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MONETARY POLICY AND INEQUALITY: THE FINNISH CASE*

January 18, 2022

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Abstract

We use Finnish household-level registry and survey data to study the effects of ECB's monetary policy on the distribution of income and wealth. We find that monetary easing has a large positive effect on aggregate economic activity in Finland, but its overall net impact on income and wealth inequality is negligible. Monetary easing increases households' gross income by reducing unemployment and leading to a general rise in wages, while at the same time it boosts asset prices. These different channels have counteracting effects on income and wealth inequality, as measured by the Gini coefficient and the ratios of income and wealth of the 90th percentile to the 50th percentile. The reduction in aggregate unemployment benefits especially households in lower income quintiles, where the initial rate of unemployment is high. Households in the upper income quintiles, where the rate of employment is higher, benefit relatively more from an increase in wages. An increase in house prices benefits all homeowners. In terms of net wealth, households with large mortgages, in the lower wealth quintiles, benefit the most from an increase in house prices due to a leverage effect. An increase in stock prices, in turn, benefits mainly households in the top wealth quintile.

Keywords: monetary policy, income inequality, wealth inequality

JEL codes: D31, E32, E52

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1 Introduction

During the past decade, in the aftermath of the global financial crisis of 2007–2009, central banks across the world have adopted a range of new monetary policy instruments to boost inflation and stimulate economic activity. Various large-scale asset purchase programmes – also termed quantitative easing or QE – have been implemented by many central banks, including the U.S. Federal Reserve and the European Central Bank (ECB). By now, these unconventional policy tools have become an established part of central banks' toolboxes. These new policies have been implemented in times of growing attention to a secular increase in income and wealth inequality, a trend observable over the past decades in the U.S. and, to a somewhat lesser extent, in Europe (see, *e.g.*, Alvaredo et al. 2017). Subsequently, distributional effects of monetary policy have also gained attention.

Monetary policy may affect income and wealth inequality both through direct effects on asset prices and through indirect general equilibrium effects by stimulating economic activity and increasing employment and wages. The overall impact of monetary policy on income and wealth inequality is ambiguous from a theoretical perspective.

In this paper, we study the effects of the monetary policy conducted by the ECB on nominal gross income and net wealth inequality in Finland, a typical small open economy and a small member of a monetary union. We adopt the framework proposed by Lenza and Slacalek (2021), who analyse the distributional impacts of monetary policy in the four largest euro area member states.

We first estimate and identify a structural vector autoregressive (SVAR) model to assess how euro area monetary policy affects aggregate economic activity in Finland. Using a household-level microsimulation based on a representative sample of Finnish households, provided by the Household Finance and Consumption Survey (HFCS) for Finland, we then study the distributional effects of monetary policy by asking how these aggregate impacts affect the distribution of households' gross income and net wealth. For tractability, when reporting the results, we aggregate households to five gross income and net wealth quantiles and discuss the results for these quintiles throughout the paper.

We analyse the impacts of both conventional interest rate policy and quantitative easing. Given our data and methodology, our focus is on the causal impact of monetary policy on the short-run cyclical variation in nominal gross income and net wealth distributions, rather than on long-run inequality trends. To our knowledge, this is the first such analysis for the Finnish economy.

Our findings can be summarised as follows. Monetary easing affects household income both by reducing unemployment and by increasing the aggregate wage level. The reduction in unemployment benefits especially low-income households, whereas households in higher income quintiles, where the level of employment is higher, benefit relatively more from an increase in wages. The net effect on income inequality, measured with the gross income Gini coefficient, is positive but small, owing to the relatively stronger impact of monetary easing on wages than on unemployment.[1]

A monetary expansion, either by means of conventional or QE measures, also boosts asset prices. We find that an increase in house prices benefits all homeowners, but households in the second quintile of the net wealth distribution gain the most in terms of net wealth. This suggests an operational leverage effect, given that this quantile likely includes many households with low net wealth due to relatively large mortgages, but who also own real estate property. Finally, monetary easing also boosts stock prices, significantly more than house prices. This increase affects mainly households in the top wealth and income deciles who are most likely to own shares. The overall effect of a monetary expansion on asset prices slightly increases net wealth inequality, measured by the net wealth Gini coefficient.

Taken together, the Gini coefficients move only very little in response to standard monetary policy shocks. Following a conventional monetary policy shock that decreases the short-term interest rate by 25 basis points, the nominal gross income Gini coefficient increases by 0.05 percentage points from 39.06% to 39.14%, whereas the nominal net wealth Gini coefficient rises by 0.20 percentage points from 66.20% to 66.40% over a two-year horizon. In a QE scenario in which the term spread between the long and short-term interest rates unexpectedly contracts by 25 basis points on impact, the income Gini coefficient also increases by 0.05 percentage points, while the wealth Gini increases by about 0.06 percentage points over a two-year horizon. When uncertainty over the macroeconomic impacts of the policy shocks is taken into account, these effects cannot be distinguished from zero in most cases. The same conclusion holds when using the ratios of income and wealth of the 90th percentile to the 50th percentile, respectively, as a measure of income and wealth inequality.

[1] The income and wealth Gini coefficients reported in this paper are computed at the household level, rather than at the individual level. Our focus is on the household level because, arguably, it provides a more realistic picture of actual inequality. Within most households, at the individual level, there are usually significant income and wealth differences (e.g., age-related, parents vs. children, head of household vs. unemployed spouse, etc.) that are typically largely eliminated through a common household budget, risk-sharing and inheritance mechanisms.

We conclude that the overall effect of standard monetary policy shocks on both income and wealth inequality in Finland is economically negligible. This is despite the monetary easing having a sizable stimulating impact on aggregate economic activity.

The estimated effects of monetary policy on the Gini coefficients are also very small in comparison with the historical variation in the coefficients (Figures 1 and 2). Mirroring developments in many other advanced economies (Alvaredo et al. 2017), both gross income and net wealth inequality have experienced a slight secular increase in Finland in the past decade. The Gini coefficient on households' nominal gross money income has increased from 38.6% in 2010 to 40.1% in 2019 (Figure 1).

Wealth inequality in Finland has grown from 64.6% in 2009 to 68.3% in 2019 as measured by the Gini coefficient on households' net wealth. Between 2016 and 2019 alone, the net wealth Gini coefficient increased by more than two percentage points (Figure 2).

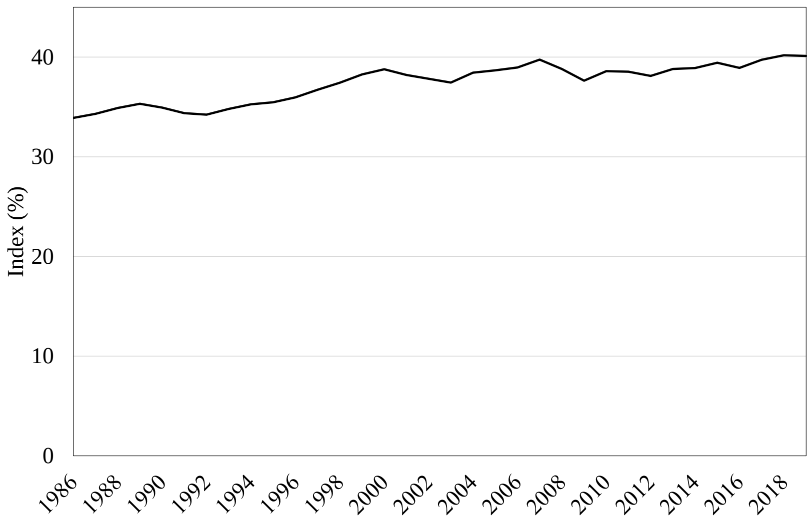

Figure 1. The Gini coefficient on households' nominal gross income in Finland in 1986–2019.
Source: Income distribution statistics, Statistics Finland and authors' calculations.

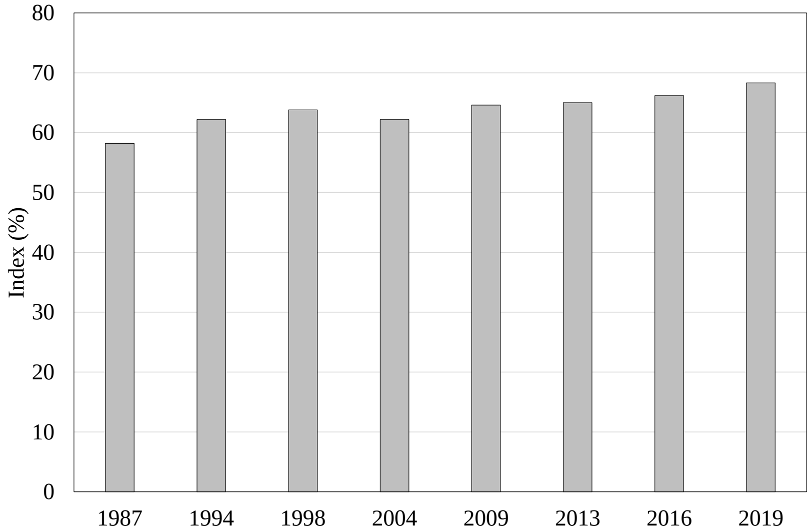

Figure 2. The Gini coefficient on households' nominal net wealth in Finland in 1987–2019.
Source: Household Finance and Consumption Survey, Statistics Finland and authors' calculations.

A growing literature studies the effects of monetary policy on different inequality measures.[2] In the study closest to ours, Lenza and Slacalek (2021) find that the expansionary QE measures of the ECB slightly reduce income inequality in the large euro area countries. This effect is mainly due to a strong reduction in unemployment, which has increased the gross income of households in the lowest income quintiles. Quantitatively the effect is very small, however.

Broadly similar findings on the effects of monetary policy on income inequality have recently been made by Furceri et al. (2018) for a panel of 32 countries, Coibion et al. (2017) for the U.S., Samarina and Nguyen (2022) for the euro area, Casiraghi et al. (2018) for Italy, Mumtaz and Theophilopoulou (2017) as well as Bunn et al. (2018) for the U.K, and Holm et al. (2020) for Norway. These studies support the view that expansionary monetary policy benefits poorer households through improvements in employment and wage growth, and thus reduces income inequality. However, in a study based on the panel of whole Danish population, Andersen et al. (2021) find that although higher wages and lower unemployment benefit mostly the lower tail of the income distribution, that effect is dominated by higher financial income in the upper tail, increasing income inequality in net terms in Denmark. Similar findings are made by Amberg et al. (2021) using Swedish administrative data.

[2] Ampudia et al. (2018) discuss the different channels through which monetary policy can have distributional effects. Colciago et al. (2019) and Bonifacio et al. (2021) provide recent surveys of theoretical research as well as the empirical evidence on the topic. The latter also argue that monetary policy has not been a driver of the secular increase in inequality observed in many advanced economies in recent decades.

Results regarding the distributional impacts of monetary policy on wealth inequality vary. Casiraghi et al. (2018), Bunn et al (2018) and Lenza and Slacalek (2021) find that the ECB's expansionary QE measures have had a negligible overall effect on wealth inequality. Adam and Tzamourani (2016) find that a monetary easing has an equalising impact on the net wealth distribution in the euro area through increases in house prices, but an opposite impact through equity prices. Holm et al. (2020) find a slight increase in wealth inequality using Norwegian data, owing to asset price movements that favour the wealthy.

More broadly, our paper speaks to the growing literature studying the interactions between household heterogeneity and monetary policy transmission. Auclert (2019) points out that, insofar as a monetary expansion reduces income inequality and low-income households have higher marginal propensities to consume out of additional income, household heterogeneity tends to amplify monetary policy transmission to aggregate consumption. The reverse is true if monetary policy increases income inequality. Kaplan et al. (2018) stress that monetary policy shocks may be transmitted mainly via indirect general equilibrium effects on labour demand and wages, rather than the usual intertemporal substitution channel.

The rest of the paper is organised as follows. In Section 2, we present the empirical methodology. We first describe the structural VAR model used to measure the aggregate impact of euro area monetary policy shocks on Finland and then the microsimulation, which distributes the aggregate impacts across household distributions of interest. Section 3 discusses the data used in the estimation and simulations, and Section 4 reports the aggregate impacts monetary policy shocks on the Finnish economy. Sections 5 and 6 describe our main results from the household-level microsimulation. In Section 5, we report the impacts of a conventional interest rate shock on gross income and net wealth at the household level. Section 6 reports a similar exercise for the quantitative easing scenario. In section 7, we discuss the robustness of our results. Section 8 concludes.

2 Methodology

The main objective of this paper is to study the effects of ECB's monetary policy on income and wealth inequality in Finland. To do so, we follow Lenza and Slacalek (2021) and proceed in two steps. First, we estimate and identify a SVAR model to infer the macroeconomic impact of monetary policy conducted by the ECB on the Finnish economy. In the second step, we distribute the aggregate responses of wages, the unemployment rate, stock prices and house prices from the identified SVAR model on the cross-section of the employment status, nominal gross income and net wealth of Finnish households in a microsimulation. The computations for the evolution of net wealth are carried out at the household level. The computations for labour income are carried out at the individual level, since the impact depends on individual-level data and characteristics (wages, employment status and demographic features). These numbers are then aggregated up to the household level..

2.1 The macroeconomic SVAR model

The general structure of the aggregate SVAR model builds on a monetary small open economy specification for Finland, as formulated by, *e.g.*, Gulan et al. (2021). The specification consists of two blocks: a foreign (euro area) block and a domestic (Finnish) block.

The euro area block comprises four variables: a measure of real aggregate economic activity, the aggregate price level, a short-term nominal interest rate, as well as a long-term interest rate. The Finnish block comprises six variables: real aggregate activity, the domestic aggregate price level, measures of nominal wages and unemployment, as well as nominal stock and house prices.

The SVAR(p) model can be written as:

$$A^0 y_t \;= c + \sum_{l=1}^{p} A^l y_{t-l} + \varepsilon_t \;,$$

where p is the number of lags, y_t is the $(n \times 1)$ vector of endogenous variables, A^0 and A^l are $(n \times n)$ structural matrices, c is a $(n \times 1)$ constant vector, and ε_t is a $(n \times 1)$ vector of structural shocks.

We treat Finland as a small member of the monetary union and therefore assume that the euro area block is exogenous to the domestic block. Accordingly, we impose exclusion restrictions on the transmission of domestic variables and shocks to the euro area, so that the model specification becomes block-recursive:

$$A^i = \begin{bmatrix} A^i_{1,1} & 0 \\ A^i_{2,1} & A^i_{2,2} \end{bmatrix} \forall i = 0, \dots, p,$$

Here, the blocks $A^i_{1,1}$ capture the interactions between foreign variables and structural shocks, $A^i_{2,1}$ the transmission of foreign structural variables and shocks to domestic variables, and $A^i_{2,2}$ the interactions between domestic variables and structural shocks.

	MP	*AP*
Short-term rate	–	+
Long-term rate	–	–
Euro area price level	+	+
Euro area real economic activity	+	+

Table 1. Identifying sign restrictions in the SVAR model.

As our focus is on euro area-wide monetary policy, we leave the domestic structural shocks unidentified and identify two foreign (euro area) aggregate structural shocks: a conventional monetary policy (*MP*) shock and an asset purchase (*AP*) shock. We identify the two euro area policy shocks using sign restrictions, summarised in Table 1. Specifically, we impose restrictions on the responses of the foreign variables to the two shocks over four model periods. We leave domestic variables unrestricted, given that the euro area-wide monetary policy may have potentially heterogeneous effects on its member countries.

The first shock (*MP*) is a conventional expansionary monetary policy shock. It lowers the short-term rate, increases aggregate economic activity and inflates the price level. It also lowers the long-term rate. The pass-through from short- to long-term rate may be imperfect, so we leave the impact on the term spread unrestricted. The second shock (*AP*) captures an unexpected purchase of long-term bonds (public or private), reducing the long-term rate. The shock is expansionary, increasing economic activity as well as the general price level. At the same time, we assume that the shock raises the short-term interest rate, which allows us to identify it from the *MP* shock.

The *AP* shock, *per se*, captures solely a sterilised purchase of a class of assets, in our case long-term bonds. It is not necessarily confined to situations with an effective lower bound binding. Instead, it captures a generic unexpected financial asset purchase by a central bank that is otherwise committed to controlling the price level through short-term open market operations.

Under the assumption that the central bank otherwise follows a short-term interest rate rule (such as proposed by, e.g., Taylor 1993), it must sterilise the inflationary effects of the asset purchase on the domestic economy by increasing the short-term rate. These identifying restrictions on the shock are in line with theoretical predictions (Chen et al. 2012; Gertler and Karadi 2013).

The two identified structural shocks enable us to construct a quantitative easing (QE) scenario. This type of policy intervention typically involves more than a pure bond purchase. It is also intended to operate at least partly through the signaling channel: asset purchases signal the central bank's commitment to keep the future path of short-term policy rates at low levels for an extended period.[3] These additional features imply that the central bank would not immediately raise the short-term interest rate following the asset purchase, i.e. it would not sterilise it.

