Working Paper Series

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ECINEQ 2023 657

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2023 October
www.ecineq.org

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expansionary monetary policy on real labour income. Overall, our results suggest that expansionary monetary policy has helped decrease labour income inequality.

Keyword: Monetary policy, income inequality, income class, structural vector autoregressions (SVARs), local projections, euro area.

JEL Cassification: C11, D31, E52

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Key words: Monetary policy; income inequality; income class; structural vector autoregressions (SVARs); local projections; euro area.

JEL code: C11, D31, E52

* We thank Gianluca Violante, Alfonso Rosolia, Marco Jacopo Lombardi, Alina-Gabriela Bobasu, Giacomo Rella and seminar participants at IARIW-Bank of Italy Conference and the European Central Bank for helpful comments.

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1. Introduction

In recent years, there is an overall concern about the situation of the middle class and its future prospects in economically advanced countries, which stems from the observation that inequality has increased, and the middle class has considerably lost ground in numerous countries (see, e.g., Cowen, 2013; Vaughan-Whitehead, 2016; Pew Research Center, 2017). This has located the question of income distribution at the core of the economic analysis (see Stiglitz, 2012; Deaton, 2013; Piketty, 2014; Atkinson, 2015; Galbraith, 2016; etc.). Moreover, the arising of theories supporting the idea that advanced economies do not inevitable evolve toward more egalitarian societies, such as Piketty (2014), which opposes to the widely refuted traditional view based on Kuznets (1955), has further sparked this debate.

Many studies have recently investigated the drivers of income distribution in order to facilitate policymaking for the sake of equity. The deepening of globalization, skill-biased technological progress, demographic trends, changes in labour market institutions, financialisaton or the low ability of the tax-benefit systems to reduce market income inequality are some of the major structural drivers addressed in the literature (see e.g. OECD, 2011 and 2015; Dabla-Norris et al., 2015; Bourguignon, 2018).

The increasing within-country inequality and the deterioration of the middle class is a long-term trend and primarily the result of deep and far-reaching structural changes. However, the unparalleled 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 considerably sparked the debate about the potential distributive implications of monetary policy among academics and policy makers. In fact, although monetary policy is focused on price stability, monetary policy decisions are not neutral for income and wealth inequality.

From an academic perspective, 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 argued in the literature by a number of authors (Coibion et al., 2017, Ampudia et al., 2018). The distributive effects of monetary policy have also drawn the attention of central bankers, concerned by the potential unintended consequences of their unconventional monetary policy decisions, essentially, via changes in asset prices and in the general macroeconomic environment (e.g. Bernanke, 2013, 2015; Yellen, 2014; Draghi, 2016; Constâncio, 2017). Looking at advanced economies, the Bank of International Settlements (2022) observes an exponential increase in the share of central bank speeches mentioning inequality since 2014.

According to Bernanke (2015), monetary policy is not a key 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". Nonetheless, given that monetary policy typically operates over a limited horizon, its influence on income distribution in the short- and medium-term should not be ignored. Furthermore, this traditional view proposing the neutrality of monetary policy over the business cycle is losing ground against the notion that cyclical and trend changes are hardly ever independent. The recent literature reveals cyclical increases in inequality during economic downturns are, in absolute magnitude, larger than the declines prompted by recovery phases. In this regard, by exerting a countercyclical effect, monetary policy might not only limit the short-term deterioration of inequality during recessions but also help reducing subsequent long-lasting scars (see e.g., Pereira da Silva et al., 2022).

Amidst the recent shift 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 reverting previous ultra-accommodative monetary policy stances to tame increasing inflation in advanced economies. The ongoing monetary tightening highlights the need to revise the impact on inequality past monetary easing tools had, so as to fully understand what might be at stake now and open the debate about whether and how other policy areas (i.e., fiscal, and structural policies) could help address potential upcoming changes in labour income inequality.

This paper evaluates how monetary policy affects the different income classes by stimulating economic activity and employment for the set of countries that originated the Economic and Monetary Union (EMU-11). We distinguish between lower, lower-middle, upper-middle and upper classes and

estimate country-specific structural vector autoregressive (SVAR) models to assess possible impacts of monetary policy on the respective income classes over the period between 2006 and 2019. As a robustness check, a series of local projections (LP) models are also estimated.

Our contribution is twofold. First, we are among the first researchers to exploit micro-level data for the euro area to generate class-specific labour market metrics and provide a deeper analysis that goes beyond the aggregate measures of inequality usually employed in this literature. In particular, we use cross-sectional data from EU-SILC and estimate an unequal incidence of monetary policy on the employment status (i.e., extensive margin) and wages (i.e., intensive margin) across income classes. Second, to shed further light on 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 probability of finding a job (i.e. job finding rate).

Our findings point towards a non-homogeneous incidence of monetary policy shocks across income classes. On the one hand, past accommodative monetary policy seems to have helped decrease unemployment rates for lower- and middle-income classes, while the impact on the upper-class is not statistically significant. However, the estimated reduction in the unemployment rate appears to be much larger for lower-income households, highlighting the employment status of poorer workers is substantially more elastic to policy shocks. This differential impact across income classes is accounted for a substantially stronger improvement in job finding rates for those located at the bottom of the income distribution. In contrast, job separation rates have been homogeneously affected across the distribution. On the other hand, we also identify a positive impact on real labour income, which, in this case, seems to mostly benefit the upper-income class. This investigation concludes expansionary monetary policy has helped decrease labour income inequality, as the positive impact via the extensive margin (i.e. improving labour opportunities for the poorer) has largely offset the comparatively minor increase in inequality driven by the intensive margin (i.e. improving wages 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 previous empirical evidence. Section 3 describes the data, while the empirical approach is elaborated throughout Section 4. Section

5 presents and discusses the results, while the robustness checks are found in Section 6. Finally, some concluding remarks are offered in section 7.

2. Literature review

2.1. Theoretical framework

Although the distributive effects of inflation on economic inequality have been traditionally more considered by the literature than the impacts of monetary policy themselves (Galli and von der Hoeven, 2001; Albanesi, 2007), some specific channels through which monetary policy might impact income and wealth distributions have been clearly identified (see e.g. Coibion et al., 2017, Amaral, 2017). Most of the channels primarily affect wealth distribution, either via inflation, such as the savings redistribution channel or the portfolio channel, or via the transmission process of monetary impulses, such as the interest rates exposure channel or the financial segmentation channel. Nonetheless, 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 main sources of households' earnings and could be interpreted as the intensive margin. It underlines that an expansionary monetary policy shock may exert a heterogeneous pressure on the different sources of earnings, for example, increasing financial assets prices more than wages. This way, its effect on income may be different for those agents who receive a large fraction of their income from wage earnings (often located in the leftmost part of the income distribution) compared to those who receive a large part of their income from capital returns and business gains (essentially, upper-income households).

Regarding the earnings heterogeneity channel, it points out that the risk of unemployment is distributed unequally across the population, and it is precisely most vulnerable households those who usually have higher odds of being or becoming unemployed. Therefore, monetary policy is expected to affect the employment situation of the different income groups heterogeneously. In particular, the employment status of households located at 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 able to support

economic activity and employment could benefit low- and middle-income classes disproportionately, thereby compressing labour income inequality. This channel could be understood as the extensive margin.

The relationship between monetary policy and inequality is bi-directional. While this investigation focuses on the potential effects of monetary policy on inequality, the literature is paying growing attention to how inequality might also affect the effectiveness of monetary policy. In this regard, greater income inequality is associated with deeper and longer recessions, while it also hampers the transmission of monetary policy (Kaplan et al., 2018). The effect of monetary stimulus on the bottom part of the income distribution is crucial for the transmission of monetary policy, as its impact on aggregate consumption is largely driven 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 point of view, there is a significant amount of work concerning monetary policy and income inequality (see e.g., Colciago et al., 2019 and Kappes, 2023). Earlier studies focused on the impact of the inflation channel on income and wealth distribution despite the fact that its effects are mainly associated with wealth. On this basis, Easterly and Fischer (2001) find (an unexpected increase in) inflation significantly increases income inequality as it hurts poorest households who are more reliant on state-determined income (that is not fully indexed to inflation) and wages (also affected by rigidities). Doepke and Schneider (2006) and Adam and Zhu (2016) evidence expansionary monetary policy triggers a significant redistribution from the rich and aged bondholders to relatively young and middle-class households with fixed-rate mortgage debts.

