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## Abstract

Monetary policy has implicit redistribution effects for households when households are different. This changes the aggregate consumption response to interest rate changes. This paper is the first to estimate the magnitude of redistributionary channels of monetary policy in the euro area. When households have heterogeneous MPCs and balance sheets, three redistributionary channels amend the standard consumption response to monetary policy – an earnings heterogeneity channel, an inflation-driven Fischer channel and a real interest rate channel. I construct a new dataset combining the ECB HFCS and the Eurostat HBS to obtain a representative euro area dataset with detailed information on household balance sheets and consumption. I use a unique question in the HFCS to calculate the sufficient statistics necessary to evaluate these redistribution channels. For the euro area the three redistribution channels enhance monetary policy – the effects of one time expansionary monetary policy shocks in stimulating consumption are stronger than in models without heterogeneity. In the euro area, a 1 percent decrease in the real interest rate redistributes wealth from creditors to debtors, and creates further income and price effects. This increases aggregate consumption through unequal exposure to interest rate changes, the price level and earnings respectively by 9 basis points, 7 basis points and another 2 basis points. Redistribution amplifies the monetary policy change and makes the aggregate consumption response 15 percent higher. The relative power of different channels of monetary policy is revised from the standard model - the redistribution channel with household heterogeneity makes up 14 percent of the total consumption response, while the aggregate demand and the substitution channel amount to respectively 53 and 33 percent. When households earnings react unequally to GDP changes, as estimated in the data, their heterogeneous individual earnings elasticities enhance this effect further and the share of the redistribution channel of earnings heterogeneity increases to between 20 and 27 percent. With heterogenous earnings elasticities redistribution amplifies the effects of monetary policy by up to 37 percent.

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Monetary policy has implicit redistribution effects for households when households are different. This changes the aggregate consumption response to interest rate changes. This paper is the first to estimate the magnitude of redistributionary channels of monetary policy in the euro area. When households have heterogeneous MPCs and balance sheets, three redistributionary channels amend the standard consumption response to monetary policy - an earnings heterogeneity channel, an inflation-driven Fischer channel and a real interest rate channel. I construct a new dataset combining the ECB HFCS and the Eurostat HBS to obtain a representative euro area dataset with detailed information on household balance sheets and consumption. I use a unique question in the HFCS to calculate the sufficient statistics necessary to evaluate these redistribution channels. For the euro area the three redistribution channels enhance monetary policy - the effects of one-time expansionary monetary policy shocks in stimulating consumption are stronger than in models without heterogeneity. In the euro area, a 1% decrease in the real interest rate redistributes wealth from creditors to debtors, and creates further income and price effects. This increases aggregate consumption through unequal exposure to interest rate changes, the price level and earnings respectively by 9 basis points, 7 basis points and another 2 basis points. Redistribution amplifies the monetary policy change and makes the aggregate consumption response 15% higher. The relative power of different channels of monetary policy is revised from the standard model - the redistribution channel with household heterogeneity makes up 14% of the total consumption response, while the aggregate demand and the substitution channel amount to respectively 53% and 33%. When households earnings react unequally to GDP changes, as estimated in the data, their heterogeneous individual earnings elasticities enhance this effect further and the share of the redistribution channel of earnings heterogeneity increases to between 20% and 27%. With heterogenous earnings elasticities redistribution amplifies the effects of monetary policy by up to 37%.

**Keywords:** MPC, Household balance sheets, Monetary policy transmission, Consumption Dynamics, Redistribution

**JEL:** D31, D52, E21, E52

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# I. Introduction

Households are different along many dimensions. They have different income, consumption and wealth. Increased interest in questions of inequality has contributed to a vast literature studying how macroeconomic policies affect these household characteristics. Households are also different in their household balance sheets and their composition - in the volume and types of assets and liabilities they hold. This type of household heterogeneity has also received some attention in the literature mainly in exploring the factors behind different portfolio choices of households. Yet these household heterogeneities have a more subtle effect - the differences between households may affect how macroeconomic shocks and policies transmit through the economy. This paper explores whether these differences between households in terms of their balance sheets change our standard understanding of monetary policy. This change is shown to be determined by the relationship between specific balance sheet positions of households and their consumption responses - as described by a classical macroeconomic object - the marginal propensity to consume (MPC) of households.

In this paper I use a new question from the ECB Household Finance and Consumption Survey (HFCS) to characterize how the heterogeneity of MPCs and of household balance sheets affects the reaction of consumption to monetary policy changes. Three sufficient statistics - in the form of three covariances, are required to characterize these additional effects and this paper is the first to evaluate these three covariances for the euro area. To calculate them I construct a new dataset that combines the ECB HFCS and the Eurostat Household Budget Survey (HBS) to obtain a representative dataset with detailed and exhaustive information on household balance sheets and consumption. I use a unique question in the HFCS to calculate the sufficient statistics.

An important recent trend in the macroeconomic literature has set a focus on the analysis of how aggregate effects of macroeconomic policy - such as changes in monetary or fiscal policy, are affected by redistribution across households with different marginal propensities to consume. This line of analysis reaches back far (e.g., Tobin (1982)) and is theoretically clear in terms of fiscal policy and budget policies with a redistributive aim. Much of the literature using representative agent models in macroeconomics, especially in what regards the transmission of monetary policy, has however ignored these redistributionary channels. A standard representative agent (RA) model ignores such channels and assumes that all households have the same MPCs. A two-agents New Keynesian model (TANK) with saver and spender agents assumes there are only two types of households with an MPC of either close to zero or one (Galí, Vallés, and López-Salido (2007)), so it also partly misses the full heterogeneity across the distribution of households. Recent contributions propose however theoretical models with incomplete markets (as in Kaplan, Moll, and Violante (2018)) that take into account fully the heterogeneity of households and can refine the intuitions of RA models about the channels through which monetary policy affects the economy. One important advantage of such models is their ability to replicate relatively higher MPCs that are documented in the microdata (Auclert, Rognlie, and Straub (2018)).

The increasing availability of micro data regarding households balance sheets, incomes and assets has made it possible to better discipline such models. Detailed household level micro data provides researchers with the opportunity to compare whether theoretical results are in line with the cross-sectional evidence of households balance sheets and portfolios. In an influential contribution, Auclert (2019) shows that certain redistribution channels affect the transmission mechanism of monetary policy to consumption when households are heterogeneous. These redistribution channels and their

magnitude can be captured through a number of sufficient statistics - the cross-sectional covariances between MPCs and different characteristics of the households along the dimensions of their asset holdings and balance sheets. An illustrative example of the importance of households heterogeneity in terms of MPCs is Slacalek, Tristani, and Violante (2020), which provide back of the envelope calculations using average estimates for several household groups' MPCs from existing surveys[1] to analyze how these affect overall macroeconomic outcomes after policy shocks.

In this paper, I make use of a specific survey question documenting the marginal propensity to consume of households in euro area countries, which is available in the third and fourth wave of the ECB Household Finance and Consumption Survey (HFCS). This question enables researchers to obtain the full distribution of MPCs across households in all countries of the sample. Until recently, exploring the importance and the magnitudes of the redistribution channels described below was limited by the lack of consistent data on MPCs across countries.[2] Building on this data and closely following the approach developed by Auclert (2019), I estimate how the heterogeneity of household balance sheets and MPCs across households in the countries of the sample affects the overall magnitude and composition of consumption responses to interest rate changes. In standard New Keynesian models with a representative household, the effects of an interest rate change are primarily driven by a response of consumption due to intertemporal substitution. Models with heterogeneity however find that the direct effects of monetary policy due to intertemporal substitution are quantitatively much smaller in comparison to the indirect, general equilibrium effects, as argued by Kaplan, Moll, and Violante (2018). In an incomplete markets environment heterogeneity between agents matters further for overall responses to macroeconomic shocks through additional channels that drive the changes in consumption and which are the main focus of this paper.

A small set of sufficient statistics can be used to characterize the sign and size of the redistributionary channels at work here - an earnings heterogeneity channel, an inflation-driven Fisher channel and a real interest rate exposure channel. Auclert (2019) derives a theorem that points how three channels enhance the effects of policy changes in a framework with household heterogeneity. To quantify these channels, three sufficient statistics can be used. They can be expressed as three covariances:

- Covariance between MPCs and an unhedged interest rate (URE) channel,
- Covariance between MPCs and individual incomes,
- Covariance between MPCs and net nominal asset positions (NNP) of households.

Using this sufficient statistics approach and my new dataset, I compute the magnitude of these redistributionary channels for the euro area. In the euro area, the three redistributionary channels work in the expected direction - the three household exposures are negatively related with MPCs and therefore they amplify the effects of monetary policy on consumption. A 1-percentage-point decrease in the real interest rate in the euro area, which redistributes wealth from creditors to debtors, increases aggregate consumption by 9 basis points through this redistribution channel alone. This channel is not present in a traditional representative agent (RANK) framework, where intertemporal substitution mainly drives the effects on consumption. In my estimation, the additional unhedged interest rate channel can be of a similar magnitude as the substitution channel if the intertemporal elasticity of substitution $\sigma$ is

[1] For an overview of the MPCs of different groups of households see their Table 1

[2] To the best of my knowledge the only available similar analysis is the study by Auclert (2019), which uses data for the US and Italy and the study by Kuchler and Crawley (2018) using new Danish data

relatively low. Furthermore, the two redistribution channels of earnings heterogeneity and net nominal asset holdings also have an elasticity that is significant and negative. A 1-percentage point increase in the aggregate income increases consumption by 2 additional basis points, as MPCs are unequal across the income distribution, and a 1-percentage point increase in prices increase consumption by further 7 basis points through the fact that MPCs are unequal across the net nominal positions of households.

