

# How Does Monetary Policy Affect Income and Wealth Inequality?

## Evidence from Quantitative Easing in the Euro Area

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### Abstract

This paper evaluates the impact of quantitative easing on income and wealth of individual euro area households. We first estimate the aggregate effects of a QE shock, identified by means of external instruments, in a multi-country VAR model with unemployment, wages, gross operating surplus, interest rates, house prices and stock prices. We then distribute the aggregate effects across households using a reduced-form simulation on micro data, which captures the portfolio composition, the income composition and the earnings heterogeneity channels of transmission. The earnings heterogeneity channel is important: QE compresses the income distribution since many households with lower incomes become employed. In contrast, monetary policy has only negligible effects on the Gini coefficient for wealth: while high-wealth households benefit from higher stock prices, middle-wealth households benefit from higher house prices.

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Online appendix: [http://slacalek.com/research/lMPinequality/lMPinequality\\_appendix.pdf](http://slacalek.com/research/lMPinequality/lMPinequality_appendix.pdf)

# 1 Introduction

The collection of reliable data in recent years has allowed researchers to characterize the evolution of wealth and income distributions over time and across countries. In particular, Piketty (2013) shows that, contrary to the traditional view based on Kuznets (1955), advanced economies do not inevitably evolve toward more egalitarian societies. This fact has stimulated an intense debate about the drivers of economic inequality. In general, inequality is seen as related to the structural features of economies, such as the emergence of skill-biased technological progress (Katz and Murphy, 1992; Acemoglu, 2002; Autor, 2014), the deepening of globalization (Katz and Autor, 1999), the tendency toward the reduction in the progressivity of tax systems (Alvaredo et al., 2013) and portfolio heterogeneity (Fagereng et al., 2020; Hubmer et al., 2020).

Recently, and especially since central banks have undertaken extensive asset purchase programmes to circumvent the lower bound on nominal interest rates, monetary policy has also been put forth as a possible driver of economic inequality (see Colciago et al., 2019, for a survey). This paper investigates how unconventional monetary policy, specifically the quantitative easing (QE) program of the European Central Bank, affects the distribution of income and wealth across individual households in the euro area. The analysis proceeds in two steps, making use of both aggregate and household-level data.

In the first stage, we estimate the transmission mechanism of a euro area QE shock. To capture the potential cross-country heterogeneity in the transmission of the common euro area monetary policy, we specify a large multi-country VAR model including macroeconomic and financial variables for the four largest countries of the euro area (France, Germany, Italy and Spain). For each country we include, among others, the variables related to the dynamics of household income and wealth: the unemployment rate, wages, house prices and gross operating surplus.<sup>1</sup>

We identify the QE shock by means of an external instrument approach (see Stock, 2008; Stock and Watson, 2012; Mertens and Ravn, 2013; Ramey, 2016; Miranda-Agrippino and Ricco, 2019; Montiel Olea et al., 2021; Jentsch and Lunsford, 2019). Gertler and Karadi (2015) suggest that the high frequency changes in financial variables recorded during the policy announcements of central banks could be used as external instruments to identify monetary policy shocks. We follow this insight and construct the external instrument for the QE shock exploiting the term-structure of overnight indexed swap rates (OIS). In order to exclusively capture the effects of QE, we use as our external instrument the QE factor of Swanson (2021) and Altavilla et al. (2019). The latter is an aggregate of the changes in the yield structure of the OIS rates recorded during the ECB press conference, which is orthogonal to two additional policy factors capturing forward guidance and conventional monetary policy and is constrained to explain a negligible share of the volatility in OIS rates when QE-type policies were not in place (i.e., in the period preceding the Lehman collapse).

Our first result is that allowing for cross-country heterogeneity in the transmission

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<sup>1</sup>Gross operating surplus is an aggregate measure of firms' profits and it is our proxy for the sources of financial income. In the model, we also include GDP and the GDP deflator for each country, and long-term interest rates and stock prices for the euro area.

mechanism is important, as the impulse responses of most variables vary across countries. For example, the unemployment rate in Spain responds considerably more to the QE shock than in the other countries. Our results are broadly in line with those of previous studies of the effects of central bank asset purchases, which generally find that asset purchase programs, such as QE, have significant effects on the real economy (for an extensive recent survey, see Dell’Ariccia et al., 2018, and our online Appendix C).<sup>2</sup>

However, aggregate cross-country heterogeneity is only one of the possible relevant dimensions to capture the different impact of QE across households. For example, the QE shock may result in heterogeneous impacts on households also because of the substantial differences in their sources of income (e.g., employment status, labor vs. financial income) and their portfolio holdings (holdings of real estate, shares and bonds). Consequently, in the second stage, we use simulation techniques to distribute the aggregate effects estimated in the VAR across the individual households, using data on their income and asset composition. We back out the effects on the wealth distribution shares of various asset components and the effects on their prices. The analysis relies on the Household Finance and Consumption Survey (HFCS), a dataset which collects detailed household-level information on balance sheets, income and socio-demographic variables for European countries (similar to the Survey of Consumer Finances for the US).

Our analysis captures the transmission of QE to households via three channels: (i) income composition, (ii) portfolio composition and (iii) earnings heterogeneity. The two composition channels operate via the heterogeneous reaction of various income and wealth components to monetary policy. Figure 1 reports the sources of income for the aggregate population of France, Germany, Italy and Spain. Both the level and the share of key income components vary substantially with the level of household income. In particular, the households in the lowest income quintile earn only roughly 20% of their gross income as employee income, while those in the top quintile about 60%. Similarly, the share of financial and rental income increases from 2% to almost 10%. In contrast, the share of transfers and unemployment benefits declines across income quintiles from almost 20% to about 3%. Figure 2 shows that the composition of household wealth is similarly varied. In particular, the share of self-employment business wealth (private businesses) and stock market wealth (shares) on total assets in the top net wealth quintile is substantially larger, while the share of real estate is lower.

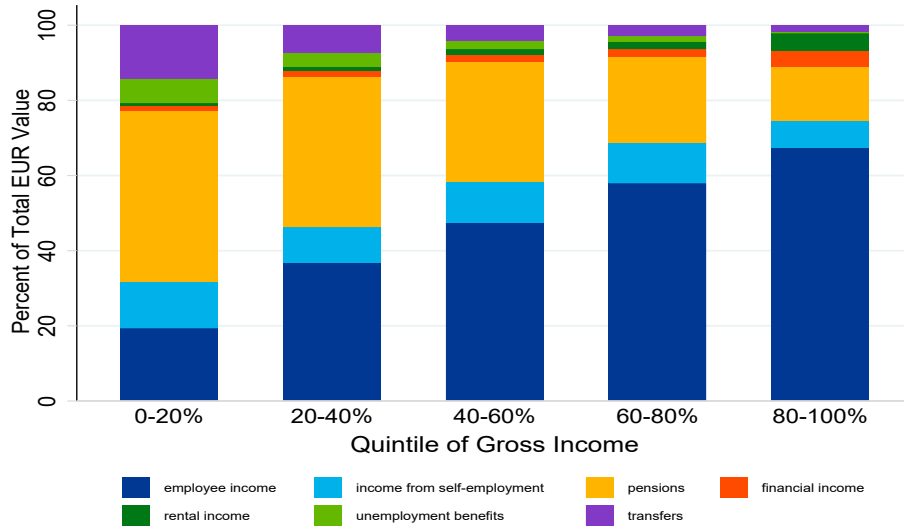
To empirically capture the two composition channels, we update the components of income and wealth at the household level using the aggregate impulse responses for wages, financial income (proxied by gross operating surplus) and for house, stock and bond prices.<sup>3</sup> The earnings heterogeneity channel, instead, relates to the heterogeneous reaction of the employment status to monetary policy. To capture this channel, we run

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<sup>2</sup>Our results, both in terms of the aggregate impulse responses of the multi-country VAR and the implications for individual households remain basically unaffected if we rely on a different identification scheme based on sign restrictions, whereby an expansionary QE shock is identified by assuming that it has a positive effect on GDP in all countries. The results based on this alternative identification scheme are available in a previous version of this paper: [http://slacalek.com/research/lsmPinequality/lsmPinequality\\_2019.pdf](http://slacalek.com/research/lsmPinequality/lsmPinequality_2019.pdf).

<sup>3</sup>In the baseline setup we assume that household portfolios are not rebalanced in response to the QE shock. This assumption is supported by the empirical evidence on considerable inertia in household portfolios, e.g., Ameriks and Zeldes (2004), Brunnermeier and Nagel (2008), Andersen et al. (2020) and others. We relax this assumption in one of our robustness simulations.

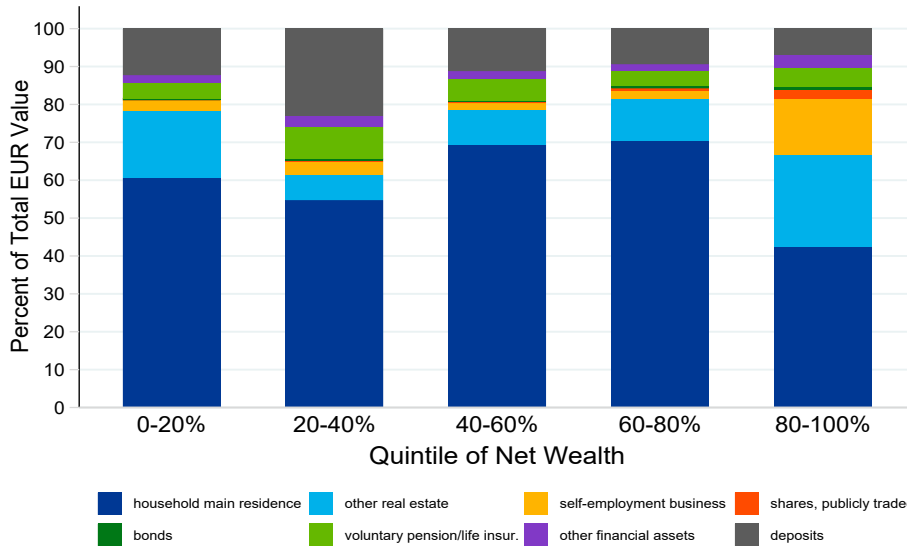
**Figure 1** Composition of Income



**Source:** Household Finance and Consumption Survey, wave 2014

**Note:** The figure shows how the share of income components in total gross income varies across quintiles of gross income. Unemployment benefits and transfers include regular social transfers (except pensions) and private transfers. The figure shows an aggregate of France, Germany, Italy and Spain.

