appendix A (Tables A1–A4).

To assess the distributive implications of monetary policy on the income class structure, we adopt a relative definition of the income class based on thresholds relative to percentages of the median income. To delimit the lower-middle class, we consider the income limits that are conventionally accepted (see, e.g., Thurow, 1987; Birdsall et al., 2000; Ravallion, 2010; Atkinson & Brandolini, 2013): 75% and 125% of the median income. These cutoffs demarcate the lower-middle class as those "comfortably" clear of being at-risk-of-poverty (below 60% of the median). Similarly, we define the upper-middle class as the share of the population whose income is between 125% and 200% of the median income. Households falling below 75% of the median income are categorized as lower class, while those above 200% constitute the upper class. The concept of income used to compute the limit of the income classes is disposable household income, as is usual in the delimitation of income classes. This includes, by definition, all income from work (salaries of employees and income of self-employed workers), income from capital and property, and transfers, while excluding taxes. Income data are collected with reference to the preceding calendar year, with Ireland being an exception among the analyzed countries, implying that the assignment of individuals to income classes is not affected by

[3]EU-SILC is organized under a framework regulation and is thus compulsory for all EU Member States. EU-SILC is based on the idea of a "common framework" that is defined by a recommended design for implementing EU-SILC, and by common requirements (for imputation, weighting, sampling errors calculation), common concepts (e.g., household and income) and classifications (ISCO, NACE, ISCED) aiming at maximizing the comparability of the information produced.

[4]Note that we use annual employee labour income, therefore, changes in the intensive margin arise both from changes in work intensity (i.e., numbers of hours worked during the year) and changes in wages (i.e., remuneration per hour).

current but rather past economic conditions, thereby leading to an exogenous classification.[5]

In EU-SILC, household serves as the basic unit for data collection and is commonly taken as the unit of measure. However, our analysis focuses on examining the income distribution of individuals, which constitutes our unit of analysis. Considering that an individual's well-being is affected not solely by their own personal income but also by the earnings of other household members and the household's composition, we utilize equivalent household income to categorize individuals into distinct income classes. Recognizing that household needs increase with each additional member, albeit not in a strictly proportional manner, we employ the concept of "equivalent" income to adjust household income according to its size, thereby assigning a value commensurate with its needs. Specifically, we employ the modified OECD equivalence scale to compute equivalent household income, a widely adopted approach throughout Europe.[6] Subsequently, we assign the equivalent household income to each member of the household. For each income class delineated above, we calculate class-specific metrics including the unemployment rate, job separation rate, job finding rate, and (mean) real labor income. Nominal variables are deflated using the GDP deflator so as to be expressed in real terms (using 2015 prices). The analysis aims to estimate the response of a series of variables to an orthogonal monetary policy shock. Consequently, we prefer using the GDP deflator as the price metric for computing real values rather than the Harmonised Index of Consumer Prices (HICP). This preference is due to the HICP's role in guiding policymaking, which results in a closer endogenous relationship with the monetary policy variable.

The unemployment rate is defined as the ratio of unemployed individuals to the total number of active persons, encompassing both the employed and unemployed. The job separation rate refers to individuals newly transitioning from "employed" to "unemployed" status from 1 year to the next (divided by total active individuals), while the job finding rate reflects individuals transitioning from "unemployed" to "employed" status within the same timeframe. The job separation and job finding rates are computed using the longitudinal dataset, which allows us to track individuals over two consecutive years, identifying changes in their labour status. We identify the change in the labour status for each individual over the last 2 years of every longitudinal dataset corresponding to the waves of the analysed period. We then determine the job separation and job finding rates by employing the longitudinal weights to address attrition.

The concept of labour income used is gross employee cash or near cash income, that is, before transfers and taxes. By focusing on income before social transfers and taxes, we aim to minimize the influence of the redistributive role of the tax and transfers system. However, examining solely market income would result in the exclusion of households entirely reliant on transfer payments, such as retirees who

[5]As argued by Böheim and Jenkins (2006), the differences in income reference periods are unlikely to be a major source of non-comparability across countries.

[6]A value of 1 to the first adult in the household, 0.5 to each remaining adult, 0.3 to each member younger than 14.

cannot be included in the analysis as their market income is close to zero in most cases. For this reason and given our interest in the effects of monetary policy via the labour market, we exclude from our sample those households whose market income is zero and simultaneously declare not to have active members. Therefore, while retirees (inactive members) relying on retirement pensions are not included, we do consider households composed by active members even if they are unemployed, as monetary policy might also affect them (see also Appendix B, Figures B1 and B2). While monetary policy might also impact income streams other than salaries, this research solely focuses on the labour market channel and thus does not consider the potential impact on business and capital gains. It also excludes the analysis of revenue received by the self-employed, who could be considered a hybrid type of earner, mixing features of workers and entrepreneurs, and receiving business and capital gains.

When examining the evolution of unemployment rate by income class (Figure 1), we observe how the burden of unemployment falls disproportionately on the lower class, where unemployment rate has remained around 30% for the period between 2009 and 2016. Interestingly, the most vulnerable households seem to have been the first ones to exit the labour market when the recession started: the unemployment rate for the lower class began increasing already in 2008, while the first year-on-year increase appeared only in 2009 for the rest of the population. At the same time, these households seem to have been the last ones to reenter the labour market during the recovery. In fact, while the unemployment rate for the upper classes started decreasing already in 2014–2015, the first decline is only observed in 2017 for the lower class (in 2016 for the lower-middle class). This "first-out, last-in" phenomenon present in the leftmost part of the income distribution, coupled with their comparatively largest increase in unemployment rate during the recession, helps explain the cyclical increase of labour income inequality and its persistence.

When considering the entire business cycle, including the full recovery up to 2019, we observe this cyclical deterioration disproportionately suffered by the lower

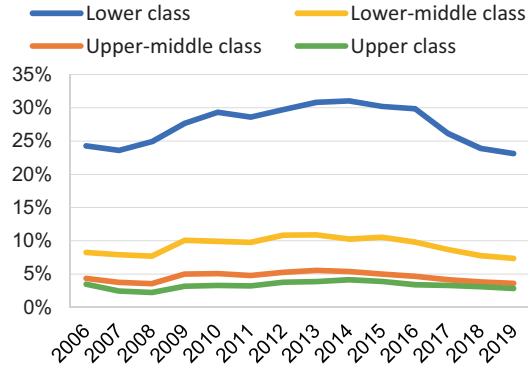

Figure 1. Evolution of Unemployment Rate by Income Class (2006–2019, %). Figure Displays the Weighted Aggregate Figures for the Countries Included in Our Sample (Namely AT, BE, DE, ES, FI, FR, IE, IT, LU, NL, PT) Using Active Population as Weights.
Source: EU-SILC (Cross-Sectional Data) and Authors' Calculations.

Figure 2. Scarring Effect of Unemployment Rate by Income Class (2006–2019, pps). Dots in the Figure Represent Each of the Countries Included in Our Sample (Namely AT, BE, DE, ES, FI, FR, IE, IT, LU, NL, PT). The Increase in Unemployment Represented in the *x*-Axis Refers to the Difference Between the Higher Unemployment Rate Witnessed During the Recession Period (2008–2013) and the Lowest Unemployment Rate During the Precrisis Period (2006–2007). The *y*-Axis Represents the Sharpest Decline in the Unemployment Rate During the Postcrisis Period (2014–2019), with Respect to the Largest Value During the Recession (2008–2013).
Source: EU-SILC (Cross-Sectional Data) and Authors' Calculations.

class is not fully reversed. Instead, the postcrisis unemployment rate remains above the precrisis figures, leading to a scarring or hysteresis effect. Visually, this is represented by the slope of the lower-class best-fit-line in Figure 2, which differs both from the "full recovery" −45° line as well as from the slope estimated for the rest of the population.[7] This finding is aligned with Pereira da Silva et al. (2022), who uncover a similar dynamic also when examining advanced economies outside the euro area.

The evolution of the mean real labor income varies significantly across income classes. Overall, labor income remained rather stagnant between 2009 and 2013, with the recovery phase starting around 2014–2015 (see Figure 3). When compared to other income classes, the distinct behavior displayed by the real labor income earned by the lower class stands out, as labor income growth decreased and then stagnated for a longer period of time. In particular, it remained approximately 5%–10% below precrisis levels for seven consecutive years and only started to recover in 2016. This extended period of stagnation reflects a lasting scarring effect, which contributed to a pronounced gap between the poorer and other income groups. This finding is aligned with Cockx & Ghirelli (2016) and Rothstein (2020), who document that the earnings of low-skilled workers and new entrants remain below precrisis levels more than 10 years after the end of the recession. By 2018, the cumulative growth rate since 2007 amounted to around 18% for the upper class

[7]Let us recall that the choice of the specific time frame, covering from the pre-crisis period (2006) until the year before the COVID-19 pandemic (2019), aims to capture the recovery phase before the negative macroeconomic impacts related to the pandemic. Furthermore, to allow for cross-country heterogeneity, on the chart we plot the country-specific changes in unemployment rates, which did not necessarily happen in the same year.