To construct such a scenario using our SVAR model, we proceed as follows. We start by simulating the model economy with a one-time unexpected AP shock, which lowers the long-term interest rate. We then accompany this shock by a series of MP shocks that keep the short-term rate unchanged for a period of one year. Hence, the QE scenario amounts to a conditional forecast that asks what happens to an economy hit by an asset purchase shock, when the short-term interest rate stays unchanged for one year.[4]

Put differently, the *QE* scenario results in a compression of the term spread and in a flattening of the yield curve. These identifying assumptions are broadly consistent with the portfolio rebalancing channel through which unconventional monetary policy operates. According to this mechanism, a withdrawal of net bond supply from the market leads to a rebalancing of investors' portfolios and changes bond prices and yields through usual demand-supply movements (see *e.g.* Bauer and Rudebusch 2014). They are also in line with general findings from the euro area that the ECB asset purchases have had an impact on yield compression through the long end of the yield curve.[5]

2.2 The microsimulation model

The second step of our study is a microsimulation exercise, in which we use the macroeconomic impulse responses from the SVAR model to assess the effects of both QE and conventional monetary policy on the income and assets of the households. In particular, we compute the household-level responses of gross nominal assets and income to the aggregate monetary policy shocks over a 12-quarter horizon. To obtain net wealth, we then subtract the nominal value of total liabilities from the value of gross assets.[6] Based on these responses, we compute the Gini coefficients and their evolution. For exposition, we then group these household-level dynamics

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[3] An example of such commitment is provided, *e.g.*, in the ECB introductory statement from 11 March 2021 (https://www.ecb.europa.eu/press/pressconf/2021/html/ecb.is210311~d368d7151a.en.html).

[4] A similar approach is taken, *e.g.*, by Baumeister and Benati (2013).

[5] See also Altavilla et al. (2019), Rostagno et al. (2019) and Kortela and Nelimarkka (2020).

[6] In the microsimulation, only the value of assets (houses, stocks) is assumed to react to monetary policy shocks, whereas gross liabilities are assumed to be unaffected by the shocks. This can be justified by the fact that essentially all household liabilities are in the form of loans or debt with a fixed face value. However, this simplification assumes away the possibility that households may change their debt principal payments schedule following the shock. More generally, changing interest rates affect debt servicing costs. However, this effect would only affect disposable income rather than gross income, which is our focus.

in quintiles and report average impulse responses at the quintile level.[7] We also compute the ratios of the 90th percentile to the 50th percentile of income and wealth at different horizons as an alternative measure of inequality to the Gini coefficient. Our microsimulation exercise follows the methodology in Lenza and Slacalek (2021).[8]

2.2.1 Computing the effects of monetary easing on household income

The effects of aggregate shocks at the household level depend on the sources of income and the structure of the asset portfolio of the households. In our simulation exercise, monetary policy affects households' nominal income through two separate channels. First, the *income composition channel* (the intensive margin of the labour market) refers to the effect of monetary policy shocks on wages and on different types of financial income of the households. The second effect of monetary policy on household income works through the *earnings heterogeneity channel* (the extensive margin of the labour market): a monetary expansion also results in a reduction in unemployment and an increase in employment, as aggregate demand and labour demand increase.

Our analysis of the income composition channel focuses on labour income. Expansionary monetary policy typically boosts the general nominal wage level, as the economic stimulus increases demand for labour and the general price level. In contrast, we assume financial income to be unaffected by monetary policy shocks in the baseline simulation. We later conduct robustness checks to assess the importance of this assumption. Since most financial assets of Finnish households are in the form of sight deposits, their interest income is negligible. Moreover, monetary policy is unlikely to affect rents and dividends in the short run.[9,10]

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[7] The quintiles are based on initial gross income or initial net wealth and fixed (not re-computed in each period) so that households are assumed to remain in their respective quintiles throughout the simulations.

[8] The microsimulations are carried out using STATA codes that were originally used to produce the microsimulations in Lenza and Slacalek (2018), kindly provided to us by the authors. The set-up of the methodology in the revised version of the analysis in Lenza and Slacalek (2021), in turn, is based on the set up of Ampudia et al. (2016). The responsibility for any possible errors in the simulations reported in this paper is only ours.

[9] Nominal housing rents in Finland are often agreed for a fixed term, most often a year, so that rents in existing rental contracts are unlikely to respond to transitory monetary policy shocks. Dias and Duarte (2019) find that a monetary policy contraction increases rents through the external margin, as the cost of homeownership and thus the demand for rental housing increases. However, we abstract away from housing tenure decisions in our microsimulation.

[10] It is widely accepted that expansionary monetary policy stimulates business investment and can thus increase corporate cash flows, albeit with some lag. Stock return reactions to expansionary monetary policy shocks are found to be driven mostly by changes in expected future excess returns and cash flows (Maio 2014, Bernanke and Kuttner 2005). The impact of monetary policy on dividend pay-out is less clear. From a theoretical standpoint, it may be preferable for a firm to reinvest its earnings instead of paying out dividends when interest rates decrease, as the cost of capital decreases and investment opportunities become more profitable. Empirically, Bernanke and Kuttner (2005) find a weakly

We apply a two-step procedure to simulate the impact of a monetary policy shock on household income. First, we use our household- and individual-level data on income, employment status and personal characteristics to simulate how the employment status of an individual changes after a shock to the aggregate unemployment rate. The job-finding probability of an unemployed individual depends both on the size of the aggregate unemployment shock and the personal characteristics of the job seeker. The probabilities are estimated using a simple probit regression model that regresses the job market status S_k of an individual k on her personal characteristics, such that:

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

where V_k denotes a vector of demographic characteristics: gender, education, age, marital status and the number of children; $\Phi(\cdot)$ denotes the normal cumulative density function.[11]

From the probit model above, we obtain, for each individual k, the fitted values of the estimated probability of being employed (S_k) conditional on her personal characteristics. Next, a uniformly distributed random employment shock ε_k is drawn for each individual k. If $S_k > \varepsilon_k + c$, where c is a scaling constant, and the person is initially unemployed, she is assumed to become employed. Thus, people with more favourable personal characteristics for employment have a higher employment probability, and they are more likely to become employed after an increase in aggregate demand. We adjust the scaling parameter c such that the overall reduction in unemployment at the individual level is consistent with the aggregate drop in the unemployment rate produced by the SVAR model.[12]

The second step of the exercise is to evaluate how much the gross income of the employed individuals increase. The wages of the newly employed are predicted using a Heckman selection model, where the individual wage level depends on gender, education, age, marital status and number of children. The levels of unemployment benefit, in turn, are assessed based on the replacement rate of the Finnish unemployment security system, i.e. the average ratio between the unemployment benefit and the wage level before unemployment.[13] For those individuals who are

significant negative impact of contractionary monetary policy shocks on firm dividends. On the other hand, using firm-level data, Binz et al. (2021) find a mildly positive effect of an unexpected monetary policy contraction on corporate profits in the short run, reflecting a decrease in firms' investment expenses that outweighs the decrease in revenues due to dampened consumer demand.

[11] The robustness of both the probit regression and the Heckman selection model were assessed with respect to changes in the set of explanatory variables. The estimates for the key coefficients of the models were not sensitive to small changes in the specifications.

[12] The simulation including the random draws is repeated 200 times, and the results are reported for the average results of the simulation rounds.

[13] Data on the replacement rates are from the OECD.

initially employed, we evaluate the impact at the intensive margin by assuming that their labour earnings develop in line with the response in the general wage level. We make the same assumption as regards the income from self-employment. Finally, in the last step of the simulation, the individual-level results are aggregated to household level.

2.2.2 Computing the effects of monetary easing on household wealth

Monetary policy is transmitted to household wealth through its effect on asset prices. This portfolio composition effect can be quantified at the household level in a straightforward way. In the microsimulation, the holdings of each asset class of a single household are multiplied by the size of the corresponding asset price response to a monetary policy shock. Monetary policy is assumed to affect the value of the holdings of the households in two different asset classes: fixed assets, which include the household main residence and other real estate property; as well as financial assets, which consist of listed and unlisted shares.[14] We assume the values of all financial assets to respond to monetary policy shocks similarly to the values of listed shares.

During the past decade, house prices have increased significantly more rapidly in certain locations, such as in the Helsinki metropolitan area (HMA) and a few other urban areas, than in other parts of the country. Our SVAR model only includes a national nominal house price index. We loosely follow the method presented in Lenza and Slacalek (2021) to take into account the regional heterogeneity in the Finnish housing market.[15]

We assume that the prices of more expensive homes, mostly located in urban areas, are more sensitive to increases in the general house price level. We sort the main residences of the Finnish households into quintiles by their price per square meter and, using a simple regression model, estimate the average house price increase in each price quintile over 2010–2017.[16] The

[14] Other classes of financial assets are not included in the simulation.

[15] Lenza and Slacalek (2021) assess the sensitivity of their results on the effect of QE on wealth inequality to the assumption of heterogenous house price responses across countries. They find that house prices have grown more rapidly in regions where house prices per square meter already tend to be higher than elsewhere. Thus, the authors sort the households in quintiles by the price per square meter of their main residence. The microsimulation model is then calibrated so that the prices of more expensive houses respond more strongly to the monetary policy shock.

[16] The sizes of the apartments are only available for the main residences of the households, so that the price per square meter cannot be calculated for other housing property owned by the households. For these items of household property, we assume homogenous price responses equal to the house price shock in the SVAR. The heterogeneity of price responses is evaluated by means of a simple weighted regression model for average house prices in the Finnish postal code areas. The postal code areas are split into quintiles by their average house prices per square meter. Next, we run a regression where the average annual house price change from 2010 to 2017 is explained by a constant term and a set of dummy variables that correspond to the house price quintiles. We use the number of home sales in the postal code areas as regression weights.

heterogeneity in house price responses to a monetary policy shock is assumed to correspond to the historical differences in the house price growth across the price quintiles (Figure 3). We scale the responses such that they add up to the national house price growth.[17]

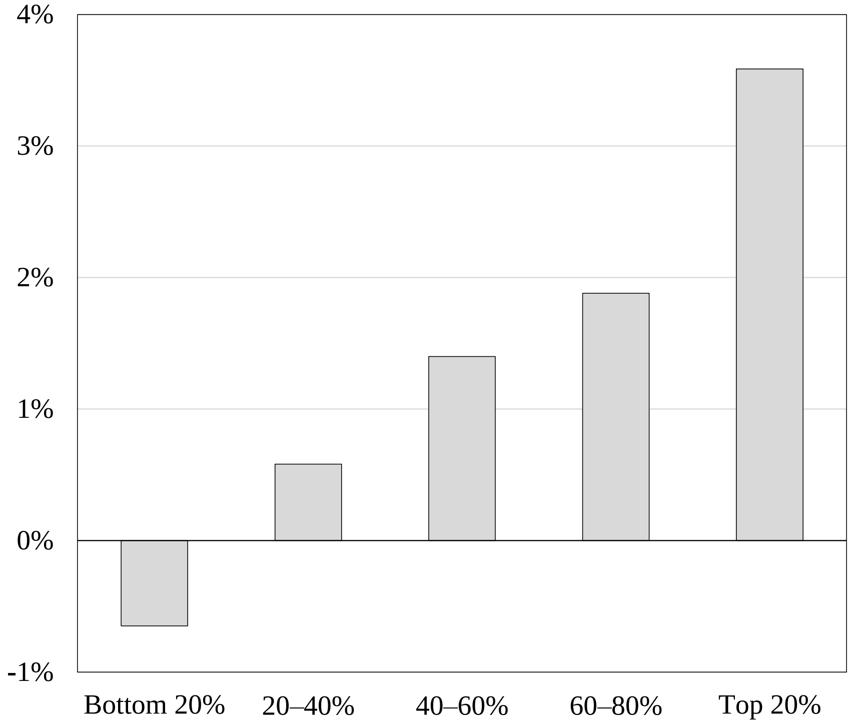

Figure 3. Average annual price increases from 2010 to 2017 for different house price quintiles in Finland.

3 Data and model specification

3.1 Macroeconomic data and the SVAR model specification

The aggregate euro area observables used in the SVAR are the volume index of euro area GDP, the harmonised index of consumer prices (HICP), the 3-month Euribor rate, and the euro area 10-year government bond yield, computed as a weighted average of corresponding yields of AAA-

[17] The price responses of the houses in each house price quintiles are obtained by multiplying the house prices with quintile specific coefficients. The coefficients are in proportion to the estimated regression coefficients of the dummies, but scaled so that the aggregate house price response of the economy, implied by the household level responses, equals to the magnitude of the estimated SVAR shock to the house prices. Thus, the responses of the 1st to the 5th quintile are [-0.2, 0.3, 0.7, 1.0, 1.8].

rated euro area government bonds. The real GDP and the HICP are compiled and published by Eurostat, and the interest rates and yields are reported by the European Central Bank. Monthly GDP data is interpolated from quarterly frequency using the Chow and Lin (1971) method.

The domestic observables are the monthly trend indicator of output, the Finnish HICP, the aggregate nominal index of wage and salary earnings, the trend unemployment rate as measured in the Finnish Labor Force Survey, the Nasdaq OMX Helsinki PI index of stock prices, and the aggregate nominal national house price index for all dwellings. All data are published by Statistics Finland, except the stock price index, which is published by Nasdaq OMX.

The model is estimated using data at monthly frequency on the period 1999M1–2019M12. The start of the sample period corresponds to the adoption of the single monetary policy regime under the Economic and Monetary Union (EMU) of the European Union. All variables enter the model in log-levels, except the unemployment rate and interest rates, which are expressed in percentages and enter in levels. The reduced-form VAR model is estimated with two lags (p=2). The lag selection is based on various information criteria and diagnostics on the reduced-form residuals. The impulse responses from the SVAR are then aggregated up to quarterly frequency.

3.2 Household-level data

In the microsimulation we use representative household-level data on the assets and gross income of Finnish households from the third wave of the Household Finance and Consumption Survey (HFCS), provided by Statistics Finland. The data were collected in 2016 and 2017. The HFCS dataset includes information on the structure of nominal gross income, assets and liabilities across households. It is based on both registry data and a household survey conducted using a uniform methodology in all euro area member states. The Finnish dataset is mostly based on registries, supplemented by only a handful of survey questions, mainly concerning the assets of the households.

The annual nominal gross income of the Finnish households consists mainly of labour income and social transfers, but income composition varies across income quintiles (Figure 4). The share of pension income is disproportionately high in the lowest income quintile. The share of employee income is the largest in the top quintile and so is the share of financial income. Even so, the average share of financial income in total income is small even in the top quintile.

On the other hand, the share of unemployment benefits is the largest in the lowest quintile, as the unemployment rate is disproportionately high in this quintile (Figure 5). In our analysis, we focus on labour market outcomes and wage income, so that monetary policy is assumed not to affect the level of pensions or other social transfers.

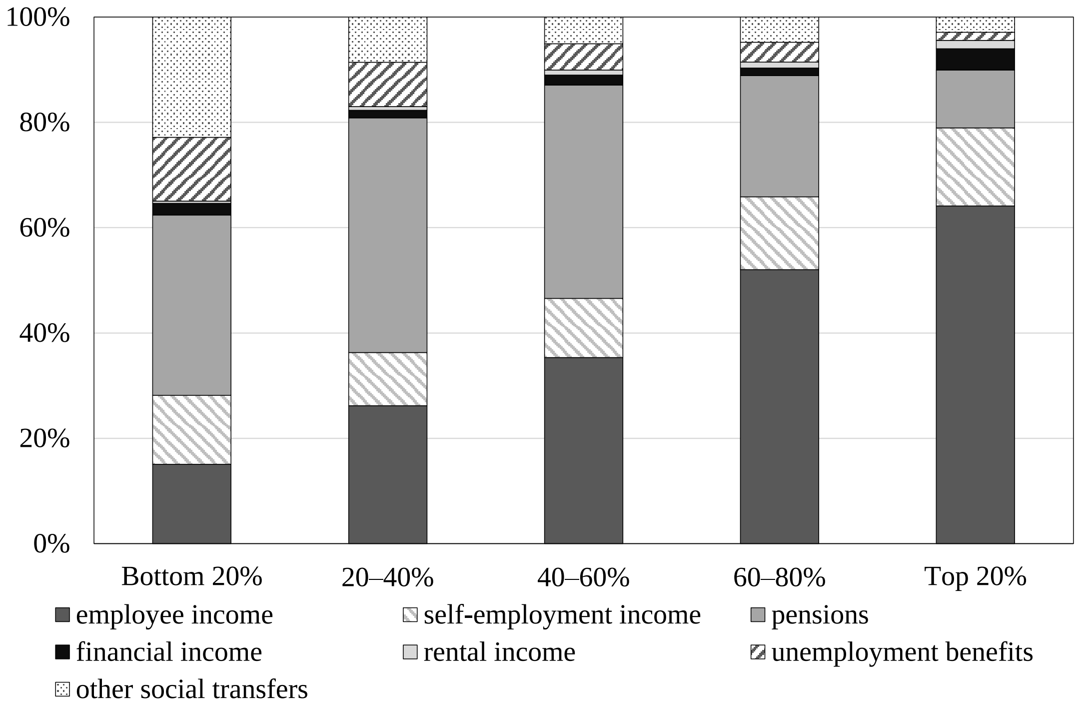

Figure 4. Composition of gross income of Finnish households by gross income quintile.