**Figure 2** Composition of Total Assets



**Source:** Household Finance and Consumption Survey, wave 2014

**Note:** The figure shows how the share of components in total assets varies across quintiles of net wealth. Other financial assets include managed accounts, mutual funds and money owed to households. The figure shows an aggregate of France, Germany, Italy and Spain.

a reduced-form simulation which redistributes the aggregate decline in unemployment across individuals depending on their employment probabilities estimated in the cross-section of micro data using their demographics. Some unemployed individuals become employed, start earning wages rather than unemployment benefits, and thus receive a substantial increase in (labor) income, estimated using a standard Heckman model. The simulation ensures that the reduction of the unemployment rate in the household data is consistent with the aggregate drop in unemployment in the VAR impulse responses.

Our empirical results show that accounting for household heterogeneity in income and wealth is important for describing the effects of quantitative easing on income and wealth inequality. For income, the overall effect of quantitative easing is dominated by the earnings heterogeneity channel: transitions from unemployment to employment account for almost all of the increase in income across households. Importantly, the contribution of this channel is particularly strong in the lowest segment of the income distribution. For households in the bottom income quintile, one year after the realization of an exogenous QE shock driving down the term spread by 30 basis points<sup>4</sup>, the unemployment rate declines by more than 1 percentage point and mean income increases by almost 1%. Due to the relatively muted response of wages to the shock, the effect on wages of all existing workers, the intensive margin, is quite small. Similarly, the effect of financial and rental income is relatively modest, although it increases with the share of financial income across the distribution.

Overall, QE reduces income inequality because the earnings heterogeneity channel dominates the income composition channel, which boosts more incomes at the top: the Gini coefficient for gross household income declines from 43.15% to 43.09%. We also show that the decline in income inequality is statistically significant, since it survives also after taking into account the statistical uncertainty surrounding the effects of QE on the aggregate variables. While the effects are likely to fade away over longer horizons, given the likely transient nature of the effects of monetary policy, this evidence suggests that quantitative easing contributes to support vulnerable households.

We then investigate how QE changes the wealth distribution via the portfolio composition channel. The policy increases the value of stocks, mostly held by wealthier households. This effect, by itself, would lead to an increase in wealth inequality. However, we find that Gini index of net wealth in fact declines slightly from 69.17% to 69.14% because the effects of the increase in stock prices on net wealth are offset by those related to housing wealth. This reflects the fact presented in Figure 2 that a large share of the population, i.e., about 60% of euro area households, own their main residence and that this asset category has a larger weight for the mid- and low quintiles of the distribution. The conclusion that the Gini index for the wealth distribution remains largely unaffected is robust to allowing for some rebalancing of financial portfolios and more differentiated responses of house prices to quantitative easing.

Finally, we also evaluate how the effects of QE on income and wealth translate to consumer spending, and we find that quantitative easing stimulates more strongly con-

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<sup>4</sup>This size of the QE shock is at the lower boundary estimated for the effect of the first QE announcement in the euro area, see for example Altavilla et al. (2015).

sumption of households with little liquid assets. The key driver operates via income (‘the income channel’): QE stimulates strongly incomes of households with least liquid assets, whose consumption response is further amplified by their high marginal propensities to consume. In contrast, because QE stimulates wealth modestly and quite evenly, also the corresponding ‘wealth effect’ on consumption varies little across households even if the marginal propensity to consume out of wealth is higher for households with little liquid assets.

Our paper is related to the growing literature on the effects of monetary policy on inequality. Most of the existing work focuses on conventional monetary policy and income inequality. Coibion et al. (2017) use quarterly data from the US Consumer Expenditure Survey in a VAR with narrative shocks to estimate the effects of standard monetary policy on the Gini coefficients for consumption and income. A few papers follow the approach of Coibion et al. (2017) to assess the impact of standard policy on income inequality in other countries, notably Mumtaz and Theophilopoulou (2017) for the UK, Guerello (2018) for the euro area, Amberg et al. (2022) and Coglianese et al. (2021) for Sweden, Andersen et al. (2023) for Denmark<sup>5</sup>, and Furceri et al. (2018) in a panel data study of 32 advanced and emerging market countries. We focus on unconventional monetary policy, specifically the euro area QE<sup>6</sup>, and assess the effects of monetary policy both on income and wealth inequality. By also looking at wealth inequality, we contribute to the debate on the relative importance of direct and indirect effects of monetary policy on consumption, since such effects can be estimated only by considering the transmission channels involving both income and wealth (Kaplan et al., 2018; Auclert, 2019; Slacalek et al., 2020; Holm et al., 2021).

Another distinctive feature of our approach compared to some of the papers above, which rely on the common practice of adding directly inequality measures (such as Gini indices) in the empirical models, is that we combine analysis based on macroeconomic data and models with microeconomic data and simulations. This approach allows us to precisely capture and assess the relative importance of the different transmission mechanisms of the QE shock to the income and wealth distributions, with the aim to inform both economic modelling and policy decisions. Instead, directly including the inequality measures in the empirical models (for example, in macro VARs as in Coibion et al., 2017) allows only an indirect and rough assessment of the transmission mechanism of the policy shock to inequality, via the impulse response of variables which are supposed to capture those channels. Moreover, our approach allows us to describe the reaction of the whole income and wealth distribution to the policy shock, which may be interesting because, for example, a shock could have a muted response on summary inequality indices either because of a muted reaction of all the quantiles of the distribution or because of offsetting changes in the distribution.<sup>7</sup> At the same time, our approach requires to explicitly model all the steps of the transmission, with the risk

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<sup>5</sup>This paper also looks at the impact of conventional monetary policy on wealth inequality.

<sup>6</sup>Corrado and Fantozzi (2021) show that conventional and unconventional monetary policy can have different effects on income inequality in Italy.

<sup>7</sup>This feature of our approach is also shared by recent work on functional vector autoregressions (Chang et al., 2024 and Chang and Schorfheide, 2022).

of mis-specification, while including inequality measures directly in the empirical models is less prone to disregarding important steps of the QE transmission. Notice also that the approach to include directly inequality measures in the macro model is not possible for us because of the unavailability of a sufficiently long time series of high frequency indicators of income and wealth inequality.

Casiraghi et al. (2018) (on Italian data) and, at least partly, Bunn et al. (2018) (on UK data) also focus on unconventional monetary policy.<sup>8</sup> We precisely identify the effects of quantitative easing in a multi-country VAR for four euro area countries which, among other things, also accounts for the cross-country spillovers of the monetary policy impulse. In addition, our approach to distribute the aggregate impulse responses of income components accounts for the transitions from unemployment to employment (the extensive margin). Adam and Tzamourani (2016) quantify the effects of hypothetical scenarios on the evolution of various asset prices (stock, bond and house prices) focusing exclusively on the wealth of euro area households. Our analysis has a different focus from the work of Kuhn et al. (2020), which describes the *unconditional* historical evolution of the US wealth distribution, highlighting the contribution of house prices for the lower 90% of the households and of stock prices for the top 10% (see Martínez-Toledano, 2020, for a similar analysis for Spain). Our purpose, instead, is to isolate the effects of quantitative easing on inequality and, for this reason, we use impulse responses from a VAR to identify the changes in the wealth distribution *conditional* on the effects of quantitative easing.

The remainder of the paper is organized as follows. Section 2 outlines our empirical method based on a multi-country VAR model and a simulation on household-level income and wealth data. Section 3 describes and interprets the empirical results and the main robustness checks. Section 4 concludes.

## 2 Empirical Methodology

We estimate the effects of QE on wealth and income of individual households in two steps: First, we estimate a Bayesian VAR model on aggregate data and identify the effects of monetary policy shocks at the aggregate level. Second, we undertake a reduced-form simulation using micro data to distribute the aggregate effects across the components of income and wealth across individual households.

### 2.1 The BVAR Model and the Identification of the QE shock

We identify the effects of QE using a large multi-country vector autoregression (VAR). Such setup allows us to estimate possibly heterogeneous country responses to a common euro area QE shock. In more detail, to capture the dynamic interrelationships among

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<sup>8</sup>For the analysis of the macroeconomic effects of the policies, Casiraghi et al. (2018) rely on the Banca d'Italia's assessment of two different "unconventional monetary policy" scenarios, with and without financial stress in the economy. Bunn et al. (2018), instead, are based on the evaluation of the effects of the conventional and unconventional monetary policy stimulus of Bank of England in 2008–2014 reported in Carney (2016).

the variables, we adopt the following VAR setting:

$$\begin{aligned} y_t &= C + B_1 y_{t-1} + \dots + B_p y_{t-p} + \epsilon_t, \\ \epsilon_t &\sim \mathcal{N}(0, \Sigma), \end{aligned}$$

where  $y_t$  is an  $N$ -dimensional vector of time-series,  $B_1, \dots, B_p$  are  $N \times N$  matrices of coefficients on the  $p$  lags of the variables,  $C$  is an  $N$ -dimensional vector of constants and  $\Sigma$  is the covariance matrix of the errors. The model is specified in terms of the annualized (log-)levels of the variables and, in our specification, we have  $N = 26$  and  $p = 4$ . In particular, for France, Germany, Italy and Spain, we consider real GDP, the GDP deflator, the unemployment rate, house prices, wages and financial income (proxied by gross operating surplus). We also include long-term interest rates and stock prices for the euro area. The variables are available at the quarterly frequency, for the sample 1999Q1 to 2019Q4.<sup>9</sup> We adopt the Bayesian estimation method described in Giannone et al. (2015).