I also look in detail into two individual countries - Italy and Germany, and find evidence consistent with previous results and the above results for the euro area. MPCs are lower with higher incomes, with higher net nominal asset wealth positions and with higher unhedged interest rate exposure - as expected from a theoretical point of view. The negative covariance between MPCs and the three dimensions of redistribution - income, net nominal positions (NNPs) and unhedged interest rate exposures (URE), all hold in these two countries. The same holds in most of the other countries in the sample. A hump-shaped relationship regarding the relationship between MPCs and households net nominal positions however can be documented in a number of countries, which is in line with previous findings regarding the behavior of wealthy hand-to-mouth households and the behavior of households with net debt. Indebted households, even if they have some considerable volumes of nominal assets, tend to have relatively low MPCs, because they spend any additional income on repaying debt instead of on consumption expenditure. I compute the elasticities of consumption in regards to the three redistributionary channels in Italy and Germany and for robustness in all countries. In most of the sample countries, the redistributive channels enhance the transmission of monetary policy to consumption by making it more potent - they make the effects of interest rate changes on aggregate demand stronger than assumed by models with a representative household.

To account fully for household heterogeneity, I furthermore relax one of my key assumptions that household incomes are equally affected by the aggregate output change - that the elasticity of household income to aggregate GDP changes is the same across households. In an accompanying paper (Pekanov (2024)), I calculate the first estimates of individual earnings elasticities in the euro area using individual level survey data from the HFCS. I impute these estimated earnings elasticities by income groups, but also use my newly created dataset ot earnings changes at the individual level, to explore how this further heterogeneity of earnings elasticities will amend my above results. Taking into account this fact - that households individual income reacts differently to aggregate fluctuations, increases considerably the magnitude of my earnings elasticity channel estimated above. The implicit redistribution thus matters even more for the transmission mechanism of monetary policy.

To understand the magnitudes of these redistributionary channels I also use a reduced form approach to compare the three redistributionary channels with the magnitude of the standard substitution and aggregate income channels from Representative Agent New Keynesian (RANK) models given a standard calibration. Indeed, the implicit redistribution channels change the monetary policy transmission mechanim - implicit redistribution accounts for between 14% and 27% of the aggregate consumption response when households are heterogenous.

## II. Empirical approaches

The literature on household heterogeneity has grown in recent years and covers the empirical measurements of these heterogeneities, the factors determining such differences and the broader macroeconomic implications from such differences between households. In this paper, I contribute to each of these branches.

There is by now extensive empirical literature documenting MPCs and the differences in households MPCs across the income distribution[3]. There are three main approaches to evaluate the consumption reactions of households to income shocks and recover empirical estimations of MPCs of households. The first branch uses direct survey questions to document the self-assessed reactions of households to unexpected changes in their income. Similar to the other alternative approaches, the data on MPCs gathered via self-reporting also has its shortcomings, discussed below - mainly the bunching and heaping of responses. In one of the seminal papers using this approach, Jappelli and Pistaferri (2014) use survey data from the Italian Survey of Household Income and Wealth (SHIW) to evaluate the consumption effects of various redistributionary policies.[4] Misra and Surico (2014) use UK data regarding self-reported MPCs to transitory income shocks to explore the variation of MPCs across the distribution of households. They document an asymmetry between the response to a positive and to a negative shock. Drescher, Fessler, and Lindner (2020) report and discuss the MPCs from the third wave of the HFCS, which I use below. They document that the average MPCs of households in the sample countries vary between 0.33 and 0.57. In line with the theory, MPCs decrease with income - which is also one of my central findings below. In this study, I use similar data regarding self-reported reactions to unanticipated income changes, but I cover the whole euro area using the HFCS. I contribute to the literature by extending the available HFCS dataset, which includes this MPC information, by accounting better for consumption, by computing after-tax incomes and by also imputing income elasticities of households based on their one period income changes, as discussed below.

The second line of studies uses a semi-structural approach to estimate MPCs by imposing restrictions on the variances and covariances of income and consumption and exploring how income changes of individuals lead to consumption changes. Blundell, Pistaferri, and Preston (2008), from now on BPP, evaluate these for the population of UK households. In a recent contribution, Kuchler and Crawley (2018) extend the BPP approach and implement it to Danish consumption and income data to predict the MPC of different household groups. They find an average MPC in the economy of 0.5, in line with the literature. However they also document large differences between different household groups associated with their levels of liquid wealth.

A third branch of the literature evaluates the consumption patterns following an exogenous shock to income by using situations similar to natural experiments. Johnson, Parker, and Souleles (2006) e.g. examine the changes in household consumption after the implementation of tax rebates in the US, given the variation in the timing of the actual receipt of the tax rebate. Their estimation around the 2001 tax rebates delivers estimations of the three month MPC of between 0.2 and 0.4. While such natural experiments present the most direct way of identifying exogenous shocks, other challenges arise from the fact that some of the tax rebates can be pre-announced and due to questions around the external validity of these estimates.

The following table summarizes reported values for the estimated average MPCs of three groups of households, which have been discussed in the recent literature as having distinct and important statistics in terms of MPCs and household portfolio balances - the poor Hand-to-Mouth, the wealthy Hand-to-Mouth and the non Hand-to-Mouth households (optimizing households).

[3]For a detailed overview see Jappelli and Pistaferri (2014)

[4]The Italian Survey of Household Income and Wealth (SHIW) is the Italian counterpart of the ECB Household Finance and Consumption Survey, used in this paper

Table 1: Estimates of the average MPC in the population and for different groups in previous studies

| Study | Type of MPC | Result | Approach |
|---|---|---|---|
| Jappelli and Pistaferri (2014) | Average Aggregate MPC | 0.48 | Italian Survey Data |
| | Poor HtM Households MPC | 0.62 | |
| | Wealthy HtM Households MPC | 0.58 | |
| | Non HtM Households MPC | 0.44 | |
| Fagereng, M. Holm, and Natvik (2018) | Poor HtM Households MPC | 0.43 | Lottery Winnings and administrative tax data from Norway |
| | Wealthy HtM Households MPC | 0.46 | |
| | Non HtM Households MPC | 0.32 | |
| | Aggregate MPC in period 0 | 0.51 | |
| | Aggregate MPC in period 1 | 0.18 | |
| | Aggregate MPC in period 2 | 0.10 | |
| Kaplan, Violante, and Weidner (2014) | Poor HtM Households MPC | 0.24 | |
| | Wealthy HtM Households MPC | 0.30 | |
| | Non HtM Households MPC | 0.13 | |
| Johnson, Parker, and Souleles (2006) | Quarterly aggregate MPC for non-durables | 0.25 | Natural experiment through taxes |
| | 6months aggregate MPC for non-durables | 0.34 | |
| Patterson (2023) | Aggregate MPC | 0.50 | |
| Ganong and Noel (2017) | Average aggregate MPC | 0.40 | Income and consumption data from JPM + identifying assumptions |
| McKee and Verner (2015) | MPC out of unemployment insurance benefits | 0.6 - 0.9 | Nielsen Consumer Panel data |

Another branch of the literature has made use of the whole universe of administrative data to analyse and estimate MPCs. Fagereng, M. Holm, and Natvik (2018) use the universe of Norwegian tax data to analyse responses of consumption and asset holdings for Norwegian households following another form of natural experiment - a surprise positive income shock in the form of a lottery winning. Since their result is based on analysing the consumption responses to lottery winnings, the income shock is truly unanticipated and random[5]. Fagereng, M. Holm, and Natvik (2018) find high MPCs for large parts of the population, especially for the groups of hand-to-mouth households. MPCs decrease with the increase of liquid wealth by group. Furthermore, Fagereng, M. Holm, and Natvik (2018) estimate the dynamic responses of consumption, income and saving along the liquid asset distribution of households. The authors document high MPCs not only in the contemporaneous period of the lottery winning, but also in the next period and are therefore the first to estimate the dynamic responses to unanticipated, transitory income shocks. Furthermore, they also find that indirect effects of monetary policy outweigh direct effects, which is in line with one of the major conclusions by Kaplan, Moll, and Violante (2018), albeit this indirect effect comes with a delay. I contribute to this questions as well by presenting new estimates below on the contribution of different channels of monetary policy to its aggregate effects.

In another contribution, Patterson (2023), using the PSID dataset for the US, characterizes different groups of workers and finds that young and low-income workers both have higher marginal propensities to consume and are most exposed to aggregate fluctuations. This exposure to aggregate fluctuations measures the sensitivity of individual or household level incomes to aggregate GDP changes and can

[5]It remains however unclear whether the responses to lottery winnings are the same as the responses to other unanticipated income changes

be percevied as the individual earnings elasticity to aggregate output changes. Patterson (2023) documents a tight link between earnings elasticities and MPCs - socioeconomic groups with higher earnings elasticities also have higher MPCs in the US according to her results. This important result means that aggregate GDP changes have overproportional effects on some groups and it is exactly these groups which then also respond more significantly in terms of adjusting their consumption. Patterson (2023) shows the quantitative importance of this channel and how it affects the size of the standard fiscal multiplier by increasing it by around 20%. In the first set of my estimations below, I assume that earnings elasticities are the same for all households - after an aggregate GDP change the income of all households increases in the same proportion. In an accompanying paper Pekanov (2024), I am the first to estimate heterogeneous earnings elasticities across the income distribution in the euro area. I then relax the assumption of constant earnings elasticities below and assume the earnings elasticities by income decile estimated in Pekanov (2024). I can therefore also calculate how this relationship - between heterogenous earnings elasticities and heterogenous MPCs, affects monetary policy transmission in the euro area.