Most recent empirical studies on the redistributive implications of monetary policy shocks focus essentially on the income composition channel and the earnings heterogeneity channel. Some papers highlight that expansionary monetary policy reduces income inequality in the U.S. (Coibion et al., 2017), the U.K. (Mumtaz and Theophilopoulou, 2017), the euro area (Guerello, 2018) and in advanced and emerging countries (Furceri et al., 2018). They argue that expansionary monetary policies tend to stimulate economic activity, employment and wages, favouring in particular low-income households inasmuch as labour earnings constitute their main source of income, while the employment status of

high-income households is less likely to change throughout the business cycle. In this regard, Heathcote et al. (2010) suggests that earnings at the bottom of the distribution are mainly affected by changes in hours worked and the unemployment rate (i.e., the extensive margin), while earnings at the top are mostly affected by changes in hourly wages (i.e., the intensive margin). Focusing on Germany, Broer et al. (2022) observe job loss is more countercyclical for lower-earning households and concludes that expansionary monetary policy helps decrease labour income inequality largely by reducing the job separation rate of the poorer. For the case of Denmark, Andersen et al. (2022) highlight that gains created by monetary policy through the labour 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 labour income across the income distribution is accounted for by the earnings heterogeneity channel, that is, to a higher sensitivity of labour income to monetary shocks in the bottom than elsewhere in the distribution. Furthermore, Lenza and Slacalek (2018) and Furceri et al. (2018), among others, evidence that the incidence of monetary policy on income inequality is asymmetric, as tightening of policy raises inequality more than easing lowers it, with the ultimate impact also depending on the state of the business cycle.

Other studies, however, find that expansionary monetary policy is associated with higher income inequality or that its distributive implications may be negligible. For instance, for Japan, Inui et al. (2017) reveal that, due to labour market rigidities and nominal wage stickiness, expansionary monetary policy may disperse wages thereby increasing income inequality. Looking at the distribution of wealth, O'Farrell et al. (2016) conclude that the distributive effects of expansionary monetary policy are on average negligible but differ considerably across OECD countries, suggesting that they should be estimated on a case-by-case basis.

From a somewhat different perspective, Dolado et al. (2018) examine the earnings heterogeneity channel based on a New Keynesian model in which they study how capital-skill complementarity interacts with monetary policy in affecting inequality between high- and low-skilled workers. They find that an unexpected expansionary monetary policy shock increases earnings inequality by lowering the labour share of income received by low-skilled workers and raising it for high-skilled workers, as it increases 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 raise the relative income share of high-skilled workers, not favouring thus substantially individuals at lower income class. The sometimes-divergent results found in this literature reveal that the impact of monetary policy on inequality needs to be empirically addressed in each case, as socio-demographic, economic, and institutional dynamics affecting e.g., the design of the labour market play an important role.

Regarding the implications of the non-standard policy measures implemented since 2008 by most major central banks (forward guidance, low/negative interest rates, and large-scale asset purchases) on the income distribution, the empirical evidence is scarcer and mostly focused on the impact of quantitative easing (QE). Regarding the earnings heterogeneity channel, the literature finds evidence on QE reducing income inequality by stimulating the economic activity, job creation and wages growth in the U.S. (Bivens, 2015), Italy (Casiraghi et al., 2018), Germany (Broer at al., 2022), Denmark (Andersen et al., 2022), Sweden (Amberg et al., 2022) and the euro area as a whole (Guerello, 2018; Lenza and Slacarek, 2018). By contrast, concerning the income composition channel, Saiki and Frost (2014) for Japan, Montecino and Epstein (2015) for the U.S. and Mumtaz and Theophilopoulou (2017) for the U.K. highlight that the increase in asset prices caused by the QE raises financial revenues of high-income households thereby exacerbating income inequality. Lenza and Slacalek (2018) focus on France, Germany, Italy and Spain and conclude that QE contributed to support vulnerable households since many households with lower incomes became employed, thereby compressing the income distribution. They remark the stimulating effect of QE on aggregate consumption disproportionately boosts income in the lower part of the distribution. Therefore, given that there are two contrasting effects on income distribution, related to the earnings heterogeneity and income composition channels, the overall effect of unconventional policies seems to depend on the relative strength of both channels. This investigation estimates the aggregate impacts of monetary policy on key macroeconomic variables such as the total unemployment rate and then imputes the aggregate impact across the different income classes using a Heckman model. In this regard, our study can be seen as complementary, as we use microdata so as to directly estimate class-specific results.

Overall, most studies use aggregate inequality measures such as the Gini index or metrics related to the share of income reaped by individuals at the top end of the distribution (compared to that accrued by those at the bottom). Our proposal is among the first attempts in the literature (see also Corrado and Fantozzi, 2023, for the case of Italy) to empirically investigate the effects of monetary policy using household survey data. This investigation employs income class-specific labour market metrics so as to provide evidence on how both the earnings heterogeneity and the income composition channel actually work through the employment via.[1]

3. Data

3.1. Micro-level data from EU-SILC

To estimate class-specific labour market metrics we use household survey data from the European Statistics on Income and Living Conditions (EU-SILC), which has been carried out since 2004[2] and is the reference source for comparative statistics on the distribution of income in Europe. The EU-SILC database has the advantage of collecting detailed information on individual and household income with data being also comparable across the participating European countries. Focusing on 11 EMU countries, we use data from cross-sectional files for the years between 2006 and 2019, the latest available data at the moment of undertaking this analysis.

In order to examine the distributive implications of monetary policy on the income class structure, we adopt a relative definition of the income class that establishes thresholds in relation to percentages of the median income of the distribution. 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 and Brandolini, 2013): 75% and 125% of the median income. These cut-offs demarcate the lower-middle class as those 'comfortably' clear of being at-risk-of-poverty (below 60% of the median).

[1] The aim of this investigation is to understand the effects that expansionary monetary policy applied since the onset of the global financial crisis (GFC) may have had in terms of boosting economic activity and thus employment. The focus is on labour market income inequality. Therefore, other effects related to the income composition channel, such as the potential financial gains stemming from quantitative easing measures, are not addressed in this analysis.

[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.

Similarly, we define the upper-middle class as the share of the population whose income is between 125% and 200% of the median income. Conveniently, the share of households belonging to the lower part of the income distribution (below 75% of the median income) are considered lower class, whereas those at the top (above 200% of the median income) compose the upper class.

The concept of income used to compute the limit of the income classes is disposable household income, as usual in the delimitation of income classes. Disposable household income includes, by definition, all income from work (salaries of employees and income of self-employed workers), income from capital and property, and transfers, while taxes are excluded. The variable income is collected with reference to the previous calendar year (with the exception of Ireland, among the countries analysed).[3]

In EU-SILC, the basic unit for collecting information is the household and this is usually taken as a unit of measure, since the level of life of an individual is influenced by her/his income and by the people with whom she/he lives. Although the unit of measurement in EU-SILC is the household, we analyse the distribution of the income of the individuals, which is our unit of analysis, whenever we allocate individuals to a specific income-class. In this regard, in order to adjust household income according to its size, we use the modified OECD equivalence scale[4] and then we attach the equivalent household income to each member of the household. For each of the income classes mentioned above, we compute the class-specific unemployment rate, job separation and job finding rates, and labour income as a proxy for salaries[5]. The concept of labour income used is gross employee cash or near cash income, that is, before transfers and taxes. By looking at income before social transfers and taxes we try to exclude, to the extent possible, the significant redistributive role of the tax and transfers system. Solely considering market income implies that households that live on transfer payments such as retirees cannot be included in the analysis as their market income is close to zero in most cases. For this reason and given that we are interested in the effects of monetary policy via the labour market, we drop from our sample those individuals with zero market income whose market income does differ from their disposable income (see Annex 1).

[3] 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.

[4] 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.

[5] Nominal variables are deflated using the GDP deflator so as to be expressed in real terms (using 2015 prices).

EU-SILC provides two types of data:

- Cross-sectional data over a certain period.
- Longitudinal data from which we can estimate individual-level changes over time (rotational panel of four years)

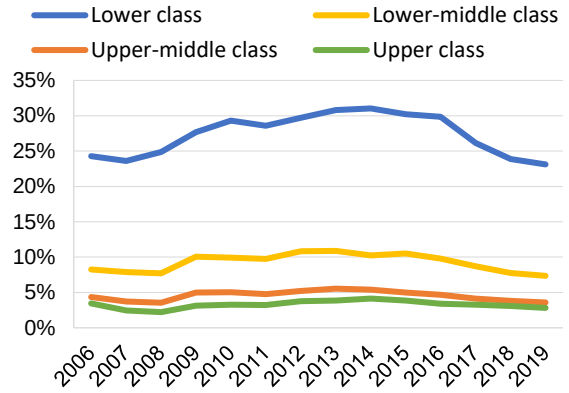
Due to its larger sample, the cross-sectional data is our preferred option for analysing the impact of monetary policy on unemployment rate and labour income by income class. The results of this analysis (Analysis I) are presented in section 5.1. On a next step, in order to better understand the impact on unemployment rate, we study how monetary policy shocks affect the job separation and the job finding rates. For this purpose, we employ the longitudinal data, where each individual is observed over time. Section 5.2. presents this analysis (Analysis II).

Looking at the evolution of unemployment rate by income class (Figure 1), we observe how the burden of unemployment falls disproportionately on the shoulders of the lower-class households, where unemployment rate has remained around 30% for the period between 2009 and 2016. Interestingly enough, most vulnerable households seem to have been the first ones to exit the labour market when the recession started: unemployment rate for the lower class starts increasing already in 2008, while the first year-on-year increase appears only in 2009 for the rest of the population. At the same time, these households seem to have been the last ones to re-enter the labour market during the recovery. In fact, while unemployment rate for the upper classes starts 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, helps explain the cyclical increase of labour income inequality and its persistence.