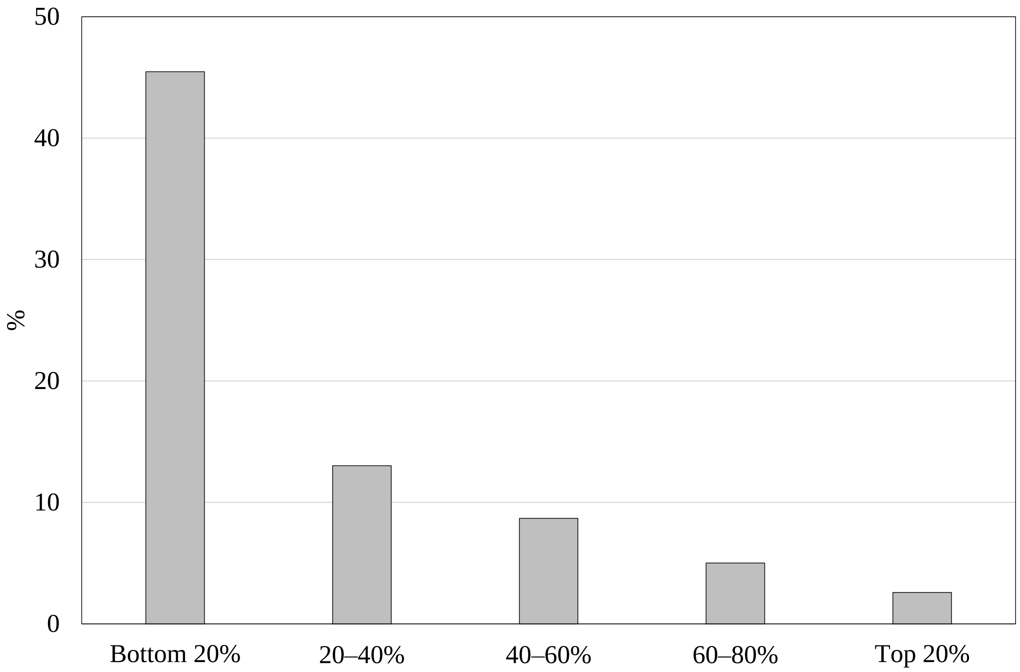

Figure 5. Unemployment rate by gross income quintile in Finland. *Note:* Unemployment rates are defined as the share of unemployed in the labour force belonging to each quintile. The labour force includes the employed, the self-employed, people working in family businesses, people in sick or parental leave, and the unemployed.

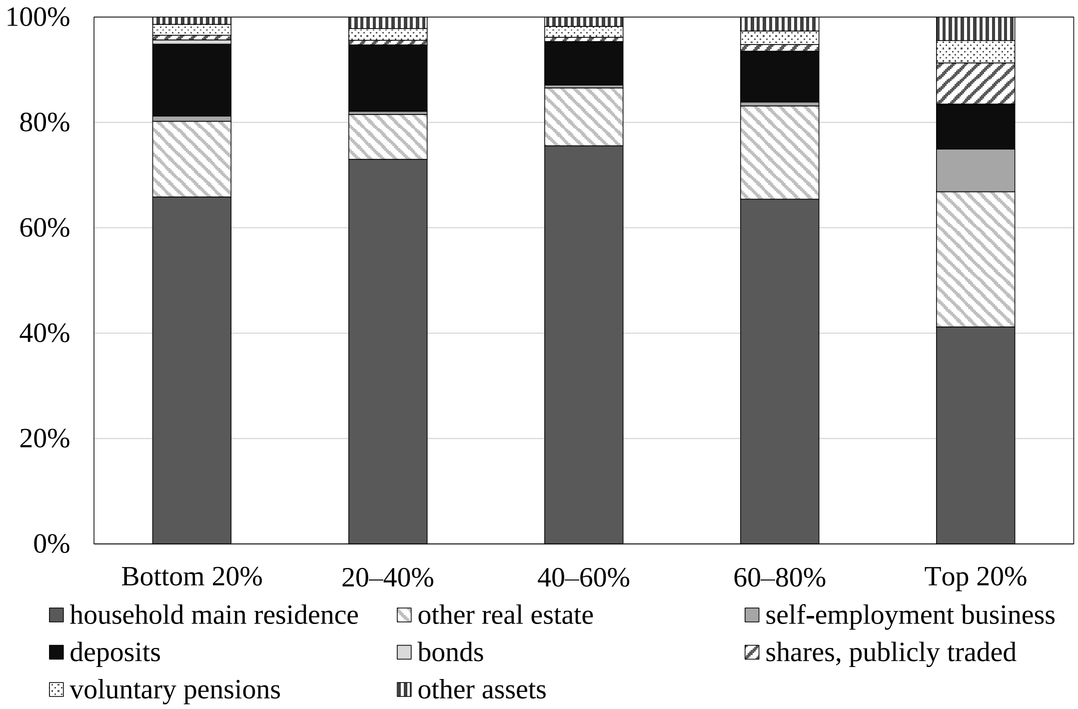

Figure 6. Composition of gross wealth of Finnish households by net wealth quintile.

A major share of household gross wealth consists of the households' main residence and other real estate. In the first four quintiles, more than 80% of total gross wealth consists of real estate, and financial wealth in these quintiles is mainly in the form of deposits. Households' holdings of shares are mainly concentrated in the wealthiest quintile of the household distribution (Figure 6).

The households' average net wealth in the lowest net wealth quintile is zero. The mean net wealth of the second quintile amounts to €27 000 per household, whereas in the third quintile it exceeds €100 000. In the second wealthiest quintile mean net wealth is roughly €230 000, and in the wealthiest quintile it is close to €700 000.

4 The aggregate impact of ECB's monetary policy on the Finnish economy

In the first step of our analysis, we estimate the impacts of ECB's monetary policy easing on the aggregate Finnish economy. Figures 7 and 8 plot quarter-by-quarter impulse responses to the identified conventional monetary policy (*MP)* shock and the *QE* scenario, respectively. The *MP* shock is standardised and scaled to produce a 25 basis point immediate reduction in the euro area short-term rate, while the *QE* scenario is scaled to produce a 25 basis point reduction in the euro area term spread while keeping the short-term interest rate fixed in the first four quarters. In what follows, we discuss the median responses to these two monetary policy shocks.

4.1 Impacts of the conventional monetary policy shock

A 25 basis point reduction in the short-term interest rate leads, on impact, to a 0.7% increase in the euro area GDP and a 0.2% increase in the euro area consumer price index relative to the initial level before the shock (Figure 7). The peak effect on GDP is eight quarters after the shock, with an over 0.8% increase in economic activity. The euro area consumer price index peaks later, after about 17 quarters, at 0.6% above its pre-shock level.

The euro area term long-term interest rate decreases by 19bp on impact. This is less than the decrease in the short-term rate, implying an initial increase in the term spread and an imperfect pass-through. According to Rostagno et al. (2019), a conventional monetary policy shock in the euro area typically has a monotonically declining impact on interest rates at longer maturities and about no impact on the 10-year rate, while for instance forward guidance has a persistent effect along the whole maturity structure. Our results are in line with that finding.

The initial impact of the shock on the Finnish GDP is somewhat weaker than on the euro area GDP but becomes stronger over time. In the first quarter, GDP increases on average by 0.5%, while after eight quarters the Finnish GDP is about 1% above its initial level, and somewhat above the euro area peak GDP response. The initial impact on consumer prices is comparable to that in the euro area, 0.3% on impact. Prices remain close to this level for about two years and then slowly catch up with the euro area price level deviation.

The domestic unemployment rate does not react on impact but experiences a persistent decline starting in the third quarter. The maximum impact of -0.2 percentage points is reached about 2 years after the shock. Similarly, domestic nominal wages initially react only weakly, by around 0.2%. However, there is subsequently a persistent and delayed increase in nominal wages peaking at about 1.3%, as aggregate economic activity remains above the pre-shock level.

In real terms (not shown), wages decrease on impact owning to a faster response of prices, but pick up in the second year, ultimately increasing by about 0.6%. Asset prices also barely react on impact but start increasing in the third quarter after the shock. Nominal house prices peak at around 1% above their initial level six quarters after the shock. Stock prices peak slightly later, eight quarters after the shock, reaching a peak at 8% above their pre-shock level.

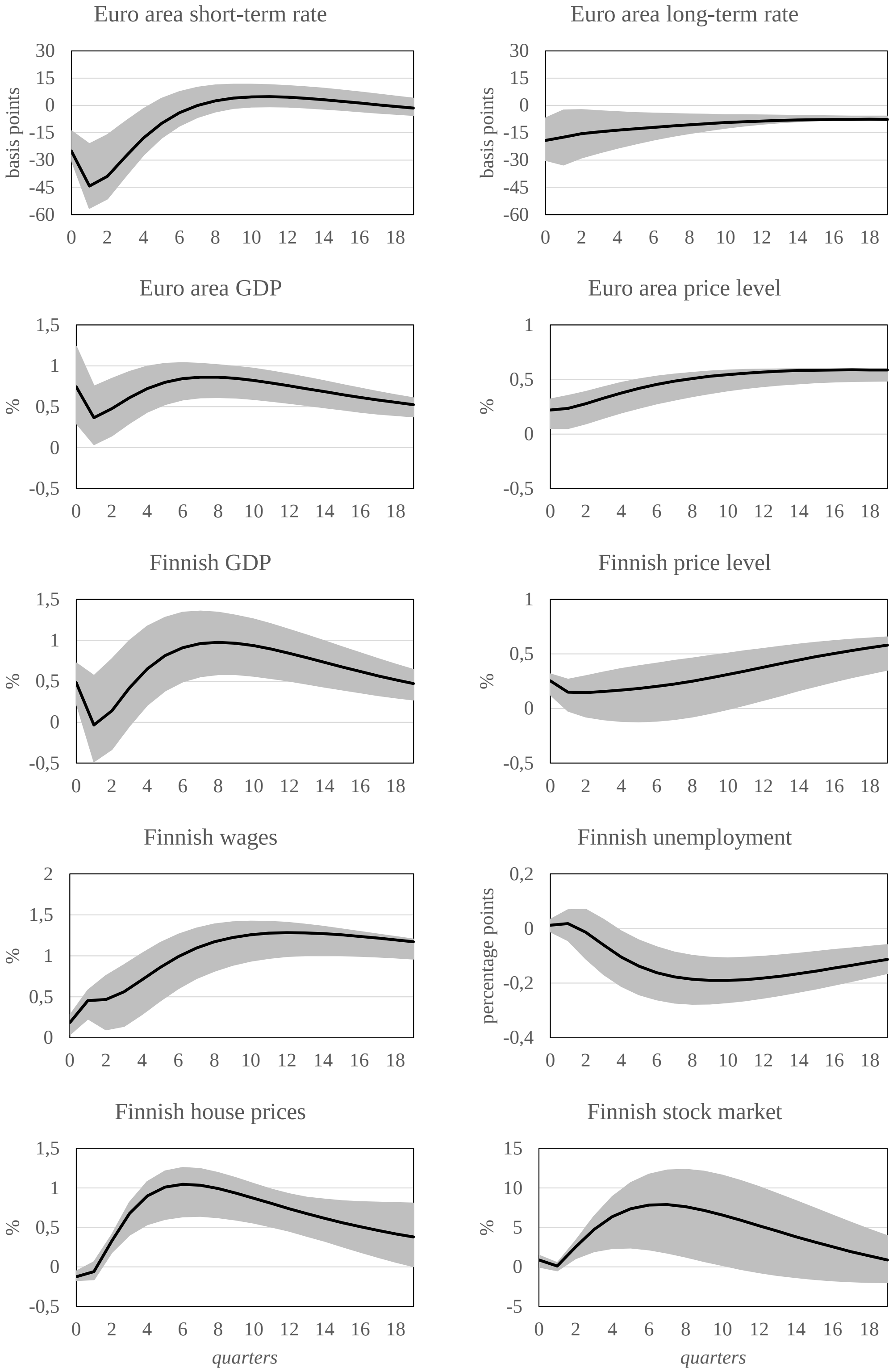

Figure 7. Aggregate impulse responses to a 25 basis point expansionary conventional monetary policy (*MP*) shock. *Note:* Solid black lines denote period-wise median impulse responses. Grey areas denote 68% period-wise bands of the identified set.

4.2 Impacts of the quantitative easing scenario

The impact of the *QE* scenario is shown in Figure 8. Throughout the simulation, we impose the restriction that the short-term rate remains unchanged for the first four quarters. The magnitude of the QE event is scaled to an initial unexpected 25 basis points drop in the long-term interest rate, which, given the binding lower bound on the short-term rate, translates into a drop in the term spread of the same size. Based on various studies on the effects of quantitative easing in the euro area, the estimated impacts on the term spread have been most likely larger than 25bp. For instance, when the ECB announced in January 2015 that it would start €60 billion monthly asset purchases in March of the same year, the anticipation of the purchases led to a term spread compression of almost 50bp for the ten-year maturity according to ECB estimates. However, these effects have varied over time, as shown by Rostagno et al (2019).

We use 25 basis points as a conservative baseline scenario and simulate the model also with an initial 100 basis point impact, which can be regarded as an upper bound on the impact of QE on long-term yields in the euro area. Since the SVAR model is linear, the effects on the macroeconomy are four times larger in this case. The microsimulation results of this exercise are reported in Appendix A, which also reports a similar exercise for the *MP* shock.

An initial 25bp reduction in the euro area term spread leads, on impact, to a 0.3% increase in euro area euro area consumer prices. Euro area GDP grows by about 0.9% on impact. Both variables show rather persistent responses. The elevated economic activity starts fading slowly two years after the shock, while prices see a mild upward trajectory over about four years.

The shock has a similarly persistent and positive impact on Finnish consumer prices, which remain elevated above their initial level for an extended period. The initial price level reaction of 0.3% is comparable to that in the euro area. It then subsides slightly before picking up again in the consecutive years. Domestic GDP increases on average by 0.5% on impact, a smaller initial magnitude compared to the euro area. Nevertheless, GDP growth picks up in the second quarter after the shock, matching the increase in the euro area of 0.9%. As in the euro area, economic activity starts to return towards its initial level two years after the shock.

The domestic unemployment rate increases marginally on impact, by 0.1 percentage points, but then falls persistently below its pre-shock level for the next few years. The maximum impact on unemployment rate is 0.2 percentage points below the initial level in the third year after the shock. Similarly, the initial impact of the QE event on domestic nominal wages is small.

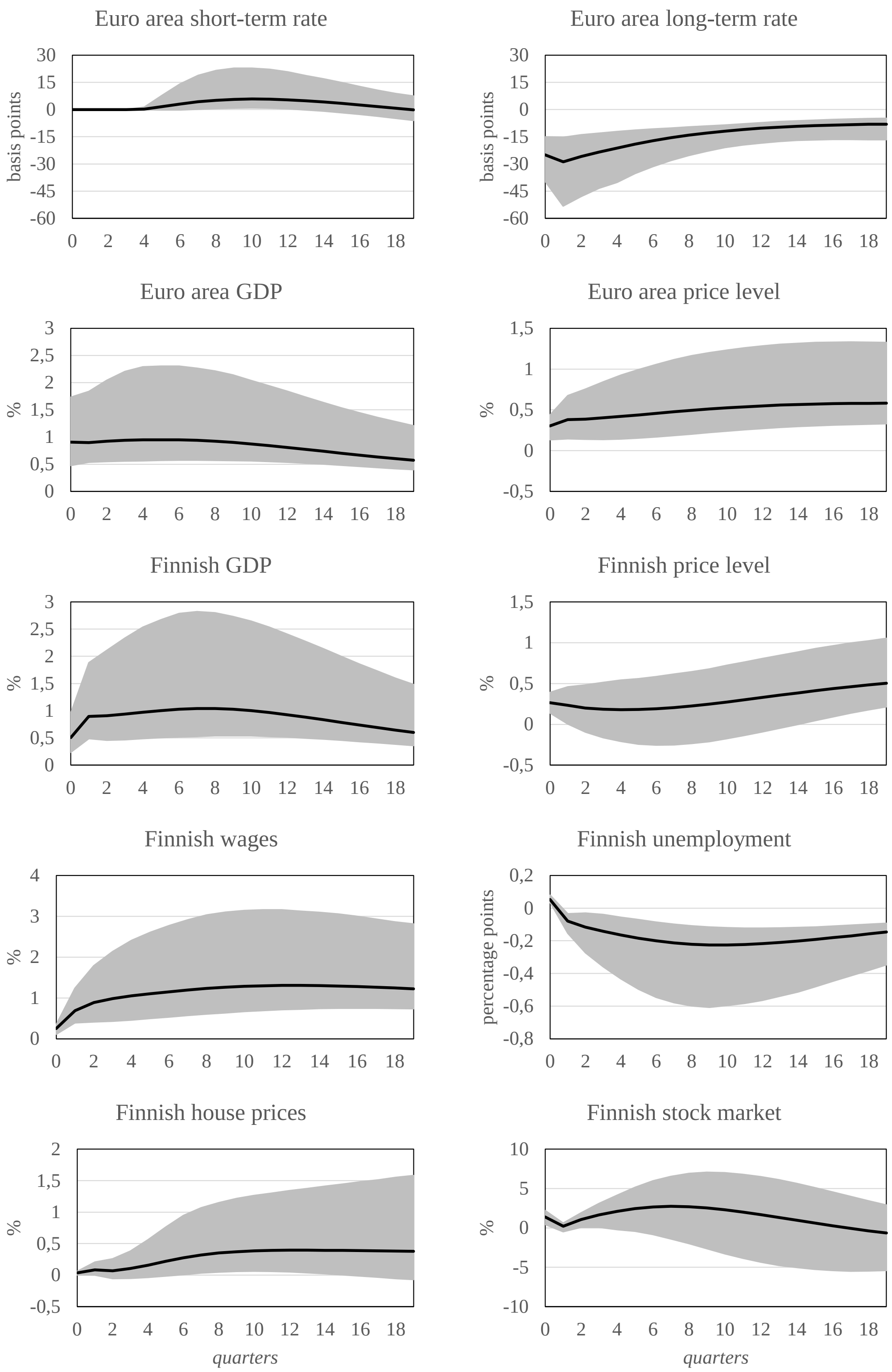

Figure 8. Aggregate impulse responses to a 25 basis point expansionary quantitative easing (*QE*) scenario. *Note:* Solid black lines denote period-wise median impulse responses. Grey areas denote 68% period-wise bands of the identified set.