To estimate the effects of quantitative easing, we identify a QE shock by means of an external instrument approach (Stock, 2008; Stock and Watson, 2012; Mertens and Ravn, 2013; Ramey, 2016; Miranda-Agrippino and Ricco, 2019; Montiel Olea et al., 2021; Jentsch and Lunsford, 2019).<sup>10</sup> The method relies on the existence of a suitable instrument to identify the QE shock. To address this potential challenge, we follow the insight of Gertler and Karadi (2015), who suggest that the high frequency changes recorded in specific financial variables during the policy announcements of central banks could be used as external instruments to identify monetary policy shocks. The idea is that such changes in financial variables are correlated to the monetary policy shocks and, at the same time, they are unlikely to reflect other sources of shocks given that the monetary policy announcements are the main drivers of the surprises in financial variables over narrow time windows around those announcements. To derive a specific external instrument for the euro area QE shock, we use the changes in the OIS rates with maturity from one month to ten years recorded during the Eurosystem press conferences (available in the Monetary Policy Database of Altavilla et al., 2019) in which the ECB President announces and describes the monetary policy decisions taken by the Governing Council.<sup>11</sup> Gürkaynak et al. (2005) pointed out that the changes in financial variables during policy announcements are likely to reflect more than one type of monetary policy measure, especially after the collapse of Lehman Brothers paved the way for unconventional monetary policy measures. Hence, we take additional steps to disentangle the fluctuations in OIS rates due to QE from those due to other policy announcements. Specifically, we use as external instrument the so called QE factor of Swanson (2021) and Altavilla et al. (2019), an aggregate of the changes in the yield structure of the OIS rates during the ECB press conferences. Altavilla et al. (2019) show that the QE factor does not explain much of the volatility in the short-term segment

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<sup>9</sup>See online Appendix B for the details on the macroeconomic database.

<sup>10</sup>In this paper we use the toolbox developed by Miranda-Agrippino and Ricco (2019).

<sup>11</sup>The quantitative easing program of the ECB is defined as Asset Purchase Programme (APP). It started in January 2015 to address the risks of a long period of low inflation. The APP includes various purchase programmes under which private sector securities and public sector securities (including sovereign bonds) are bought. For an early assessment of the macroeconomic effects of the APP see Andrade et al. (2016).



of the OIS yield curve, while it is a relevant driver of the long-term segment, lending support to the idea that the factor correctly captures the fluctuations in OIS rates due to QE. The external instrument approach identifies the QE shock up to a scaling constant. To pin down the constant to a reasonable value, we set the size of the shock to imply a 30 basis points impact reduction in the euro area long-term interest rate, the lower boundary of the estimated effects of the first QE announcement on the euro area long-term bond yields (Altavilla et al., 2015). For more details on the VAR estimation and identification, see online Appendix A.

## 2.2 The Reduced-Form Simulation on Household-Level Wealth and Income Data

We distribute the aggregate impulse responses of unemployment, wages, financial income and asset prices across individual households depending on the structure of their assets and sources of their income. Table 1 provides an overview of the methodology. We apply this methodology to the draws of the posterior distribution of the VAR impulse responses, so that we can build credible intervals for the responses of the individual households which account for the uncertainty surrounding the impact of QE on aggregate variables.<sup>12</sup>

We use the 2014 wave of the Household Finance and Consumption Survey (HFCS). The HFCS is a unique ex ante comparable household-level dataset, which contains rich information on the structure of income and household balance sheets and their variation across individual households. The dataset also collects information about socio-demographic variables, assets, liabilities, income and indicators of consumption. The reference year, 2014, matches quite well the start of the Asset Purchase Programmes. We focus on the four largest euro area countries, in which the (net) sample ranges roughly between 4,500 households (Germany) and 12,000 households (France).<sup>13</sup> To adequately capture the top tail of the distribution, wealthy households in Spain, France and Germany are over-sampled.

### *2.2.1 Estimating the Effects of Quantitative Easing on Household Income: The Earnings Heterogeneity and the Income Composition Channels*

Starting with our baseline characterization of the income composition channel, which we also define as the intensive margin of QE, Figure 1 shows that the key income component for most households is income from employment and self-employment. We use impulse responses of wages to assess how these income components are affected by QE at the household level. For income from rental of properties and financial investments we use VAR impulse responses of gross operating surplus. For pensions, instead, we assume that there is no change due to QE, in line with the fact that most pensions in the euro area are defined-benefit (and thus not linked to asset prices).

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<sup>12</sup>Our credible regions on individual household variables are based on one thousand draws.

<sup>13</sup>See Household Finance and Consumption Network (2016), in particular Table 1.1, for information on the 2014 wave of the HFCS.

**Table 1** Modeling of Responses of Wealth and Income Components at Household Level

<b>Wealth / Income Component</b>	<b>Modeling Procedure</b>
<b>Real Assets</b>	
Household's main residence	Multiplied with impulse response of house prices (estimated in VAR) <sup>1</sup>
Other real estate property	Multiplied with impulse response of house prices (estimated in VAR) <sup>1</sup>
Self-employment businesses	No adjustment
<b>Financial Assets</b>	
Shares, publicly traded	Multiplied with response of stock prices (estimated in VAR) <sup>2</sup>
Bonds	Multiplied with response of long-term bond prices (estimated in VAR) <sup>3</sup>
Voluntary pension/whole life insurance	No adjustment
Deposits	No adjustment
Other financial assets	No adjustment
<b>Debt</b>	
Total liabilities (mortgage + non-mortgage debt)	No adjustment
<b>Gross Income</b>	
Employee income	Extensive margin: Some unemployed become employed and receive wage <sup>4</sup> Intensive margin: Multiplied with response of wages (estimated in VAR) <sup>4</sup>
Self-employment income	Multiplied with response of wages (estimated in VAR) <sup>4</sup>
Income from pensions	No adjustment
Rental income from real estate property	Multiplied with response of gross operating surplus (estimated in VAR)
Income from financial investments	Multiplied with response of gross operating surplus (estimated in VAR)
Unemployment benefits and transfers	If becomes employed, replace benefits with wage (else no adjustment) <sup>4</sup>

<sup>1</sup> In a robustness scenario in section 3.2.4 we allow for differences in house prices depending on quality of housing.

<sup>2</sup> In a robustness scenario in section 3.2.4 we allow for some stock trading, whereby wealthier households increase their holdings of stocks in response to the quantitative easing shock.

<sup>3</sup> We calibrate the duration of bonds using data from Teles and Tristani (2021) as follows: Germany, 5.6 years; Spain, 6.6 years; France 6.7 years; Italy 5.9 years; see details in footnote 18.

<sup>4</sup> For details of the imputation of income components, see section 2.2.

The earnings heterogeneity channel pertains to the effect of monetary policy on employment. We model this extensive margin as follows. The aggregate results imply that quantitative easing reduces the aggregate unemployment rate. In turn, micro data on employment and income can be used to simulate which unemployed people become employed (step 1) and by how much their incomes increase (step 2). The simulation, which broadly follows the setup of Ampudia et al. (2016), proceeds in two steps and runs at the individual level (not at the household level); the results are then aggregated to household level.

### Step 1: Probit Simulation for the Employment Status

In the first step, we distribute the aggregate decline in unemployment across individuals, using a probit regression which takes into account individual characteristics. The simulation tries to account for the fact that some unemployed people are more likely to become employed (e.g., because they have higher education). This approach allows us to pin down which individuals become employed as a result of QE, also accounting for the fact that the probabilities are not independent, but are affected by demographics.

For each country  $c$ , we first estimate in the cross-section a probit model regressing individual's  $k$  employment status  $S$  on her demographic characteristics:

$$\Pr(S_k = 1|V_k = v_k) = \Phi(v_k' \beta_c), \quad (1)$$

where  $V$  denotes demographics: gender, education, age, marital status and the number of children;  $\Phi(\cdot)$  denotes the normal cdf. For each individual we denote the fitted values, the estimated probability of being employed, as  $\hat{S}_{c,k}$  and use it to simulate who becomes employed as a result of QE.

The idea of the simulation is that it accounts for the fact that individuals differ in how likely they are to find a job: for example, more educated individuals are more likely to become employed and thus have a higher probability  $\hat{S}_{c,k}(V)$ —which depends on the demographics  $V$ . We run many replications of the following simulation. For each person  $k$  we draw a uniformly distributed random ‘employment’ shock  $\xi_k$ . If the value of  $\xi_k$  is sufficiently below  $\hat{S}_{c,k}$  and the person is unemployed, she becomes employed. This implies that people with higher  $\hat{S}_{c,k}$  are more likely to become employed. At the same time there is some randomness in the simulation, so that even people with lower  $\hat{S}_{c,k}$  become employed in some replications if they draw a low  $\xi_k$ . For each replication, the threshold for  $\xi_k - \hat{S}_{c,k}$ , which determines how many people become employed, is set so that the number of newly employed individuals is, for each country, consistent with the aggregate decline in unemployment estimated in the VAR impulse response.<sup>14</sup> We repeat the simulation many times and report the average results across replications.<sup>15</sup>

### Step 2: Imputation of Labor Income

In the second step we replace unemployment benefits of people who are newly employed

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<sup>14</sup>In practice, we sort unemployed individuals by their value of  $(\xi_k - \hat{S}_{c,k})$  and those with the lowest rank become employed until the reduction in the unemployment rate matches the value given by the impulse response. We use survey weights in this calculation.

<sup>15</sup>The empirical results in the paper are based on 1000 replications.

with wage, which is estimated based on their demographic characteristics. Specifically, the log of wage of newly employed individuals is estimated by a two-step Heckman model of the system of wage and selection equations. Our exclusion restrictions are the marital status and the presence of children. We assume that these factors may affect the work status but not the wage of the employed. The remaining regressors in the model are gender, education and age.<sup>16</sup>

The estimates from the Heckman selection model are in line with the evidence from the literature for standard market economies (see online Appendix C for details). Wages increase with age and education, and are higher for men. As for the selection equation, the effects of the presence of children and of being married are both positive. The probability of the selection into employment also increases with age and education, and is higher for men in Italy and Spain (and insignificant in France and Germany). The implied average replacement rate for after-tax labor income of the newly employed is roughly 45–50%.