How does this extensive evidence on the heterogeneity of MPCs across the distribution affect macroeconomic dynamics? The majority of the evidence from the literature above points toward a relatively high average MPC in the samples explored. From a theoretical perspective however, the baseline result for the consumption response to unexpected, one-off income shocks in the representative agent New Keynesian model (RANK) is very mild and MPCs are low. This result follows the assumption about the consumption-smoothing behavior of individuals, which according to the permanent income hypothesis do not react strongly to transitory income changes, as they should optimally smooth them over time through savings. This assumption, applied in representative agents models (RANK), means that MPC out of temporary income changes is very small and equals the annuity under quadratic utility. This result from RANK is however partly unrealistic - because a non-trivial part of the population is credit-constrained, these agents are not able to perfectly smooth their consumption and savings intertemporally. The literature addressed this by introducing rule-of-thumb, Keynesian households, which consume all of the additional transitory income they receive (Galí, Vallés, and López-Salido (2007), Bilbiie (2008)). This enabled these two agents models (TANK) to produce much higher average MPCs and therefore to deliver results closer to empirical estimates. Such MPCs were however not an endogenous result of the model, but calibrated by including the two extreme cases of households with MPC of close to 0 (Ricardian households) and MPC of 1 (hand-to-mouth households) in a proportion necessary to match empirical MPCs.

The new generation of heterogeneous agents New Keynesian models (HANK) aims to address this shortcoming by endogenously creating high MPCs in accordance with the empirics. In this line of models, incomplete markets give raise to credit constraints and make it impossible for households to be insured to all possible income shocks - a more realistic framework. Incomplete markets and uninsurable income risk then can also have important repercussions for the response of aggregate demand to macroeconomic shocks and policies (Werning (2015)). New solution techniques, such as using the impulse response to an MIT shock as a numerical derivative in sequence space (Boppart, Krusell, and Mitman, 2018, Auclert, Bardoszy, Rognlie and Straub, 2019), are then useful to solve these models. HANK models are able to replicate the higher MPCs from the empirical literature and also to match some important moments of the distribution of income or wealth, while also contributing to a better and new understanding of the mechanisms of monetary policy (Kaplan, Moll, and Violante (2018)) and fiscal policy (Hagedorn, Manovskii, and Mitman (2019)). They thus provide a useful theoretical

framework to analyse how inequality and macroeconomic policies interact. HANK models with two types of assets - liquid and illiquid, can best replicate high average MPCs, while also matching the persistence in the change of consumption after the shock (Auclert, Rognlie, and Straub (2018)). On the empirical side, Gelman (2016) provides robust evidence that the factor best explaining high MPCs is high holdings of liquid wealth. Carroll, Slacalek, Tokuoka, and White (2017) also point that high MPCs are connected to the fact that households hold little wealth despite the expected precautionary motive. This literature is related to my estimates below, as it provides a better understanding of the full macroeconomic adjustments after a monetary policy shock. It therefore can serve as a benchmark to which I compare the results obtained via the sufficient statistics approach developed by Auclert (2019) and examined in what follows for the first time for the euro area.

# III. Theoretical framework

In the following analysis, I follow closely the approach proposed by Auclert (2019) to characterize how household heterogeneity affects monetary policy. I only sketch and discuss the proofs, with the full set of derivations and proofs documented in Auclert (2019). To obtain a reduced form representation of the consumption response to monetary policy changes, Auclert (2019) proceeds as follows.

## 1. Life-cycle consumption choice

First, consider a simple life-cycle model, where the individual maximizes a separable utility function over consumption and labor. The individual obtains income through working for a wage $w$ and through unearned income $y$ and makes a decision on their household portfolio - whether to save in financial assets in the form of a nominal bond $B$ or a real denominated asset $b$. The Fisher equation holds so there can be no arbitrage between the nominal and real asset. There is no uncertainty - the exercise involves a perfect foresight model over the general level of prices $P$ and nominal wages $W$. A shock happens in the first period and does not happen ever again.[6] With non-satiable and separable preferences, the consumer problem is each period, given the current portfolio of assets, to choose consumption $c$, labor supply $n$ and amount of financial assets $b$ to save in for next period. The portfolio of financial assets is kept as general as possible and could include nominal assets - e.g. deposits, long-term bonds and typical mortgages, or real assets - stocks, inflation-indexed assets such as government bonds or adjustable mortgages.

A classical flow budget constraint for this problem can be rewritten using the terminal condition. Thus one obtains the result that lifetime consumption should equal lifetime financial wealth and lifetime human wealth, given in (1). Financial asset holdings in the form of nominal and real bonds are determined before the start of the period, as they are due to savings from last period. There are no bequests and the individual also cannot die with negative wealth. In this infinite horizon set-up, the composition of the household balance sheet does not matter for assets with the same net present value - e.g. there is no difference between adjustable-rate mortgage and fixed-rate mortgages if they have the same principle. However, directly after a shock, this composition will matter as the direct effects

[6]The shock is similar to a so-called MIT shock and also to the exercise used in Eggertsson and Krugman (2012).

will have price and adjustment effects, which will differ.

$$\sum_{t\geq 0} q_t c_t = \underbrace{\sum_{t\geq 0} q_t \left(y_t + w_t n_t\right)}_{\text{Human wealth } \omega^H} + \underbrace{\sum_{t\geq 0} q_t \left({}_{-1}b_t + \left(\frac{{}_{-1}B_t}{P_t}\right)\right)}_{\text{Financial wealth } \omega^F} = \underbrace{w}_{\text{Financial wealth}} \tag{1}$$

## 2. Monetary Policy Experiment and Household Exposures

Now consider an experiment that replicates the contemporaneous effects of an expansionary monetary policy shock - a one-off nominal interest rate decrease. The interest rate $R$ decrease happens in period 0 and has no persistence. This leads to the following outcomes - all nominal prices rise in proportion $dP$ in the current period and stay higher permanently, while all present-value real discount rates $q$ rise in proportion from next period. The Fisher equation holds. Unearned income $y$ and wages $w$ rise contemporaneously and only for one period. This is exactly the effect of the change in the standard representation of the basic New Keynesian model, as in Galí (2008) and Woodford (2003).[7] This experiment therefore results in a vector of changes $m$ given by $dR < 0$, $dY > 0$ and $dP > 0$.

My goal is to analyse how this experiment - an interest rate decrease, affects initial consumption $dc_0$. Defining $MPC = \frac{\partial c_0}{\partial y_0}$ and $MPS = 1 - MPC + w_0 MPN$, to a first order Auclert (2019) shows that the first order change in initial consumption is given by:

$$dc = MPC(d\Omega + \psi n dw) - \sigma c MPS \frac{dR}{R} \tag{2}$$

where d $\Omega$ is a term for the net-of-consumption wealth change, which summarizes all the balance sheet changes in the households balance sheet:

$$d\Omega = dy + ndw - \sum_{t>0} Q_t \left(\frac{{}_{-1}B_t}{P_0}\right)\frac{dP}{P} + \left(y + wn + \left(\frac{{}_{-1}B_0}{P_0}\right) + ({}_{-1}b_0) - c\right)\frac{dR}{R} \tag{3}$$

The consumption change $dc_0$ is driven thus by a standard substitution effect combining the MPS and the interest rate change, a labor supply effect and a wealth effect from the revaluation of balance sheets given by $d\Omega$, which interacts with the MPC. The term d $\Omega$ captures all household income and balance sheet terms and can be written separately - it is an expression of the net-of-consumption change of wealth and will be central for the sufficient statistics approach described below.

Each of the elements of this vector of changes in aggregates will affect and interact with three specific household balance sheet positions, as we show in the next subsection. These three positions or exposures of households are the net nominal asset position, the gross income of households and a term for what we define as the unhedged interest rate exposure (URE) of households. We define them as follows.

All changes in income to the individual - the unearned income change plus the wage income multiplied by hours worked, to take into account any labour supply reaction, can be rewritten as:

$$dY = dy + ndw + wdn \tag{4}$$

[7] See Figure 1 and Appendix A1 in Auclert (2019)

The nominal assets, which households hold, are given by the difference between nominal assets and nominal liabilities. After a change in nominal prices, households with positive nominal balance sheet positions will become less rich in real terms and households with negative nominal balance sheet positions become less indebted. The monetary policy change induces an aggregate prices change, which itself induces winners and losers across households. The importance of this channel has already been discussed and analysed in Doepke and Schneider (2006). This exposure of households describes the change in their net wealth from a price level change in the economy, also known as a Fischer revaluation effect.

$$NNP \equiv \sum_{t>0} Q_t \left( \frac{{}_{-1}B_t}{P_0} \right) \tag{5}$$

Finally, Auclert (2019) introduces a term to represent the direct exposure of household balance sheets and therefore households disposable income to a change in the nominal interest rate. This unhedged interest rate exposure (URE) measures the exposure to the interest rate change in this period by taking into account the maturing assets and maturing liabilities in the given period. URE is defined as follows:

$$URE \equiv y + wn + \left( \frac{{}_{-1}B_0}{P_0} \right) + ({}_{-1}b_0) - c \tag{6}$$

The difference between maturing assets and liabilities is the net saving requirement or net resource flow of the household for the given period. Importantly, this URE expression can exactly be obtained from the flow budget constraint from the consumer choice problem posed in (1). In each period, some portion of the assets of households mature - there are assets which pay out their principle and interest rate income, but also maturing liabilities for which the principle and the interest rate payments are due. If these assets are positive in sum, they are available for the household to decide to reinvest them - however under a lower interest rate after the interest rate cut we examine. And vice versa, for households for which the maturing liabilities are more than the maturing assets, in sum the interest that needs to be paid is lower, which constitutes a disposable income gain for these households. As is obvious, across this dimension of exposure to the unhedged interest rate, there are also winners and losers due to the monetary policy change.