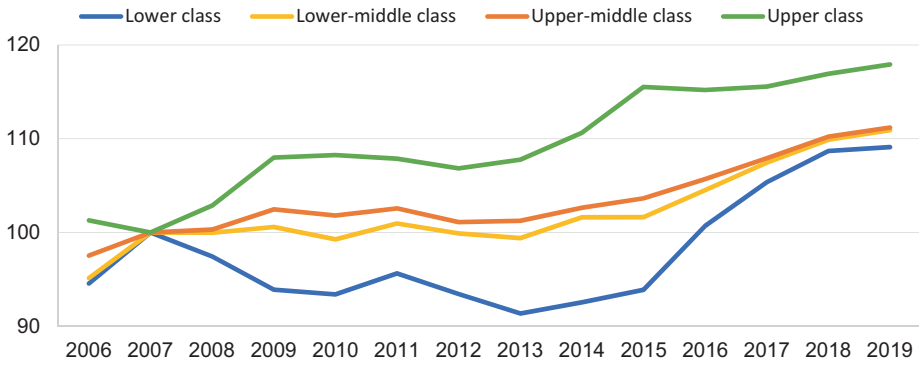

Figure 3. Evolution of Real Labor Income by Income Class (2006–2019; Index: 2007 = 100). Figure Displays the Weighted Aggregate Figures for the Countries Included in Our Sample (Namely AT, BE, DE, ES, FI, FR, IE, IT, LU, NL, PT) Using Active Population as Weights. Nominal Values Are Deflated Using the Country-Specific GDP Deflator (2015 Prices). For Each Income Class, the Figure Represents the Evolution of the Mean Real Labor Income.
Source: EU-SILC (Cross-Sectional Data) and Authors' Calculations.

and around 12% for the middle classes, while it remained below 10% for lower-class households. These dynamics highlight a notable widening of labor income dispersion throughout the recession period, which persisted above precrisis levels even after the recovery phase. Particularly noteworthy is the gap between the upper class and the rest of the population, which expanded around 2007–2009, continued to do so through 2014–2015 and persisted in 2019.

Figure 4 shows that the probability of becoming unemployed increased significantly during the recession years, this increase being larger for the lower class (0.8 percentage points from trough to peak) compared to the other income classes (around 0.5–0.6 percentage points). The job separation rate increased during the GFC and then began to decline progressively after the peak in 2011–2013. The parallel deterioration of the job finding rate followed a different dynamic: it declined abruptly in 2009 (−0.4 percentage points for the lower class, and around −0.25 percentage points for the others), remaining low throughout the recession, particularly for the most vulnerable households. While the job finding rate improved gradually for the middle and upper classes, the recovery only materialized in 2017 for the lower class.

On average, both the job separation and the job finding rates are higher for the lower class, revealing the higher volatility of their employment status, as these workers are more likely to exit and reenter the labor market. The higher job finding rate of the lower class (Figure 5) is also explained by their higher unemployment rate (Figure 1), as unemployed individuals are more likely to be found in the lower class.

3.2. *Macro-Level Data from Various Sources*

In accordance with the literature (see e.g., Coibion et al., 2017; Peersman, 2011), apart from the indicators derived from the EU-SILC microdata, we also include a series of macroeconomic variables as controls in our various models. In particular, we employ real gross domestic product, GDP_{it}, and also consider the

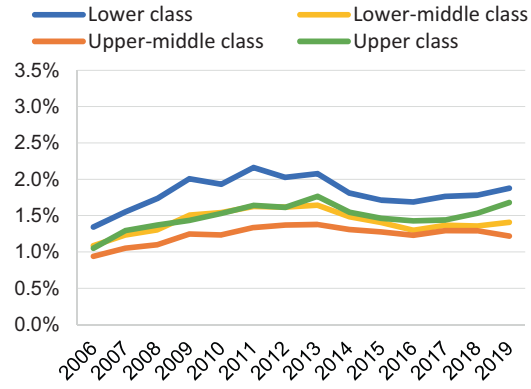

Figure 4. Job Separation Rate by Income Class (2006–2019, %). Figure Displays the Weighted Aggregate Figures for the Countries Included in Our Sample (Namely AT, BE, ES, FI, FR, IE, IT, LU, NL, PT) Using Active Population as Weights. Data for DE Are Not Available.
Source: EU-SILC (Longitudinal Data) and Authors' Calculations.

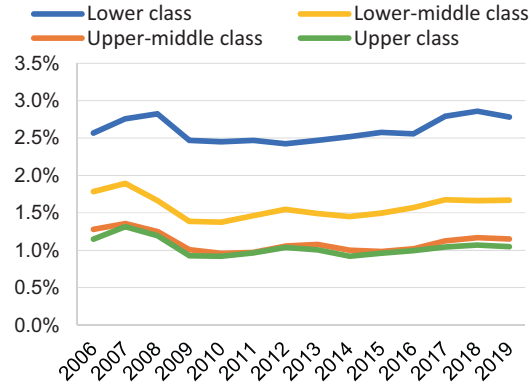

Figure 5. Job Finding Rate by Income Class (2006–2019, %). Figure Displays the Weighted Aggregate Figures for the Countries Included in Our Sample (Namely AT, BE, ES, FI, FR, IE, IT, LU, NL, PT) Using Active Population as Weights. Data for DE Are Not Available.
Source: EU-SILC (Longitudinal Data) and Authors' Calculations.

evolution of prices by including the deflator of gross domestic product (referring to 2015 prices), $GDPdef_{it}$. To account for dynamics present in the financial markets, we also include in our models the Eurostoxx 600 prices, $StockPrices_t$, and the term spread between the euro area 10-year Government Benchmark bond yield and its 2-year counterpart, $TermSpread_t$.

Concerning monetary policy, it is commonly proxied either by short-term or policy interest rates (e.g., Coibion et al., 2017; Furceri et al., 2018; Mumtaz & Theophilopoulou, 2017), central bank assets (Guerello, 2018; Saiki & Frost, 2014), or government bond spreads (Ampudia et al., 2018; Baumeister & Benati, 2010; Lenza & Slacalek, 2018), particularly when intending to examine specifically unconventional monetary policy. To capture, as far as possible, the overall effects of the wide variety of monetary policy decisions adopted by the ECB since the onset of

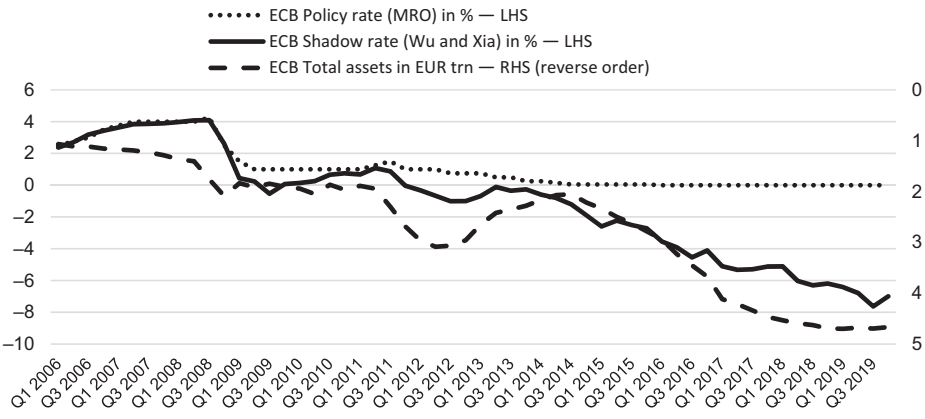

Figure 6. Evolution of Various Monetary Policy Indicators (2006Q1–2019Q4). ECB, European Central Bank.
Source: ECB Statistical Data Warehouse (SDW) and Wu & Xia (2020).

the financial crisis, including both conventional and unconventional monetary policy tools, we use the shadow rate from Wu & Xia (2020), $ShadowRate_t$. The shadow rate can be construed as the hypothetical short-term interest rate that would prevail in the economy if the effective lower bound were not binding. Authors infer the indicator from the term structure of interest rates so that it includes the information coming from longer-term interest rates, thereby reflecting unconventional monetary policy actions aimed at influencing the long end of the yield curve. As reflected in Figure 6, while at the beginning of our sample period the shadow rate perfectly co-moves with the conventional monetary policy rate applied to main refinancing operations, it also reflects the expansion of the ECB's balance sheet over the Quantitative Easing (QE) period when the shadow rate falls below zero.

4. Empirical Approach—Country-Specific Vector Autoregression (SVAR) Models

Macroeconomic analyses and policy evaluations require considering the interdependencies among the different economic variables to assess impacts from a global perspective and uncover causal relationships. The effects of monetary policies materialize through numerous transmission mechanisms, giving rise to both direct and indirect impacts of a different nature. The existence of interactions between the analyzed variables constitutes the main reason why a simultaneous equation system appears to be an accurate way to approach our analysis. Initially developed by Sims (1980), the SVAR approach considers all variables to be endogenous and interdependent. The variables are included in the system as functions of lagged and present values of all endogenous variables, with the aim of tackling endogeneity issues as much as possible. SVAR models have become a pillar in empirical macroeconomic research and are widely used for multivariate time-series analysis, including the investigation of the effects of monetary policy (see e.g., Bernanke et al., 2005; Sims & Zha, 2006). However, the use of SVAR methods has some limitations in capturing the complex dynamics of real-world

economies. One limitation is that they rely on simplifying assumptions, as the set of covariates included in the model might not fully account for all relevant factors shaping income distribution and labor market dynamics. Another caveat, also related to the previous one, stems from the potential remaining endogeneity, as lingering endogeneity issues stemming from an imperfect model specification (and the existence of unobserved variables) cannot be fully excluded. Even though SVAR models are widely used to examine the distributive implications of monetary policy shocks, this approach is not well equipped for studying multiple distributional channels, and analyses usually aim to tackle, either fully or partially, one or two transmission mechanisms. In our case, we aim to address the effects of the earnings heterogeneity and income composition channels that operate through the labor market. Notwithstanding these caveats, a stream of literature employs large-scale micro-econometric models to complement and overcome some of the constraints related to multivariate time-series analyses (see e.g., Bunn et al., 2018; Casiraghi et al., 2018). In the area of dynamic stochastic general equilibrium models, a growing number of researchers are capturing the interplay between inequality and monetary policy via New Keynesian models with heterogeneous agents (HANK). These authors highlight that the distributive implications of monetary policy shocks largely depend on the marginal propensity to consume of hand-to-mouth households, which shapes their more sizeable reaction to monetary policy decisions compared to other income classes (see e.g., Ampudia et al., 2018; Dolado et al., 2021; Kaplan et al., 2018).