However, nominal wages start increasing more substantially in the quarters after the shock, overlapping largely with the elevated real economic activity. After three years, the nominal wage index is 1.3% above its initial level. Comparing the paths of prices and wages shows that real wages grow by about 0.5–0.6% relative to the pre-shock level, which is similar in size to the effects of the conventional monetary policy shock.

As a reaction to the QE scenario, stock prices increase on impact by 1.4%, but the peak effect of 2.7% comes with substantial delay, about two years after the shock. House prices pick up only gradually, reaching a persistent increase of 0.4% relative to the pre-shock level. The overall mild reaction of house prices suggests that, even if the QE measures induce an increase in housing demand, they may also boost housing construction in the domestic economy.

Overall, both types of monetary policy measures boost aggregate economic activity in the euro area and in Finland significantly. The reactions of Finnish GDP and consumer prices are fairly similar to those in the euro area, both in terms of magnitude and persistence. Furthermore, both policies have comparable effects on the domestic labour market. Wages increase and unemployment falls. These effects come, however, with a delay. The most significant difference between the two policies is visible in their impact on asset prices. The *MP* shock has a stronger impact on both housing and stock markets.

5 The effects of conventional monetary policy on income and wealth inequality

In the following analysis, the estimated effects of monetary policy measures on households' income and wealth are first described by a set of impulse responses derived from the microsimulation. The impulse responses show how unemployment, the gross income and the net wealth of households in each income and wealth quintile evolve over 12 quarters after the macroeconomic shocks. Finally, the effects of monetary policy on the income and wealth distributions are assessed with Gini coefficients and the ratios of the 90^{th} to the 50^{th} percentile of income and wealth, measured at one to three years after the initial shocks. We assess the household-level impacts of both conventional monetary policy, in this section, and quantitative easing, in the next section.

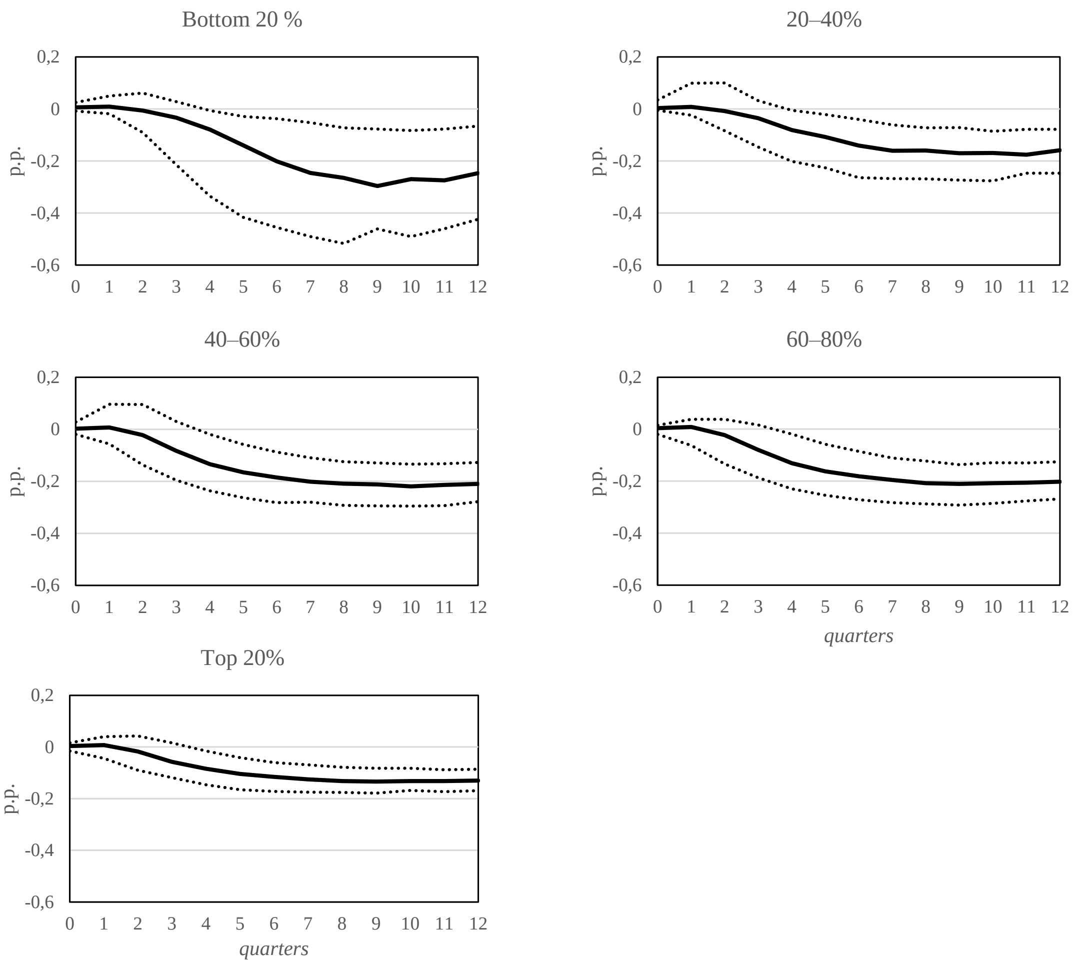

Figure 9. Response of the unemployment rate to an expansionary conventional monetary policy (*MP*) shock of 25bp, in percentage point deviations from initial level, by gross income quintiles. *Note:* The solid lines show the average responses in each quintile that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

5.1 Effects of conventional monetary policy on employment and household income

As an expansionary *MP* shock leads to a reduction in aggregate unemployment, the income of previously unemployed people increases as they become employed. The relative importance of this extensive margin across income quintiles depends on two factors. On the one hand, households in upper income quintiles tend to be better educated, so the probability of the unemployed in these groups to become employed is higher compared to less educated households with lower incomes. On the other hand, the number of unemployed jobseekers is remarkably higher in the lowest income quintile compared to the other quintiles (Figure 5). Regardless of their level of education, many of the unemployed in low-income households also find a job when economic conditions improve and aggregate unemployment decreases.

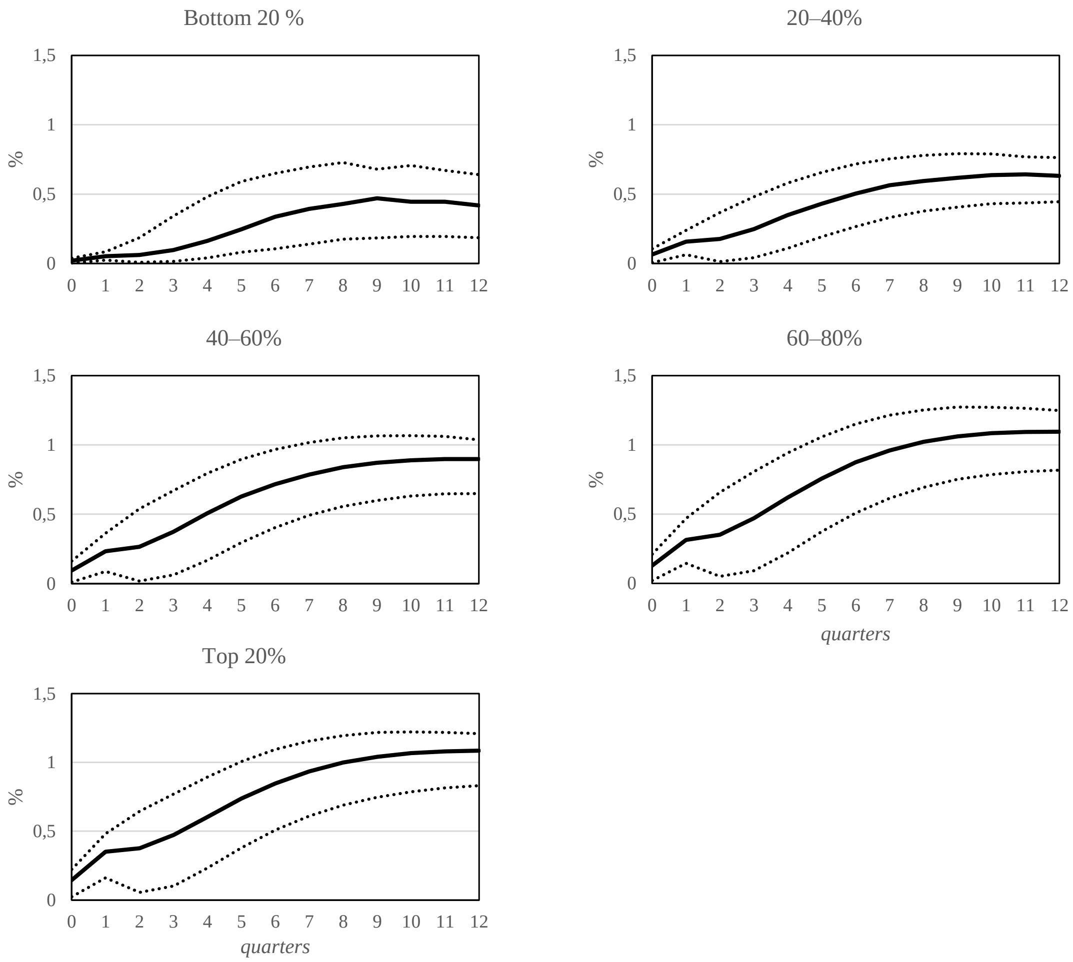

Figure 10. Response of households' mean gross income to an expansionary conventional monetary policy (*MP*) shock of 25bp, in percent deviations from initial level, by gross income quintiles. *Note:* The solid lines show the average responses in each quintile that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

A conventional monetary policy (*MP*) shock generates a persistent decline in unemployment across all income quintiles (Figure 9). Unemployment declines the most in the bottom income quintile and the least in the top quintile: the unemployment rate of the least-earning households bottoms at roughly 0.3 percentage points below its initial level, while in the other quintiles the decline in the unemployment rate remains between 0.15–0.2 percentage points. The stronger response of unemployment in the lower income quintiles is explained by the larger initial rate of unemployment in these quintiles. The higher level of education somewhat increases the employment probability in the higher income quintiles, but this effect plays only a minor role.

A conventional monetary policy shock also leads to a persistent increase of mean gross income in all income quintiles (Figure 10). The impact is dominated by the income composition channel, as wage growth (the intensive margin) contributes more to the growth in gross income than the reduction in unemployment (the extensive margin). Thus, mean income increases most in the top two income quintiles, and the increase in gross income becomes smaller towards lower income quintiles. Three years after a 25bp *MP* shock, the mean incomes in the two highest income quintiles reach 1.1% above their initial levels, while the mean income of the bottom quintile remains at 0.4% above its initial level.

The relative income gains of the quintiles, however, depend on the size of the monetary policy shock. Following a larger 100bp shock, the relatively larger increase in employment boosts the mean income of the bottom quintile, so that the total effect of the *MP* shock on gross income is no smaller than in the 20–40% quintile. The mean gross incomes of the top two quintiles, however, still increase the most. The impulse responses of this scenario are reported in Appendix A.

The effect of monetary policy shocks on income inequality is measured with the Gini coefficient calculated for gross income at the household level (Table 2). We calculate the Gini coefficient of the initial income distribution and at four, eight and twelve quarters following the initial shock to capture both short- and medium-term effects.

The monetary easing slightly increases income inequality due to the dominating income composition channel, which benefits the upper income quintiles. Two years after the 25bp *MP* shock, the gross income Gini coefficient is 0.09 percentage points higher, an increase from 39.06% to 39.14% (Table 2). However, the effect is economically very small. It is also negligible in comparison to the historical variation in the income Gini coefficient (Figure 1).

After a larger, 100bp shock, the income Gini increases roughly by twice as much as after the 25bp shock, although the initial monetary policy shock is four times larger. Even though high-income households benefit relatively more in terms of gross income growth, the non-linear response of the unemployment rate supports low-income households and mitigates the increase in inequality due to a large monetary policy easing through the earnings heterogeneity channel.

The Gini coefficient can be interpreted as a measure of average inequality. Thus, even large increases in one part of the income distribution can be hidden if inequality simultaneously decreases in other parts of the distribution. To further examine whether monetary policy has disproportionally benefitted the top income decile, the impact of the *MP* shock on income inequality is also examined by computing the ratio of the income of the 90th gross income percentile to the median income (the P90/P50 ratio). Monetary easing slightly increases inequality according to this metric as well, but the increase in the P90/P50 ratio remains negligible. Prior to the 25bp *MP* shock, the gross income of the top decile is equal to 2.37 times the median income, and the ratio peaks at 2.38 two years after the shock (Table 2).

Shock size	Gini coefficient	Initial	Quarters after shock		
			4	*8*	*12*
25bp	Gross income, %	39.06	39.12	39.14	39.15
	Net wealth, %	66.20	66.36	66.40	66.33
100bp	Gross income, %	39.06	39.23	39.29	39.33
	Net wealth, %	66.20	66.84	66.96	66.70

Shock size	P90/P50 ratio	Initial	Quarters after shock		
			4	*8*	*12*
25bp	Gross income	2.374	2.379	2.381	2.383
	Net wealth	4.527	4.529	4.528	4.522

Table 2. Effects of a conventional monetary policy (*MP*) shock on income and wealth inequality. *Note:* The top panel shows the evolution of the Gini coefficients on gross income and net wealth following a 25bp and a 100bp *MP* shock. The bottom panel shows the evolution of the ratios of gross income and net wealth, respectively, of the 90th percentile to the 50th percentile (the P90/P50 ratio).

5.2 Effects of conventional monetary policy on households' net wealth

Wealth responses to monetary easing are mostly driven by the changes in house prices, as the total wealth of most Finnish households is mostly comprised of housing. In terms of *gross* wealth (not reported here), monetary easing benefits most the households with the largest asset holdings, regardless of the size of the shock. Prices of most expensive real estate properties increase significantly more than those of less expensive ones, and the more expensive properties are mainly owned by households in the upper net wealth quintiles. The wealthiest households also benefit from their more diverse asset composition. Similarly, the increase in equity prices mainly benefits the wealthiest quintile of households.

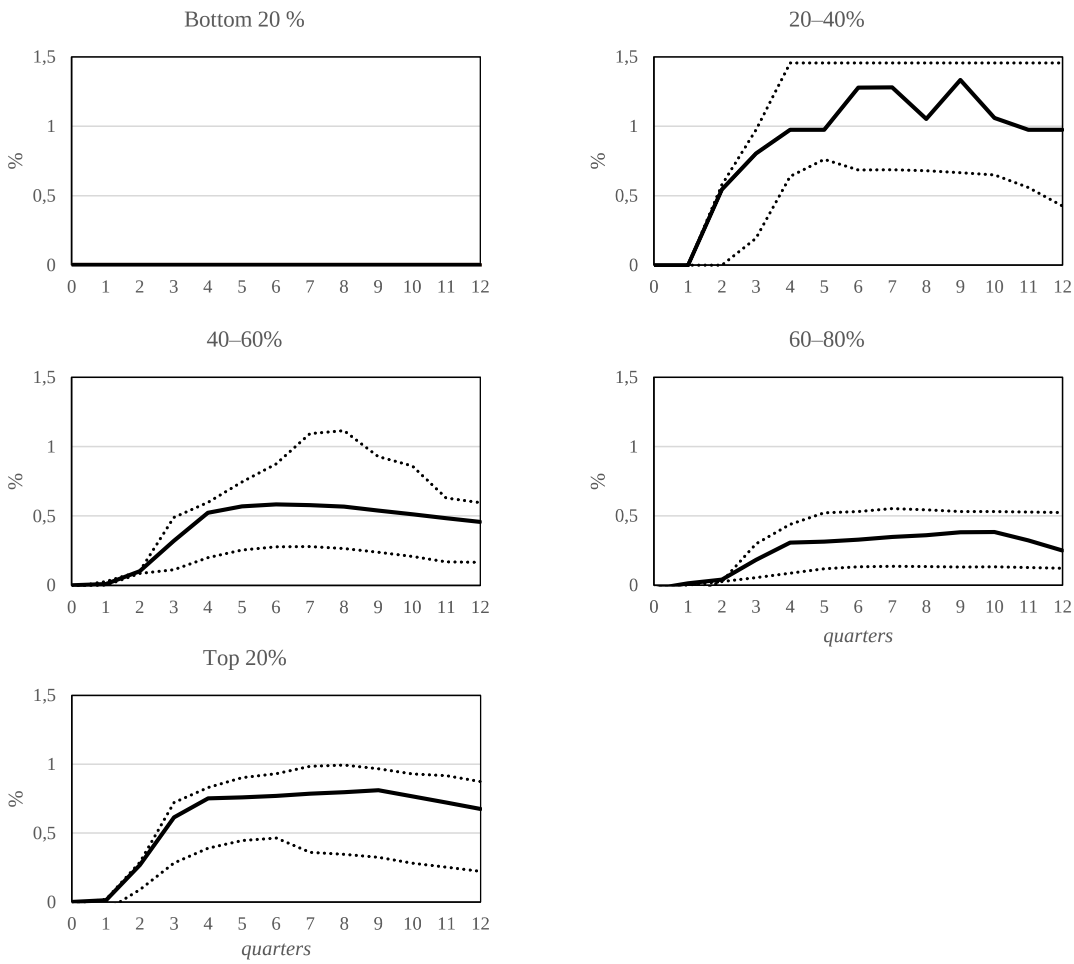

Figure 11. Response of households' net wealth to an expansionary conventional monetary policy (*MP*) shock of 25bp, in percent deviations from initial level, by net wealth quintiles. *Note:* The solid lines show the average responses in each quintile that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

In terms of *net* wealth, the second quintile (20–40%) gains the most from the expansionary *MP* shock, followed by the top quintile. Monetary easing persistently boosts the net wealth of all four net wealth quintiles that initially have positive mean net wealth (Figure 11). The households in the bottom wealth quintile have on average approximately zero net wealth, so that the response of this quintile is not simulated.[18]

[18] The net wealth at the 20th percentile (i.e. the upper bound of the bottom quintile) is roughly €4000, and a little less than 10% of the households have zero or negative net wealth. Because of this very small (or even negative) base, any percentage changes are by construction hard to interpret.