## 3. The Response of Consumption to Overall Household Income Changes

Given the vector of changes in aggregates coming from the monetary policy change, their effect on the consumer environment and the balance sheet exposures of each household, the aggregate consumption response in period 0 can be described analytically. To derive this analytical expression, Auclert (2019) first uses Slutsky's equation on the expenditure function of the agent to decompose the reactions to the shock into a substitution and a wealth effect. The terms of the wealth effect are the components that correspond to the changes in the consumption environment due to aggregate changes and the household balance sheet exposures described above. All wealth effects can be separately described by this wealth change term, net of consumption, which multiplied by the marginal propensities deliver the aggregate effects on consumption.[8] By rewriting the terms for the marginal propensities and combining them with the household exposures and aggregate changes in the environment, the contemporaneous change to consumption can be expressed as:

[8] More details on this derivation are provided in the original paper

$$dc = M\hat{P}C\left(dY + URE\frac{dR}{R} - NNP\frac{dP}{P}\right) - \sigma c(1 - M\hat{P}C)\frac{dR}{R} \tag{7}$$

In a next step, it can be shown that the previous result holds under an environment of incomplete markets with idiosyncratic income risks. The incomplete markets set-up is based on the borrowing constraint that debt cannot go too negative - a standard borrowing limit constraint. In this set-up, the consumer can either be at an interior optimum of his problem, at the binding borrowing constraint or not able to access financial markets. In all these cases, Auclert (2019) shows that the consumption response continues to be in line with (2).

## 4. Aggregation and implicit redistribution

The next step considers aggregating the microeconomic consumption responses explored in the previous sections to general equilibrium of the economy to obtain macroeconomic aggregate dynamics after the monetary policy experiment discussed above. We consider a closed economy with a population of heterogeneous agents with separable preferences, their own discount factor, utility function and some form of idisyncratic uncertainty through a distribution of states for income. The agent receives some income through earned income - the real wage multiplied by hours worked and an unearned income from dividends. There is a fixed supply of capital $K$. Agents trade nominal and real financial assets. Goods in the economy are produced by a competitive firm for final goods and firms producing under monopolistic competition the intermediate goods. Aggregate production is equal to aggregate income. The government spends on government spending, issues debt via government bonds and targets a constant level of debt by adjusting taxes and transfers when necessary. Price level shocks with positive effects on the government balance therefore result instantly in a rebate back to households.

To achieve aggregation, we impose that in equilibrium the goods market, the capital market and the labour market clears. The market clearing conditions imposes also that all nominal positions in the aggregate net out except the one by the government, which has a positive steady state evel of debt set exogenously. Furthermore, in a closed economy the net nominal position and interest rate exposures across the distribution also net out since the assets of one agent are the liabilities of another. This crucial assumption enables the aggregation of microeconomic responses given by household balance sheet exposures to aggregate consumption.

My interest is on the aggregate consumption response to the vector of changes in aggregates described above based on the microeconomic responses of agents derived already. After aggregation, the first order response of consumption to the monetary policy change given by the vector of changes $dR < 0$, $dY > 0$ and $dP > 0$ is given by:

$$\begin{aligned} dC = & \underbrace{\mathbb{E}_I\left[\frac{Y_i}{Y}M\hat{P}C_i\right]dY}_{\text{Aggregate income channel}} + \underbrace{\text{Cov}_I\left(M\hat{P}C_i, dY_i - Y_i\frac{dY}{Y}\right)}_{\text{Earnings heterogeneity channel}} - \underbrace{\text{Cov}_I\left(M\hat{P}C_i, NNP_i\right)\frac{dP}{P}}_{\text{Fisher channel}} \\ & + \Big( \underbrace{\text{Cov}_I\left(M\hat{P}C_i, URE_i\right)}_{\text{Interest rate exposure channel}} - \underbrace{\mathbb{E}_I\left[\sigma_i\left(1 - M\hat{P}C_i\right)c_i\right]}_{\text{Substitution channel}}\Big)\frac{dR}{R} \end{aligned} \tag{8}$$

This expression shows us how the existence of heterogeneous households can enrich the transmission of monetary policy changes to consumption through three new channels. The three redistributionary channels can be described as follows. The interest rate exposure channel describes the relationship

between MPCs and UREs. When this covariance is different from zero, there is a relation between the position of the household in term of URE and their MPC. If for example households that need to borrow in this period in terms of their unhedged liabilities being higher than their unhedged assets (negative URE) have higher MPCs than agents that have a positive URE, as in (9), then this will enhance the consumption response to $dR < 0$ in addition to the standard intertemporal substitution effect.

$$\text{Cov}_I \left( M\hat{P}C_i, URE_i \right) < 0 \tag{9}$$

The Fisher channel describes household heterogeneity across nominal asset positions of households and its relation to MPCs. It implies a similar effect - net borrowers may have higher or lower MPCs than nominal net savers.

$$\text{Cov}_I \left( M\hat{P}C_i, NNP_i \right) < 0 \tag{10}$$

Again, if the covariance is negative, as in (10), this Fisher channel means that the redistributive effect of $dP > 0$ would increase the consumption response in comparison to standard models.

$$\text{Cov}_I \left( M\hat{P}C_i, Y_i \right) < 0 \tag{11}$$

Finally, an earnings heterogeneity channel describes the relationship between individual, household income and MPCs, which then determines the overall consumption effect. This channel is well-known and has already been discussed in numerous theoretical papers and frameworks, as well as in empirical studies. Werning (2015) explores the theoretical framework around earnings heterogeneity risk and its implications for macroeconomic aggregates. Guvenen, Ozkan, and Song (2014) examines the empirics of the cyclicality of earnings heterogeneity. Patterson (2023) explores how socioeconomic groups are affected differently from macroeconomic fluctuations. In this study for the US, Patterson (2023) then also examines the relationship between estimated earnings changes of different groups during recessions and the aggregate MPCs of these groups and finds a tight link. The fact that those groups with higher MPCs are most affected during recessions is evidence that this covariance is important and negative, as in (11).

The earnings heterogeneity channel however is more subtle that the other channels examined above. For the first two channels, the monetary policy change leads to a change in the environment given by changes in aggregate prices $dP$ and nominal interest rates $dR$, which affect all households along the respective balance sheet position directly. The change in aggregate income $dY$ however affects households indirectly - by leading to changes in their individual earnings, which can be expressed as the earnings elasticity $\gamma$ of individual income to aggregate GDP changes. As assumption therefore needs to be made whether these changes in individual earnings are proportionate to the aggregate change $dY$ and equal across the income distribution. Auclert (2019) assumes constant earnings elasticities $\gamma$ in his analysis. Patterson (2023) and Guvenen, Ozkan, and Song (2014) however present evidence for the

US that earnings elasticities are different across income groups and are higher for the lowest income bins. In an accompanying paper, I examine three different datasets and show with euro area data that earnings elasticities differ across the income distribution (Pekanov (2024)). Most importantly, one of my data sources is an extended version of the HFCS, where I use panel data to examine earnings changes of households across different periods. This data enables me further in this paper to relax the assumption of constant earnings elasticities and also explore its implications, which is a significant contribution of the present paper.

The decomposition in (8) shows us that a small number of sufficient statistics - in the form of covariances and expected values of products of variables, can describe in a reduced form the aggregate consumption response to any macroeconomic shock in the model. To put those in perspective, we can compare (7), and its extension in (8), with the case of a classical representative agent New Keynesian model. There is only one, representative agent in this-setup and therefore all the covariance terms expressed above equal 0. Therefore, the overall consumption is described only by the standard aggregate income and substitution effects, as given by:

$$dC = \underbrace{M\hat{P}CdY}_{\text{Aggregate income channel - GE}} \underbrace{-\sigma\left(1 - M\hat{P}C\right)C\frac{dR}{R}}_{\text{Substitution channel}} \tag{12}$$

Comparing the difference between (7) and (12) is the main result of this paper. To obtain such results, we need to calculate the above covariances. These covariances between MPCs and household balance sheet exposures can be calculated from detailed household surveys such as the US Survey of Consumption and Finance (SCF) or the Eurosystem's Household Finance and Consumption Survey (HFCS). In the data section I explain how a question in the third and fourth wave of the HFCS and the already existing detailed information on households' consumption, income and wealth, enable researchers to calculate these sufficient statistics for all euro area countries.

Auclert (2019) characterizes the expected sign of these three channels and what this implies for redistribution and monetary policy. He concludes and finds out, based on data for Italy and US, that all three channels show a negative correlation between MPCs and the exposure channels in question (URE, NNP and income). This means that the redistributionary channels, that would otherwise be ignored by a representative agent analysis, amplify the effects of monetary policy. In this paper, I use data from the HFCS, implement and extend his analysis of the sign and magnitude of these three channels for the euro area, as well as for separate countries.

## 5. Redistribution elasticities

Finally, the previous reduced-form expression can alternatively be rewritten and expressed in terms of elasticities. This is due to the fact that the products of expectations can be expressed as covariances.