### *2.2.2 Estimating the Effects of Quantitative Easing on Household Wealth: The Portfolio Composition Channel*

To simulate the effects of quantitative easing on wealth, i.e., to capture the portfolio composition channel, we use the detailed *quantitative* information about holdings of various asset classes by each household in the HFCS (i.e., we know the nominal market value of each asset class owned by households). The effects of monetary policy on household wealth are obtained by multiplying the holding of each asset class (in EUR) by the corresponding change in asset prices given by the VAR impulse response.

In particular, our VAR includes three asset price variables: house prices, stock prices and long term interest rates, which are related to bond prices. We multiply the holdings of housing wealth—i.e., household’s main residence and other real estate—by house prices. We multiply the holdings of shares by stock prices. We assume that the value of self-employment businesses is unaffected by the QE shock, due to the difficulty to reliably measure the value of such component of wealth.<sup>17</sup> Finally, we multiply the holdings of bonds by the change in the price of the long-term bond implied by the change in the interest rate, calibrating the average bond duration at the country level.<sup>18</sup>

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<sup>16</sup>We chose the classic Heckman procedure to impute labor income when it is not observed. Alternative imputation methods based on matching techniques could be considered; see, e.g., Olivetti and Petrongolo (2008) and many others.

<sup>17</sup>As described in Table 1, we assume that other classes of net wealth, most importantly deposits and liabilities remain unaffected by monetary policy. For the time period we focus on—since 2014—this seems reasonable as the short-run interest rate was at the zero lower bound. The HFCS also records holdings of voluntary pensions, for which we in the baseline scenario assume they are unaffected by stock prices. Data on Euro area insurance corporation and pension fund statistics, <https://www.ecb.europa.eu/press/pr/stats/icpf/html/index.en.html>, indicate that pension funds hold a small fraction of their assets in stocks, i.e., about 9% of total assets is held in equities (2016Q4). Notice however that 21.5% is held in investment funds, for which it is difficult to determine what fraction of their assets they hold in stocks.

<sup>18</sup>In particular, we use country-specific data from Teles and Tristani (2021) to calibrate duration as follows: Germany, 5.6 years; Spain, 6.6 years; France 6.7 years; Italy 5.9 years. As in our identification of the OMT shock we assume that the short-term interest rate does not change, we interpolate the change in the interest rate at the required duration by proportionally scaling down changes in the 10-year rate,  $w_c \times \Delta R_t^{10y}$  with  $w_c = \frac{(\text{duration in country } c)}{10 \text{ years}}$  (which means that  $w_c$  ranges between 0.56 and 0.67). The implied change in the bond price is then:  $-(\text{duration in country } c) \times w_c \times \Delta R_t^{10y}$ .

This calculation assumes that households do not adjust their portfolios in response to monetary policy. The assumption of no rebalancing seems a reasonable first-order approximation for two reasons. First, we consider responses to a relatively *small* monetary policy shock over the short-run horizon of several quarters. Related, the literature documenting the effects of quantitative easing on portfolio rebalancing (Koiijen et al., 2017) finds rather small effects for the household sector (in the aggregate data). Second, substantial micro evidence exists on the sluggishness in household portfolios. This holds not only for very illiquid assets (such as housing) but also for many financial assets. For example, a well-known paper by Ameriks and Zeldes (2004) documents that almost half of the households in their data on retirement accounts (held by TIAA–CREF) made no active changes to their portfolio of stock over the *nine-year* period they consider. Similar findings are reported in Biliás et al. (2010): The bulk of US households exhibit considerable inertia in their stock portfolios (held in brokerage accounts). Several papers examine inertia in household portfolios using high-quality administrative data. Fagereng et al. (2021) document evidence on the limited extent of rebalancing of illiquid and risky assets in response to receiving a lottery prize in Norwegian data. Using Danish data, Andersen et al. (2020) study the substantial inaction of households regarding mortgage refinancing. In Swedish data, Calvet et al. (2009) find very weak active rebalancing in the household sector as a whole, though at the household-level active rebalancing compensates about half of idiosyncratic passive variations in the risky share and is stronger for financially sophisticated households. In section 3.2.4 below, we investigate how robust the results are to assuming some rebalancing in holdings of stocks and bonds, also accounting for more reallocation by wealthy households.

### 3 Empirical Results

First, we describe the effects of monetary policy on aggregate variables identified using the VAR model. Then, we consider the effects on wealth and income of individual households via the three channels described in the previous section: (i) income composition, (ii) portfolio composition and (iii) earnings heterogeneity.<sup>19</sup>

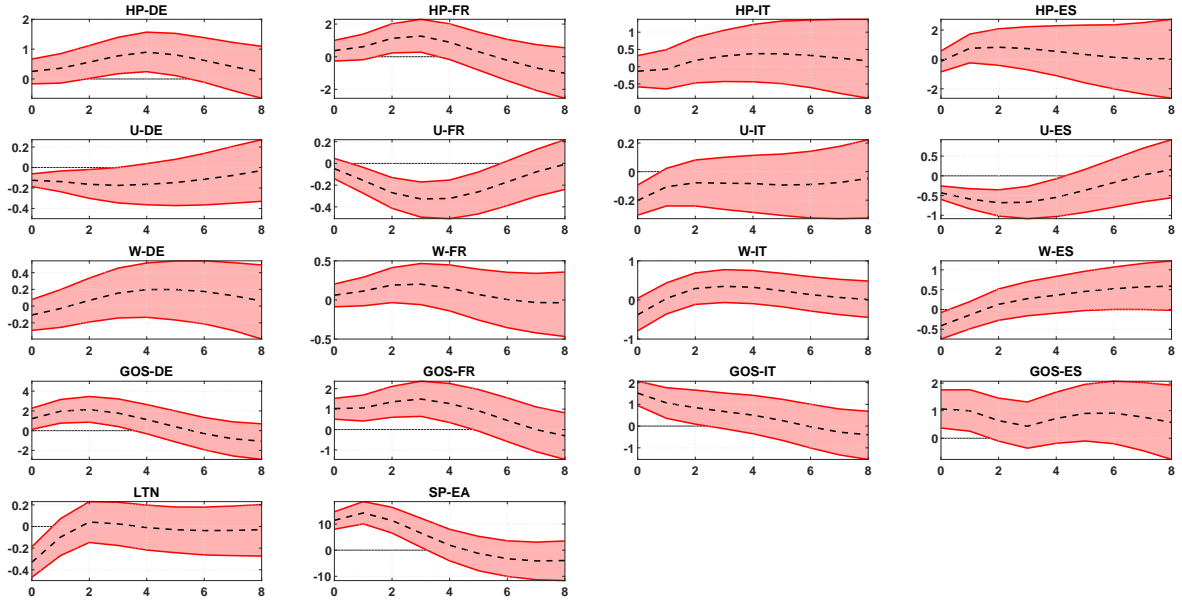
#### 3.1 Aggregate Effects of Quantitative Easing

This section reports the aggregate responses of the variables in our multi-country VAR to a QE shock. The shock is meant to be expansionary and implies a 30 basis point drop in the euro area ten-year government bond yields. The full set of impulse responses is reported in the online Appendix C. The impulse responses for GDP and unemployment are qualitatively in line with the previous literature, which also finds relevant and statistically significant effects of asset purchases—see Dell’Ariccia et al. (2018) (e.g., their Table 1) for an up-to-date overview of the literature. We also find that QE stimulates

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<sup>19</sup>We do not consider other channels of transmission, such as the interest rate exposure channel of Auclert (2019) and the inflation channel of Doepke and Schneider (2006). These channels are analyzed quantitatively in Slacalek et al. (2020).

**Figure 3** VAR Impulse Responses of relevant variables to a 30bp QE shock



**Note:** The orange area refers to 16th–84th percentile range, while the dashed line captures the median response. Long-term interest rates (LTN): deviation from baseline levels; house prices (HP): percent deviation from baseline levels; wages (W): percent deviation from baseline levels; unemployment rate (U): deviation from baseline level; stock price (SP): percent deviation from baseline levels; gross operating surplus (GOS): percent deviation from baseline levels. Horizontal line: quarters after the shock.

asset prices and nominal variables such as the GDP deflator, wages and gross operating surplus. In Figure 3, we focus on the impulse responses of the variables that play an important role in the subsequent analysis on individual households.

Starting from the last row, the shock has a relatively short-lived impact on the long-term bond yields, whose median response is close to zero already after four quarters. The peak response of stock prices is quite large, about 12% at the peak one quarter after the shock—but fades away substantially thereafter. The country-specific impulse responses in Figure 3 document the extent of heterogeneity across the four countries. House prices (first row) increase in all countries to a similar extent, with the peak responses ranging around 0.5–1%. The responses of the labor market variables display cross-country heterogeneity. The unemployment rate (second row) drops significantly in all countries, with a markedly stronger effect in Spain.<sup>20</sup> The response of wages (third row) is surrounded by quite large uncertainty but its median is positive and also heterogeneous across countries, a known feature also documented in Angelini et al. (2019). Finally, the response of our proxy for financial income (gross operating surplus, fourth row) is significant in all countries and peaks at values between 1% and 2%,

<sup>20</sup>We have not included hours worked in our VAR model because their median response to the QE shock is small and the 68% credible intervals include the zero at all horizons.

although the persistence of the responses is relatively limited and the gains halve after about one year.<sup>21</sup>

## 3.2 Effects of Quantitative Easing on Individual Households

We report the estimates of the effects on income and wealth of individual households in a series of figures with ‘micro’ impulse responses obtained in the micro-simulation described in section 2.2. The impulse responses are grouped in terms of quintiles of the income and wealth distributions. For the sake of readability, we plot the median results of our micro-simulations across the draws of the aggregate VAR results used in the micro-simulations. To provide an assessment of the uncertainty surrounding the micro-impulse responses, a solid line indicates that the 16th–84th percentiles of the distribution of the micro-impulse response functions do not include the zero.<sup>22</sup>

### *3.2.1 Effects on Household Income: The Earnings Heterogeneity and the Income Composition Channels*

In the baseline setup, the effects of QE on income arise via two channels: (i) the earnings heterogeneity—the increase in income as unemployed people become employed (the extensive margin) and (ii) the income composition channel—the effect on labor income for all employed people due to the change in wages (the intensive margin) together with the increase in financial and rental income.