The dynamic interactions among the set of macroeconomic endogenous variables collected in the vector Y_t, $(g \times 1)$ are governed by the following system of autoregressive simultaneous equations in reduced form:

$$Y_t = C + A_1 Y_{t-1} + A_2 Y_{t-2} + \ \dots \ + A_p Y_{t-p} + \varepsilon_t \tag{1}$$

$$Y_t = C + \sum_{j=1}^{p} A_j Y_{t-j} + \varepsilon_t \tag{2}$$

$$\varepsilon_t \sim N\left(0, \Sigma_\varepsilon\right) \tag{3}$$

where $t = 1 \dots, T$, indicates times with $T = 56$ quarters from 2006Q1 to 2019Q4. Here, C denotes a $(g \times 1)$ vector of constants, and A_j are $(g \times g)$ matrices of coefficients on the p lags of the variables, where $p = 8$ is the optimal number of lags, which stems from the Akaike Information Criterion. ε_t is an error process which is assumed to be white noise with zero mean and to have a time invariant covariance matrix, Σ. The vector Y_t includes 7 endogenous variables; therefore, g is equal to 7 for each of the four models corresponding to each of the four income classes. Four models (one per income class) are estimated for each of the countries of our sample, while charts throughout Section 5 plot the aggregated results (using real gross domestic product as weight).[8] The source and the transformation of the

[8]Let us recall that, due to data availability in EU-SILC, Analysis I (Section 5.1) includes AT, BE, DE, ES, FI, FR, IE, IT, LU, NL, and PT, while Analysis II (Section 5.2) excludes DE, thereby considering AT, BE, ES, FI, FR, IE. IT, LU, NL, and PT.

different variables included in the models can be found in Appendix C. The set of class-specific variables vary for each of the analyses:

1. *Analysis I* (based on EU-SILC cross-sectional data), where the vector of endogenous variables, Y_t, is composed of (i) GDP, (ii) GDP deflator, (iii) stock prices, (iv) term spread, (v) shadow rate, (vi) *unemployment rate*, and (vii) *real labor income*.
2. *Analysis II* (based on EU-SILC longitudinal data), where the vector of endogenous variables, Y_t, is composed of (i) GDP, (ii) GDP deflator, (iii) stock prices, (iv) term spread, (v) shadow rate, (vi) *job separation rate*, and (vii) *job finding rate*.

The estimation of the structural VAR might be biased due to the large number of parameters coupled with the rather limited temporal availability, which might lead to over-parametrization, thus biasing the results due to the trade-off between the length of the sample and model accuracy. To overcome this limitation, commonly referred to as the curse of dimensionality, we use a Bayesian approach to estimate VAR models with sign restrictions, following Rubio-Ramirez et al. (2010). The choice of the degree of informativeness implied by the foregoing is approached in a data-based fashion via hierarchical modelling in the spirit of Giannone et al. (2015). More specifically, the hyperparameters of the prior distributions are treated as additional random parameters to be estimated in the model.[9]

While the macroeconomic and financial variables are available at a quarterly frequency, this is not the case for the household survey data from EU-SILC. To solve this mixed-frequency problem, we perform a regression-based temporal disaggregation so as to convert the low-frequency data (annual data) into a higher frequency (quarterly data). In particular, we use quarterly data on GDP growth rate and aggregate unemployment rate (at country-level) to disaggregate the class-specific metrics on unemployment rate, and job separation and job finding rates. For real labor income, we follow the same approach using as regressors the real GDP per capita and the aggregate compensation by employee in real terms (at country level). The underlying implicit assumption is that the annual relationship between the variables also holds intra-annually. As the data on real labor income collected by EU-SILC refer to the year preceding the survey, we perform a temporal matching to align the income data to the corresponding time period, thereby allowing for accurate comparison and analysis. Essentially, we use the income reference period rather than the year in which the income data are collected. As a direct consequence of this approach, data on real labor income were only available until 2018 at the time we performed the analysis. The disaggregation approach mentioned above is also used to extend this data for the period 2019Q1–2019Q4.[10]

The reduced-form VAR system above (Equations (1)–(3)) does not account for direct contemporaneous relationships among the variables, as there are no contemporaneous endogenous variables on the right-hand side. In fact, the error

[9]The estimate of the models is done via the Bayesian Estimation, Analysis and Regression toolbox (BEAR) developed by Dieppe et al. (2016) and made available via the European Central Bank website.

[10]Results are robust to estimates including the period between 2006Q1 and 2018Q4.

terms in the reduced form are typically correlated (matrix Σ tends to have nonzero off-diagonal elements), and thus, this form does not have a clear economic interpretation. To derive a meaningful interpretation of the impulse-response functions, we perform the identification via sign restrictions, which rely on expectations about the response directions of the variables following certain shocks (Rubio-Ramirez et al., 2010). Our aim is to estimate the effect of monetary policy, for which we identify an exogenous expansionary monetary policy shock and trace the response over time of the different endogenous variables. The main identifying assumption is that an expansionary monetary policy shock (defined as a negative orthogonal deviation in the shadow rate) has a positive impact on inflation (measured via the GDP deflator) and stock prices, while decreasing the term spread. Regarding the macroeconomic environment, an expansionary monetary policy is expected to exert a positive impact on the real economy (real GDP), while the class-specific variables related to the labor market are left unrestricted. The identifying assumptions are imposed contemporaneously (i.e., on impact, for the same period in which the shock materializes) and one period-ahead. As a cross-validation check, we also use an alternative identification strategy via zero restrictions using the Cholesky decomposition (the associated restrictions and estimates can be found in Appendix D, Tables D1 and D2).

5. Results

5.1. *Analysis I—Focus on Unemployment Rate and Labor Income*

First, country-specific SVAR models are estimated for each of the income classes using sign restrictions (results presented throughout Figures 7–10, and

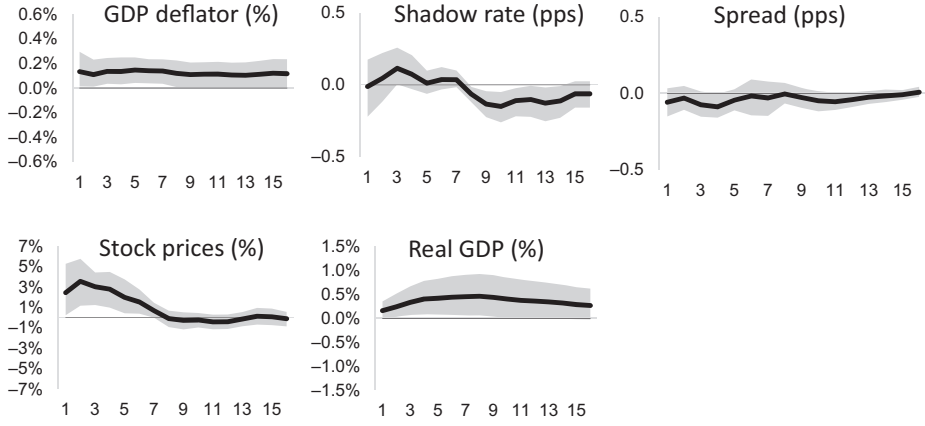

Figure 7. Analysis I—Estimated impulse-response functions to an Expansionary Monetary Policy Shock (1/3) (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock. Charts Present the Results Aggregated for All Countries in the Sample (Namely, AT, BE, DE, ES, FI, FR, IE, IT, LU, NL, PT) Using as Weight the Average Real Gross Domestic Product During the Period Between 2006 and 2019

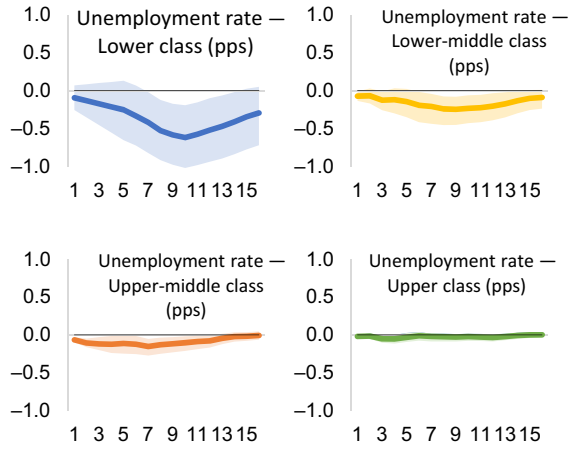

Figure 8. Analysis I—Estimated impulse-response functions to an Expansionary Monetary Policy Shock (2/3) (Shock: −1 percentage point shock to an orthogonal deviation in the shadow rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock. Charts Present the Results Aggregated for All Countries in the Sample (Namely, AT, BE, DE, ES, FI, FR, IE, IT, LU, NL, PT) Using as Weight the Average Real Gross Domestic Product During the Period Between 2006 and 2019