The full impact of the shock on household wealth materialises four to seven quarters after the shock. The peak effect of a 25bp *MP* shock to the average net wealth in the 20–40% quintile amounts to 1.3%, while in the third and fourth quintiles the peak increase in net wealth remains at 0.3–0.4%. Consequently, the net wealth Gini coefficient increases by 0.20 percentage points from 66.20% to 66.40% two years after the shock (Table 2). This impact is again small in comparison to the historical variation observed in the net wealth Gini coefficient (Figure 2).

This finding is explained by leverage effects. Households even in the second-lowest quintile possess notable gross wealth primarily due to housing wealth, but also have mortgage loans and other liabilities that are sizable relative to their total assets.[19] Thus, the net wealth of these households remains relatively small when compared to the higher quintiles. As the net wealth of the households remains relatively small, even a small increase in asset prices may lead to a significant relative increase in the net wealth of these households, as the nominal value of their liabilities stays unchanged. This finding is in line with those reported for Finland by Adam and Tzamourani (2016)

In Appendix B, we show the Gini coefficients computed from the microsimulation using the period-wise upper and lower bounds of the identified bands of the aggregate impulse responses. They capture aggregate uncertainty stemming from the identification of the structural shocks in the SVAR model. When this uncertainty is considered, the change in the net wealth Gini coefficient following the shock cannot be statistically distinguished from zero over the three years following the shock.

As regards to the net wealth inequality measured by the P90/P50 ratio, the impact of the *MP* shock is also very small. Prior to the shock, the net wealth of the 90th percentile of households is roughly 4.5 times that of the 50th percentile. The *MP* shock very slightly increases inequality at horizons up to 8 quarters.

6 The effects of quantitative easing on income and wealth inequality in Finland

In this section, we distribute the aggregate impacts of the quantitative easing (*QE*) scenario on households' employment, gross income and net wealth according to their initial gross income and net wealth levels.

[19] The average gross wealth of the quintile amounts to €70 000 and the median wealth €40 000. The average liabilities of these households are roughly €73 000 per household, while the median liabilities are €46 000.

6.1 Effects of QE on employment and household income

Figure 12 shows the household-level impulse responses of unemployment by income quintiles to the expansionary *QE* scenario where the long-term interest rate initially unexpectedly decreases by 25 basis points, while the short-term rate stays fixed during the initial four quarters.

Quantitative easing reduces unemployment in all income quintiles. The unemployment rate in the lowest quintile bottoms at 0.4 percentage point below its initial level (Figure 12). As following the *MP* shock, the unemployment responses weaken towards the higher income deciles, so that the average unemployment rate of the households belonging to the top 20% falls by at most 0.2 percentage points. The larger initial rate of unemployment in the bottom income quintile again explains the relatively stronger reduction in the unemployment rate. In all income quintiles, the unemployment effects of the *QE* scenario are persistent. The peak impacts are reached 8–10 quarters after the shock. Twelve quarters after the shock, the unemployment rates are still 0.2–0.4 percentage points below their initial levels.

In addition to the decrease in unemployment, quantitative easing boosts household income through higher wages. The gross income responses to the *QE* scenario include the net effect of both the earnings heterogeneity channel (through reduced unemployment) and the income composition channel (through higher wages).

After the initial 25bp shock, household gross income increases fastest during the first three quarters after the initial shock, but the full impact of the *QE* scenario takes more than two years to materialize (Figure 13). Income grows the most in the two top quintiles, in which mean household income peaks roughly two years after the shock at 1.1% above its initial level. The effect on income remains smallest in the bottom quintile, in which mean household income peaks at roughly at 0.6% above its initial level. Again, the impact of the shock on gross income is non-linear in the shock size, with the lowest quintile benefiting relatively more from a four-fold (100bp) initial compression in the term spread due to a proportionally stronger reduction in unemployment in this quintile.

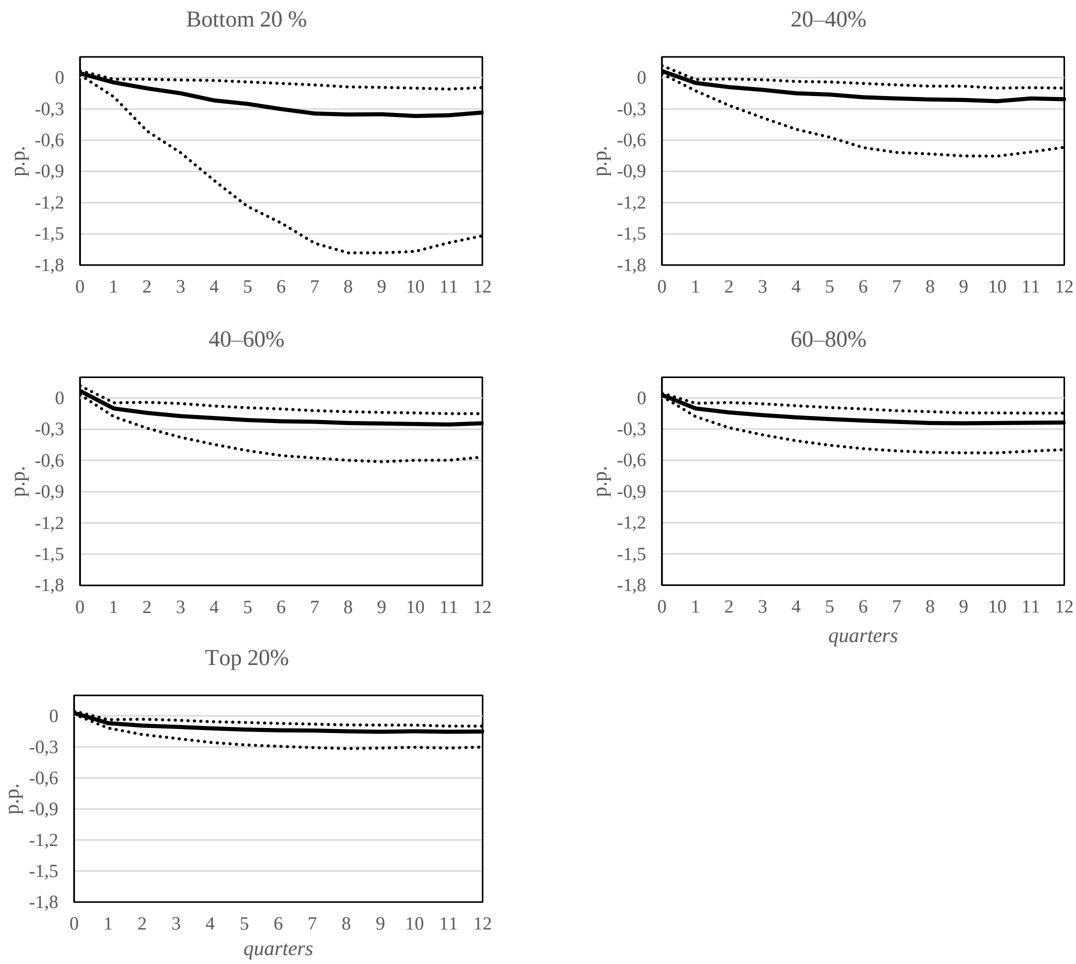

Figure 12. Response of the unemployment rate to an expansionary quantitative easing (*QE*) scenario of a 25bp unexpected initial compression of the term spread, in percentage point deviations from initial level, by gross income quintiles. *Note:* The solid lines show the average responses in each quintile that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

As suggested by the impulse responses, QE slightly increases income inequality, as it benefits the highest income quintiles the most, owing to the relatively strong reaction of wages in these quintiles. Four quarters following the 25bp shock to the term spread, the gross income Gini coefficient is 0.08 percentage points higher than initially, after increase from 38.06% to 38.14% (Table 3).

Similarly to the *MP* shock, following a four times larger 100bp shock to the term spread, the income Gini increases only by twice as much as after the 25bp shock. The non-linear response of the unemployment rate supports low-income households and mitigates the increase in inequality.

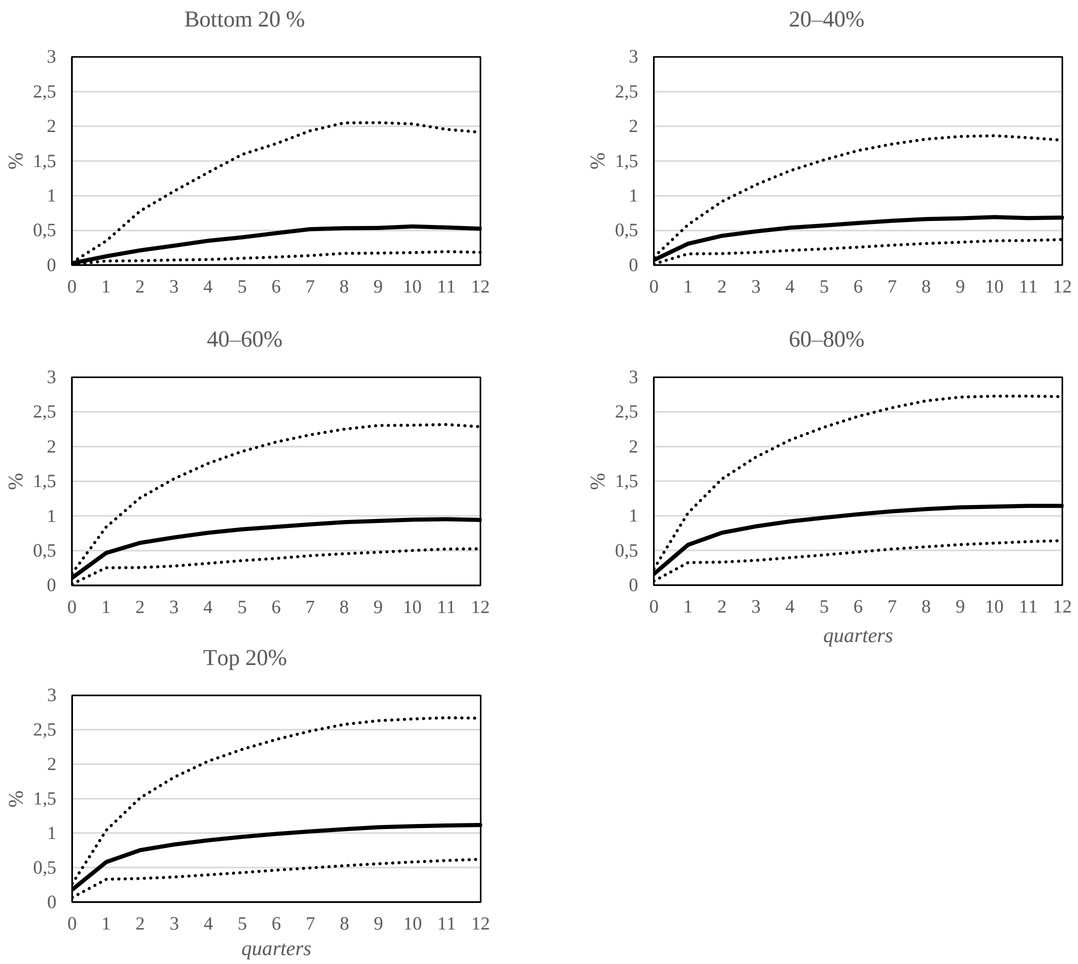

Figure 13. Response of households' mean gross income to an expansionary quantitative easing (*QE*) scenario of a 25bp unexpected initial compression of the term spread, in percent deviations from initial level, by gross income quintiles. *Note:* The solid lines show the average responses in each quintile that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

The *QE* scenario also leads to a slight increase in the P90/P50 ratio, but the rise in inequality remains negligible (Table 3).

Overall, the effect of quantitative easing on income inequality in Finland is economically negligible, as the magnitude of the responses of both Gini coefficient and the P90/P50 ratio are very small. When aggregate uncertainty concerning the identification of the structural shocks is taken into account, the impact on the Gini coefficient cannot be statistically distinguished from zero within two and three years following the shock. These results are reported in Appendix B.

The effects of quantitative easing on income inequality appear modest also in comparison to the historical variation of the income Gini in Finland (Figure 1).

6.2 Effects of QE on household wealth

Figure 14 reports the impulse responses of households' net wealth to the *QE* scenario by net wealth quintile. The distributional impacts of quantitative easing are qualitatively similar to those of conventional monetary easing.

All four quintiles with positive initial net wealth gain in the *QE* scenario, but it is the quintile with the second smallest initial net wealth (the 20–40% quintile) that gains the most (Figure 14). This result is again driven by the leverage effect. House prices respond less in the *QE* scenario than following an *MP* shock, but households with small but positive net wealth located in the second net wealth quintile benefit the most even from a small increase in asset prices.

Shock size	Gini coefficient	Initial	Quarters after shock		
			4	*8*	*12*
25bp	Gross income, %	39.06	39.14	39.14	39.15
	Net wealth, %	66.20	66.25	66.26	66.24
100bp	Gross income, %	39.06	39.27	39.26	39.29
	Net wealth, %	66.20	66.41	66.45	66.34
Shock size	**P90/P50 ratio**	**Initial**	**Quarters after shock**		
			4	*8*	*12*
25bp	Gross income	2.374	2.380	2.381	2.382
	Net wealth	4.527	4.532	4.530	4.522

Table 3. Effects of the quantitative easing (*QE*) scenario on income and wealth inequality. *Note:* The top panel shows the evolution of the Gini coefficients on gross income and net wealth following a 25bp and a 100bp *MP* shock. The bottom panel shows the evolution of the ratios of gross income and net wealth, respectively, of the 90th percentile to the 50th percentile (the P90/P50 ratio).