Let us first investigate the earnings heterogeneity channel in isolation. Figure 4 shows the impulse responses of the unemployment rate by (country-level) income quintiles. Notice that the effect of an expansionary QE shock on the distribution of unemployment is not clear, a priori, because there are two countervailing factors that can affect the response of unemployment across income quintiles. On the one hand, higher income individuals have generally more favourable demographics (for example, a higher level of education) and, hence, also a higher estimated probability to become employed in response to the expansionary QE shock.<sup>23</sup> On the other hand, the bottom panel of Figure 4 shows that the number of unemployed is heavily skewed toward the bottom income quintile across all four countries. Hence, if QE leads to a considerable reduction of aggregate unemployment, a proportionally larger number of individuals in the lower

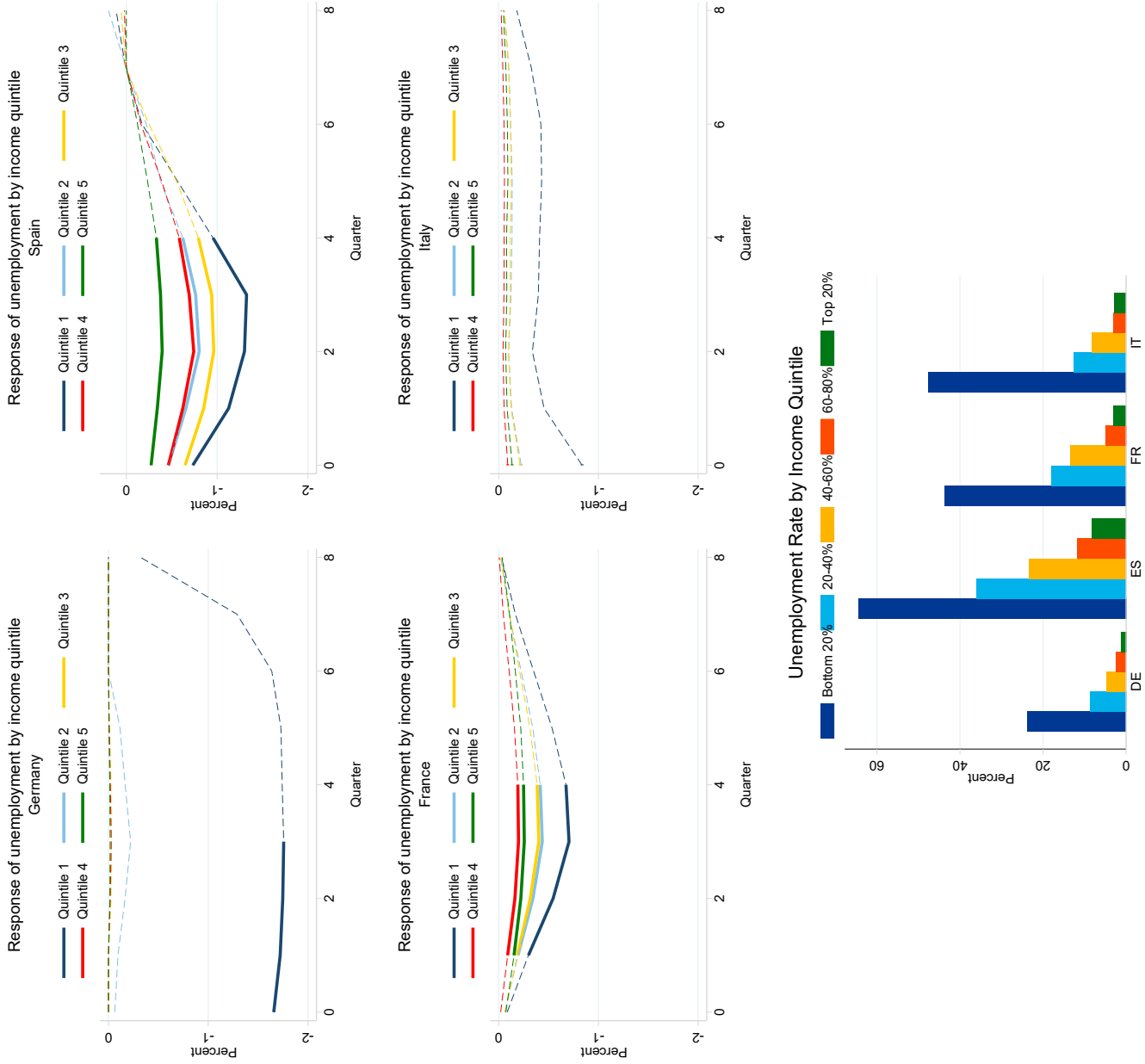
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<sup>21</sup>In our previous draft, [http://slacalek.com/research/lsmPinequality/lsmPinequality\\_2019.pdf](http://slacalek.com/research/lsmPinequality/lsmPinequality_2019.pdf), we identify the QE shock by means of sign restrictions, similarly to Baumeister and Benati (2013). Specifically, we identify the effects of asset purchases using a combination of zero and sign restrictions (employing the algorithm of Arias et al., 2018). The main identifying assumption there is that an expansionary asset purchase shock decreases the term spread (defined as long-term minus short-term interest rate, where the short-term rate is the 3-month Euribor and the long-term rate is the euro area 10-year government benchmark bond yield) and has a positive impact on real GDP in the four countries under analysis. The responses of all other variables, notably the GDP deflator, the unemployment rate, wages and house prices in the four countries and stock prices, are left unrestricted. The effects of a QE shock identified by means of sign restrictions are qualitatively and quantitatively comparable with those we obtain by means of external instruments.

<sup>22</sup>For the euro area as a whole, table 2 reports the median and the 16th–84th percentile ranges for the Gini coefficients computed by using the whole distribution of the aggregate VAR impulse responses.

<sup>23</sup>In order to appreciate the quantitative relevance of this heterogeneity in probabilities to become employed, a counterfactual scenario where all individuals have the same probability to be drawn out of unemployment implies a significantly stronger stimulating effects on the lower income quintiles compared to our scenario based on estimated probabilities—as documented in the online Appendix C.

**Figure 4** Impulse Responses of Unemployment by Country and Income Quintile



**Source:** Household Finance and Consumption Survey, wave 2014  
**Note:** The figures show the impulse responses of unemployment by income quintile. We run the micro-simulation for 1000 draws of the VAR impulse responses and we report the mean of the micro-simulations. Bold solid lines signal statistical significance at 68%; thin dashed lines signal insignificant responses.



income quintiles are drawn out of unemployment and this tends to reduce income inequality. We find that this second effect dominates and, hence, the stimulative effects of QE on employment are skewed toward low-income households. Across the four countries, the peak unemployment response for the bottom income quintile ranges roughly between  $-0.5\%$  and  $-2\%$ , while for the highest income quintile unemployment declines by much less than  $0.5\%$ .

The micro impulse responses also vary across countries, both regarding the level and the dispersion of responses across income quintiles. One factor to explain the differences, in particular for the levels, is the cross-country difference in macro responses. For example, the overall reduction in unemployment is larger in Spain than in the other three countries. Instead, the dispersion of micro impulse responses across income quintiles is importantly affected by the distribution of the unemployed across income quintiles, which varies across countries. Indeed, a relevant mass of unemployed people in Spain lives in households whose income falls into higher quintiles, so that the differences in impulse responses across quintiles in Spain are smaller (see the bottom panel in Figure 4). In contrast, the number of the unemployed in Germany and Italy is more strongly skewed toward the lowest income quintile, which causes unemployment in the lowest income quintile to drop more (relative to other quintiles).<sup>24</sup>

Figure 5 shows the micro responses of mean income by income quintile, combining the earnings heterogeneity and the income composition channels. These responses are primarily driven by the transitions into employment and by differences in unemployment insurance replacement rates (as estimated by the Heckman model). The replacement rates are in general more generous in Germany and France than in Spain and, in particular, Italy.<sup>25</sup> As a result, the magnitude and dispersion of income responses in Italy and Spain is larger. For example, the large positive response in mean income of the lowest quintile in Italy arises thanks to both the substantial decline in unemployment rate highlighted in Figure 4 and the substantial increase in (labor) income of the newly employed individuals.<sup>26</sup>

These findings imply that the earnings heterogeneity channel is the most relevant factor to explain the changes in income across quintiles. To more precisely show this point, Figure 6 decomposes the overall increase in mean income for the euro area (obtained as the aggregate of the four countries), one year after the shock, into three components: the extensive margin of labor income (earnings heterogeneity), the intensive margin of labor income (income composition) and the financial income. The extensive margin is particularly strong in the bottom income quintile, for which wage growth plays a very small role. However, transitions from unemployment to employment account for the bulk of the total increase on income across much of the whole distribution (except for the top income quintile). The role of the intensive margin is limited due to the relatively