When looking at the entire business cycle, also including the full recovery up to 2019, we observe this cyclical deterioration disproportionately suffered by the lower class is not fully reversed. Instead, post-crisis unemployment rate remains above the pre-crisis 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" -45º line as well as from the slope estimated for the rest of the population.

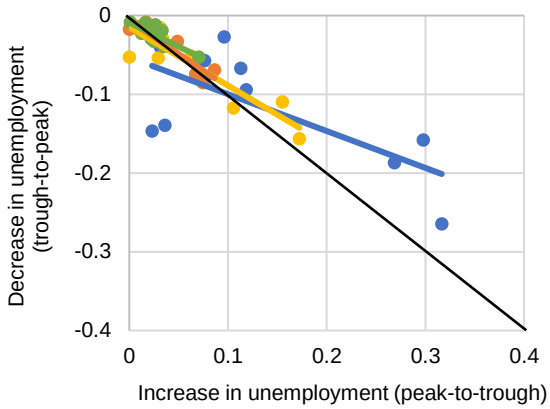
This finding is aligned with Pereira da Silva et al. (2022), which uncover a similar dynamic also when looking at advanced economies outside the euro area.

Figure 1. Evolution of unemployment rate by income class (2006-2019, %)



Source: EU-SILC (cross-sectional data) and authors' calculations. Note: Figure displays the weighted aggregate figures for the countries included in our sample (namely AT, BE, DE, ES, FI, FR, IT, LU, NL, PT) using active population as weights.

Figure 2. Scarring effect of unemployment rate by income class (2006-2019, pps)

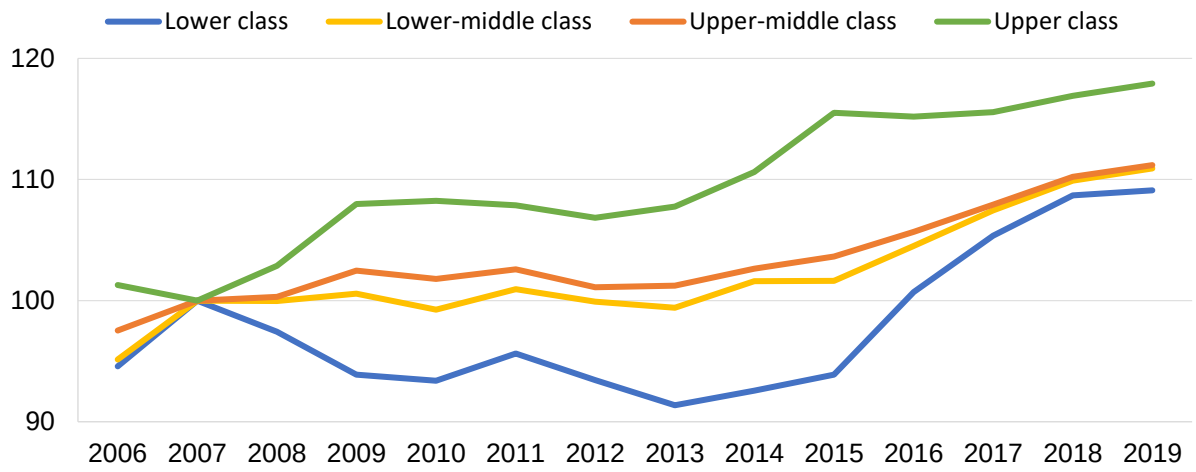


Source: EU-SILC (cross-sectional data) and authors' calculations. Notes: Dots in the figure represent each of the countries included in our sample (namely AT, BE, DE, ES, FI, FR, IT, LU, NL, PT). The increase in unemployment represented in the x-axis refers to the difference between the higher unemployment rate witnessed during the recession period (2008-2013) and the lower unemployment rate during the pre-crisis period (2006-2007). The y-axis represents the sharpest decline in unemployment rate during the post-crisis period (2014-2019), with respect to the largest value during the recession (2008-2013).

The evolution of real labour income vastly differs across income classes. Overall, labour income remained rather stagnant between 2009 and 2013, while it only started the recovery phase around 2014-2015 (Figure 3). When compared to the other income classes, the different behaviour displayed by the real labour income earned by the lower class stands out, as wage growth decreases and then stagnates for a longer period of time. In particular, it remains around 5-10% below pre-crisis levels for seven years in a row and only starts recovering in 2016, thereby suffering a long-lasting scarring effect and driving a marked gap between the poorer and the rest. This finding is aligned with Cockx and Ghirelli (2016) and Rothstein (2020), which document that the earnings of the low-skilled workers and new entrants remain below pre-crisis levels more than ten years after the end of the recession. By 2018, the cumulative growth rate with respect to 2007 amounted to around 18% for the upper class, and around 12% for the middle classes, while it was below 10% for the lower-class households. These dynamics highlight that wage dispersion widened notably throughout the recession period and remained elevated above pre-crisis levels even after the recovery phase. In particular, the gap between the upper class and

the rest of the population that widened around 2007-2009 further increased during 2014-2015 and still remained by 2019.

Figure 3. Evolution of real labour income by income class (2006-2019; index: 2007=100)



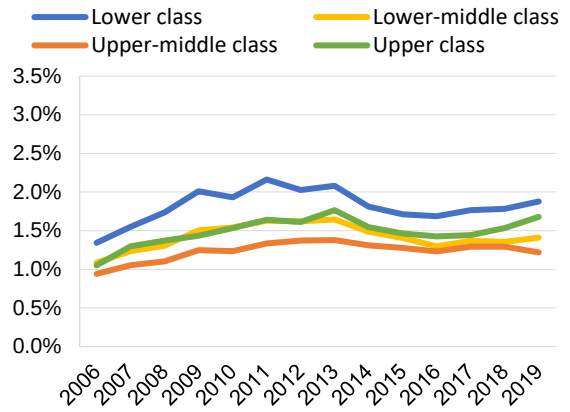
Source: EU-SILC (cross-sectional data) and authors' calculations. Note: Figure displays the weighted aggregate figures for the countries included in our sample (namely AT, BE, DE, ES, FI, FR, IT, LU, NL, PT) using active population as weights. Nominal values are deflated using the country-specific GDP deflator (2015 prices).

For each of the different income classes, the job separation rate is computed as the ratio of newly unemployed to the active population and provides a measure of job loss risk. Figure 4 shows that the probability of becoming unemployed increased significantly during the recession years, being this increase larger for the case of the lower class (0.8 percentage points from trough to peak) when compared to the rest of the income classes (around 0.5-0.6 percentage points). The job separation rate increased during the GFC and then started to decline progressively after the peak in 2011-2013. The parallel deterioration of the job finding rate followed a different dynamic, as it declined abruptly in 2009 (-0.4 percentage points for the lower class, and around -0.25 percentage points for the rest) and then remained 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 materialised in 2017 for the case of the lower class.

On average, both the job separation and the job finding rates are higher for the case of the lower class, which reveals the higher volatility of their employment status, as these workers are more likely to exit and re-enter the labour market. The higher job finding rate of the lower class (Figure 5) is also

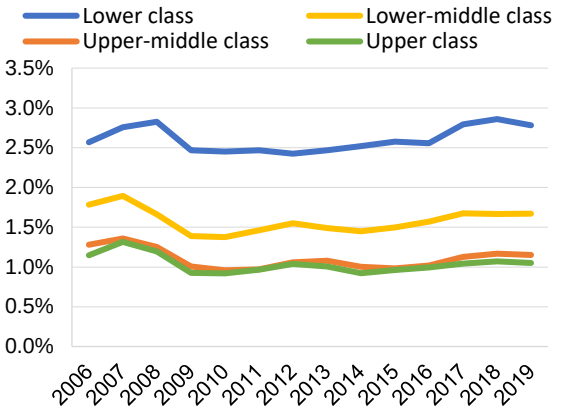
explained by their higher unemployment rate (Figure 1), as unemployed individuals are more likely to be found in the lower class.

Figure 4. Evolution of job separation rate by income class (2006-2019, %)



Source: EU-SILC (longitudinal data) and authors' calculations. Note: Figure displays the weighted aggregate figures for the countries included in our sample (namely AT, BE, ES, FI, FR, IT, LU, NL, PT) using active population as weights. Data for DE is not available.

Figure 5. Evolution of job finding rate by income class (2006-2019, %)



Source: EU-SILC (longitudinal data) and authors' calculations. Note: Figure displays the weighted aggregate figures for the countries included in our sample (namely AT, BE, ES, FI, FR, IT, LU, NL, PT) using active population as weights. Data for DE is not available.