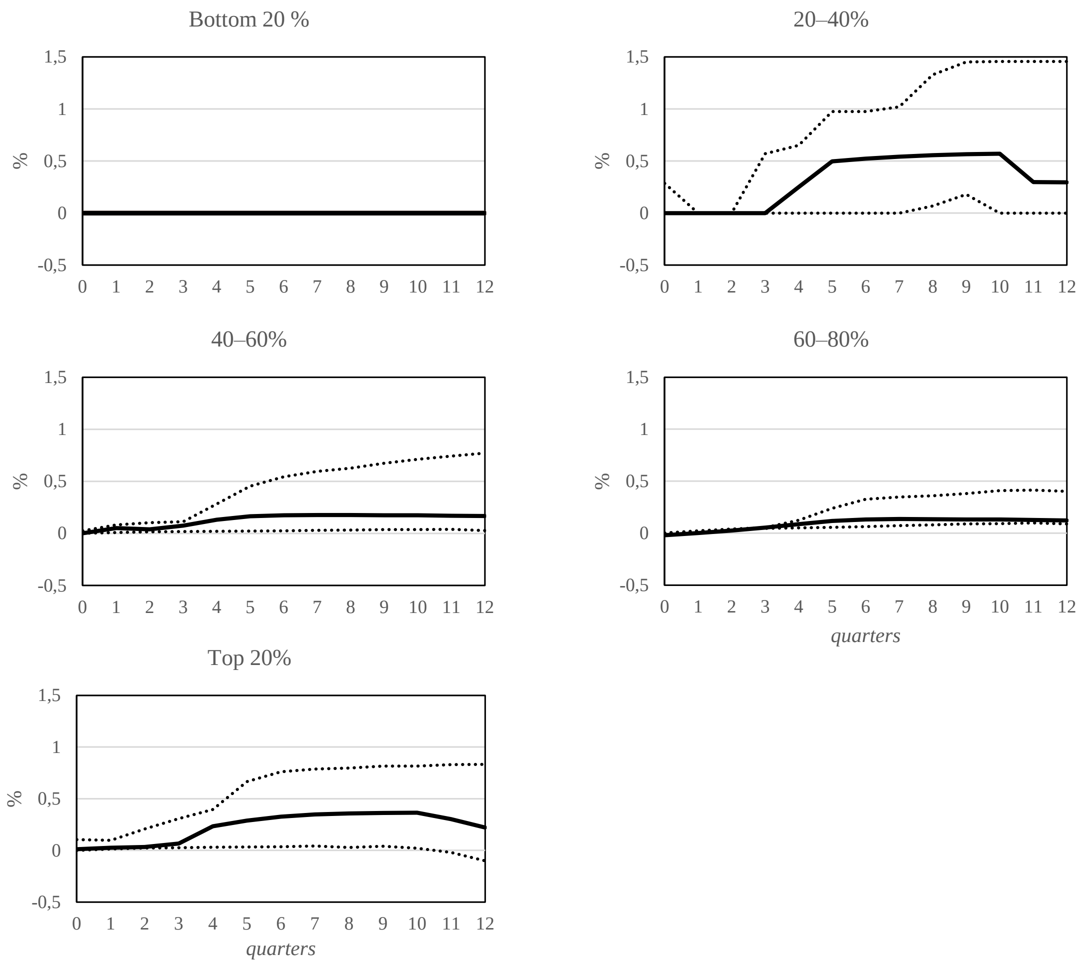

Figure 14. Response of households' net wealth to an expansionary quantitative easing (*QE*) scenario of a 25bp unexpected initial compression of the term spread, in percent deviations from initial level, by net wealth quintiles. *Note:* The solid lines show the disaggregated quintile-level responses that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

The *QE* scenario persistently increases net wealth inequality, but the effect remains small (Table 3). The impact on the Gini coefficient is again very small compared to historical variation in the coefficient (Figure 2). Following the initial 25bp shock to the term spread, the Gini coefficient on net wealth reaches its peak value at 66.26% after eight quarters, 0.06 percentage points above its initial value of 66.20%. At the same time, the P90/P50 ratio slightly increases from 4.52 to 4.53. Again, when aggregate uncertainty concerning the identification of the structural shocks is considered, the impact of the monetary policy shock on the Gini coefficient cannot be distinguished from zero.[20]

7 Robustness and discussion of the results

7.1 The SVAR model and aggregate results

To assess the robustness of our findings, we use two modifications of our set-up. First, we estimate a specification of the SVAR model that includes the German DAX stock index to control for international developments in stock markets. Second, we examine the relative importance of the macro and micro level mechanisms in driving household-level variation in income and wealth. To examine the relative importance of the macro- and micro-level dynamics, we carry out a microsimulation exercise in which we feed Spanish and German aggregate impulse responses, estimated in Lenza and Slacalek (2021), in our microsimulation that uses Finnish household-level data. In other words, we construct a counterfactual simulation in which Finnish macroeconomic aggregates respond to monetary policy shocks in the same way as either corresponding German or Spanish aggregates.

The second exercise is motivated by the fact that, in contrast to Lenza and Slacalek's (2021) results for the four largest euro area countries, monetary easing leads to small increases in both income and wealth inequality in Finland in our baseline model. These differences in results may partly be explained by heterogeneity in the macroeconomic effects of monetary policy across countries in the monetary union. The dissimilarities in the results may also reflect differences in how assets, incomes, job market status and employment prospects are distributed across households in different countries.

In the first robustness exercise, we find that the aggregate responses to both conventional monetary policy shocks and to the *QE* scenario are somewhat sensitive to the inclusion of a measure of developments in the international stock markets. The inclusion of the German DAX stock index in the SVAR model results in a slightly larger increase in both income and wealth inequality, following both types of monetary policy shocks. However, the differences in the estimated Gini coefficients remain quantitatively small. We conclude that the effects of both conventional monetary policy and QE shocks on income and wealth inequality are robust to the inclusion of the DAX index in the SVAR specification. More detailed results, including the quintile-level impulse responses and the Gini coefficients, are reported in Appendix C.

[20] Figures showing the macroeconomic uncertainty around the Gini coefficient estimates are presented in Appendix B.

The second robustness exercise shows that the differences in results between large euro area countries and Finland are mainly explained by different aggregate responses to monetary policy shocks. Both in Germany and in Spain, the responses of wages and asset prices to both QE and conventional monetary policy shocks are significantly weaker (and in the case of stock prices, of opposite sign) than the same responses in Finland. To the contrary, the unemployment rate decreases more in these countries, benefitting the bottom income quintile. When combined with the Finnish household data, the German and Spanish aggregate impulse responses imply considerably smaller responses of both household income and net wealth. Consequently, the foreign macro impulses also imply negligible impacts of both QE and conventional monetary policy on income and wealth inequality in Finland. We conclude that the key driver of differences in the impacts of monetary policy is heterogeneity in aggregate responses at the country level, rather than some differences in the distributions of household-level characteristics across countries.

7.2 Microsimulation assumptions

In this paper, we use gross income as our income concept to focus on the direct effect of monetary policy on the income distribution, and abstract away from the interaction of monetary and fiscal policies. We find that absent any change in fiscal policy per se, after the shock, the Gini coefficient computed on households' disposable income, net of taxes, increases slightly more than the Gini coefficient on gross income. That is, income inequality increases more in net terms. This surprising result arises because effective marginal tax rates increase steeply at low earnings levels and level off at higher earnings levels, despite progressive taxation. Households in lower income deciles thus benefit relatively less from the increase in their gross income, as their tax burden increases relatively more than that of high-income households. [21]

Once social security is also taken into account, the dynamics of the income Gini are even more favourable to the upper income quintiles. This is because unemployed low-income households that become employed following the shock are no longer entitled to various social security transfers. In our simulations, we assume that households' transfers remain unaffected following the monetary policy shocks, except for the unemployment benefit. For this reason, our estimates may under-estimate the impact of monetary policy shocks on income inequality.

To examine how robust our results are with respect to the measure of household income used in the microsimulations, we estimate the effects of monetary policy on income inequality using an

[21] Viitamäki (2015) presents results from detailed microsimulations showing how the schedule of effective marginal tax rates is shaped when various social security benefits are considered.

alternative income measure that excludes social transfers, and only includes labour and financial income of the households. This alternative income measure is calculated by simply excluding all social transfers from the original gross income series.

In qualitative terms, social transfers play a fairly important role in the dynamics of income inequality. Both QE and conventional monetary easing now result in slight declines in the income Gini coefficient. In the absence of unemployment benefits, unemployed individuals gain significantly more from employment than in the baseline case, so that the effects of monetary policy through the extensive margin dominate over the intensive margin. However, the decreases in income inequality are still quantitatively small.

Another key assumption in our microsimulation concerns the dynamics of households' financial income. In the baseline simulation, we assume that this income component is not affected by monetary policy shocks, and instead stays unchanged at its initial level throughout the simulation.

As a robustness check, loosely following the approach in Lenza and Slacalek (2021), we first regress households' aggregate financial income, obtained from the Finnish quarterly sectoral accounts, on the estimated structural *MP* shocks from the baseline SVAR specification. This results in an estimated semi-elasticity of -4.9: when the short-term interest rate unexpectedly decreases by 1 percentage point, households' financial income increases, on average, by 4.9%.

We then use this estimate in the microsimulation to assess the impact of such a change in financial income at the household level following an *MP* shock. We find that this alone has a negligible impact on the gross income Gini coefficient. The coefficient increases to 39.14% eight quarters after the initial shock and reaches 39.15% twelve quarters after the shock, just as in the baseline simulation. As financial income makes up a significant part of total gross income only in the very top income quintile – and even there, most income comes from labour earnings – accounting for changes in financial income does not have a significant impact on the income Gini coefficient in our analysis.

8 Conclusions

This paper studies the effects of the ECB's monetary policies on income and wealth inequality in Finland. Following a two-step procedure, proposed by Lenza and Slacalek (2021), we first estimate the aggregate effects of monetary policy shocks on the Finnish macroeconomy using a structural vector autoregressive (SVAR) model. In the second step, we distribute the aggregate effects on the unemployment rate, wage level and asset prices across households by means of a microsimulation using Finnish data from the Household Finance and Consumption Survey from 2016.

We find that a monetary expansion, via either conventional or unconventional policy instruments, has a sizable positive impact on aggregate economic activity (output, employment and wages), but only a marginal effect on the distributions of gross income and net wealth in Finland. We also find that quantitative easing has similar distributional impacts on gross incomes of households to a conventional monetary policy shock, but even smaller distributional impacts on net wealth. Our results are in line with earlier literature, which mostly finds only small impacts of monetary policy on either income or wealth inequality in euro area countries and other developed economies.

Monetary easing affects households' labour income both by reducing unemployment and by leading to a general rise in wages. The lowest-income households, many of which are initially unemployed, experience the strongest increase in employment, a force that decreases income inequality. The increase in wages, in turn, benefits mostly households with initially high incomes. This impact works towards increasing income inequality. We find that the latter effect (the income composition channel) dominates the former (the earnings heterogeneity channel), but the importance of the earnings heterogeneity channel grows with the size of the monetary policy expansion. The overall effect remains economically very small.

A monetary expansion, either by means of conventional or QE measures, also makes the net wealth distribution slightly more inequal. There are again various counteracting forces at play. An increase in house prices benefits all homeowners. In terms of net wealth, highly leveraged households in the second-lowest net wealth quintile benefit the most from an increase in house prices. These households benefit from a strong leverage effect, as even a small increase in asset prices strengthens their net asset position. At the same time, a monetary expansion boosts stock prices significantly more than house prices. This benefits mainly the wealthiest households, which are most likely to own shares.

Our analysis is subject to a few important caveats. First, in our baseline analysis of impacts on income inequality, we limit our attention to labour income, which is only one component of households' total income. We also abstract away from interactions between monetary and fiscal policies in the distribution of income by focusing on gross incomes. At the same time, our estimates on wealth inequality are less affected by these limitations.

Based on robustness analysis, however, our finding that monetary policy only has small effects on income inequality remains unchanged when we take into account the effects of monetary policy on financial income or exclude the effects of social transfers in the transmission of monetary policy shocks.

Second, our analysis only pertains to the short-run cyclical impacts of monetary policy on income and wealth inequality. Our analytical framework does not allow us to touch upon long-run drivers of inequality, such as the possible effects of a secular decrease in the natural interest rate. These themes are important areas for future research.

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APPENDIX A. Distributional effects of large monetary policy shocks

This appendix describes the effects of initial shocks to the short-term interest rate and to the term spread that are scaled to 100 basis points, *i.e.* four times larger compared to the baseline simulations. As the SVAR model is linear, the aggregate impulse responses in this case are four times larger compared to the baseline. However, as the microsimulation is highly non-linear, the quintile-level responses are markedly different from the baseline case.

Figures A.1, A.2 and A.3 report the quintile-level impulse responses to a large 100bp *MP* shock of the unemployment rate, gross income, and net wealth, respectively. Compared to the baseline (25bp shock), the decrease in the average unemployment rate in the bottom income is eight times larger and bottoms at -2.4 percentage points (Figure A.1). This leads to an almost 3% increase in the mean gross income in this quintile, six times the impact in the baseline simulation (Figure A.2). In the other quintiles, the decrease in unemployment remains more modest, between 0.4 (the top quintile) and 1 percentage points (the 20–40% quintile). As a result, the increase in the gross income Gini coefficient three years after the shock is only twice as large as in the baseline scenario, despite the aggregate shock being four times larger.

The weaker impact on the Gini coefficient is a result of the larger change in the income composition of households in the bottom income quintile. These households benefit, on average, relatively more from a larger stimulus to aggregate economic activity, as their job-finding probabilities improve the more, the bigger the stimulus.

In contrast, following a 100bp *MP* shock, households in each net wealth quintile gain proportionally as much as following a 25bp shock, as we assume the portfolio composition of each household to remain fixed following the shock. Following a 100bp *MP* shock, the top quintile gains roughly as much as the 20–40% quintile (Figure A3). The peak impacts range between 1.0% and 2.8% depending on the quintile.

As a consequence, the net wealth Gini coefficient increases by 0.81 percentage points over a two-year horizon, a four-fold increase compared to the impact of the 25bp shock.

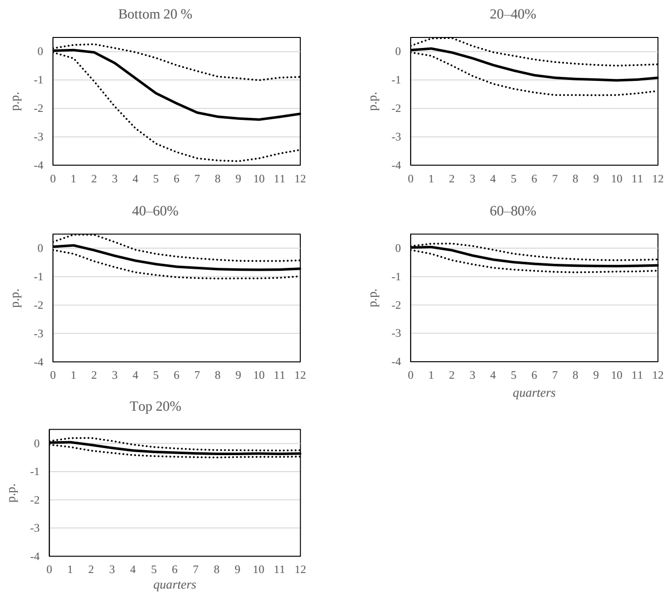

Figure A.1. Response of the unemployment rate to an expansionary conventional monetary policy (*MP*) shock of 100bp, in percentage point deviations from initial level, by gross income quintiles. *Note:* The solid lines show the average responses in each quintile that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

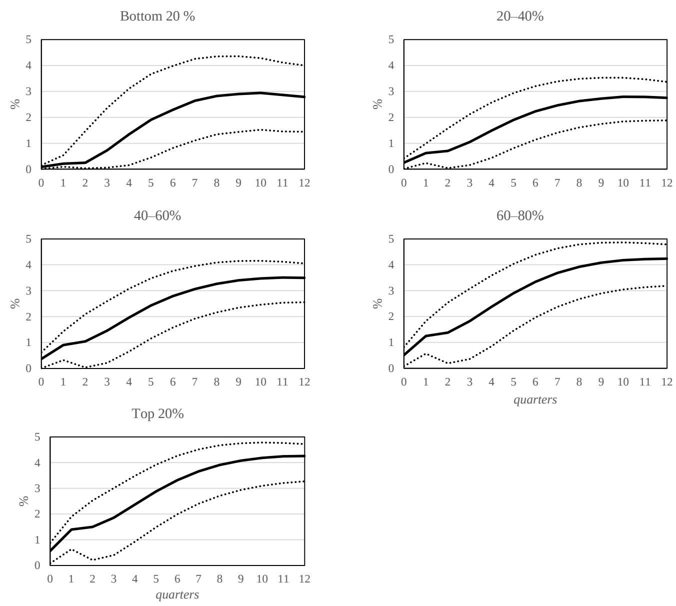

Figure A.2. Response of households' mean gross income to an expansionary conventional monetary policy (*MP*) shock of 100bp, in percent deviations from initial level, by gross income quintiles. *Note:* The solid lines show the average responses in each quintile that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

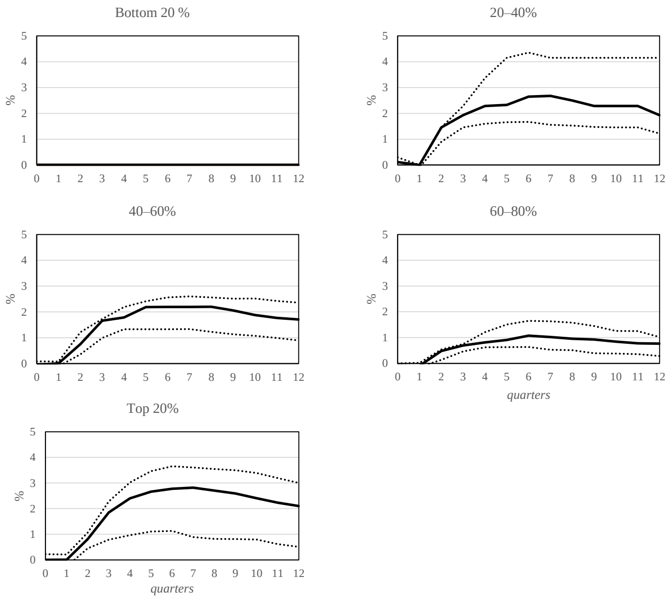

Figure A.3. Response of households' net wealth to an expansionary conventional monetary policy (*MP*) shock of 100bp, in percent deviations from initial level, by net wealth quintiles. *Note:* The solid lines show the average responses in each quintile that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

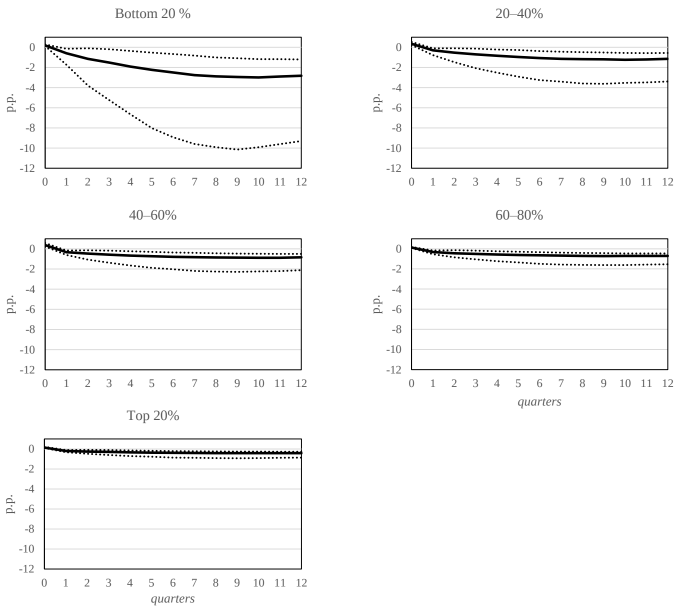

Figure A.4. Response of the unemployment rate to an expansionary quantitative easing (*QE*) scenario of an initial 100bp compression of the term spread, in percentage point deviations from initial level, by gross income quintiles. *Note:* The solid lines show the average responses in each quintile that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

In the *QE* scenario, following a large 100bp initial shock to the term spread, the mean income of the bottom quintile is boosted particularly by the significant decline in the unemployment in that quintile (Figure A.4). As in the baseline scenario of a 25bp shock to the term spread, the gross income still increases most in the two top quintiles. Following the initial shock, the mean incomes of these two quintiles continue to increase over three years, ending up 4.5% above their initial level. This increase is roughly linearly proportional to the corresponding increase after the 25bp shock. The mean incomes of the two bottom quintiles increase proportionally more, by 3.0–3.5% (Figure A.5). As a result, similarly to the 100bp *MP* shock, the income Gini increases only by twice as much as after the 25bp shock to the term spread, as the bottom quintiles benefit relatively more from the stronger improvement in aggregate employment through the extensive margin.