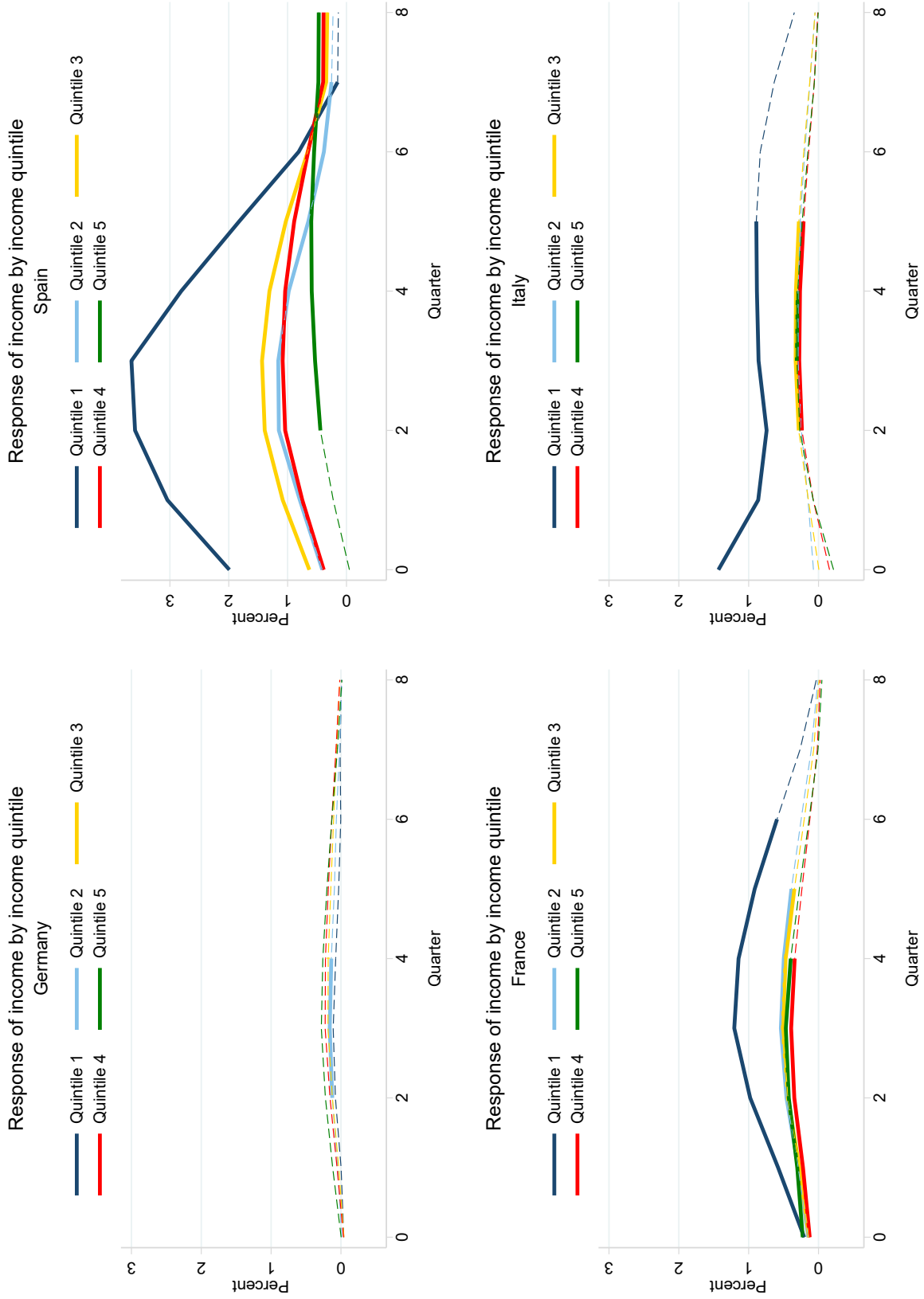
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<sup>24</sup>Notice also that, in principle, the cross-country dispersion could also be explained by the fact that the employment probabilities in the probit models (1) are country-specific. This factor turns out to play a very minor role to explain our results.

<sup>25</sup>See, e.g., the OECD Statistics on Benefits and Wages: <http://www.oecd.org/els/benefits-and-wages-statistics.htm>.

<sup>26</sup>The results are shown for gross (pre-tax) income. The increase in after-tax income would be somewhat lower, however, not by much, as most newly employed people are not subject to large taxes. As for the effect on inequality of net income, it would be reduced more than inequality of gross income because of progressivity of taxes.

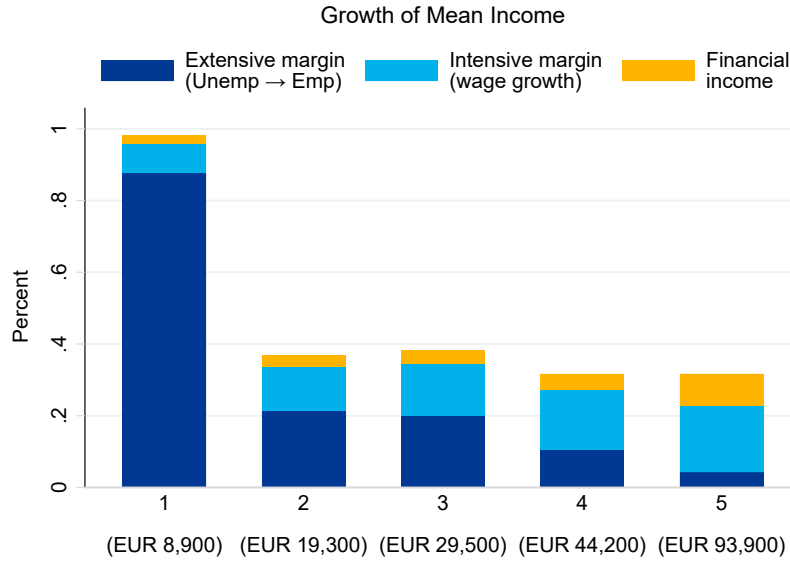
**Figure 5** Impulse Responses of Mean Income by Country and Income Quintile



Source: Household Finance and Consumption Survey, wave 2014

Note: The charts show impulse responses of mean income by income quintile. We run the micro-simulation for 1000 draws of the VAR impulse responses and we report here the mean of the micro-simulations. Bold solid lines signal statistical significance at 68%; thin dashed lines signal insignificant responses.

**Figure 6** Decomposition of the Total Effect on Mean Income into the Extensive Margin, the Intensive Margin and Financial Income



**Source:** Household Finance and Consumption Survey, wave 2014

**Note:** The figure shows the percentage change in mean income across income quintiles in the euro area four quarters after the impact of the QE shock. It also shows the decomposition of the change into the extensive margin of labor income (transition from unemployment to employment), the intensive margin of labor income (change in wage) and financial and rental income. The numbers in parentheses show the initial levels of mean gross household income. The figure shows an aggregate of France, Germany, Italy and Spain. We run the micro-simulation for 1000 draws of the VAR impulse responses and we report here the mean of the micro-simulations.

mented response of wages to the monetary policy shock. Financial and rental income contributes the least, due to its small share on total income (as shown in Figure 1), although its effect is larger at the top quintiles of the distribution.

To summarize the effects on income inequality, Table 2 shows that quantitative easing reduces the Gini coefficient for gross household income from 43.145%, the value computed from the HFCS in 2014, to 43.091%. Remarkably, the 68% credible interval (i.e., the range between the 16th and the 84th percentile of the distribution) reported in parentheses in the table does not include the value of the Gini in actual data, allowing us to conclude that the finding is also statistically significant. These results are in line with recent analysis on the sensitivity of individual incomes to business cycle and monetary policy. For example, Alves et al. (2020) and Heathcote et al. (2020) estimate that individuals with lower earnings are particularly sensitive to aggregate fluctuations. Similarly, Broer et al. (2020) find in German data that earnings in the bottom tail of the distribution are particularly sensitive to monetary policy shocks. In addition, they report that income risk for the poor is almost entirely extensive (due to labor market transitions) while, for individuals with higher incomes, intensive risk is much more important.<sup>27</sup> These

<sup>27</sup>For the US, Guvenen et al. (2017) estimate a U-shaped exposure of individual earnings to (aggregate) GDP growth,

**Table 2** Effects of Quantitative Easing on Income and Wealth Inequality

	Gini Coefficient (%)	
	Income	Net Wealth
Actual Data	43.145	69.168
Baseline Simulation	43.091 (43.022, 43.126)	69.135 (69.086, 69.179)
Robustness Scenarios		
1. Stock Trading (Household- & Country-Specific Response $-0.9$ to $2.0\%$ )		69.143 (69.094, 69.187)
2. Heterogeneous House Price Responses (Country-Specific Response $0.5$ to $1\%$ )		69.183 (69.134, 69.227)

The table shows the Gini coefficients for gross household income and net wealth for actual data, the baseline scenario and two alternative, robustness scenarios described in section 3.2.4: a scenario on portfolio rebalancing of stocks (stock trading) and a scenario with heterogeneity in responses of house price to quantitative easing. The scenarios report the Gini coefficients four quarters after the impact of the quantitative easing shock. Numbers in parentheses report the 68% credible intervals, obtained by running the micro-simulations for 1000 draws of the posterior distribution of the VAR impulse responses. The two robustness scenarios correspond to the results shown in the two panels of Figure 9.

empirical results are also consistent with models with indivisible labor, which imply higher labor supply elasticities for lower income groups (e.g., Chang and Kim, 2007 and Ma, 2020).

The reduction in the Gini index for income at euro area level is quite broad based across countries, reflecting a reduction of the Gini index for France, Italy and, above all, Spain, while the index slightly increases for Germany. Precisely, the Gini index changes from 44.85% to 44.88% for Germany, from 37.26% to 37.20% for France, from 41.61% to 41.57% for Italy and from 43.24% to 43.07% for Spain.