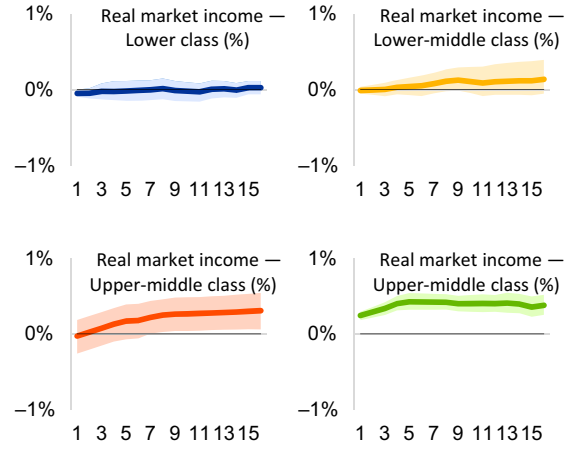

Figure 9. Analysis I—Estimated impulse-response functions to an Expansionary Monetary Policy Shock (3/3) (Shock: −1 percentage point shock to an orthogonal deviation in the shadow rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock. Charts Present the Results Aggregated for All Countries in the Sample (Namely, AT, BE, DE, ES, FI, FR, IE, IT, LU, NL, PT) Using as Weight the Average Real Gross Domestic Product During the Period Between 2006 and 2019

Tables 1 and 2), while additional estimates using triangular factorization are provided as a robustness check in Appendix D (results presented throughout Figures D1–D3). Figure 7 shows that an expansionary monetary policy shock, equivalent to a one-percentage-point decrease in the shadow rate, is associated with long-lasting changes in inflation. Specifically, it appears to be linked to an

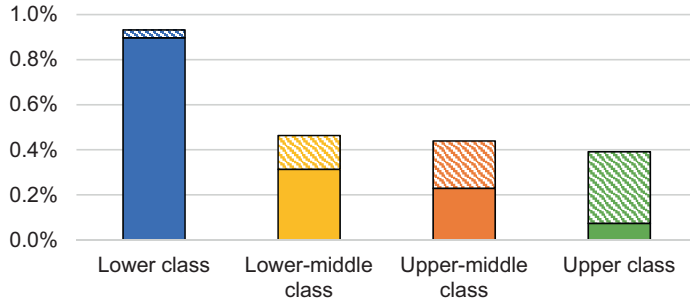

Figure 10. Analysis I—Decomposition of the Overall Impact on Mean Labor Income (in Real Terms) into the Extensive (Solid Bars) and the Intensive Margins (Dashed Bars) (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Figures Display the Total Effect for all Countries (EMU-11) Comprising Our Sample. Impacts Used for the Computation Are the Peak Impacts Estimated Via the Bayesian SVAR Set Up with Sign Restrictions. The Chart Presents the Aggregate Results Including All Countries in the Sample (Namely, AT, BE, DE, ES, FI, FR, IE, IT, LU, NL, PT)

increase in the gross domestic product deflator by approximately 0.12%–0.15%. Moreover, the term spread seems to correlate with the shock, exhibiting a negative peak response of −0.1 percentage points approximately four quarters after the shock. Stock prices also appear to increase by around 2.5%–3.5% during the first year after the shock. Real gross domestic product remains 0.3%–0.5% above its pre-shock level for at least 16 quarters after the shock.

Figure 8 highlights that the estimated response of the unemployment rate to a monetary easing shock varies significantly across income classes. Particularly, the lower class displays the most substantial change in magnitude, remaining approximately −0.5 percentage points below the initial value during the second and third year after the shock (i.e., between the seventh and the thirteenth quarter). The magnitude of the response diminishes as one moves up through the income strata, with the unemployment rate showing a reduction of around −0.2 percentage points for the lower-middle class, and between −0.1 and −0.15 for the upper-middle class. In contrast, the unemployment rate for the upper class does not seem to change significantly with the monetary policy shocks. This indicates that the increased economic activity promoted by expansionary monetary policies is associated with more employment opportunities, which seem to have been unevenly distributed among the different income classes. In fact, these changes seem to particularly favor households in the lower-income class, as they appear to have captured most of the generated employment.

These findings suggest that, over the past economic cycle, monetary easing might have potentially contributed to the containment of income inequality via the extensive margin of the labor market. However, the positive contribution to the reduction of the unemployment rate suffered by the lower class appears to vary significantly across countries, being particularly sizeable for Ireland, Spain, Italy, and Portugal, in contrast to the Netherlands, Austria, Germany, and Finland, which exhibit more moderate changes (see Table 1). These disparities are linked to differences in labor market dynamics across countries. Specifically, countries that suffered larger increases in the unemployment rate during the recession are those for which

TABLE 1
Analysis I—Country-Specific Peak Impulse-Response Coefficient for Unemployment Rate (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate)

		AT	BE	DE	ES	FI	FR	IE	IT	LU	NL	PT
Response of unemployment rate	Lower class	−0.42	−0.52	−0.37	−0.97	−0.36	−0.43	−2.11	−0.87	−0.60	−0.18	−0.80
	Lower-middle class	−0.19	−0.18	−0.13	−0.35	−0.26	−0.15	−1.19	−0.42	−0.29	−0.08	−0.24
	Upper-middle class	−0.13	−0.12	−0.09	−0.12	−0.22	−0.09	−0.83	−0.11	−0.31	−0.06	−0.18
	Upper class	−0.04	−0.04	−0.04	−0.05	−0.07	−0.02	−0.25	−0.04	−0.09	−0.04	−0.08

Note: Figures other than zero are deemed to be significant (i.e., within the 90% confidence bands).

TABLE 2

Analysis I—Country-Specific Peak Impulse-Response Coefficient for Real Labor Income (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate)

		AT	BE	DE	ES	FI	FR	IE	IT	LU	NL	PT
Response of real labor income	Lower class	0.02%	0.04%	0.00%	0.00%	0.04%	0.05%	0.07%	0.00%	0.00%	0.04%	0.00%
	Lower-middle class	0.00%	0.19%	0.00%	0.00%	0.15%	0.14%	0.23%	0.00%	0.00%	0.00%	0.03%
	Upper-middle class	0.18%	0.12%	0.32%	0.33%	0.18%	0.17%	0.18%	0.11%	0.33%	0.12%	0.18%
	Upper class	0.37%	0.19%	0.26%	0.66%	0.25%	0.54%	0.43%	0.50%	0.50%	0.16%	0.30%

Notes: Figures other than zero are deemed to be significant (i.e., within the 90% confidence bands). Not significant responses are shaded in grey.

our analysis identifies larger impacts. The status of lower-income workers tends to be more sensitive to the economic cycle in the first group of countries mentioned above due to factors related to the flexibility and the sectoral specialization of the labor market.

Figure 9 presents the estimated impulse-response functions (IRFs) for the case of real labor income. First and foremost, this analysis reveals that the labor income perceived by the lower and lower-middle classes has not been significantly affected by monetary shocks. For the other income classes, the results present a mixed picture both in terms of magnitude and time evolution. On one hand, the upper-middle class appears to experience an increase in labor income, although this association appears to be gradual and only becomes significant in the long run, approximately eight quarters after the shock. At its peak, this increase is as high as 0.25%–0.35%. In contrast, the IRF pattern for the upper class shows that labor income for these households increases three quarters after the shock, with income approximately 0.4% higher than they would otherwise be. Notably, upper classes in Spain, France, Ireland, Italy, and Luxembourg appear to benefit particularly from this effect (see Table 2). Overall, expansionary monetary policy might be linked to an exacerbation of income inequality via the intensive margin, as higher-income classes seem to experience a larger positive effect. Conversely, annual labor income accrued by the most vulnerable households seem to be largely unresponsive to expansionary monetary policy shocks.

This analysis leads to the conclusion that expansionary monetary policy seems to be associated with a reduction in income inequality via the extensive margin (i.e., unemployment rate) of the labor market, while it appears to correlate with increasing disparities across income classes via the intensive margin (i.e., annual labour income or annual salary). Using the country-specific peak coefficient of the IRFs estimated in the SVAR models (see Tables 1 and 2), we compute the implications for labor income by income classes. This result indicates that a negative shock to the shadow rate equivalent to a one-percentage-point decrease is associated with an increase in the labor income of circa 1% for the lower class (Figure 10). This result is largely explained by changes in the unemployment rate (i.e., the extensive margin). In comparison, changes in the labor income are much lower and stay between 0.4% and 0.5% for the other income classes. In contrast, the role played by the intensive margin increases as we move towards the higher end of the income distribution. Considering the overall implications for all income classes, and in line with Lenza & Slacalek (2018), our results suggest that expansionary monetary policy seems to be linked to a decrease in income inequality, as the inequality-decreasing response of the extensive margin of the labor market appears to predominate.