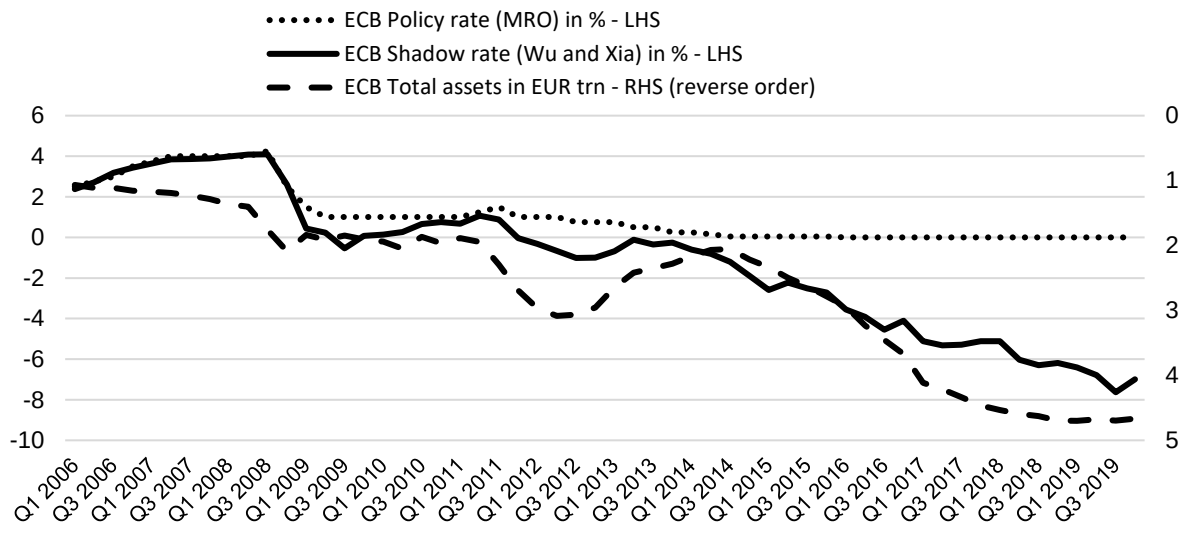
3.2. Macro-level data from various sources

In accordance with the literature (see, for example, Peersman, 2011 and Coibion et al., 2017), 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 evolution of prices by including the deflator of gross domestic product (referring to 2015 prices), $GDPdef_{it}$. In order to factor in the 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., Furceri et al., 2018; Mumtaz and Theophilopolou, 2017; Coibion et al., 2017), central bank assets (Saiki and Frost, 2014; Guerello, 2018), or government bond spreads (Baumeister and Benati, 2010; Ampudia et al. 2018; Lenza and Slacalek, 2018), particularly when intending to examine specifically unconventional monetary policy. In order 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 the financial crisis, including

both conventional and unconventional monetary policy tools, we use the shadow rate from Wu and Xia (2020), $ShadowRate_t$. 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.

Figure 6. Evolution of various monetary policy indicators (2006Q1-2019Q4)



Source: ECB Statistical Data Warehouse (SDW) and Wu and Xia (2020).

4. Empirical approach – Country-specific Vector Autoregressive (SVAR) models

Macroeconomic analyses and policy evaluations require considering the interdependencies among the different economic variables, with the purpose of assessing the impacts from a global perspective and uncovering causal relationships. Monetary policies effects are distributed through numerous transmission mechanisms, giving rise to both direct and indirect impacts of different nature. The existence of interactions between the analysed 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 vector autoregression approach considers each variable as endogenous, and they are included in the system as functions of lagged and present values of all endogenous variables, thus tackling the endogeneity issue. This is the first empirical approach we use to address our research question.

The dynamic interactions among the set of macroeconomic endogenous variables[6] collected in the vector Y_{it}, $(g \times 1)$, is governed by the following system of autoregressive simultaneous equations in reduced form:

$$Y_{it} = C + A_1 Y_{it-1} + A_2 Y_{it-2} + \cdots + A_p Y_{it-p} + \varepsilon_{it} \quad (1)$$

$$Y_{it} = C + \sum_{j=1}^{p} A_j Y_{it-j} + \varepsilon_{it} \quad (2)$$

$$\varepsilon_{it} \sim N(0, \Sigma_\varepsilon) \quad (3)$$

where $i = 1..., N$ indicates countries. In our case N=11, corresponding to the 11 countries of the European Monetary Union in 1999. Time is $t = 1..., T$, with T = 56, the 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. ε_{it} 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_{it} includes 7 endogenous variables therefore g is equal to 7 for each of the four models corresponding to each of the four income classes. The set of class-specific variables vary for each of the analyses:

- Analysis I (based on EU-SILC cross-sectional data): $Y_{it} = (GDP_{it}, GDPdef_{it}, StockPrices_t, TermSpread_t, ShadowRate_t, \boldsymbol{UnempRate}_{it}, \boldsymbol{LabourIncome}_{it})'$,
- Analysis II (based on EU-SILC longitudinal data): $Y_{it} = (GDP_{it}, GDPdef_{it}, StockPrices_t, TermSpread_t, ShadowRate_t, \boldsymbol{SeparationRate}_{it}, \boldsymbol{FindingRate}_{it})'$,

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 we use to estimate the class-specific unemployment rate and real labour income. 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 labour income, we follow the

[6] For each of the variables included in our models, the source and the transformation can be found in Annex 2.

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. This disaggregation approach is also used to extend the data on real labour income for the period 2019Q1-2019Q4, as it is only available in EU-SILC until 2018.

The reduced-form VAR system above (equations 1 to 3) does not account for direct contemporaneous relationship among the variables, as there are no contemporaneous endogenous variables on the right-hand side. In fact, the error terms in the reduced form are typically correlated (matrix Σ tends to have non-zero off-diagonal elements), and thus does not have a clear economic interpretation. In order to identify the structural model so as to recover the impulse-response functions associated to an orthogonal shock to the shadow rate, we follow two different identification strategies: triangular factorization and sign restrictions. The associated restrictions can be found in Annex 3.

5. Results

5.1. Analysis I – Focus on unemployment rate and labour income

First, country specific SVAR models are estimated for each of the income classes, both using sign restrictions and triangular factorisation. The results are presented throughout Figures 7, 8, 9 and 10, and Tables 1 and 2. Figure 7 shows that an expansionary monetary policy shock equal to minus one percentage point in the shadow rate results in long-lasting implications for inflation, in particular, the deflator of gross domestic product increases around 0.10-0.15%. The term spread also reacts to the shock, displaying the negative peak impact between -0.1 and -0.3 percentage points around three quarters after the shock. Stock prices seem to increase around 3% during the first year after the shock takes place. Regarding real gross domestic product, it remains 0.3-0.5% above its pre-shock level at least during the sixteen quarters after the shock.

Figure 8 highlights that the response of unemployment rate to monetary easing is largely unequal across income classes. In particular, the lower class displays the largest reaction in size, as seven to ten quarters after the shock it remains around -0.3 to -0.6 percentage points below the initial value. The magnitude of the response decreases as we go up through the income strata, with the unemployment

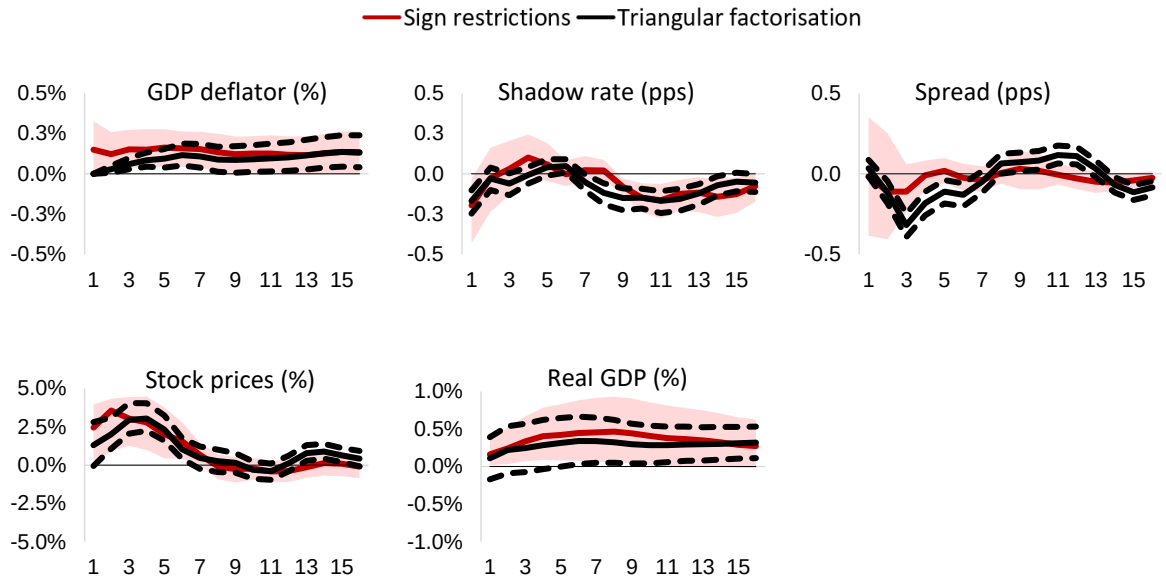
rate reacting between -0.15 and -0.25 percentage points for the lower-middle class, and between -0.1 and -0.15 for the upper-middle class. Regarding the upper class, its unemployment rate does not seem to be significantly affected by monetary policy shocks. This reveals that the greater economic activity promoted by expansionary monetary policies, materialized in more employment opportunities, which seem to have been unevenly distributed among the different income classes. In fact, it has particularly favoured households located in the lower income class as they seem to have captured most of the generated employment. These results suggest that, over the past economic cycle, monetary easing might have helped contain income inequality via the extensive margin of the labour market. However, the positive contribution to the unemployment rate of the lower class seems to have been largely unequal across countries, being particularly sizeable for Ireland, Luxembourg, and Spain, in stark contrast with countries like the Netherlands, Germany and Finland, which display more moderate impacts (see Table 1). These disparities relate to the differences in labour market dynamics across countries. In particular, countries that suffered larger relative increases in the unemployment rate during the recession are those for which our analysis identifies larger impacts.