Auclert (2019) shows that equation 7 can be rewritten in a reduced form with only moments estimable from microdata, based on only a few assumptions - that the elasticity of intertemporal substitution $\sigma$ is the same across individuals and that individual incomes elasticity $\gamma$ is the same across households relative to aggregate income. For a discussion on the theoretical implications of this specific assumption for incomplete markets see Werning (2015)). The equation can therefore be rewritten in terms of

elasticities:

$$\frac{dC}{C} = (M + \gamma \mathcal{E}_Y) \frac{dY}{Y} - \mathcal{E}_P \frac{dP}{P} + (\mathcal{E}_R - \sigma S) \frac{dR}{R} \tag{13}$$

To evaluate these moments then, one needs to find a way to evaluate the three elasticities $\mathcal{E}_Y$, $\mathcal{E}_P$ and $\mathcal{E}_R$ in the data. To do that, a measure for the unhedged interest rate (URE), the net nominal asset position (NNP) and income is needed. Table 2, similar to Table 1 in Auclert (2019), describes these elasticities and the cross-sectional moments in the data that feed into equation (8):

Table 2: Channels of effect of monetary policy

| | Definition | Name | Channel |
|---|---|---|---|
| $\mathcal{E}_R$ | $\mathrm{Cov}_I\left(MPC_i, \frac{URE_i}{\mathbb{E}_I[c_i]}\right)$ | Redistribution elasticity for R | Interest-rate exposure |
| $\mathcal{E}_R^{NR}$ | $\mathbb{E}_I\left[MPC_i \frac{URE_i}{\mathbb{E}_I[c_i]}\right]$ | −, No Rebate | − |
| $\widehat{S}$ | $\mathbb{E}_I\left[(1 - MPC_i) \frac{c_i}{\mathbb{E}_I[c_i]}\right]$ | Hicksian scaling factor | Substitution |
| $\mathcal{E}_P$ | $\mathrm{Cov}_I\left(MPC_i, \frac{NNP_i}{\mathbb{E}_I[c_i]}\right)$ | Redistribution elasticity for P | Fisher |
| $\mathcal{E}_P^{NR}$ | $\mathbb{E}_I\left[MPC_i \frac{NNP_i}{\mathbb{E}_I[c_i]}\right]$ | −, No Rebate | − |
| $\mathcal{E}_Y$ | $\mathrm{Cov}_I\left(MPC_i, \frac{Y_i}{\mathbb{E}_I[c_i]}\right)$ | Redistribution elasticity for Y | Earnings heterogeneity |
| $\mathcal{M}$ | $\mathbb{E}_I\left[MPC_i \frac{Y_i}{\mathbb{E}_I[c_i]}\right]$ | Income-weighted M P C | Aggregate income |

# IV. Data and measurement

In the next step, I explore the data available to characterize the sign and magnitude of the redistributionary channels in the euro area. I use the Eurosystem's Household Finance and Consumption Survey (HFCS) and extend it by merging it with the Eurostat Household Budget Survey along the bins of the household income distribution to obtain my full dataset. To obtain the necessary covariance measures I need data on the MPC of households, together with their consumption, income, assets and liabilities. I restrict my sample to only include those households with head of households between 25 and 64 years. All measurements are calculated using survey weights. The main results of this paper use the fourth wave of the HFCS.

The income measure can be taken from the data on total household earnings in the HFCS. The measure of income is total household gross income. This includes household employee income, self-employment income of all households members, rental income from real estate property, income from financial assets, income from pensions, income from regular social or private transfers, income from other sources and interest payments. I require both pre-tax and after-tax income, since the calculation of URE positions requires after-tax income data. I therefore compute an approximation of after-tax income for each household in the sample countries using the personal income tax rates reported by the OECD. [9]

The measure of unhedged interest rate exposure (URE) is a measure of the difference between incoming and outgoing maturing flows in the households balance sheets in each period. It consists of disposable income and maturing assets minus consumption and maturing liabilities. The URE is thus given by:

$$URE_i = Y_i - T_i - C_i + A_i - L_i \tag{14}$$

[9] This new measure of after-tax income is not perfect as it does not embed all details of the individual national tax systems, but should be a good enough approximation.

To compute the average amounts of assets maturing in the respective year, assumptions on the maturity of different asset types need to be made. I follow the baseline scenario assumed by Auclert (2019). The annual measure of maturing flows is then given by $1/N_j$, with $N_j$ being the average maturity of the asset type. For all type of deposits the base-line assumption is a duration of two quarters. Regarding maturing liabilities, the duration of credit card debt is assumed to be two quarters as well and on adjustable rate mortgages it is assumed to be three quarters. The measure of income after taxes is $Y_i - T_i$, which I computed above.

Consumption $C_i$ is a measure of household consumption throughout the period in question. The HFCS does not include a total consumption measure that can be divided into durable and non-durable consumption, which would be optimal for the aims of the study. The baseline consumption measure that can be calculated in the HFCS consists of annual expenditures on food spent at home, food spent outside home, amount spent on utilities, amount spent on consumer goods and services (excluding the already mentioned), amount spent on trips and holidays and the monthly amount paid as rent. The measure of consumption therefore does not encompass total expenditure of the household, but only these components. While not a complete measure of consumption expenditures, the consumption measure in the HFCS is similar to the one used by Blundell, Pistaferri, and Saporta-Eksten (2016), which includes food at home and away from home, utilities, car maintenance and public transport expenditure, childcare, healthcare and education. In all three surveys Auclert (2019) uses in his study - the SHIW, the PSID and the CE, the expenditure measure is also not complete. In the PSID it includes only non-durable consumption and in the CE survey it includes only food expenditures. Auclert (2019) argues that this should not systematically bias the results as long as any mismeasurement of the MPC and the cross-variable (URE, NNP and income) are additive and not correlated. Patterson (2020) also discusses the problem regarding the lack of measurement of total consumption in the PSID. To resolve it, Patterson (2020) uses the CE historical panel data to estimate total consumption as a demand function of food expenditure and demographic statistics (following previous work on this in Blundell et. al 2008, and Guvenen and Smith, 2014). The paper however also concludes that covariances between MPCs and socio-demographic statistics are not affected by the definition of consumption whether it is only food or total expenditures.

We therefore have a measure in the HFCS that covers household spending on services and non-durable goods. A trivial approach to solving this data mismeasurement would be to scale the consumption measure from HFCS upwards by a scalar given by the share of non-durable goods and services spending. The aggregate average shares for each category of consumption expenditures - durable, non-durable, semi-durable goods, and services is available from the national accounts statistics from Eurostat. The average shares for each sample country are reported for 2017 in the Table 1 in Appendix 1. This scaling up should then better reflect the overall expenditure and should theoretically reduce the mismeasurement of consumption because of the missing categories of semi-durable and durables consumption. This approach would however lead to a bias across the distribution, since the average shares spent on non-durable goods, mostly food, and e.g. services by low and by rich income households vary systematically. Using the data from the Eurostat Household Budget Survey (HBS), I show this is true in Appendix 2. The figures in Appendix 2 show this with the example of Belgium. Systematically, poorer households spend a higher shares of their income on non-durable goods and services, while richer households spend higher shares of their income on semi-durable and durable goods.

To overcome this problem of mismeasurement of consumption along the distribution of income in the

HFCS, I merge the HFCS with data from the Eurostat Household Budget Survey (HBS), which contains detailed micro evidence on consumption by consumption categories. Using the HBS, I calculate the shares of the different consumption categories – durable goods, semi-durable goods, non-durable goods and services, for all countries along the distribution of income of households. I calculate the average shares of the different consumption categories in overall consumption for the 100 bins of the household income distribution. I then impute the shares into the HFCS and scale up the consumption measure that is available in the HFCS along the same distribution. I find this step to be important since the consumption measure needs to be precisely measured to calculate the correct URE exposures and without this matching, consumption would be significantly undermeasured in my dataset.

The measure of the net nominal asset position (NNP) is obtained by taking the difference between total nominal financial assets and total nominal financial liabilities. The total financial assets, excluding public and occupational plans, and total financial liabilities are directly reported in the HFCS.

Finally and most essentially, the HFCS delivers a ready-to-use data on the marginal propensity to consume (MPC) of each household in the sample. The survey enables this by introducing a hypothetical question on the marginal propensity to consume of households. Survey respondents are asked the question:

*"Imagine you unexpectedly receive money from a lottery, equal to the amount of income your household receives in a month. What percent would you spend over the next 12 months on goods and services, as opposed to any amount you would save for later or use to repay loans?"*

The design of this question results in a ready-to-use self-reported estimate of the marginal propensity to consume of each household for a period of 12 months ($MPC_A$). The specific way of asking the question through the lense of an unexpected lottery winning embeds it well as a question on the reaction of households to an unexpected positive income shock. The self-reported estimates therefore already address the difficult econometric problem of identifying an unanticipated income shock, while not requiring any assumptions on the structural relationship between consumption and income, as in the structural approaches to estimating MPCs from the literature. It also delivers us a point estimate for MPCs for all households, thereby enabling the analysis of the factors that can influence these MPCs, as done further in the study. The question asks about overall spending by the household, so there is no distinction between durable and non-durable goods. This is exactly the variable that matters for aggregate spending changes in the economy and is therefore the suitable variable for this study on the effects of redistributionary channels of monetary policy.

Nevertheless, it is important to note that self-reported estimates of the MPC by households are not perfect. Figure 1 reports the distribution of MPCs for two individual countries - Italy and Germany. Figure 2 reports the distribution of MPCs for the euro area in our sample. The sample mean for the euro area is 42%, for Italy is 44% and for Germany it is 47% percent, in line with the evidence on average MPCs from other studies. As is obvious and is in many such surveys, there are two phenomena - heaping of answers towards round numbers (e.g. 10, 20, 80), but more importantly there is bunching of answers at three specific points - 0, 50 and 100. This can be understood as many households stating to behave either as Ricardian households, with an MPC of 0, as rule-of-thumb consumers, consuming half of the extra income with an MPC of 50, or as Keynesian households, consuming 100% of the extra income. This is also documented in Drescher, Fessler, and Lindner (2020). The heavy concentration of responses at these three responses reminds also of other studies, where the answers are only formulated in qualitative terms as either "mostly save" or "mostly spend". Furthermore,

there can be an important asymmetry in the responses to a positive and negative income shock, as documented by Bunn, Le Roux, Reinold, and Surico (2018). A further shortcoming of these MPC estimates is that they report the intentions of the households in question, which may not necessarily be the same as their actions in reality. Nevertheless, the results of the HFCS are the first estimates of self-reported MPCs that allow cross-country comparison in the euro area. Therefore I use the reported result as the statistic regarding the MPC of households.