5.2. *Analysis II—Focus on Job Separation Rate and Job Finding Rate*

The preceding analysis highlights that monetary policy shocks appear to be associated with changes in the labor market primarily linked to the responsiveness of the unemployment rate, particularly prominent for the lower class. In this subsequent analysis, we delve deeper to ascertain the extent to which this association is driven by the reaction of the job separation rate (i.e., employed people becoming less likely to lose their jobs) or rather relates to the job finding rate (i.e., unemployed

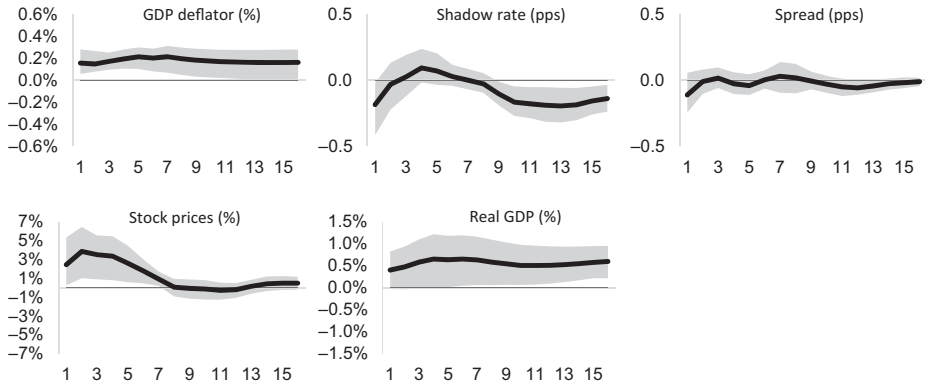

Figure 11. Analysis II—Estimated impulse-response functions to an Expansionary Monetary Policy Shock (1/3) (−1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock. Charts Present the Results Aggregated for All Countries in the Sample (Namely, AT, BE, ES, FI, FR, IE, IT, LU, NL, PT) Using as Weight the Average Real Gross Domestic Product During the Period Between 2007 and 2019

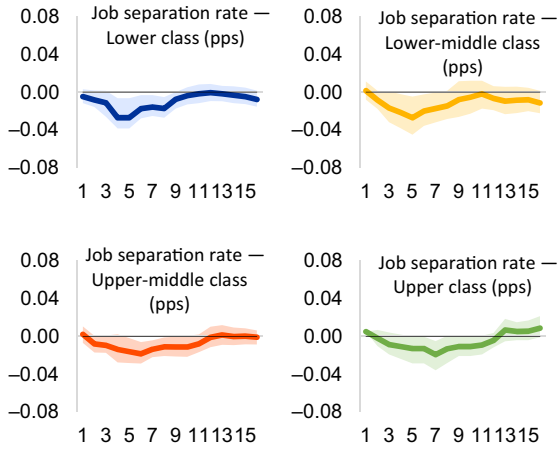

Figure 12. Analysis II—Estimated impulse-response functions to an Expansionary Monetary Policy Shock (2/3) (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock. Charts Present the Results Aggregated for All Countries in the Sample (Namely, AT, BE, ES, FI, FR, IE, IT, LU, NL, PT) Using as Weight the Average Real Gross Domestic Product During the Period Between 2007 and 2019

people becoming more likely to find a job). As in the previous section (Analysis I), we estimate country-specific SVAR models for each income class, employing both sign restrictions (see Figures 11–14, and Tables 3 and 4) and triangular factorization as a cross-validation test (results presented in Figures D4–D6).

Figure 11 illustrates the impulse-response functions for the set of macro variables encompassed in the models. Analogous to our observations in Analysis I (Section 5.1), an expansionary monetary policy shock equivalent to a

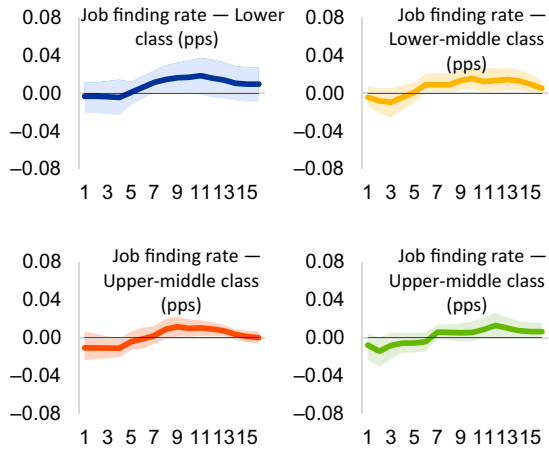

Figure 13. Analysis II—Estimated impulse-response functions to an Expansionary Monetary Policy Shock (3/3) (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock. Charts Present the Results Aggregated for All Countries in the Sample (Namely, AT, BE, ES, FI, FR, IE, IT, LU, NL, PT) Using as Weight the Average Real Gross Domestic Product During the Period Between 2007 and 2019

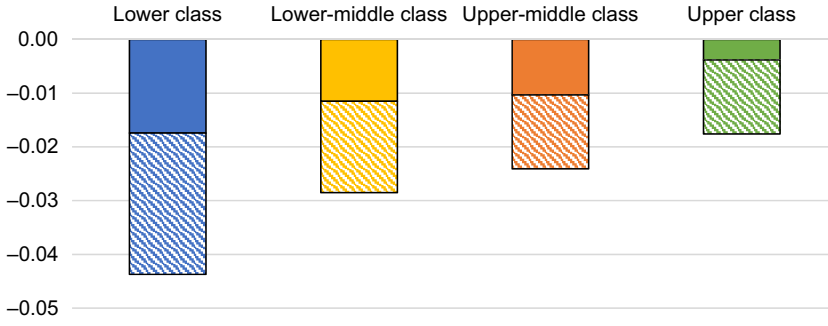

Figure 14. Analysis II—Decomposition of the Overall Impact on (Proxy) Unemployment Rate into the Job Finding (Solid Bars) and the Job Separation Rate (Dashed Bar) (−1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Figures Display the Total Effect for All Countries Comprising Our Sample. Impacts Used for the Computation Are the Peak Impacts Estimated Via the Bayesian SVAR Set Up with Sign Restrictions. The Chart Presents the Aggregate Results Including All Countries in the Sample (Namely, AT, BE, ES, FI, FR, IE, IT, LU, NL, PT)

one-percentage-point negative deviation in the shadow rate is associated with a lasting increase in the GDP deflator of approximately 0.15%–0.20%. The change in the term spread hovers around −0.05 and peaks five quarters after the shock. Stock prices remain 3%–4% above pre-shock levels during the first year, while the real gross domestic product registers an increase of around 0.5%.

The response of the job separation rate to a monetary easing shock varies across income classes, with particularly significant effects observed for the most vulnerable households (Figure 12). For the lower and the lower-middle classes, the rate is approximately −0.025 percentage points lower four to five quarters after the

TABLE 3

Analysis II—Country-Specific Peak Response of Job Separation Rate (−1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate)

		AT	BE	ES	FI	FR	IE	IT	LU	NL	PT
Response of job separation rate	Lower class	−0.02	−0.02	−0.04	−0.02	−0.02	−0.06	−0.04	−0.03	−0.02	−0.04
	Lower-middle class	−0.02	−0.01	−0.02	−0.02	−0.02	−0.02	−0.02	−0.03	−0.02	−0.02
	Upper-middle class	−0.01	−0.01	−0.01	−0.01	−0.01	−0.05	−0.01	−0.02	−0.01	−0.02
	Upper class	−0.01	−0.01	−0.01	−0.01	−0.01	−0.03	−0.01	−0.02	−0.01	−0.02

Note: Figures other than zero are deemed to be significant (i.e., within the 90% confidence bands).

TABLE 4

Analysis II—Country-Specific Peak Response of Job Finding Rate (−1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate)

		AT	BE	ES	FI	FR	IE	IT	LU	NL	PT
Response of job finding rate	Lower class	0.02	0.01	0.02	0.02	0.01	0.05	0.02	0.02	0.02	0.02
	Lower-middle class	0.01	0.01	0.01	0.02	0.01	0.03	0.01	0.02	0.01	0.01
	Upper-middle class	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Upper class	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01

Note: Figures other than zero are deemed to be significant (i.e., within the 90% confidence bands).

shock. Although smaller in magnitude, the changes in the upper-middle and upper classes become statistically significant during the second year (ranging between −0.015 and −0.02 percentage points). In line with the variation in the unemployment rate (see Table 1), the changes in the job separation rate are notably pronounced for Ireland, Italy, Spain, and Portugal, contrasting with the more moderate variations observed in the Netherlands, France, and Finland (Table 3).

While the IRF suggests that the reaction of the job separation rate becomes evident during the second year after the shock, the positive response of the job finding rate materializes later in time, during the third year (Figure 13). The contribution is again more pronounced for the lower class, where the change stands at 0.02 percentage points, above the one estimated for the middle classes (ranging between 0.01 and 0.015 percentage points). The increase in the job finding rate for the upper class appears relatively sluggish, becoming statistically significant 12 quarters after the shock (around 0.005–0.01 percentage points). Across countries, variations in the job finding rates appear to be more substantial for Ireland, while being relatively similar for Austria, Spain, Finland, Italy, Luxembourg, the Netherlands, and Portugal. Conversely, Belgium, and France exhibit less association between the transition from unemployment to employment and monetary policy shocks (Table 4).

The findings of Analysis II suggest monetary easing positively correlates with a reduction in labor income inequality via both a decrease in the risk of job loss and an increase in the probability of finding a job, with larger changes observed for individuals located on the leftmost side of the income distribution (Figure 14). The positive contribution via the reduction in the job separation rate helps explain the overall decline in the unemployment rate, with a more significant impact observed for the lower class, albeit relatively similar impacts are observed for the middle and upper classes. Furthermore, variations in the job separation rate also appear to elucidate most of the heterogeneity in the response of the extensive margin across countries. Regarding the job finding rate, the change appears relatively consistent across countries but notably heterogeneous across income classes, increasing as we progress towards the lower end of the distribution, thus contributing to a reduction in labor income inequality. The lower magnitude of the response estimated for the upper- and upper-middle classes complements and reinforces the previous findings in Analysis I, which indicated a more moderate variation of the extensive margin for better-off households.