Figure 9 displays the estimated impulse-response functions for the case of real labour income. First and foremost, this analysis highlights that the labour income perceived by the lower class has not been significantly affected by monetary shocks. For the rest of the income classes the results paint a mixed picture both in terms of magnitude and time evolution. On the one hand, the middle classes (both lower- and upper-middle classes) seem to derive a positive effect on their wages. However, this impact appears to be slow-moving and only becomes significant in the long run, namely around eight to twelve quarters after the shock. On its peak, this impact appears to be as high as 0.15-0.25%. This contrasts with the pattern displayed by the IRF related to the upper class, as labour income for these households already reacts during the first three to eight quarters after the shock, when wages seem to be around 0.3-0.5% above what they would be otherwise. Upper classes in France, Ireland, Italy, Luxembourg, and Spain seem to have particularly benefitted (see Table 2). Overall, expansionary monetary policy might have exacerbated income inequality via the intensive margin, as the higher income classes seem to have enjoyed a larger positive effect. On their side, wages accrued by most vulnerable households seem to have been rather unresponsive to expansionary monetary policy shocks.

This analysis concludes that expansionary monetary policy seems to have decreased income inequality via the extensive margin (i.e., unemployment rate) of the labour market, while increasing disparities across income classes via the intensive margin (i.e., salaries). Using the country-specific peak impacts estimated in the SVAR set up (see Tables 1 and 2), we compute the total impact on labour income by income classes. Our results suggest that a negative shock to the shadow rate equal to a percentage point leads to an increase in the mean annual labour income of around 1% for the lower class (Figure 10). This impact is almost entirely driven by the reaction of the unemployment rate (i.e., the extensive margin). In comparison, the total impact for the rest of the income classes is much lower and stays between 0.4% and 0.55%. The role played by the increase in salaries (i.e., the intensive margin) increases as we move towards the rightmost side of the income distribution. In particular, the bulk of the positive consequences for the labour income earned by the upper class is derived via wages. When considering the overall implications for all income classes, and in line with Lenza and Slacalek (2018), our results suggest that expansionary monetary policy seems to have helped decrease income inequality via the extensive margin of the labour market.

Figure 7. 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)

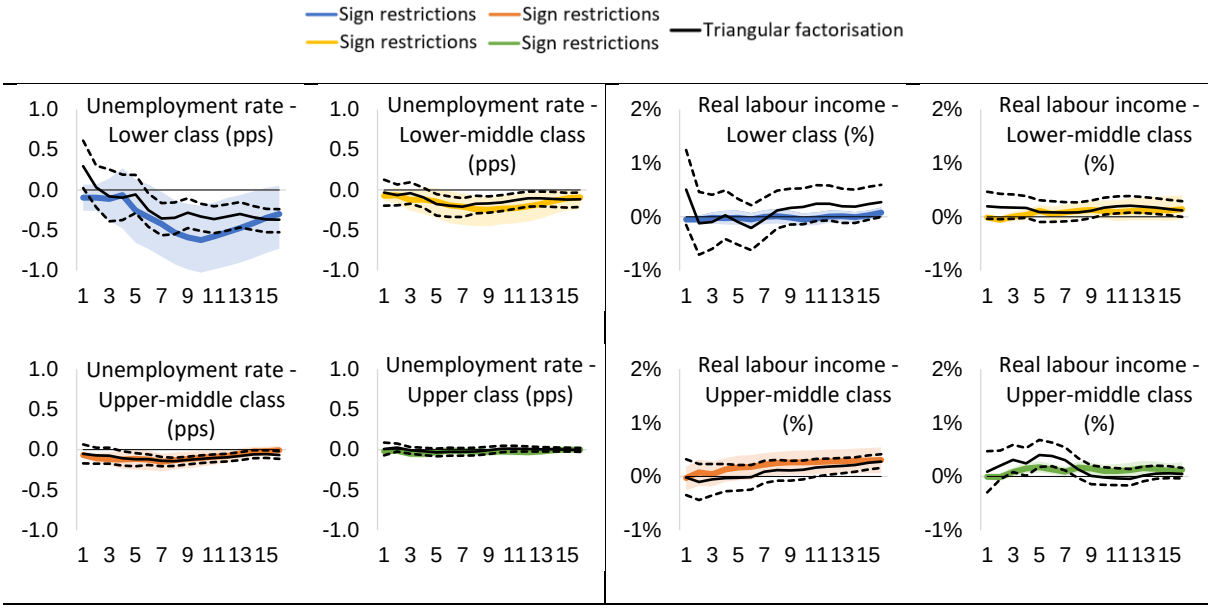


Notes: Shaded areas and dotted lines refer to 90% confidence bands. X-axis refers to the number of quarters after the shock.

Figure 8. Analysis I – Estimated IRFs to an expansionary monetary policy shock (2/3)

Figure 9. 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)



Note: Shaded areas and dotted lines refer to 90% confidence bands. X-axis refer to the number of quarters after the shock.

Table 1. Analysis I – Country-specific peak response of 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	EMU-11
Sign restrictions	Lower-class	-0.53	-0.56	-0.36	-0.93	-0.41	-0.72	-2.36	-0.70	-0.98	-0.24	-0.59	-0.62
	Lower-middle class	-0.24	-0.23	-0.17	-0.19	-0.31	-0.18	-1.55	-0.21	-0.51	0.00	-0.30	-0.21
	Upper-middle class	-0.19	-0.15	-0.11	-0.15	-0.27	-0.11	-1.07	-0.14	-0.39	-0.08	-0.23	-0.15
	Upper class	-0.05	-0.05	-0.05	-0.06	-0.09	-0.03	-0.31	-0.05	-0.11	-0.05	-0.10	-0.05
Triangular factorisation	Lower-class	-0.19	-0.17	-0.18	-0.65	-0.18	-0.35	-2.20	-0.34	-0.58	-0.18	-0.22	-0.34
	Lower-middle class	-0.19	-0.26	-0.19	-0.13	-0.15	-0.20	-0.71	-0.16	-0.15	-0.16	-0.13	-0.19
	Upper-middle class	-0.08	-0.09	-0.10	-0.07	-0.07	-0.08	-1.16	-0.09	-0.09	-0.05	-0.08	-0.11
	Upper class	-0.01	-0.02	-0.04	-0.05	0.00	-0.01	-0.05	-0.01	-0.02	0.00	0.03	-0.02

Table 2. Analysis I – Country-specific peak response of real labour 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	EMU-11
Sign restrictions	Lower-class	0.02%	0.03%	0.03%	0.00%	0.02%	0.02%	0.05%	0.00%	0.03%	0.02%	0.01%	0.02%
	Lower-middle class	0.10%	0.07%	0.12%	0.09%	0.09%	0.09%	0.00%	0.11%	0.10%	0.07%	0.13%	0.10%
	Upper-middle class	0.22%	0.16%	0.15%	0.17%	0.22%	0.13%	0.76%	0.16%	0.32%	0.11%	0.21%	0.17%
	Upper class	0.26%	0.23%	0.20%	0.31%	0.29%	0.38%	0.41%	0.32%	0.41%	0.14%	0.23%	0.28%
Triangular factorisation	Lower-class	0.06%	-0.16%	0.07%	0.02%	0.05%	0.04%	0.08%	-0.02%	0.07%	0.05%	0.03%	0.03%
	Lower-middle class	0.16%	-0.01%	0.20%	0.10%	0.10%	0.21%	0.61%	0.08%	0.08%	0.17%	0.30%	0.17%
	Upper-middle class	0.10%	0.02%	0.33%	0.27%	0.12%	0.16%	0.19%	0.14%	-0.07%	0.12%	0.19%	0.21%
	Upper class	0.15%	0.10%	0.34%	0.76%	0.27%	0.60%	0.42%	0.70%	0.36%	0.16%	0.27%	0.47%

Figure 10. Analysis I - Decomposition of the overall impact on mean labour 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)

Notes: Figures displays the total effect for all countries (EMU-11) composing our sample. Impacts used for the computation are the peak impacts estimated via the SVAR set up with sign restrictions.