### 3.2.2 Effects on Household Wealth: The Portfolio Composition Channel

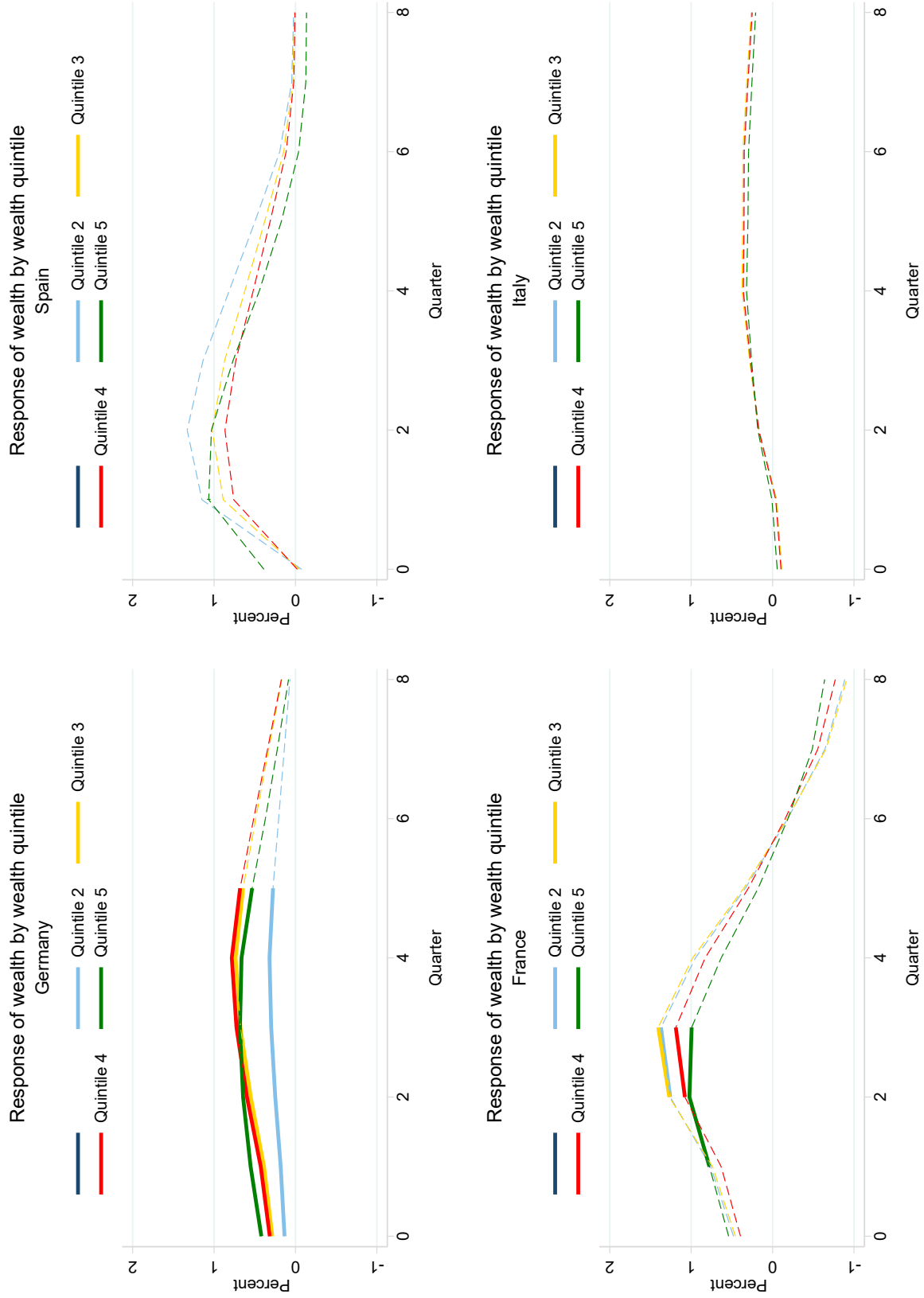
This section analyses how the portfolio composition channel affects household net wealth. Figure 7 shows the micro responses of mean net wealth by wealth quintile. These responses arise from a combination of the response of house prices, stock prices and bond prices, and holdings of wealth components across the distribution (and countries).

Broadly, the responses of wealth in the four upper quintiles show an increase by around 1.0% in France and Spain, and are rather flat in Germany and in particular Italy. There is little evidence that the median wealth among the top wealth quintile households

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which is rising in the top tail, above the 99th percentile of earnings. For European countries, the Global Income Dynamics Project provides very recent detailed evidence. For France, Italy and Spain the dispersion of residual one-year earnings changes is particularly large in the bottom tail of the permanent income distribution, with little evidence of increased dispersion in the top tail (see Kramarz et al., 2022, Hoffmann et al., 2022, and Arellano et al., 2022). For Germany the distribution is U-shaped, also rising above the 90th percentile of permanent income (see Drechsel-Grau et al., 2022).

**Figure 7** Impulse Responses of Mean Net Wealth by Country and Net Wealth Quintile



**Source:** Household Finance and Consumption Survey, wave 2014

**Note:** The figures show impulse responses of net wealth. The response for the bottom 20% not shown as the value of net wealth in the lowest quintile is negative or close to EUR 0. We run the micro-simulation for 1000 draws of the VAR impulse responses and we report here the mean of the micro-simulations. Bold solid lines signal statistical significance at 68%; thin dashed lines signal insignificant responses.

would increase more strongly, though this does happen for the top 10% of the wealth distribution, where the holdings of stocks are prevalent. Overall, Table 2 documents that the Gini coefficient for net wealth is only modestly affected by QE, declining from 69.169% to 69.135%, a decrease which is not economically and statistically significant. An important takeaway from this exercise is the key role of including house prices in the analysis, since most households own large holdings of housing wealth rather than stocks and bonds, which are only relatively more prominent in the top tail of the distribution.<sup>28</sup>

The small reduction in the Gini index for wealth at euro area level reflects a small reduction of the Gini index for all countries. Precisely, the Gini index changes from 76.15% to 76.11% for Germany, from 67.63% to 67.58% for France, from 60.25% to 60.24% for Italy and from 66.88% to 66.80% for Spain.<sup>29</sup>

### 3.2.3 Effects on Household Consumption Implied by Income and Wealth Changes

This section calculates how the effects of quantitative easing on household income and wealth translate to spending. For each quintile of liquid assets, we calibrate a simple, linear setup and investigate how QE stimulates spending of individual households via the two channels. We focus on the breakdown by liquid assets and assume that marginal propensities to consume out of income and wealth decline with liquid assets (e.g., due to precautionary saving and liquidity and collateral constraints), in line with the large literature documenting this fact.

We calibrate the marginal propensities to consume nondurables out of transitory income as:

$$\{\text{MPC}_{\text{Liquid Assets Quintile } i} | i = 1, \dots, 5\} = \{0.30, 0.25, 0.15, 0.10, 0.05\}$$

and the marginal propensities to consume nondurables out of wealth as:

$$\{\text{MPCW}_{\text{Liquid Assets Quintile } i} | i = 1, \dots, 5\} = \{0.05, 0.03, 0.01, 0.01, 0.01\}.$$

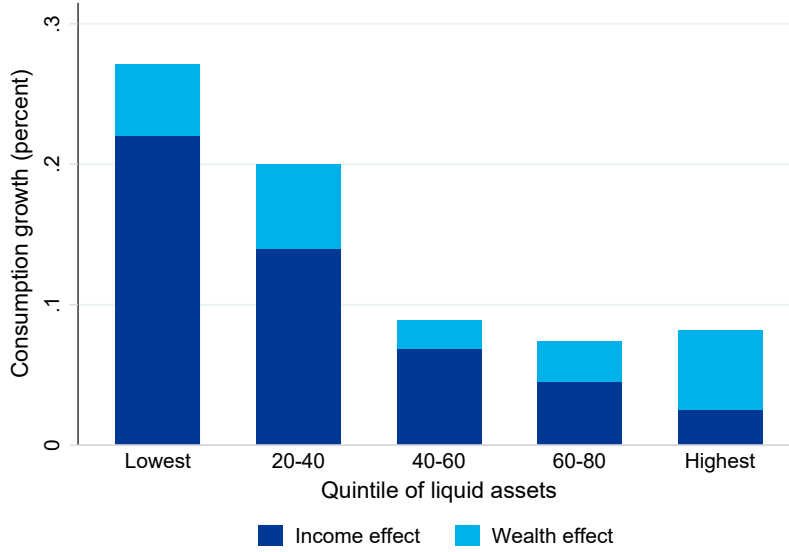
These values are in line with the average (aggregate quarterly) MPC between 0.15 and 0.25 based on extensive existing literature as summarized in Kaplan and Violante (2022), which finds that a part of the differences in MPCs is explained by liquid assets (with constrained, “hand-to-mouth” households having higher MPCs). The specific values for MPC above are taken from Ganong et al. (2020), Figure 6. The values of the marginal propensity to consume out of wealth are calibrated based on Mian et al. (2013), Cooper and Dynan (2016) and in particular Garbinti et al. (2022), which estimate that much of the wealth effects is due to collateral constraints and report aggregate MPCWs of

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<sup>28</sup>This finding is in line with Adam and Tzamourani (2016); see, e.g., their Figure 4. See also Kuhn et al. (2020), Figure 17 for historical evidence from the US and Martínez-Toledano (2020) for estimates from Spain.

<sup>29</sup>Notice that our simulation involves two aspects. First, we look at the reaction to QE of a set of financial prices. Then we apply such changes to the portfolio holdings of the households in different countries. In our baseline simulation, we effectively consider a scenario in which all households in the four countries under analysis invest in a portfolio of bonds and stocks which earn the aggregate euro area returns. Adding country-specific stock prices and bond rates in the VAR model and assessing the effects of QE under the assumption that euro area households only invest in sovereign bonds and stock quoted in their own country (full home bias) hardly affects our result that QE does not have a material impact on wealth inequality. Precisely, in this scenario of full home bias, the median Gini index would drop to 69.167, which is statistically and economically indistinguishable from the pre-shock Gini index reported in Table 2.

**Figure 8** Effects of QE on Consumption via Higher Income and Wealth



**Source:** Household Finance and Consumption Survey, wave 2014; Household Budget Survey 2018

**Note:** The figure shows the percentage change in mean nondurable consumption across quintiles of liquid assets in the euro area four quarters after the impact of the QE shock. It also shows the decomposition of the change into the effects due to higher income and due to higher wealth. The figure shows an aggregate of France, Germany, Italy and Spain.

0.002–0.020 for European countries (for the US the literature typically estimates higher values, around 0.05–0.07).