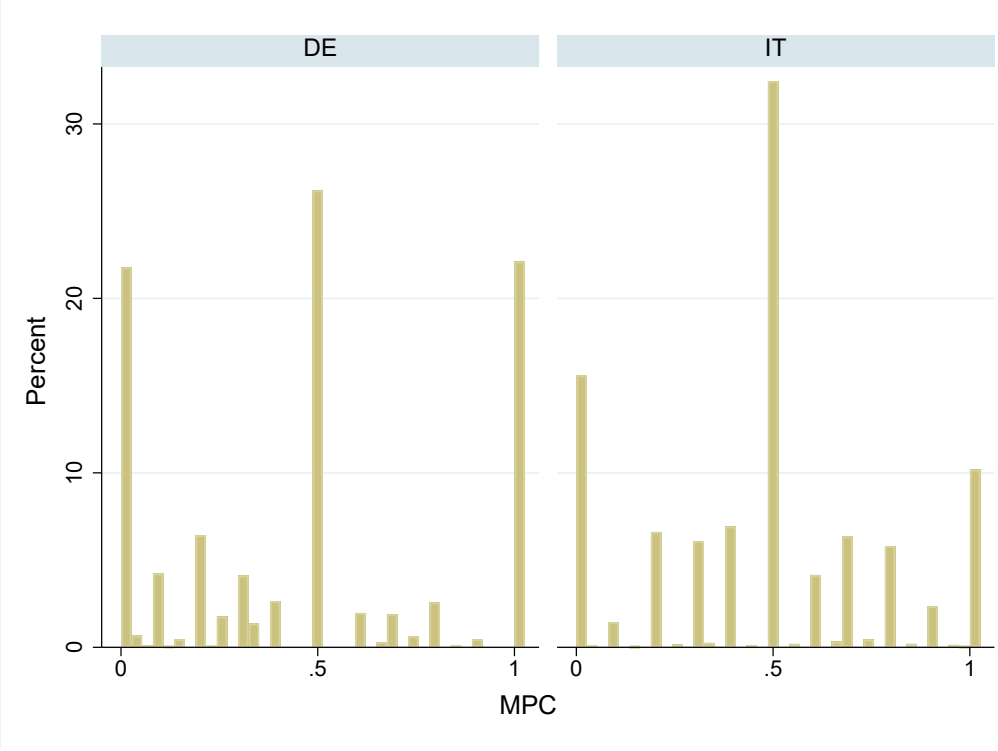


Figure 1: Distribution of the marginal propensity to consume of households in Germany and Italy. HFCS Fourth Wave.

In this paper, I examine the euro area as a whole, as well as two countries in more detail - Italy and Germany. The descriptive statistics for the euro area for households income, consumption, assets and liabilities are presented in Table 3. Data in the HFCS is gathered through personal interviews and all samples are representative. When aggregating for the euro area, I use 18 countries and the sample includes 32 728 households. For Germany the cross-section sample includes 2 333 households and for Italy - 3 398 households. To compare the different household balance sheet exposures across countries, I normalise them by average consumption in the country. Table 4 reports the summary statistics for the main balance sheet positions of households in Germany, Italy and the euro area.[10]

[10] All observations without a reported MPC value are dropped out of the sample.

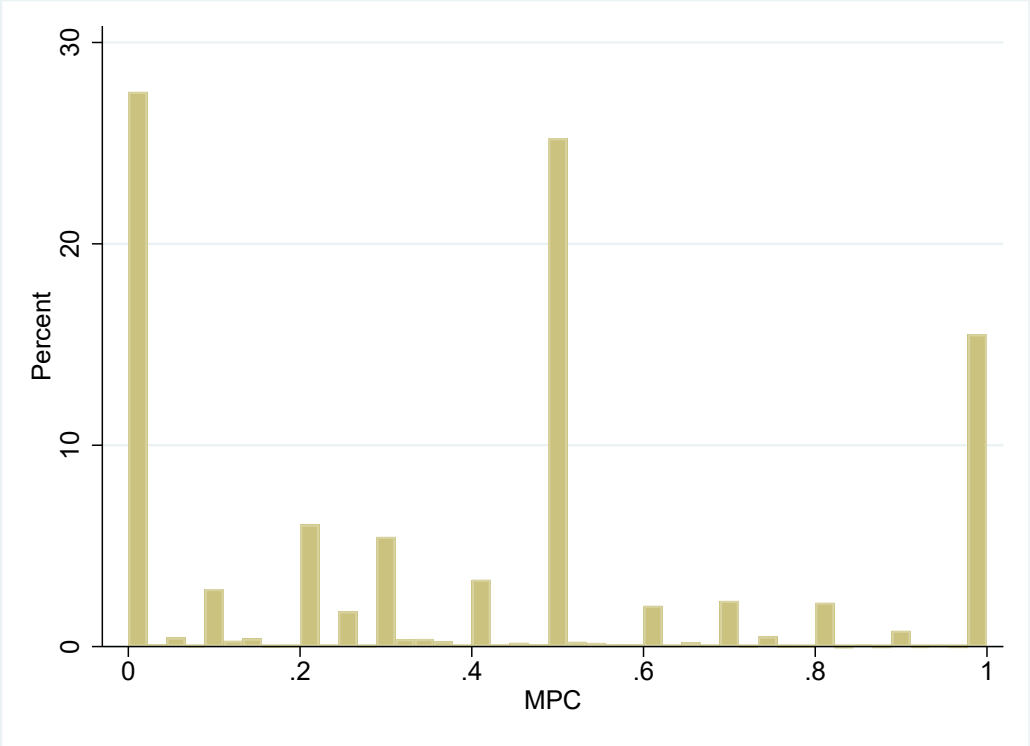


Figure 2: Distribution of the marginal propensity to consume of households in the euro area. HFCS Fourth Wave.

Table 3: Summary statistics for Euro area. HFCS Fourth Wave.

| | N | Mean | p5 | p25 | p50 | p75 | p95 |
|---|---|---|---|---|---|---|---|
| Net Income | | 40,884 | 5,630 | 18,100 | 32,730 | 52,900 | 99,326 |
| Consumption | | 19,444 | 6,395 | 11,553 | 16,692 | 23,974 | 40,994 |
| Maturing assets | | 58,043 | 0 | 3000 | 16,900 | 58,640 | 231,428 |
| Maturing liabilities | | 22,440 | 0 | 0 | 400 | 9,100 | 141,060 |
| URE | | 57,043 | -90,276 | 3,451 | 25,632 | 75,913 | 262,987 |
| Nominal assets | | 60,791 | 10 | 2,400 | 14,220 | 53,200 | 242,500 |
| Nominal liabilities | | 45,509 | 0 | 0 | 1,000 | 48,730 | 221,000 |
| Net nominal position | | 15,282 | -174,477 | -16,077 | 1,999 | 29,566 | 206,547 |
| Gross income | | 53,125 | 7,578 | 22,022 | 39,000 | 64,400 | 139,470 |
| MPC | 32 728 | 0.42 | 0.00 | 0.00 | 0.50 | 0.60 | 1.00 |

HFCS Fourth Wave. Units: Euros. All statistics are computed using survey weights.

## 1. Monetary policy experiment

This paper analyses the question how household heterogeneity changes the monetary policy transmission mechanism. The main idea is that with household heterogeneity different households due to their different balance sheet positions will be exposed differently to the change in macroeconomic aggregates following a monetary policy change. I assume that the monetary policy change is equal to an interest rate cut $dR$ = -1%. Furthermore, I assume that this $dR$ then also leads to an increase in aggregate GDP and therefore income of $dY = 0.4\%$ and increase in aggregate prices of $dP = 0.2\%$. These are the results broadly assumed to be the baseline outcome for a monetary policy change in a study conducted by leading central banks and international institutions (Günther (2012).

To put these numbers in context, let us simplify the full household distribution by taking a look at three extremes - the lowest earnings households given by the bin between the 5th and 10th percentile of the income distribution, the middle class households broadly defined as given by the bin between the 25th and 75th percentile, and the highest earners given by the bin between the 90th and 95th percentile. Figure 3 summarizes the data for the euro area for these three household types on their exposures in terms of their income, their unhedged interest rate position and their net nominal wealth. These are the average exposures of each of these three groups - low earning households, middle income households and top earning households. For each of these three types of households, Table 5 also reports the average change to their three balance sheet positions following the monetary policy change.

Importantly, the exposures in Figure 3 are not the same as the separate distributions per household balance sheet position - income, net nominal asset position and unhedged interest rate position. Figure 4 presents the exposures of the low end of the distribution, at the 5th percentile; the middle exposure, at the median; and the high end of the distribution, at the 95th percentile, along each of the household balance sheet positions separately. Figure 4 demonstrates how for the URE and the net nominal asset position, households at the two ends of the distribution have the opposite exposure. Given the same aggregate change in the macroeconomic environment, they will thus be affected in different directions - there will be winners and losers from this aggregate change, as already discussed.