5.2. Analysis II – Focus on job separation rate and job finding rate

The previous analysis highlights the bulk of the effect of monetary policy shocks on the labour market are driven by the responsiveness of the unemployment rate, which is particularly prominent for the lower class. In this second analysis, we take a step further and try to understand to what extent this effect is due to 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 people becoming more likely to find a job). As done in the previous section (Analysis I), we estimate country-specific SVAR models for each of the income classes, using both sign restrictions and triangular factorisation and present the results throughout Figures 11, 12, 13, and 14, and Tables 3 and 4.

Figure 11 provides the impulse response functions for the set of macro variables included in the models. Similar to what we observed in Analysis I (Section 5.1), an expansionary monetary policy shock equal to a one percentage point negative deviation in the shadow rate results in a long-lasting increase in the GDP deflator of around 0.15-0.20%. The reaction of the term spread is around -0.1 and -0.3 and peaks three quarters after the shock. Stock prices remain 3-4% above pre-shock levels during the first year, while the impact on the real gross domestic product is positive and stands at around 0.3%.

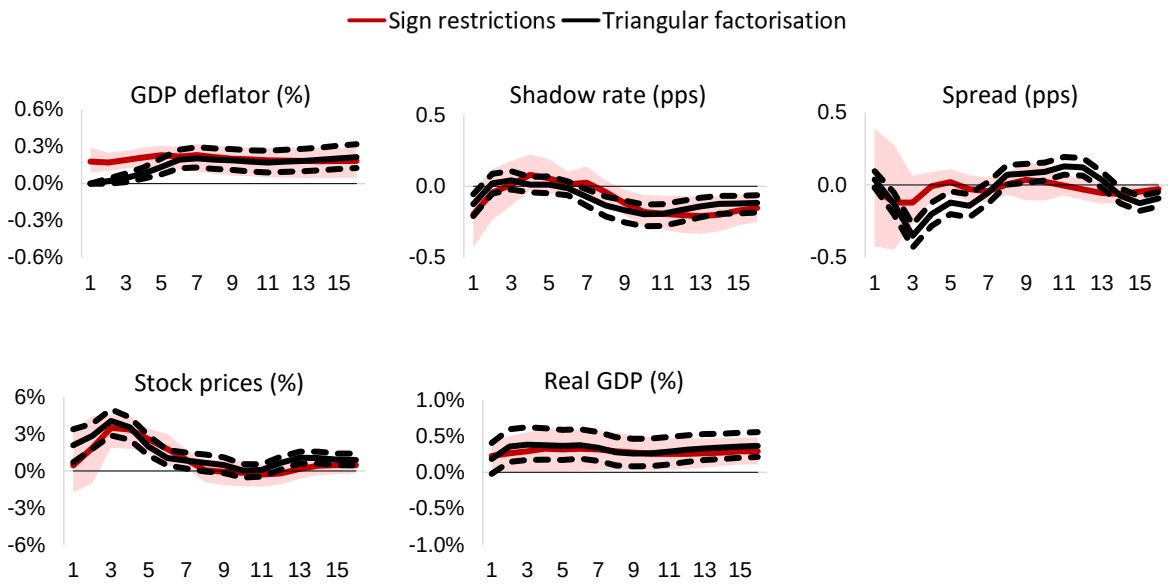
The response of the job separation rate to a monetary easing shock is heterogeneous across income classes and particularly large for the most vulnerable households (Figure 12). For the case of the lower class, the rate is almost -0.03 percentage points lower six to seven quarters after the shock. The reactions of the middle and upper classes also become significant during the second year, albeit they are smaller in size (between -0.015 and -0.02 percentage points). Similar to the reaction of the unemployment rate (see Table 1), the impact appears particularly sizeable for the case of Ireland, Luxembourg, Spain, and Portugal. This contrasts with the case of the Netherlands and Finland, where the implications of monetary policy appear to be more moderate.

While the reaction of the job separation rate already appears during the second year after the shock, the positive impact of monetary easing on the job finding rate materialises later in time, during the third year (Figure 13). The contribution is again larger for the case of the lower class, where the impact stands between 0.015 and 0.025 percentage points, above that of the middle classes (around 0.01 percentage points). The impact on the job finding rate of the upper class appears rather sluggish, and only becomes statistically significant twelve quarters after the shock (slightly below 0.005 percentage points). Across countries, the reaction of the job finding rate appears larger for the case of Ireland, while being rather similar for Austria, Spain, Finland, Luxembourg, the Netherland and Portugal. Lastly, Belgium, France and Italy are the countries where the shift from unemployed to employed seems to be less affected by monetary policy shocks.

The results of Analysis II suggest monetary easing positively contributes to reducing labour income inequality via both reducing the job loss risk and increasing the probability of finding a job, being the impact larger for those located at the leftmost side of the income distribution (Figure 14). The positive contribution via decreasing the job separation rate helps explain in the overall reduction of the unemployment rate, being the impact larger for the case of the lower class albeit rather similar across the middle and upper classes. In contrast, the reaction of the job finding rate appears remarkably heterogeneous across income classes, becoming larger as we move towards the left of the distribution and thus helping decrease labour income inequality.

Figure 11. Analysis II – Estimated IRFs to an expansionary monetary policy shock (1/3)

(-1 percentage point shock to an orthogonal deviation in the shadow rate)



Notes: Shaded areas and dotted lines refer to 90% confidence bands. X-axis refers to the number of quarters after the shock.

Figure 12. Analysis II – Estimated IRFs to an expansionary monetary policy shock (2/3)

Figure 13. 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)

Notes: Shaded areas and dotted lines refer to 90% confidence bands. X-axis refers to the number of quarters after the shock.

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	W. Agg.
Sign restrictions	Lower class	-0.03	-0.03	-0.03	-0.02	-0.02	-0.13	-0.03	-0.04	-0.02	-0.03	-0.03
	Lower-middle class	-0.02	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02
	Upper-middle class	-0.02	-0.02	-0.02	-0.02	-0.02	-0.06	-0.02	-0.02	-0.02	-0.02	-0.02
	Upper class	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.02	-0.01	-0.02	-0.01
Triangular factorisation	Lower class	-0.02	-0.02	-0.03	-0.01	0.00	-0.05	0.00	-0.02	-0.06	-0.04	-0.03
	Lower-middle class	-0.02	-0.02	-0.02	-0.01	-0.02	-0.03	-0.02	-0.02	-0.01	-0.02	-0.02
	Upper-middle class	-0.02	-0.03	-0.03	-0.01	-0.02	-0.05	-0.02	-0.01	-0.02	-0.03	-0.02
	Upper class	-0.02	-0.02	-0.02	-0.01	0.00	-0.03	-0.02	0.00	-0.02	-0.03	-0.01

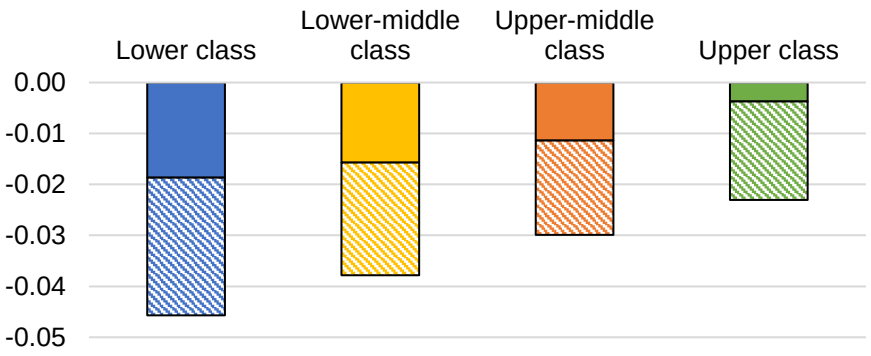
Table 4. Analysis II – Country-specific peak response of job finding rate

(-1 percentage point shock to an orthogonal deviation in the shadow rate)

		AT	BE	ES	FI	FR	IE	IT	LU	NL	PT	W. Agg.
Sign restrictions	Lower class	0.02	0.01	0.02	0.02	0.01	0.04	0.01	0.02	0.02	0.02	0.02
	Lower-middle class	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.02	0.02
	Upper-middle class	0.01	0.01	0.01	0.02	0.02	0.00	0.01	0.02	0.01	0.01	0.01
	Upper class	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00
Triangular factorisation	Lower class	0.02	0.02	0.02	0.02	0.02	0.06	0.01	0.02	0.05	0.03	0.02
	Lower-middle class	0.01	0.01	0.02	0.02	0.01	0.03	0.01	0.02	0.02	0.02	0.01
	Upper-middle class	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
	Upper class	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01

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)



Notes: Figures displays the total effect for all countries composing our sample. Impacts used for the computation are the peak impacts estimated via the SVAR set up with sign restrictions.