6. Conclusions

This study examines the impact of the ECB's expansionary monetary policy across income classes in the countries comprising the EMU-11 during the period between 2006Q1 and 2019Q4. Specifically, using household survey microdata from EU-SILC, we calculate class-specific unemployment rates, job separation and job finding rates, and labor income. Additionally, we examine the implications of monetary policy on different income classes. Our analyses reveal that an expansionary monetary policy shock appears to be associated with a boost in real gross domestic product, a decrease in the unemployment rate, and an increase in labor income. Notably, these changes exhibit high heterogeneity both across income classes and countries.

In terms of employment status, a monetary easing shock seems to be linked to an increase in employment for individuals at the lower end of the income distribution. However, the decline in the unemployment rate appears to be comparatively less pronounced for lower-middle and upper-middle households, while the unemployment rate of the upper class seems to remain unaltered. Regarding the underlying dynamics, we observe a significant improvement in job finding rates, which predominantly benefits lower-income households. Conversely, the estimated changes in job separation rates appear to be rather homogeneous across income classes. Overall, our findings suggest that expansionary monetary policy shocks are associated with a reduction in labor income inequality primarily through increased employment among lower-income workers (i.e., via the extensive margin).

Turning to labor income, we observe two key findings. First, most vulnerable households do not appear to experience an increase in their salaries following a monetary easing shock. Secondly, labor income for middle classes only significantly increases in the medium to long run, whereas for the upper class, the increase materializes earlier. The finding that employee compensation accrued by the low-income class has remained largely unresponsive to counter-cyclical monetary policy helps partially explain a stylized fact outlined in the text: the increase in salary dispersion during the recession was not fully reversed in the recovery phase. In this regard, our results suggest that past expansionary monetary policy may be linked to an exacerbation in labor income inequality via the intensive margin.

Overall, when considering changes in both the extensive (i.e., unemployment rate) and the intensive margin (i.e., labor income), the former appears to dominate due to the higher sensitivity of employment to monetary shocks among lower-income households compared to elsewhere in the distribution. In fact, our analysis suggests that the employment status of households at the lower end of the income distribution tends to be more sensitive to the economic cycle, thus reacting more significantly to counter-cyclical monetary policy impulses. Hence, this research reveals that the additional labor income associated with expansionary monetary policy appears to have particularly benefitted low-income workers, thereby reducing labor income inequality.

While these findings hold qualitatively for all countries in our sample, our analyses uncover significant differences across countries. Broadly, results from country-specific models allow us to differentiate between two groups in terms of the size of the effects, largely influenced by differing national economic and institutional environments, as well as labor market dynamics.

Among the countries where estimated impacts on the extensive margin appear more prominent, we find Southern European countries (Italy, Spain, and Portugal), which experienced the most severe and prolonged downturns in terms of unemployment following the GFC. In these countries, the crisis primarily affected small and medium-sized firms, with strong impacts on the service sector, where human capital tends to be less firm-specific, and firms are more inclined to reduce their labor force rather than adjust the intensive margin. This amplified the sensitivity of the employment rate to the economic cycle, thereby exacerbating the consequences of the crisis. The domestic weaknesses of these countries, together with the different reforms that were carried out to increase the flexibility of their labor markets, may also help understand their larger reaction to monetary policy shocks. Likewise, the relatively

subdued estimated response of salaries for the lower class in these countries may be associated with the measures aiming at reduced labor costs and the centralization of collective bargaining in the wage-setting system (see also, e.g., Izquierdo et al., 2017; Ehmer & Schwegmann, 2017).

A similar situation occurred in Ireland, considered one of the most flexible labor markets in Western Europe before the recession. Following the onset of the GFC, Ireland witnessed a sharp rise in unemployment rates that soared to unprecedented levels, largely driven by the collapse in construction activity and widespread layoffs across various sectors. Stimulus packages, job creation initiatives and support for the unemployed aimed at enhancing labor market flexibility played a role in the subsequent recovery, potentially explaining as well the larger sensitivity to expansionary monetary policy shocks.

Conversely, countries that experienced comparatively less severe economic impacts during the GFC, such as Austria, Belgium, Finland, and Germany, exhibited less intense declines in employment and returned to positive economic growth paths shortly after the crisis. These countries were less inclined to reduce labor input during the recession phase, leading to lower rates of transitions both towards unemployment and back towards employment during the recovery phase.

Indirectly, this research also highlights two crucial potential challenges for the ECB's single monetary policy, which stem from the unequal consequences of economic shocks across euro area countries: divergent economic cycles and structural differences. While the former resulted in unequal magnitude and persistence of the GFC and the subsequent recovery, the latter also influenced the extent to which counter-cyclical monetary policy could effectively stimulate aggregate demand and boost employment.

Finally, it should be emphasized that our findings broadly align with the official standpoint of most central bankers, who acknowledge expansionary monetary policy may help reduce income inequality by stimulating economic activity and employment during demand-driven recessions. This way, beyond value judgments regarding whether monetary policy should incorporate considerations of economic inequality, our analysis underscores the critical need for policymakers to earnestly weigh the differential impacts of monetary stimulus on households across the income distribution. This nuanced understanding highlights the varying implications of monetary policy for employment and labor income among the different income classes, urging policymakers to consider such insights when examining the multitude of factors influencing income distribution within their decision-making processes.

References

Albanesi, S. (2007). Inflation and inequality. *Journal of Monetary Economics*, *54*, 1088–114.

Amaral, P. (2017). *Monetary policy and inequality*. Cleveland: Federal Reserve Bank of Cleveland.

Amberg, N., Jansson, T., Klein, M., & Picco, A. R. (2022). Five facts about the distributional income effects of monetary policy shocks. *American Economic Review*, *4*, 289–304.

Ampudia, M., Georgarakos, D., Slacalek, J., Tristani, O., Vermeulen, P., & Violante, G. L. (2018). *Monetary policy and household inequality* (Working Paper Series No. 2170). Frankfurt Am Main: European Central Bank.

Andersen, A. L., Johannesen, N., Jørgensen, M., & Peydró, J. L. (2023). Monetary policy and inequality. *Journal of Finance*, *78*, 2945–89.

Atkinson, A. B. (2015). *Inequality*. London: Harvard University Press.

Atkinson, A. B., & Brandolini, A. (2013). *On the identification of the middle class* (Working Paper 2011-217). Rome: Society for the Study of Economic Inequality.
Baumeister, C., & Benati, L. (2010). *Unconventional monetary policy and the Great Recession: Estimating the impact of a compression in the yield spread at the zero-lower bound*(Working Paper Series No. 1258). Frankfurt Am Main: European Central Bank.
Bernanke, B. (2013). *Chairman Bernanke's press conference*. United States of America: The Federal Open Market Committee.
Bernanke, B. (2015). *Monetary policy and inequality*. Washington, DC: Brookings Institution.
Bernanke, B., Boivin, J., & Eliasz, P. (2005). Measuring the effects of monetary policy: A factor-augmented vector autoregressive (FAVAR) approach. *Quarterly Journal of Economics*, *120*, 387–422.
Birdsall, N., Graham, C., & Pettinato, S. (2000). *Stuck in the tunnel: Is globalization muddling the middle class?* (Working Paper 14). Washington, DC: Center on Social and Economic Dynamics, Brookings Institution.
Bivens, J. (2015). *Gauging the impact of the Fed on inequality during the Great Recession* (Working Paper 12). Washington, DC: Hutchins Center on Fiscal & Monetary Policy, Brookings Institution.
Bourguignon, F. (2018). World changes in inequality: An overview of facts, causes, consequences and policies. *CESifo Economic Studies*, *64*, 345–70.
Broer, T., Kramer, J., & Mitman, K. (2022). *The curious incidence of monetary policy across the income distribution* (Working Paper Series No. 416). Stockholm: Sveriges Riksbank.
Bunn, P., Pugh, A., & Yeates, C. (2018). The distributional impact of monetary policy easing in the UK between 2008 and 2014 (Staff Working Paper 720). Bank of England.
Casiraghi, M., Gaiotti, E., Rodano, L., & Secchi, A. (2018). A "reverse Robin Hood"? The distributional implications of non-standard monetary policy for Italian households. *Journal of International Money and Finance*, *85*, 215–35.
Cockx, B., & Ghirelli, C. (2016). Scars of recession in a rigid labor market. *Labour Economics*, *41*, 162–76.
Coibion, O., Gorodnichenko, Y., Kueng, L., & Silvia, J. (2017). Innocent bystanders? Monetary policy and inequality. *Journal of Monetary Economics*, *88*, 70–88.
Colciago, A., Samarina, A., & de Haan, J. (2019). Central bank policies and income and wealth inequality: A survey. *Journal of Economic Surveys*, *33*, 1199–231.
Constâncio, V. (2017). *Inequality and macroeconomic policies*. Annual Congress of the European Economic Association, Lisbon.
Corrado, L., & Fantozzi, D. (2021). *Micro level data for macro models: The distributional effects of monetary policy* (Discussion Paper 529). London: National Institute of Economic and Social Research (NIESR).
Cowen, T. (2013). *Average is over: Powering America beyond the age of the Great Stagnation*. London: Penguin Group.
Dabla-Norris, E., Kochhar, K., Suphaphiphat, N., Ricka, F., & Tsounta, E. (2015). *Causes and consequences of income inequality: A global perspective*. Washington, DC: International Monetary Fund, SDN/15/13.
Deaton, A. (2013). *The great escape: Health, wealth, and the origins of inequalities*. Princeton, NJ: Princeton University Press.
Dieppe, A., Legrand, R., & van Roye, B. (2016). *The BEAR toolbox* (Working Paper Series No. 1934). Frankfurt Am Main: European Central Bank.
Dolado, J., Motyovszki, G., & Pappa, E. (2021). Monetary policy and inequality under labor market frictions and capital-skill complementarity. *American Economic Journal: Macroeconomics*, *13*, 292–332.
Draghi, M. (2016). *Stability, equity, and monetary policy*. German Institute for Economic Research, 2nd DIW Europe Lecture, Berlin.
Easterly, W., & Fischer, S. (2001). Inflation and the poor. *Journal of Money, Credit and Banking*, *33*, 160–78.
Ehmer, P., & Schwegmann, A. (2017). *Euro area labour markets: Reform successes are a good signal for employment* (KfW Research No. 155). Frankfurt Am Main: Focus on Economics.
EU-SILC. (2021a). *Longitudinal UDB, 2007–2019*. Eurostat, Luxembourg: European Union Statistics on Income and Living Conditions, European Commission.
EU-SILC. (2021b). *Cross-section UDB, 2008–2019*. Eurostat, Luxembourg: European Union Statistics on Income and Living Conditions, European Commission.
Furceri, D., Loungani, P., & Zdzienicka, A. (2018). The effects of monetary policy shocks on inequality. *Journal of International Money and Finance*, *85*, 168–86.
Galbraith, J. K. (2016). *Inequality: What everyone needs to know*. Oxford: Oxford University Press.
Galli, R., & von der Hoeven, R. (2001). *Is inflation bad for income inequality? The importance of the initial rate of inflation* (ILO Employment Paper 2001/29). Geneva: International Labour Organization.