The monetary policy experiment leads to the changes in macroeconomic aggregates described above. Each of the changes in these macroeconomic aggregates relates to one of the household exposures. This leads to a change in the household balance sheets. Table 7 reports these changes as well. As is obvious, households at the two ends of the income distribution, may be affected differently from this monetary policy change. The aggregate output change leads to a change in income which is proportional, because we assume all individual earnings react in the same magnitude $\gamma$ to the aggregate income change. This is an assumption I relax later. Second, households at the low end of the income distribution profit from the change in interest rate because it reduces their interest rate payments on those assets which are maturing in the given period. For the richest households the effect is the opposite - since these households in general profit from interest rate payments on their interest rate bearing assets, they now receive less in such payments. For the third channel, the net nominal wealth, inflation erodes the real value of nominal assets. This effect is positive for the poorest households, since they are net indebted in terms of nominal net positions. Their debt is eroded in real value by the increased price level $dP$. Rich households on the other side lose in real terms, because they have positive and considerable net wealth. Its value diminishes from the higher price level in the economy. In the next stage, these heterogeneous exposures to the interest rate change have an aggregate effect - through their effect on

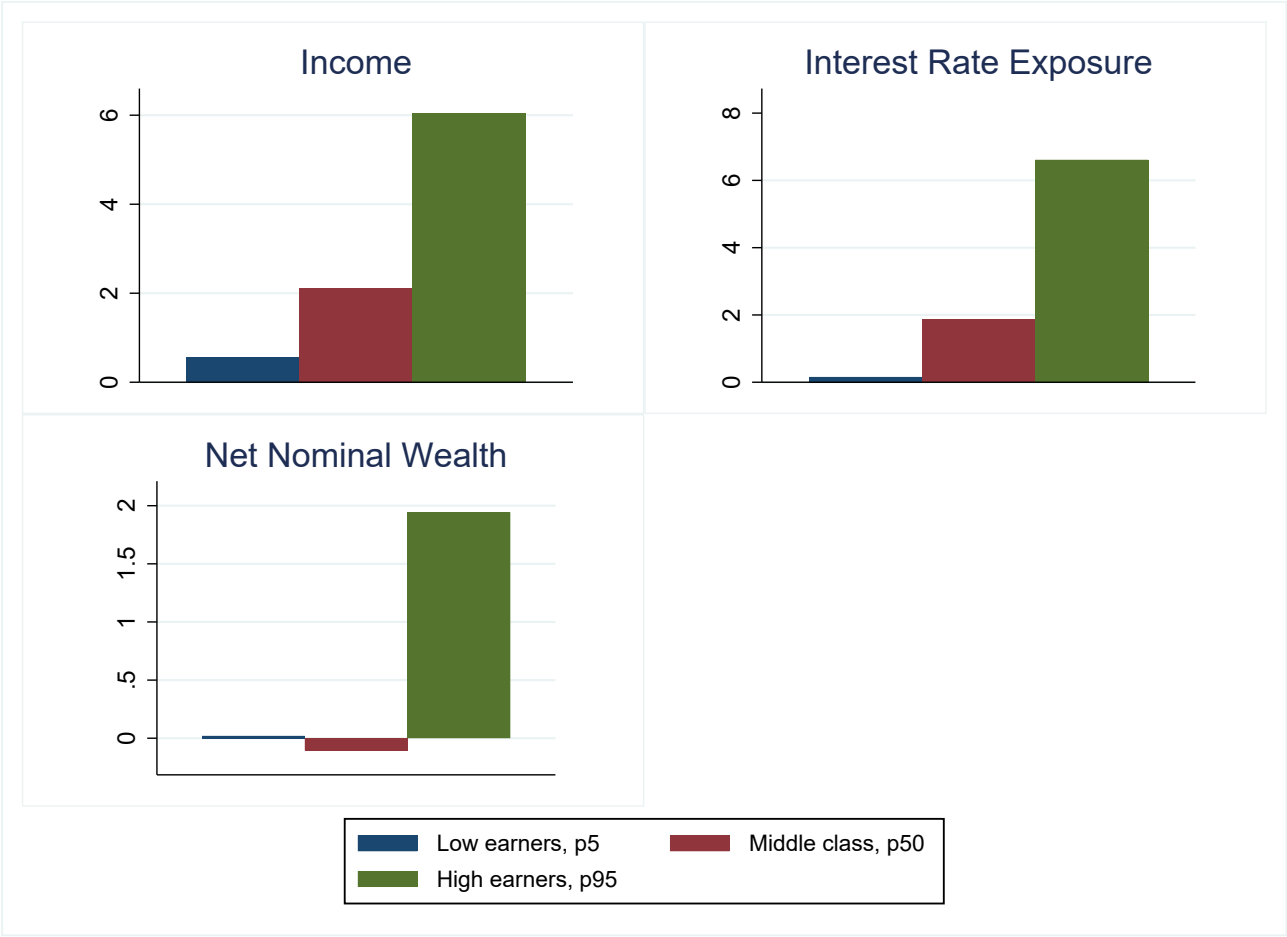


Figure 3: Main household balance sheet positions of households at the low end, the middle and the high end of the income distribution (in relation to average consumption).

consumption of these households. This effect on consumption is at the core of the analysis in this paper.

Table 4: Main summary statistics scaled by mean consumption.

| **Variable** | **Italy** | | **Germany** | | **Euro area** | |
|---|---|---|---|---|---|---|
| | **mean** | **sd** | **mean** | **sd** | **mean** | **sd** |
| Net income (NY) | 1.55 | 1.89 | 2.91 | 2.16 | 2.12 | 1.96 |
| Consumption (NC) | 1.00 | 0.76 | 1.00 | 0.57 | 1.00 | 0.64 |
| Maturing assets (NB) | 2.97 | 16.37 | 3.24 | 7.45 | 3.00 | 9.86 |
| Maturing liability (ND) | 0.70 | 2.51 | 0.52 | 2.31 | 1.37 | 4.77 |
| Unhedged interest rate exposure (NURE) | 2.82 | 16.93 | 4.62 | 8.52 | 2.75 | 11.17 |
| Nominal assets | 3.39 | 22.75 | 3.75 | 7.66 | 3.10 | 13.26 |
| Nominal liability | 1.49 | 3.90 | 2.02 | 6.10 | 2.44 | 5.65 |
| Net nominal position (NNNP) | 1.90 | 22.76 | 1.74 | 9.15 | 0.66 | 14.01 |
| Gross income (NINC) | 2.50 | 4.00 | 3.45 | 3.37 | 2.75 | 3.06 |
| Marginal propensity to consume (MPC) | 0.49 | 0.30 | 0.47 | 0.36 | 0.42 | 0.35 |

Source: HFCS Fourth Wave. All statistics are computed using survey weights.

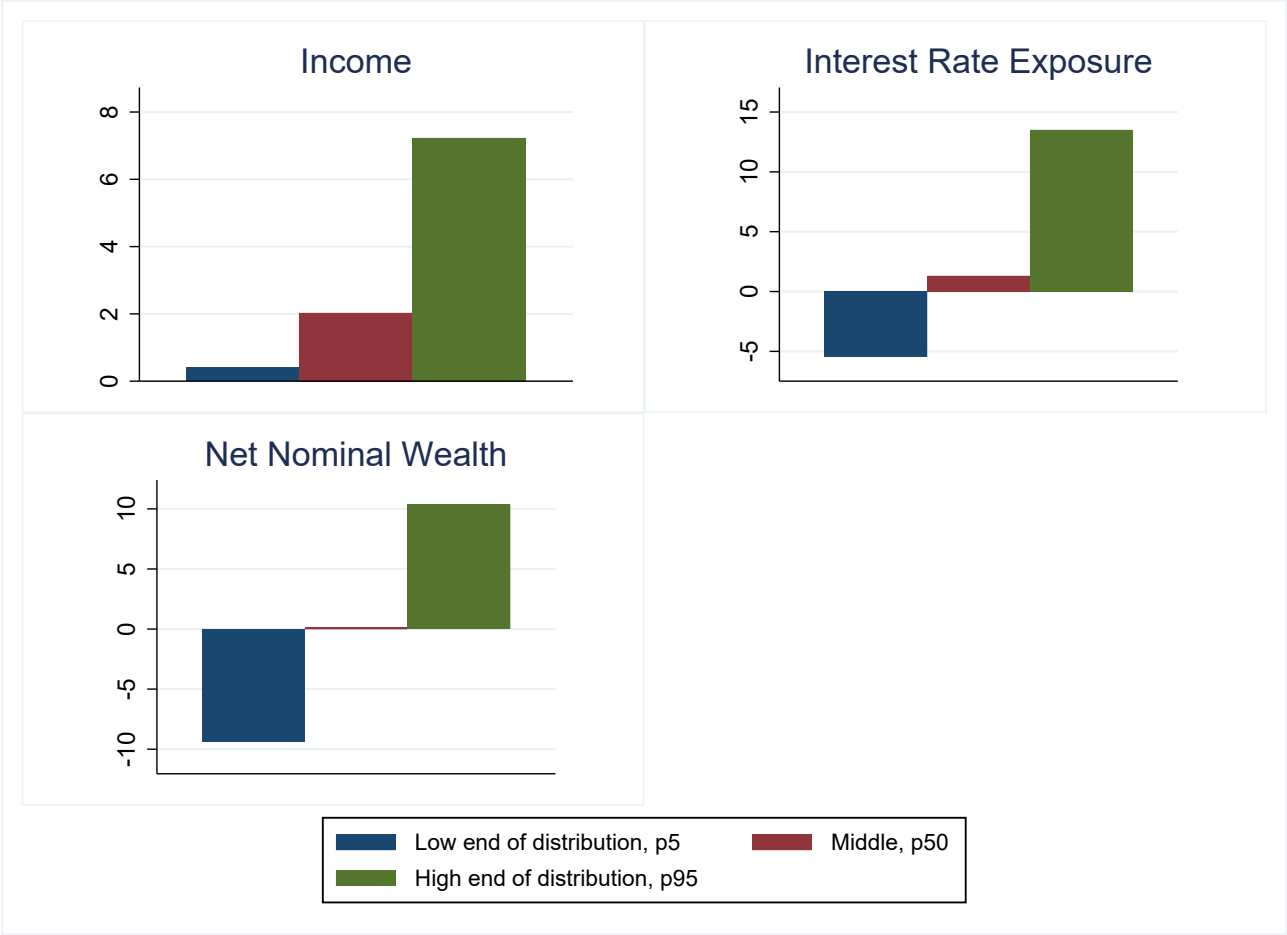


Figure 4: Main household balance sheet positions of a household at the 5th, 50th and 95th percentile of each distribution of positions (in relation to average consumption).