6. Robustness check - Panel local projection models

To complement the analysis based on SVAR models, we also estimate a series of models following the local projections approach à la Jordà (2005). In this case, we use the original annual frequency of the microlevel data and estimate panel models. On the one hand, the decision to use annual frequency is motivated by the results obtained throughout section 5. In particular, the reactions of the

main variables of interest (unemployment, labour income, job separation and job finding rates) to a monetary policy shock become significant only in the second year after the shock, where the bulk of the total impact takes place. Therefore, annual frequency appears to be sufficiently good for a robustness check, as it also allows us to use the data on its original shape (i.e. without conducting a time disaggregation). On the other hand, the decision to estimate panel models and thus ignore the unequal responses across countries, is motivated by the features of the local projections (LP) methodology. In particular, we try to reduce the potential small sample bias of the LP estimator by enhancing the cross-sectional dimension.

Under a local projections set-up, the orthogonal shocks are not internally estimated in the system but instead are exogenous variables that are included directly in the regression. In our case, we use the euro area shocks estimated by Jarociński and Karadi (2020), aggregated annually. Based on equation (4) below, we estimate a sequence of regressions of the variable of interest (including control variables) on a structural orthogonal shock for different horizons so as to derive the coefficients of the impulse response functions (IRFs) directly. When compared to the VAR approach, the local projections methodology does not impose any underlying dynamics on the variables in the system, does not suffer from the curse of dimensionality and can accommodate non-linearities. Unlike in a VAR set up, the fact that the response is computed at each horizon makes potential misspecification errors not to be compounded over time.

$$Y_{it+h} - Y_{it} = C^h + A_1^h Y_{it-1} + \beta^h MP_t + \partial^h MP_{t-1} + FE_i^k + \varepsilon_{it+h} \quad (4)$$

$$\varepsilon_{it+h} \sim N(0, \Sigma_\varepsilon^h) \quad (5)$$

This equation is estimated for each of our variables of interest. Therefore, Y_{it+h} includes individually each of the endogenous variables mentioned in the previous section (GDP deflator, real GDP, stock prices, term spread, shadow rate, and both unemployment rate and real labour income for each of our four income classes), at different horizons h. Y_{it-1} includes the first lag of the endogenous variables, which are included in the model as control. The estimates are robust to the inclusion of two lags as controls. ε_{it+h} represents the error term. The exogenous shock, MP_t, is directly included in the model both contemporaneously and in first lag form, in order to control for potential first-order

autocorrelation. FE are country fixed effects which are included in order to control for unobserved country-specific factors. Equation (4) is estimated for h = 1, 2, 3, 4, 5, 6, and therefore allows us to retrieve the response of the variable of interest to a monetary policy shock up to six years after the shock. Impulse-response functions are computed using the coefficients estimated, β^h, and the associated estimates for the standard errors.

We now turn to the results associated with the panel Local Projections methodology, which are displayed in Figures 15, 16, 17, 18 and 19. The reaction of the macroeconomic variables to a negative percentage point impact on the euro area monetary policy shock estimated by Jarociński and Karadi (2020) are displayed in Figure 15. In line with the SVAR methodology, both the GDP deflator and real GDP display a long-lived positive reaction that lasts for around four years. Stock prices also react strongly, being the bulk of the impact concentrated in the first two years. In line with previous estimates, the immediate response of the term spread is negative.

In line with the previous set of results, Figure 16 highlights that monetary easing shocks have helped decrease unemployment rate, being the impact heterogeneous across income classes and particularly larger for the lower class. For these households, unemployment rate seems to have remained around -0.3 to -0.5 during the first two years after the shock. In comparison, the peak impact stood around -0.25 and -0.15 for the lower-middle and upper-middle class, respectively. Regarding the upper class, unemployment rate does not seem to react to the monetary policy shock in a statistically significant manner.

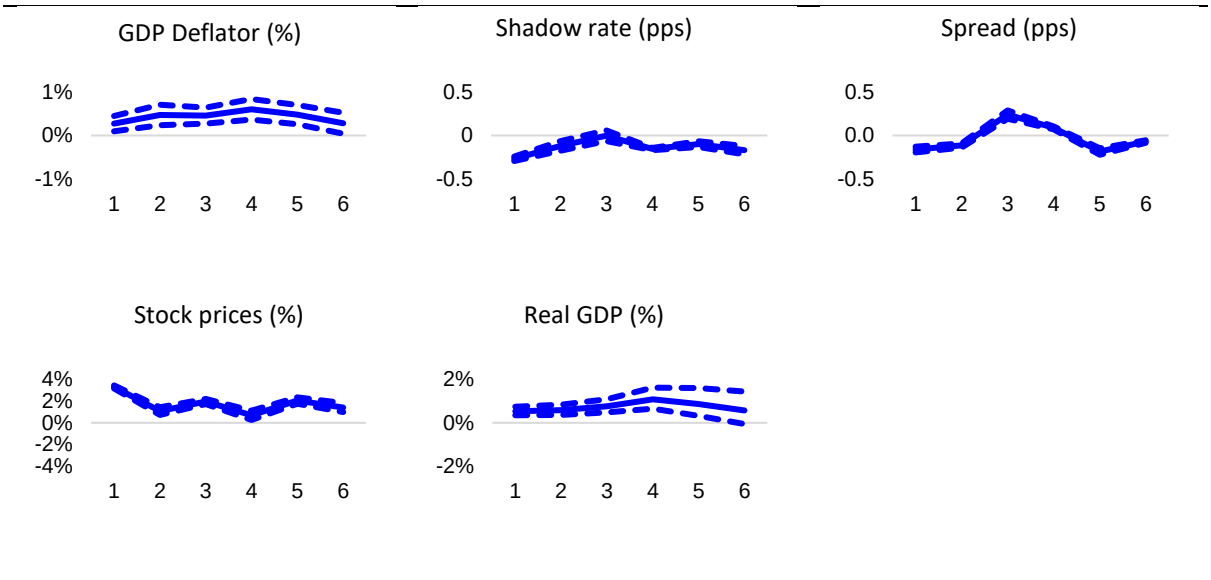
Turning to the reaction of real labour income, Figure 17 reveals the differing patterns across income classes. In particular, wages received by lower- and lower-middle classes only seem to react to the easing shock in the long run. In comparison, the reaction of upper-middle and upper classes appears earlier in time, as their labour income appears to be already around 0.2-0.5% above pre-shock values during the first two years after the shock. The earlier reaction of the salaries of the upper-middle and upper classes is aligned with the findings in the previous section.

Looking at Figure 18, we observe that the response of the job separation rate to a monetary easing

shock appears 2-3 years after the shock for the case of the lower and middle classes, for which the impact ranges between -0.015 and -0.02 (slightly smaller for the case of the upper-middle class). Results are not statistically significant for the case of the upper class. In comparison, the reaction of the job finding rates seems to be more protracted in time and appears only during the fourth year after the shock. In this case, the absolute magnitude of the impact is heterogeneous across income classes and diminishes as we move up in the income strata (e.g., it peaks at around -0.01 for the case of the lower classes, while being below half as high for the upper class).

Figure 15. LP – Estimated IRFs to an expansionary monetary policy shock (1/5)

(-1 percentage point shock to an orthogonal deviation in the shadow rate)

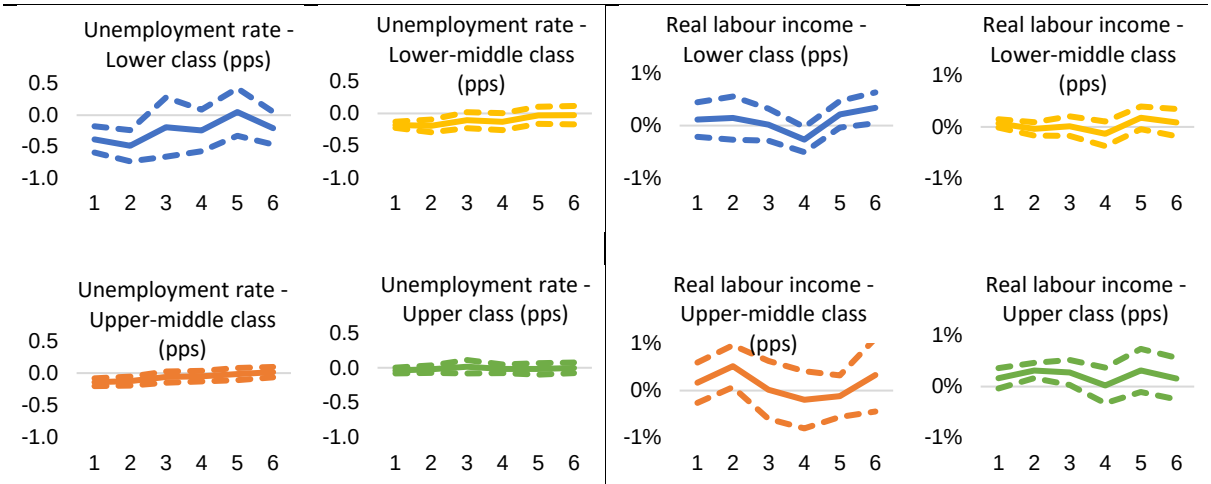


Note: Shaded areas and dotted lines refer to 90% confidence bands. X-axis refer to the number of years after the shock.