In a simple setup higher income and wealth affect consumption growth depending on marginal propensities and their ratios to consumption:

$$\frac{\Delta C_i}{C_i} = \underbrace{\text{MPC}_i \times \frac{I_i}{C_i} \times \frac{\Delta I_i}{I_i}}_{\text{Income channel}} + \underbrace{\text{MPC}W_i \times \frac{W_i}{C_i} \times \frac{\Delta W_i}{W_i}}_{\text{Wealth channel}},$$

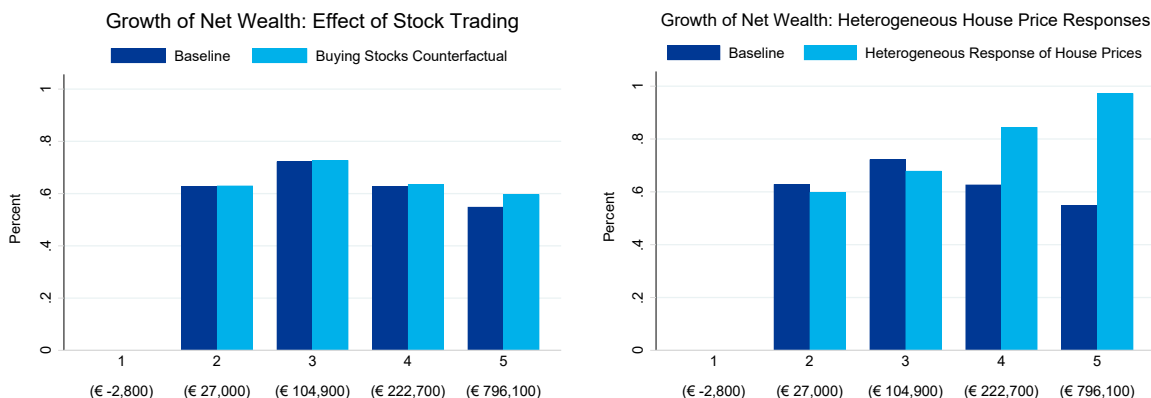
where  $\Delta I_i/I_i$  and  $\Delta W_i/W_i$  denote income and wealth growth, respectively (for each quintile of liquid assets) and  $I_i/C_i$  and  $W_i/C_i$  denote ratios of income and wealth respectively to (nondurable) consumption. We measure the first two objects using our simulations above and the two consumption ratios using the Household Budget Survey data.<sup>30</sup>

Quantitative easing stimulates more strongly consumption of households with little liquid assets (Figure 8). In addition, the key driver of the total effect is the income

<sup>30</sup>Given our tabulation by liquid assets, we need data on consumption, income, wealth as well as liquid assets. For this we use the 2018 German part of the Household Budget Survey, the “Einkommens- und Verbrauchsstichprobe”. The key advantage of the HBS in general is that it provides the best, representative data on consumption expenditures (in contrast, the HFCS only uses simple broad questions to collect indicators of consumption, which are subject to substantial measurement error). In contrast to the German survey, most national consumption surveys do not collect data on wealth or liquid assets and include noisy information on income, if at all.

The income–consumption ratios  $I_i/C_i$  range between 1.2 and 1.5, while the wealth–consumption ratios  $W_i/C_i$  range between 1.5 and 11; see the online Appendix C.

**Figure 9** Robustness Scenarios for Wealth



**Note:** The figures show for two robustness scenarios the percentage increase mean net wealth across quintiles of net wealth for an aggregate of France, Germany, Italy and Spain. The left panel compares the baseline scenario with the one in which the holding of stocks increases for the middle net wealth quintile in each country as follows: France  $-0.9\%$ , Germany  $0.6\%$ , Italy  $1.4\%$ , Spain  $2.0\%$ . In addition, across wealth quintiles the spread varies by  $\pm 2\%$ , so that households in the lowest quintile buy  $2\%$  less and households in the highest quintile buy  $2\%$  more stocks than those in the middle quintile. The right panel compares the baseline scenario with the one in which house prices of more expensive houses (in terms of price per square meter) react more strongly to monetary policy. House price growth ranges across quintiles of price per square meter: France, Germany and Spain  $0.0\%$  to  $2.0\%$ , and Spain  $-0.5\%$  to  $1.5\%$ . The numbers in parentheses show the initial levels of mean net wealth. The change for the lowest quintile of net wealth is not shown because its initial level is negative.

channel, while the wealth channel is much smaller. The income channel is particularly strong for households with least liquid assets, for whom the channel is amplified by their high marginal propensities (a finding in line with Patterson, 2023, who similarly documents an amplification via matching of high-MPC workers with strongly cyclical jobs, rather than for the effects of monetary policy, as we do). The wealth channel is quite evenly distributed across households, reflecting the fact that wealth growth varies little. The wealth channel is somewhat stronger for the top quintile as the wealth–consumption ratio rises strongly with liquid assets.

### 3.2.4 Robustness Checks

This section explores whether some plausible perturbations of our baseline specification affect the main results for wealth inequality which are weaker than for income inequality and, possibly, more likely to change sign. From a methodological point of view, we extract the time series of the QE shocks from our multi-country VAR and we use the local linear projection method of Jordà (2005) to derive the effects of the shock on additional variables which are useful to capture alternative scenarios to our baseline analysis.<sup>31</sup>

<sup>31</sup>See online Appendices A and B for the description of the local linear projection method and for more information on the data sources we use for the robustness checks.



First, we relax our assumption of no portfolio rebalancing. To get an idea of a plausible amount of rebalancing, we rely on aggregate country-level flow-of-funds data on the holdings of different asset categories by households, and we compute their response to a QE shock by means of local projections. Then, in line with the responses of these variables to the shock, we simulate a scenario in which quantitative easing increases aggregate holdings of stocks by 0.6% to 2.0% across countries (except for France, where we estimate a decline of 0.9%). In addition, in line with the household finance literature on trading,<sup>32</sup> we account for more reallocation by wealthy households, which are likely to be more attentive and trade more, by calibrating their stock holdings to increase by 2% more than the holdings of households in the middle quintile.

We find that stock trading affects the distribution of net wealth only very little (Figure 9, left panel), increasing mean wealth in the top quintile by about 0.1%. Correspondingly, Table 2 documents that the Gini coefficient on wealth under this alternative scenario (robustness scenario 1) declines to 69.143% (compared to 69.135% for the baseline scenario). This is explained by the fact that the share of stocks in the portfolios of European households lies below 5% even for the top wealth quintile. We view this finding as an upper bound of the extent to which active portfolio rebalancing can affect wealth inequality because evidence from micro data, including the influential work of Calvet et al. (2009) and Brunnermeier and Nagel (2008), typically estimates that (if at all) individual households tend to actively rebalance in the opposite direction, i.e., by selling (not buying) risky financial assets after experiencing high returns.

Second, our treatment of wealth inequality does not account for a possible heterogeneity in the responses of house prices across regions (arising, e.g., due to differences in elasticity of housing supply). For this reason, we also investigate a scenario in which the prices of more expensive houses (measured in EUR per square meter) react more strongly to quantitative easing. This calibration is based on our estimates exploiting regional data from Spain, which suggests that the prices of more expensive houses respond more strongly to monetary policy.<sup>33</sup> Specifically, the dispersion in the responses of house prices across Spanish provinces is about 3 percentage points. The right panel of Figure 9 shows the comparison of our baseline results with those obtained by assuming that the increase in house prices due to the QE shock also depends on the level of house prices.<sup>34</sup> Because poorer households tend to own less expensive houses, this alternative assumption increases the dispersion of growth rates of net wealth across quintiles: for the second lowest net wealth quintile, mean wealth grows by 0.6%, while for the top quintile the mean wealth increases by almost 1% (compared to around 0.6% for the baseline). Table 2 shows that under this scenario (robustness scenario 2) the Gini coefficient for

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<sup>32</sup>For example, Calvet et al. (2009) find that more educated and wealthier households tend to rebalance their portfolios more actively. Similar, Biliias et al. (2010) report that households with higher education, income and net financial wealth trade more.

<sup>33</sup>See Figure C.5 in the online Appendix C. Spain is the only country in our sample for which quarterly data on regional house prices are available since 1999. Fagereng et al. (2020) estimate positive *unconditional* correlation between the level of wealth and returns to wealth in Norwegian data.

<sup>34</sup>Specifically, house price growth ranges across quintiles of price per square meter as follows: France, Germany and Spain 0.0% to 2.0%, and Spain  $-0.5\%$  to 1.5%. This calibration thus preserves the aggregate response of house prices to quantitative easing estimated in the VAR, upper right-hand panel in Figure 3, and adds to it a positive relationship between the level of house prices and their sensitivity to monetary policy.

net wealth rises slightly from 69.169% to 69.183% (compared to a decline to 69.135% for the baseline) and, hence, our conclusion that the effect of quantitative easing on wealth inequality is overall quite muted remains broadly unaffected.

## 4 Conclusions

Combining estimates from a VAR with aggregate data and a simulation on household-level data, we assess how quantitative easing in the euro area affect individual households via the portfolio composition, the income composition and the earnings heterogeneity channels. We find that although QE has only negligible effects on wealth inequality, it compresses the income distribution since many households with lower incomes become employed. Specifically, a year after the shock, the Gini coefficient for income falls from 43.15% to 43.09%, while the change of the Gini coefficient for net wealth is substantially smaller.

The effects of monetary policy fade away over time and, hence, quantitative easing should not be a key driver of inequality in the long run, when other factors, such as globalization or the progressivity of the tax system are more important. However, our results suggest that quantitative easing contributed to support vulnerable households.

Our results are also informative about the strength and nature of the transmission of monetary policy to consumption. An extensive literature has recently documented that constrained households—e.g., those with low incomes or little liquid assets—have high marginal propensities to consume. We find that such households also particularly benefit from a monetary stimulus, which boosts their employment and income. In combination, these two facts imply that the stimulating effect of quantitative easing on aggregate consumption is amplified both because it disproportionately boosts incomes in the lower part of the distribution and because this impulse has a stronger effect on consumption via the larger MPCs of the constrained households.<sup>35</sup>

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<sup>35</sup>Patterson (2023) documents a positive covariance between worker MPCs and the elasticity of their earnings to GDP in the US data. Slacalek et al. (2020) quantify the channels of monetary transmission to consumption and their heterogeneity across households.

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