Giannone, D., Lenza, M., & Primiceri, G. E. (2015). Prior selection for vector autoregressions. *Review of Economics and Statistics*, *97*, 436–51.
Guerello, C. (2018). Conventional and unconventional monetary policy vs. household's income distribution: An empirical analysis for the Euro area. *Journal of International Money and Finance*, *85*, 187–214.
Heathcote, J., Perri, F., & Violante, G. (2010). Unequal we stand: An empirical analysis of economic inequality in the United States, 1967-2006. *Review of Economic Dynamics*, *13*, 15–51.
Inui, M., Sudo, N., & Yamada, T. (2017). *Effects of monetary policy shocks on inequality in Japan* (Bank of Japan Working Paper Series, 17-E-3). Tokyo: Bank of Japan.
Izquierdo, M., Jimeno, J. F., Kosma, T., Lamo, A., Millard, S., Rõõm, T., & Viviano, E. (2017). *Labour market adjustment in Europe during the crisis: Microeconomic evidence from the Wage Dynamics Network Survey* (Occasional Paper Series, 192). Frankfurt Am Main: European Central Bank.
Kaplan, G., Moll, B., & Violante, G. (2018). Monetary policy according to a HANK. *American Economic Review*, *108*, 697–743.
Kappes, S. A. (2023). Monetary policy and personal income distribution: A survey of the empirical literature. *Review of Political Economy*, *35*, 211–30.
Kuznets, S. (1955). Economic growth and income inequality. *The American Economic Review*, *45*, 1–28.
Lenza, M., & Slacalek, J. (2018). *How does monetary policy affect income and wealth inequality? Evidence from the Euro area* (European Central Bank Working Paper Series, No. 2190). Frankfurt Am Main: European Central Bank.
Montecino, J. A., & Epstein, G. (2015). *Did quantitative easing increase income inequality?* (Working Paper 28). New York: Institute for New Economic Thinking.
Mumtaz, H., & Theophilopoulou, A. (2017). The impact of monetary policy on inequality in the UK: An empirical analysis. *European Economic Review*, *98*, 410–23.
OECD. (2011). *Divided we stand: Why inequality keeps rising*. Paris: OECD Publishing.
OECD. (2015). *In it together: Why less inequality benefits all*. Paris: OECD Publishing.
O'Farrell, R., Rawdanowicz, L., & Inaba, K. I. (2016). *Monetary policy and inequality* (OECD Economics Department Working Papers, No. 1281). Paris: OECD Publishing.
Peersman, G. (2011). *Macroeconomic effects of unconventional monetary policy in the Euro area* (European Central Bank Working Paper No. 1397). Frankfurt Am Main: European Central Bank.
Pereira da Silva, L. A., Kharroubi, E., Kohlscheen, E., Lombardi, M., & Mojon, B. (2022). *Inequality hysteresis and the effectiveness of macroeconomic stabilisation policies*. Basel: Bank for International Settlements.
Pew Research Center. (2017). Middle class fortunes in Western Europe. https://www.pewresearch.org/global/2017/04/24/middle-class-fortunes-in-western-europe.
Piketty, T. (2014). *Capital in the twenty-first century*. Cambridge, MA: Harvard University Press.
Ravallion, M. (2010). The developing world's bulging (but vulnerable) middle class. *World Development*, *38*, 445–54.
Rothstein, J. (2020). *The lost generation? Labor market outcomes of post-great recession entrants* (NBER Working Papers, No. 27516). Cambridge, MA: NBER.
Rubio-Ramirez, J. F., Waggoner, D. F., & Zha, T. (2010). Structural vector autoregressions: Theory of identification and algorithms for inference. *Review of Economic Studies*, *77*, 665–96.
Saiki, A., & Frost, J. (2014). Does unconventional monetary policy affect inequality? Evidence from Japan. *Applied Economics*, *46*, 4445–54.
Sims, C. A. (1980). Macroeconomics and reality. *Econometrica*, *48*, 1–48.
Sims, C. A., & Zha, T. (2006). Were there regime switches in US monetary policy? *American Economic Review*, *96*, 54–81.
Stiglitz, J. E. (2012). *The price of inequality: How today's divided society endangers our future*. New York: W.W. Norton & Company.
Thurow, L. (1987). A surge in inequality. *Scientific American*, *256*, 30–7.
Vaughan-Whitehead, D. (2016). *Europe's disappearing middle class? Evidence from the world of work*. Geneva: Edward Elgar Publishing; International Labour Organization.
Wu, J. C., & Xia, F. D. (2020). Negative interest rate policy and yield curve. *Journal of Applied Econometrics*, *35*, 653–72.
Yellen, J. L. (2014). Perspectives on inequality and opportunity from the Survey of Consumer Finances. *Conference on Economic Opportunity and Inequality*, Federal Reserve Bank of Boston.

APPENDIX A: ADDITIONAL INFORMATION ON EU-SILC DATABASES

TABLE A1
Cross-Sectional Dataset

Years	Number of observations
2006	210,458
2007	203,405
2008	200,837
2009	201,706
2010	197,628
2011	199,351
2012	190,837
2013	191,504
2014	185,740
2015	196,452
2016	192,223
2017	182,466
2018	186,403
2019	208,460

TABLE A2
Longitudinal Dataset

Years	Number of observations
2006–2007	125,366
2007–2008	129,162
2008–2009	125,273
2009–2010	127,139
2010–2011	136,657
2011–2012	129,654
2012–2013	130,581
2013–2014	132,461
2014–2015	131,672
2015–2016	136,648
2016–2017	134,775
2017–2018	130,905
2018–2019	115,837

TABLE A3
Descriptive Statistics of Variables in the Cross-Sectional File

	Mean	SD	Min	Max
Low-class mean labor income	7084.9	2094.0	2422.0	22,223.8
Lower-middle-class mean labor income	18,530.6	5086.8	6052.9	40,995.7
Upper-middle-class mean labor income	31,121.1	8617.8	10,622.6	68,248.9
Upper-class mean labor income	49,267.7	13,828.9	24,882.0	123,446.4
Low-class unemployment rate	27.0%	0.09	3.9%	55.8%
Lower-middle-class unemployment rate	8.8%	0.06	1.0%	27.0%
Upper-middle-class unemployment rate	4.3%	0.03	0.8%	14.3%
Upper-class unemployment rate	3.1%	0.02	0.3%	9.6%

Source: EU-SILC *Cross-sectional UDB*, 2006–2019.

TABLE A4
DESCRIPTIVE STATISTICS OF VARIABLES IN THE LONGITUDINAL FILE

	Mean	SD	Min	Max
Low-class job separation rate	1.9%	0.005	1.1%	4.5%
Lower-middle-class job separation rate	1.4%	0.003	0.8%	2.6%
Upper-middle-class job separation rate	1.3%	0.003	0.5%	1.9%
Upper-class job separation rate	1.6%	0.003	0.7%	2.6%
Low-class job finding rate	2.7%	0.011	1.6%	8.3%
Lower-middle-class job finding rate	1.5%	0.003	1.1%	2.9%
Upper-middle-class job finding rate	1.1%	0.002	0.5%	1.8%
Upper-class job finding rate	1.0%	0.003	0.3%	1.9%

Source: EU-SILC *Longitudinal UDB*, 2007–2019.