Figure 16. LP – Estimated IRFs to an expansionary monetary policy shock (2/5)

Figure 17. LP – Estimated IRFs to an expansionary monetary policy shock (3/5)

(-1 percentage point shock to an orthogonal deviation in the shadow rate)

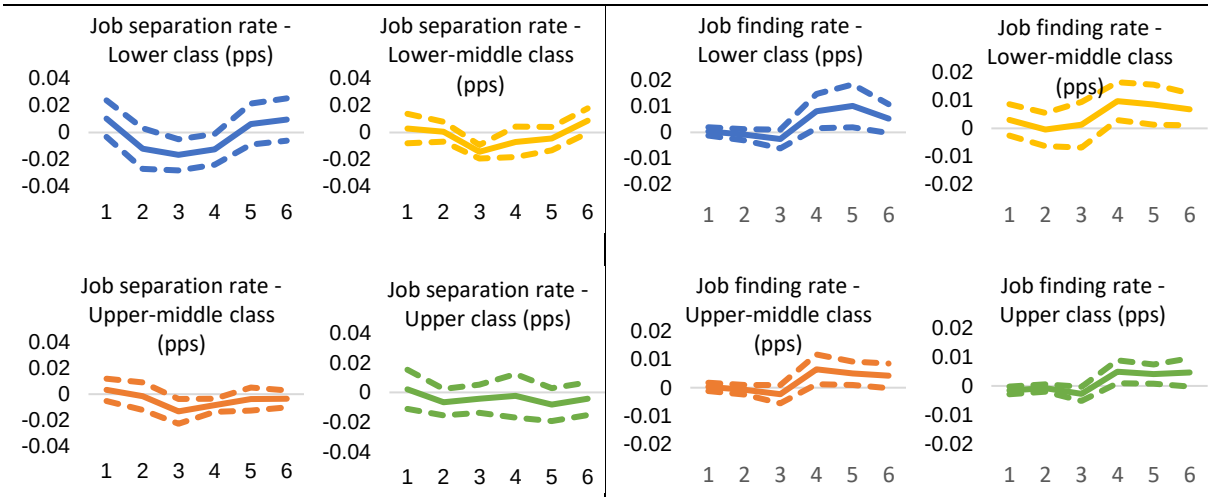


Note: Shaded areas and dotted lines refer to 90% confidence bands. X-axis refer to the number of years. After the shock.

Figure 18. LP – Estimated IRFs to an expansionary monetary policy shock (4/5)

Figure 19. LP – Estimated IRFs to an expansionary monetary policy shock (5/5)

(-1 percentage point shock to an orthogonal deviation in the shadow rate)



Note: Shaded areas and dotted lines refer to 90% confidence bands. X-axis refer to the number of years. After the shock.

7. Conclusions

This study presents a new set of empirical facts about the impact of ECB's expansionary monetary policy across income classes in the countries composing the EMU-11 in the period between 2006Q1 and 2019Q4. In particular, using household survey microdata from EU-SILC, we compute class-specific unemployment rate, job separation and job finding rates, and labour income and directly estimate the effect of monetary policy on the different income classes, hence complementing the literature up to date, which tends to focus on aggregate inequality metrics such as the Gini index.

Our analyses reveal that an expansionary monetary policy shock boosts real gross domestic product and contributes to decrease the unemployment rate while it also increases salaries. However, the reaction is highly heterogeneous across income classes.

Essentially, looking at the employment status, a monetary easing shock seems to particularly support employment for those at the leftmost part of the income distribution, especially in Ireland, Luxembourg, and Spain. The magnitude of the decline in unemployment rate prompted by expansionary monetary policy is comparatively more modest for the lower-middle and upper-middle households, while the unemployment rate of the upper class seems to be largely unaffected. Looking at the drivers behind this dynamic, we observe the associated improvement in job finding rates has mostly benefitted those located at the bottom of the income distribution. In CO

the effect of past monetary easing measures on the job separation rates have been rather homogeneous across income classes. In contrast,

Regarding real salaries, we observe, first, that most vulnerable households do not seem to enjoy an increase in their wages after a monetary easing shock. Second, the impact of monetary policy on middle classes' labour income only becomes significant in the medium to long run, while it materialises earlier in time for the upper class and with more emphasis in countries such as Ireland, Luxembourg, Spain, France and Italy. The fact that employee compensation accrued by the low-income class has remained rather irresponsive to countercyclical monetary policy helps partially understand a stylised fact we document in the text: the increase in wage dispersion during the recession was not fully reversed

in the recovery phase. In this regard, our results reveal that the past expansionary monetary policy might have exacerbated labour income inequality via the intensive margin.

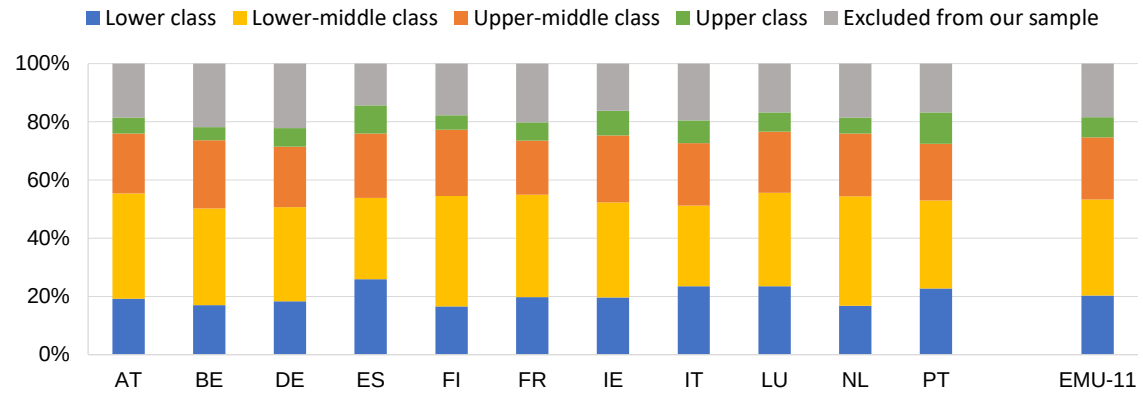
Overall, when considering the joint impact of both the extensive (i.e., unemployment rate) and the intensive margin (i.e., salaries), we observe the former dominates, due to the higher sensitivity of employment to monetary shocks in the bottom than elsewhere in the distribution. Therefore, the income gains generated by monetary policy through the labour market seems to have concentrated among the relatively low-income workers, thereby reducing labour income inequality.

While these findings qualitatively hold for all countries that compose our sample, our analyses uncover significant differences across countries, highlighting differing labour market dynamics across countries. In particular, countries where unemployment rate and real wages fluctuated the most during the economic cycle are those for which the largest impacts are estimated (see e.g., Ireland, Luxembourg, Spain and Portugal). Aspects related to labour market flexibility also shape how wages react to countercyclical monetary policy.

Our findings are broadly in line with the official standpoint of most central bankers, for whom, even though monetary policy may be neutral or nearly in the long run, in the short-term monetary easing measures are thought to reduce income inequality by stimulating the economic activity and employment. Nevertheless, our results go further as they evidence that monetary stimulus may accrue differentially to households in different parts of the income distribution, with different implications in terms of unemployment and salaries for the different income classes.

Annex

Annex 1. Percentage of population represented by each income class



Source: EU-SILC and authors' calculations.

Annex 2. 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 (10y vs. 2y)	ECB Statistical Data Warehouse	Levels (percentage points)
Shadow rate	Wu and Xia (2020)	Levels (percentage points)
Unemployment rate (by income class)	EU-SILC (cross-sectional data)	Levels (percentage points)
Labour 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)

Annex 3. Identification of the SVAR models

Table A1. Analysis I – Contemporaneus restrictions used in the identification via triangular factorisation

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 A2. Analysis II – Contemporaneus restrictions used in the identification via triangular factorisation

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							

Table B1. Analysis I - Contemporaneous and one-period ahead restrictions used in the identification via sign restrictions

Shock:	Demand	Supply	Monetary policy
Response:			
GDP deflator	+	-	-
Shadow rate			+
Term spread	+	+	+
Stock prices	+	+	-
Real GDP	+	+	
Unemp. rate	-	-	
Labour income			

Table B2. Analysis II - Contemporaneous and one-period ahead restrictions used in the identification via sign restrictions

Shock:	Demand	Supply	Monetary policy
Response:			
GDP deflator	+	-	-
Shadow rate			+
Term spread	+	+	+
Stock prices	+	+	-
Real GDP	+	+	
Job separation rate	-	-	
Job finding rate			

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