Following a 100bp initial shock, households in each net wealth again benefit from the increases in asset prices in the same proportions as after a 25bp shock. The peak effects range between 0.7% and 1.5%, somewhat smaller than following the 100bp *MP* shock (Figure A.6). The net wealth Gini coefficient peaks at 66.5% two years after the shock, a 0.3 percentage point increase from its initial level.

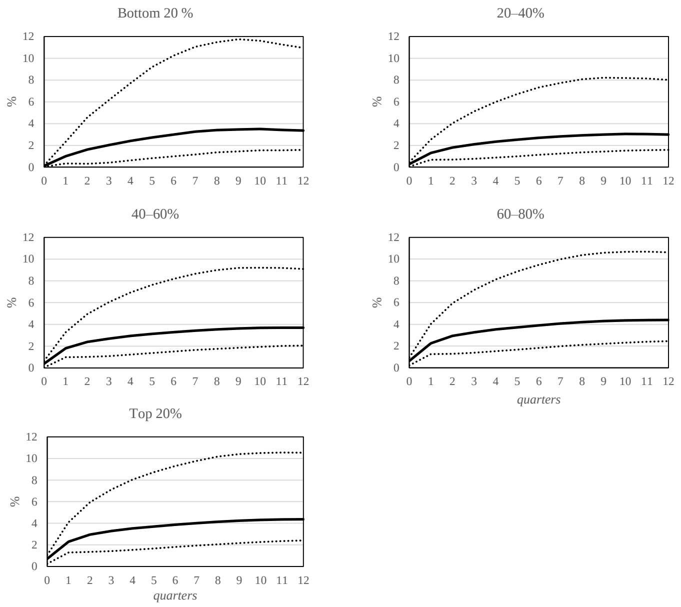

Figure A.5. Response of households' mean gross income to an expansionary quantitative easing (*QE*) scenario of an initial 100bp compression of the term spread, in percent deviations from initial level, by gross income quintiles. *Note:* The solid lines show the disaggregated quintile-level responses that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

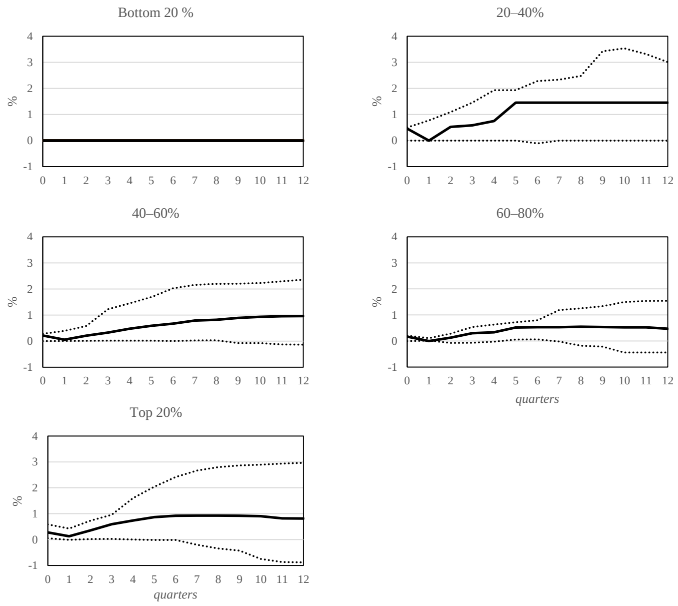

Figure A.6. Response of households' net wealth to an expansionary quantitative easing (*QE*) scenario of an initial 100bp compression of the term spread, in percentage point deviations from initial level, by net wealth quintiles. *Note:* The solid lines show the disaggregated quintile-level responses that correspond to the period-wise median aggregate impulse responses, and the dotted lines correspond to the 68% period-wise bands of the identified set of the aggregate impulse responses.

APPENDIX B. Additional figures

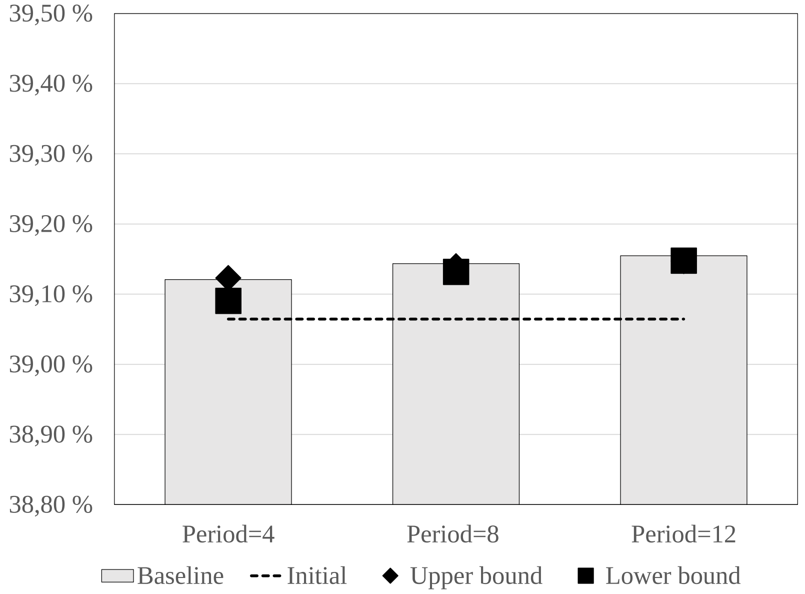

Figure B.1. Gini coefficients on gross income following a 25bp *MP* shock. *Note:* the grey bars denote the Gini coefficients computed from the microsimulation using the period-wise median aggregate impulse responses, and the black diamonds and squares denote the Gini coefficients computed from the microsimulation using the period-wise upper and lower bounds of the 68% identified set of the aggregate impulse responses. The dashed black line shows the value of the Gini coefficient prior to the shock.

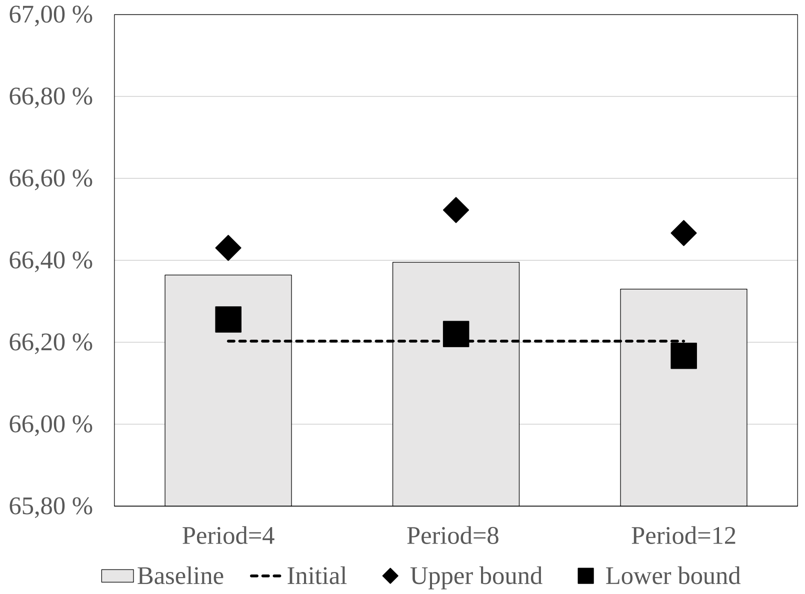

Figure B.2. Gini coefficients on net wealth following a 25bp *MP* shock. *Note:* the grey bars denote the Gini coefficients computed from the microsimulation using the period-wise median aggregate impulse responses, and the black diamonds and squares denote the Gini coefficients computed from the microsimulation using the period-wise upper and lower bounds of the 68% identified set of the aggregate impulse responses. The dashed black line shows the value of the Gini coefficient prior to the shock.

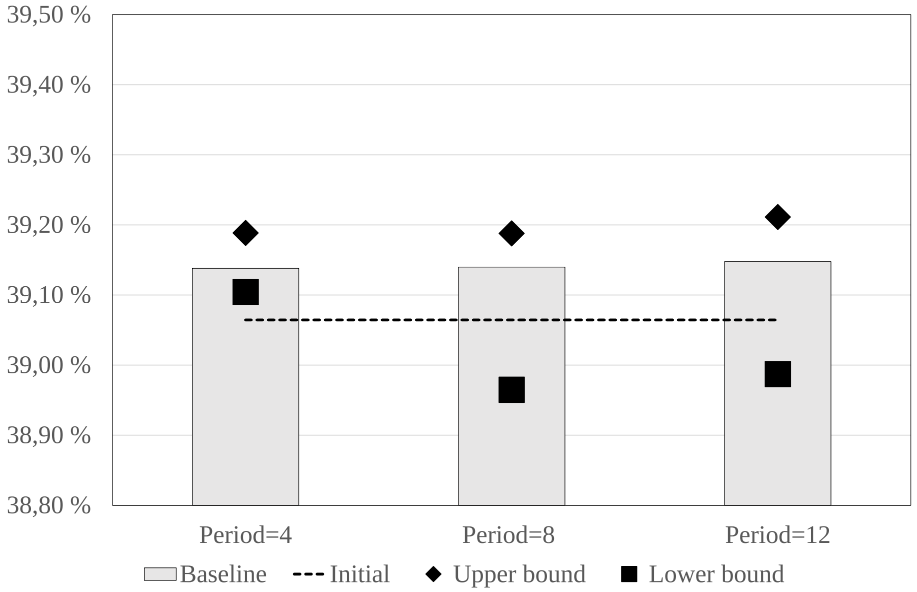

Figure B.3. Gini coefficients on gross income following a 25bp *QE* shock. *Note:* the grey bars denote the Gini coefficients computed from the microsimulation using the period-wise median aggregate impulse responses, and the black diamonds and squares denote the Gini coefficients computed from the microsimulation using the period-wise upper and lower bounds of the 68% identified set of the aggregate impulse responses. The dashed black line shows the value of the Gini coefficient prior to the shock.

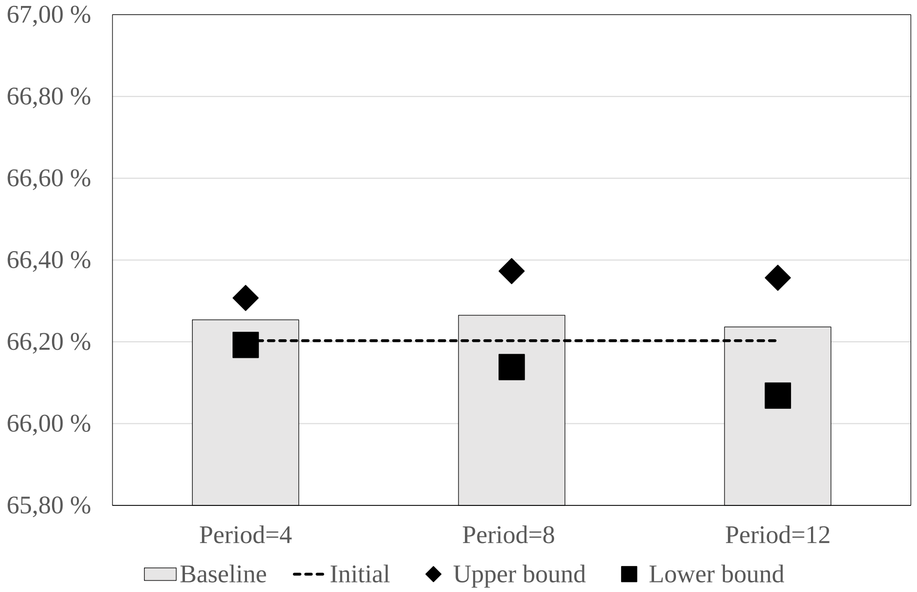

Figure B.4. Gini coefficients on net wealth following a 25bp *QE* shock. *Note:* the grey bars denote the Gini coefficients computed from the microsimulation using the period-wise median aggregate impulse responses, and the black diamonds and squares denote the Gini coefficients computed from the microsimulation using the period-wise upper and lower bounds of the 68% identified set of the aggregate impulse responses. The dashed black line shows the value of the Gini coefficient prior to the shock.

APPENDIX C. Sensitivity analysis: Including the DAX stock index in the SVAR model specification

We assess the robustness of our baseline SVAR specification by estimating an alternative SVAR model that includes the German DAX stock index (in log levels). Apart from this additional variable, the SVAR specification is identical to the baseline specification. In this way, we control for the transmission of monetary policy shocks to the Finnish economy through the international stock market.

Overall, the estimated effects of monetary policy to income and wealth inequality in Finland are robust to the choice between the two alternative model specifications. Following an *MP* shock, both the shape and magnitude of the responses of the domestic unemployment rate and nominal wage level are fairly similar in both specifications. The responses of asset prices (stock and house prices) differ more across these two specifications. House prices respond by less, and stock prices exhibit a stronger initial increase but also a stronger reversal towards the initial level starting about one year after the shock (Figure C.1).

In line with the aggregate results, the quintile-level responses of the unemployment rate and the gross mean income are very similar across the two specifications (Figures C.2 and C.3). The bottom quintile benefits the most from the stronger decline in the aggregate unemployment rate relative to the baseline. By contrast, it is the top quintile that gains least in terms of average gross income, as the households in this quintile do not see a marked improvement in their employment prospects, but their wage growth following the shock is more subdued than in the baseline.

Accordingly, also the impact of the shock on the gross income Gini coefficient is very similar to the baseline estimate, with a peak impact of 39.14%. In either model specification, the effect of the conventional monetary policy shock on income inequality is negligible. Income and wealth Gini coefficients are reported in Table C.1.

The quintile-level responses of net wealth to the *MP* shock are somewhat more sensitive to the SVAR specification. As in the baseline, the quintiles with the second smallest and the largest net wealth benefit the most (Figure C.4). Because most of household wealth is in the form of real estate property and house prices respond by less in the alternative specification, the overall effect on net wealth remains weaker, in particular in the second poorest quintile. The impact on the net wealth Gini coefficient is similar, with the coefficient peaking at 66.40% under both specifications.

The effects of the expansionary *QE* scenario on the real economy are also similar between the two SVAR specifications. However, stock prices respond more strongly to the initial shock when the DAX index is included in the model, whereas the response of house prices is weaker (Figure C.5). Accordingly, the household-level effects on unemployment and gross income are robust to the model specification (Figures C.6 and C.7). The positive effects of monetary easing on wages again dominate the positive effects on employment.

The stronger response of stock prices benefits especially the wealthiest households. Other net wealth quintiles, in which most of the wealth is in real estate property, now experience smaller gains from QE (Figure C.8). Consequently, the increase in the net wealth Gini coefficient is slightly larger under the alternative specification. The coefficient now peaks at 66.56% four quarters after the shock. The overall impact on inequality remains economically negligible (Table C.2).