APPENDIX B: PERCENTAGE OF POPULATION REPRESENTED BY EACH INCOME CLASS

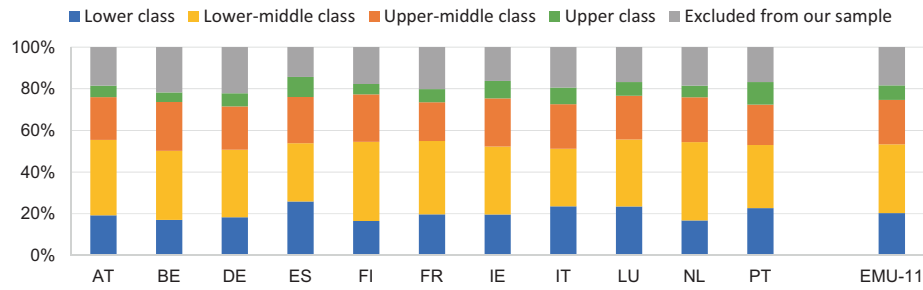

Figure B1. Average Percentage of Population per Income Class by Country. Figures Represent 2006–2019 Averages.

Source: EU-SILC *Cross-Sectional UDB*.

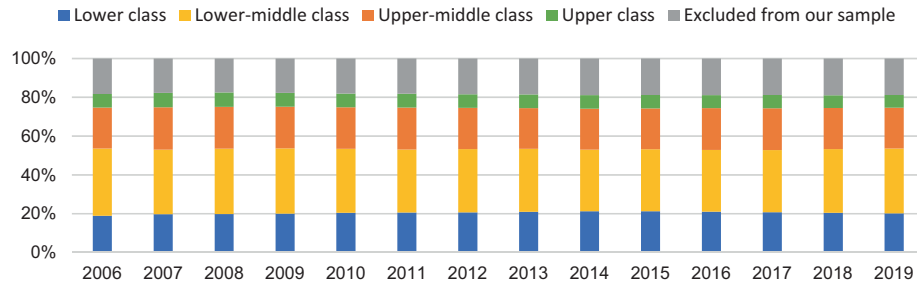

Figure B2. Average Percentage of Population per Income Class by Year. Figures Represent Averages Across Countries.

Source: EU-SILC *Cross-Sectional UDB*.

APPENDIX C: DATABASE

Variable	Source	Transformation
Gross domestic product (GDP)	Eurostat	Log-levels
Deflator of GDP (2015 prices)	Eurostat	Log-levels
Eurostoxx 600	ECB Statistical Data Warehouse	Log-levels
Term spread (10 vs. 2 years)	ECB Statistical Data Warehouse	Levels (percentage points)
Shadow rate	Wu & Xia (2020)	Levels (percentage points)
Unemployment rate (by income class)	EU-SILC (cross-sectional data)	Levels (percentage points)
Labor income (by income class)	EU-SILC (cross-sectional data)	Log-levels
Job separation rate (by income class)	EU-SILC (longitudinal data)	Levels (percentage points)
Job finding rate (by income class)	EU-SILC (longitudinal data)	Levels (percentage points)

APPENDIX D: CROSS-CHECK VALIDATION: BAYESIAN SVAR MODEL IDENTIFIED VIA ZERO RESTRICTIONS

TABLE D1
Analysis I—Contemporaneous Restrictions

Shock	GDP deflator	Shadow rate	Term spread	Stock prices	Real GDP	Unemp. rate	Labour income
Response:							
GDP deflator		0	0	0	0	0	0
Shadow rate			0	0	0	0	0
Term spread				0	0	0	0
Stock prices					0	0	0
Real GDP						0	0
Unemp. rate							0
Labour income							

TABLE D2
ANALYSIS II—CONTEMPORANEOUS RESTRICTIONS

Shock	GDP deflator	Shadow rate	Term spread	Stock prices	Real GDP	Unemp. rate	Labour income
Response:							
GDP deflator		0	0	0	0	0	0
Shadow rate			0	0	0	0	0
Term spread				0	0	0	0
Stock prices					0	0	0
Real GDP						0	0
Job separation rate							0
Job finding rate							

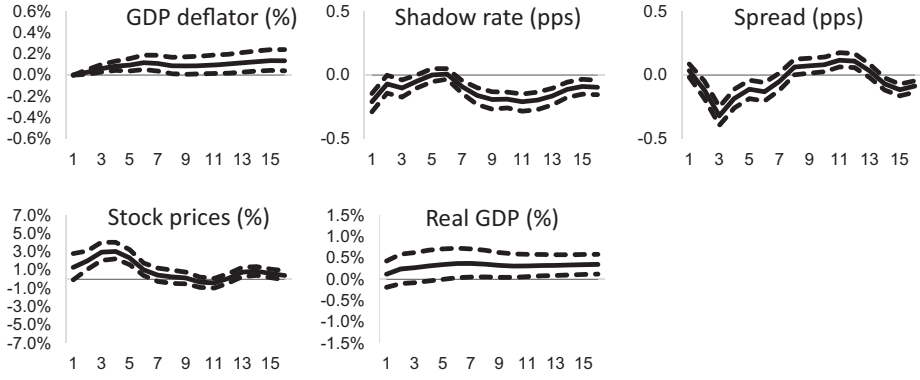

Figure D1. Analysis I—Estimated IRFs to an Expansionary Monetary Policy Shock (1/3) (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock

Figure D2. Analysis I—Estimated IRFs to an Expansionary Monetary Policy Shock (2/3)

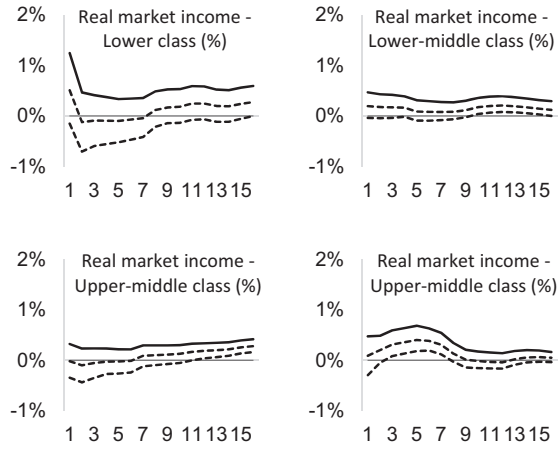

Figure D3. Analysis I—Estimated IRFs to an Expansionary Monetary Policy Shock (3/3) (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock. Charts Present the Results Aggregated for All Countries in the Sample (Namely, AT, BE, DE, ES, FI, FR, IE, IT, LU, NL, PT) Using as Weight the Average Real Gross Domestic Product During the Period Between 2007 and 2019

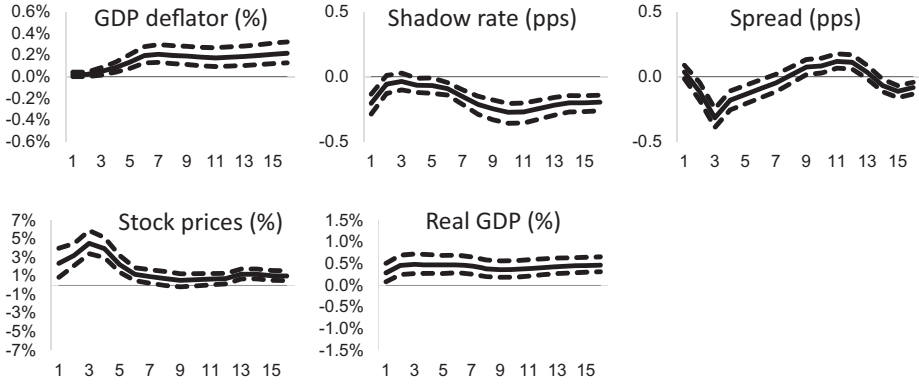

Figure D4. Analysis II—Estimated IRFs to an Expansionary Monetary Policy Shock (1/3) (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock

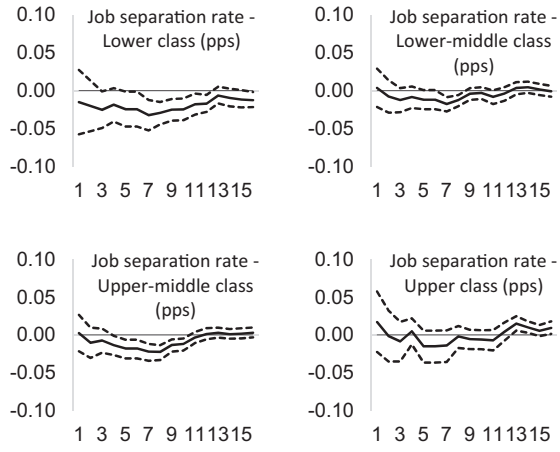

Figure D5. Analysis II—Estimated IRFs to an Expansionary Monetary Policy Shock (2/3)

Figure D6. Analysis II—Estimated IRFs to an Expansionary Monetary Policy Shock (3/3) (Shock: −1 Percentage Point Shock to an Orthogonal Deviation in the Shadow Rate). Shaded Areas and Dotted Lines Refer to 90% Confidence Bands. *x*-Axis Refers to the Number of Quarters After the Shock. Charts Present the Results Aggregated for All Countries in the Sample (Namely, AT, BE, ES, FI, FR, IE, IT, LU, NL, PT) using as Weight the Average Real Gross Domestic Product During the Period Between 2007 and 2019