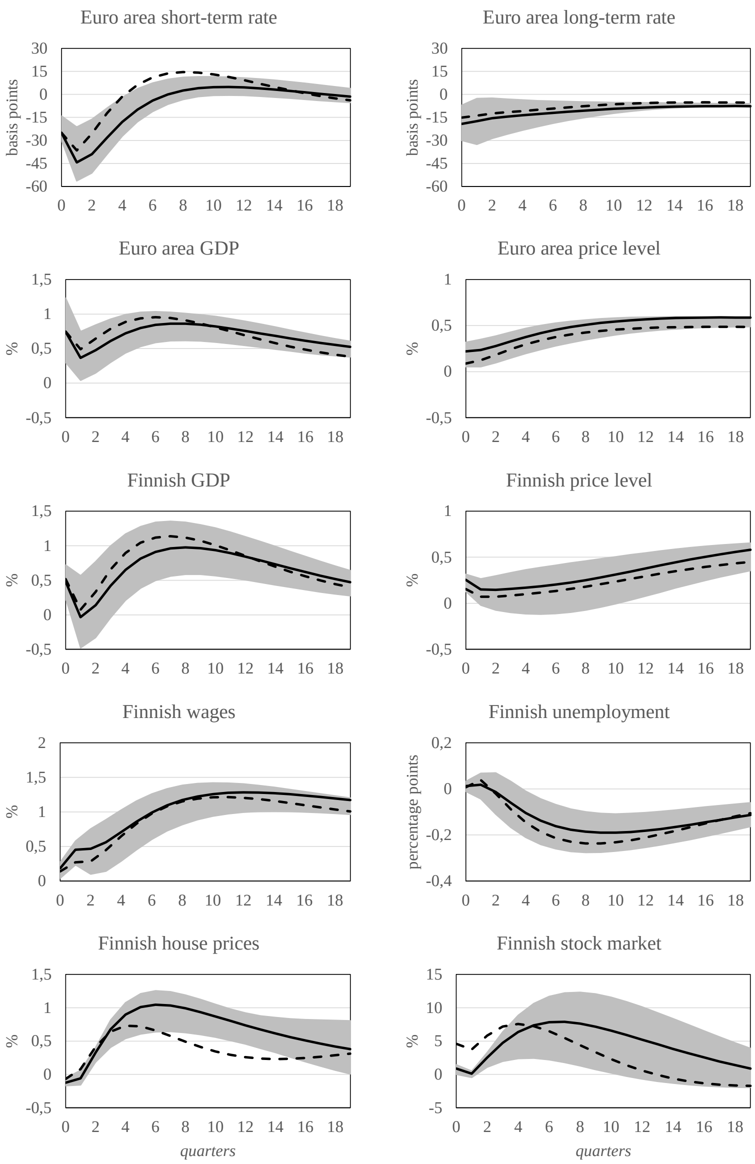

Figure C.1. Aggregate impulse responses to a 25 basis point expansionary conventional monetary policy (*MP*) shock. *Note:* Solid black lines denote period-wise median impulse responses, and grey areas denote 68% period-wise bands of the identified set in the baseline SVAR specification. Dashed black lines show period-wise median impulse responses computed from the alternative specification with the DAX index.

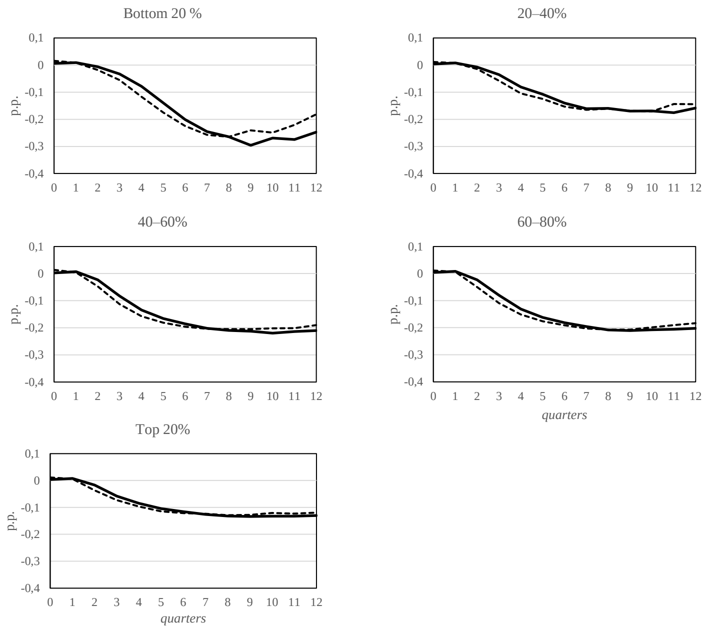

Figure C.2. Response of the unemployment rate to an expansionary conventional monetary policy (*MP*) shock of 25bp, in percentage point deviations from initial level, by gross income quintiles. *Note:* The solid lines show the disaggregated quintile-level responses that correspond to the period-wise median aggregate impulse response in the baseline SVAR specification, and the dashed lines show the corresponding quintile-level responses to the SVAR specification that includes the DAX index.

Gini coefficient	Specification	Initial	Quarters after shock		
			4	*8*	*12*
Gross income, %	Baseline	39.06	39.12	39.14	39.15
	With DAX	39.06	39.11	39.13	39.14
Net wealth, %	Baseline	66.20	66.36	66.40	66.33
	With DAX	66.20	66.40	66.31	66.21

Table C.1. Effects of a 25bp conventional monetary policy (*MP*) shock on income and wealth Gini coefficients under the baseline and the alternative specification.

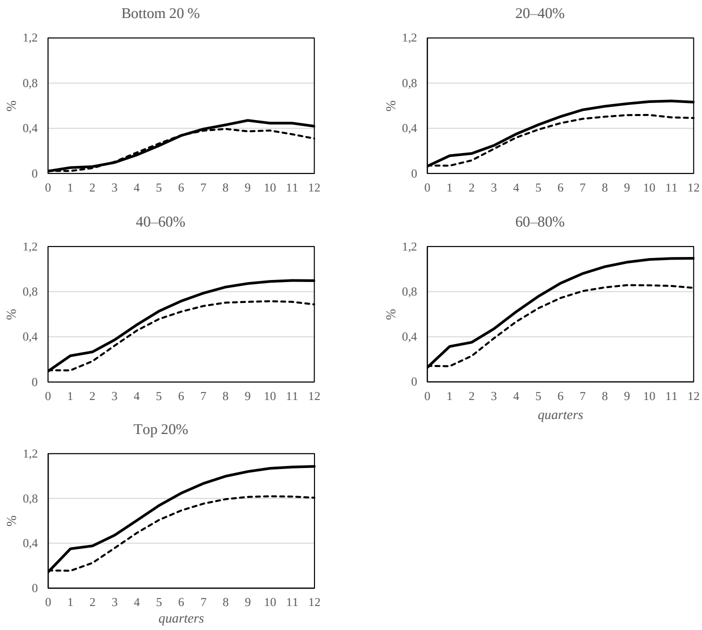

Figure C.3. Response of households' gross income to an expansionary conventional monetary policy (*MP*) shock of 25bp, in percent deviations from initial level, by gross income quintiles. *Note:* The solid lines show the disaggregated quintile-level responses that correspond to the period-wise median aggregate impulse response in the baseline SVAR specification, and the dashed lines show the corresponding quintile-level responses to the SVAR specification that includes the DAX index.

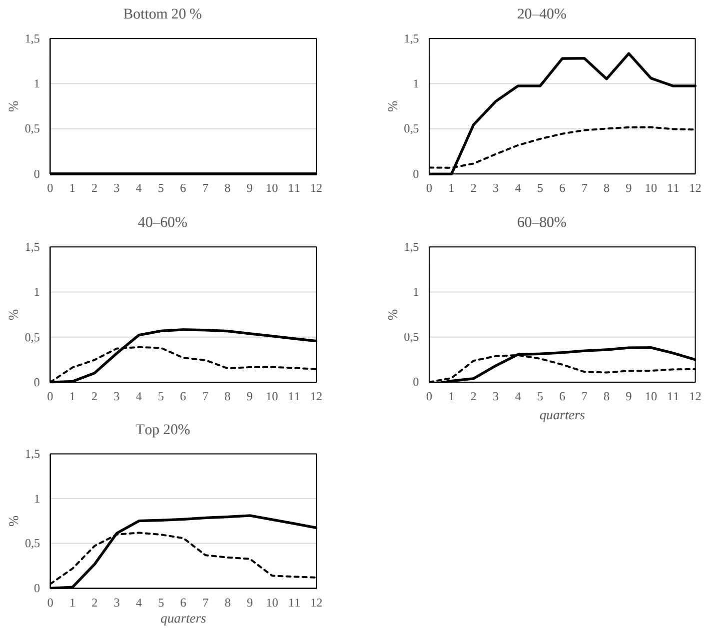

Figure C.4. Response of households' net wealth to an expansionary conventional monetary policy (*MP*) shock of 25bp, in percent deviations from initial level, by net wealth quintiles. *Note:* The solid lines show the disaggregated quintile-level responses that correspond to the period-wise median aggregate impulse response in the baseline SVAR specification, and the dashed lines show the corresponding quintile-level responses to the SVAR specification that includes the DAX index.

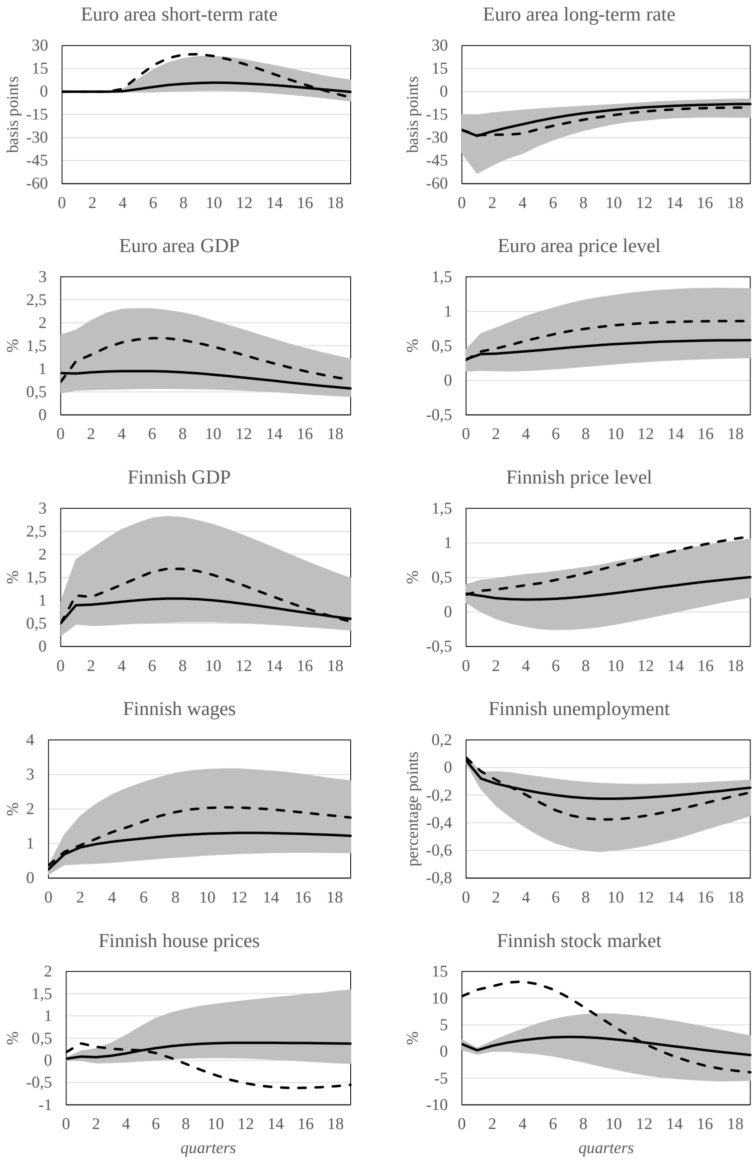

Figure C.5. Aggregate impulse responses to an initial 25 basis point compression of the term spread in the *QE* scenario. *Note:* Solid black lines denote period-wise median impulse responses, and grey areas denote 68% period-wise bands of the identified set in the baseline SVAR specification. Dashed black lines show period-wise median impulse responses computed from the alternative specification with the DAX index.

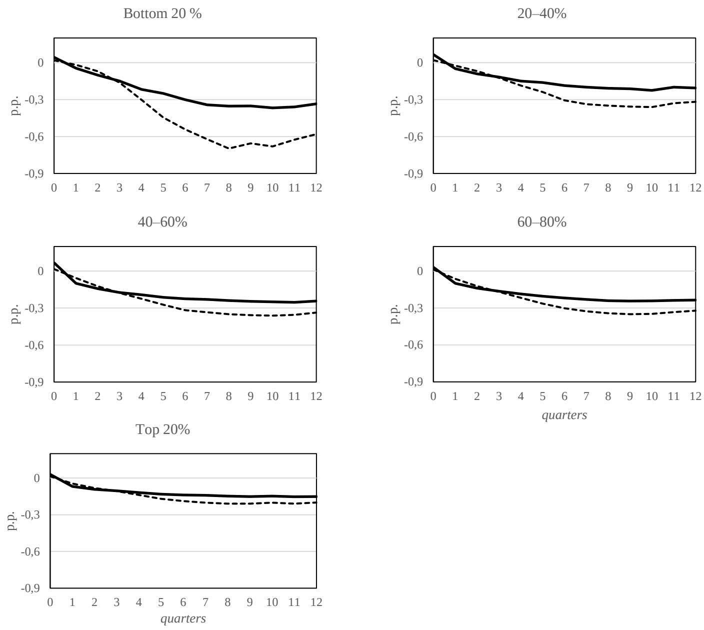

Figure C.6. Response of the unemployment rate to an initial 25 basis point compression of the term spread in the *QE* scenario, in percentage point deviations from initial level, by gross income quintiles. *Note:* The solid lines show the disaggregated quintile-level responses that correspond to the period-wise median aggregate impulse response in the baseline SVAR specification, and the dashed lines show the corresponding quintile-level responses to the SVAR specification that includes the DAX index.

Gini coefficient	Specification	Initial	Quarters after shock		
			4	*8*	*12*
Gross income, %	Baseline	39.06	39.14	39.14	39.15
	With DAX	39.06	39.16	39.16	39.18
Net wealth, %	Baseline	66.20	66.25	66.26	66.24
	With DAX	66.20	66.56	66.43	66.25

Table C.2. Effects of a 25bp quantitative easing (*QE*) shock on income and wealth Gini coefficients under the baseline and the alternative specification.

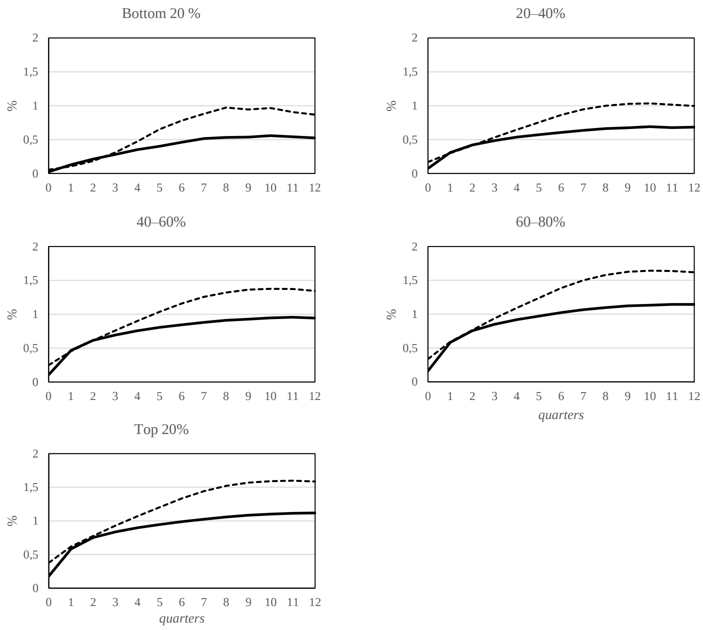

Figure C.7. Response of households' gross income to an initial 25 basis point compression of the term spread in the *QE* scenario, in percent deviations from initial level, by gross income quintiles. *Note:* The solid lines show the disaggregated quintile-level responses that correspond to the period-wise median aggregate impulse response in the baseline SVAR specification, and the dashed lines show the corresponding quintile-level responses to the SVAR specification that includes the DAX index.

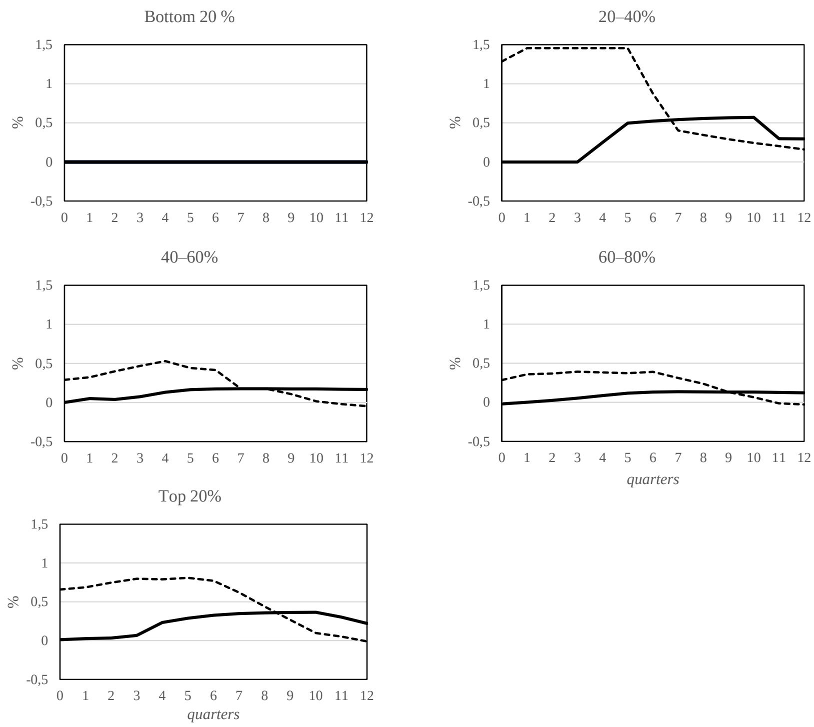

Figure C.8. Response of households' net wealth to an initial 25 basis point compression of the term spread in the *QE* scenario, in percent deviations from initial level, by net wealth quintiles. *Note:* The solid lines show the disaggregated quintile-level responses that correspond to the period-wise median aggregate impulse response in the baseline SVAR specification, and the dashed lines show the corresponding quintile-level responses to the SVAR specification that includes the DAX index.

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