Table 5: Changes in household balance sheet positions due to the monetary policy experiment. HFCS Fourth Wave.

| | Mean | p5 | p50 | p95 |
|---|---|---|---|---|
| Income | 53 126 | 7 578 | 39 000 | 139 470 |
| Δ Income | 212 | 30 | 156 | 558 |
| Interest Rate Exposure (Maturing) | 57 043 | - 90 276 | 25 632 | 262 988 |
| Δ Interest Rate Exposure | -570 | 902 | -256 | -2629 |
| Net Nominal Wealth | 15 282 | -174 475 0 | 1 999 | 206 548 |
| Δ Net Nominal Wealth | -31 | 349 | -4 | -413 |
| Δ Income Heterogeneous | 212 | 106 | 234 | 335 |
| All statistics are computed using survey weights. | | | | |

# V. Empirical results

## 1. Italy and Germany

I start by analysing the results from two individual countries in detail - Italy and Germany. The results from Italy can be directly compared with those from Auclert (2019), which uses a similar dataset - the Italian Survey of Household Income and Wealth (SHIW), a part of the HFCS. For Germany, I provide the first available estimates and compare those with the conclusions in Auclert (2019). In each of the following results, households are binned in 100 bins according to their position in the distribution of the exposure in question (either URE, NNP or income). In each of the following graphs, the horizontal axis represents the average value for the given exposure for a given bin, normalized by average consumption, and the vertical axis represents the average value of the reported MPCs for this household bin.

Starting with Italy, I compare the results obtained with the fourth wave of the HFCS, with the results of Auclert (2019). Figure 5 shows graphically the relationship between average MPCs per income bin and the average exposures of households in this bin for each of the three balance sheet positions - URE, net nominal asset position and income. The three covariances between MPCs and the three redistributive channels are negative and work in the expected direction - the relationship of MPCs with the unhedged interest rate exposure, with the net nominal asset positions of households and with idiosyncratic income are all negative. This graphical representation points that the three sufficients statistics in (9), (10) and (11) are all negative. The three redistributionary channels thus amplify the effects of monetary policy changes on consumption through household heterogeneity. In Table 6 I report the estimated cross-sectional moments that characterize the seven channels through which monetary policy works, based on Equation 1. The results are slightly stronger than the ones reported by Auclert (2019). Auclert (2019) estimates them to be equal to $\widehat{E_R}$ = -0.11, $\widehat{E_P}$ =-0.07 and $\widehat{E_Y}$ = -0.05. Thus the redistributionary channels affect the transmission mechanism to a higher extent than when using the data from 2010.

Table 6: Estimates of the cross-sectional moments describing the different channels of monetary policy in Italy

| Channel | **Estimate** | **95% C.I.** |
|---|---|---|
| Interest rate exposure $\widehat{E_R}$ | -0.39 | [-0.63, -0.15] |
| Substitution channel $\widehat{S}$ | 0.52 | [ 0.50, 0.54] |
| Fisher channel $\widehat{E_P}$ | -0.44 | [-0.66, -0.22] |
| Earnings heterogeneity $\widehat{E_Y}$ | -0.16 | [-0.22, -0.10] |
| Aggregate income $\widehat{M}$ | 1.07 | [ 1.01, 1.13]] |

Source: HFCS Fourth Wave. All statistics are computed using survey weights.

Turning to Germany, Figure 6 plots again graphically the relationship between MPCs and the three exposures of households. The linear relationship again resembles a negative direction, but all three relationships are flatter. The negative correlation between MPCs and each of the three exposures is thus weaker in Germany. Table 7 reports again the elasticities of the three channels, following Equation 1. The URE and the NPP channels are lower in terms of elasticities for Germany and are closer to those estimated in Italy in Auclert (2019). The income heterogeneity channel however is not

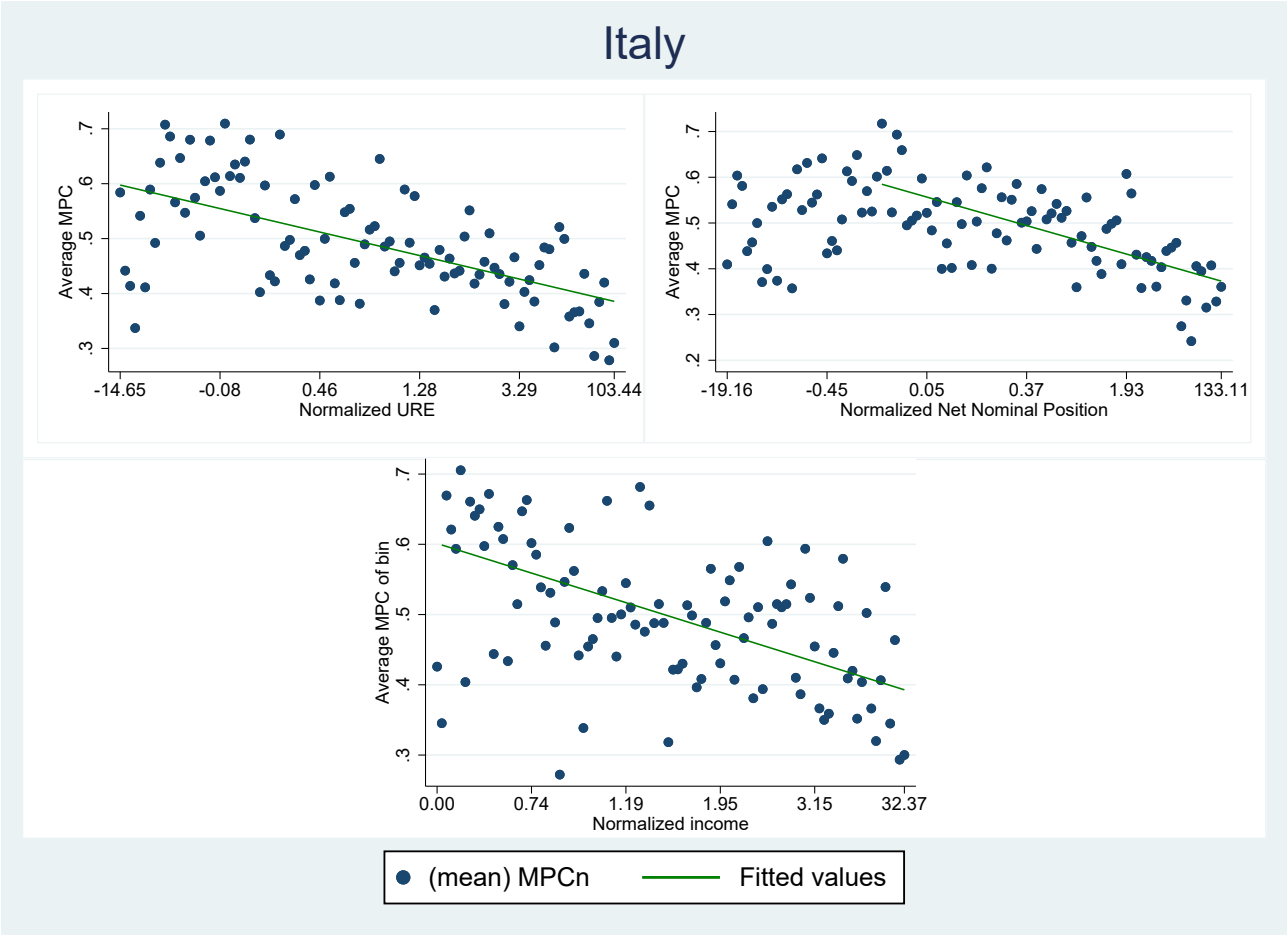


Figure 5: Marginal propensities to consume and household balance sheets, Italy
Source: HFCS Fourth wave. The x axes report mean exposure per bin (all exposure measures are normalized by average consumption). The y axis reports mean MPCs for each of the 100 bins.

significantly different from 0. The magnitude of the three redistribution channels therefore can vary across countries. Exploring how different country specific characteristics determine this variation is an important path of future work.

Table 7: Estimates of the cross-sectional moments describing the different channels of monetary policy in Italy and Germany

| Channel | **Italy** | **Germany** |
|---|---|---|
| Interest rate exposure $\widehat{E_R}$ | -0.39 | -0.17 |
| Substitution channel $\widehat{S}$ | 0.52 | 0.53 |
| Fisher channel $\widehat{E_P}$ | -0.44 | -0.16 |
| Earnings heterogeneity $\widehat{E_Y}$ | -0.16 | 0.01 |
| Aggregate income $\widehat{M}$ | 1.07 | 0.65 |

Source: HFCS Fourth wave. All statistics are computed using survey weights.

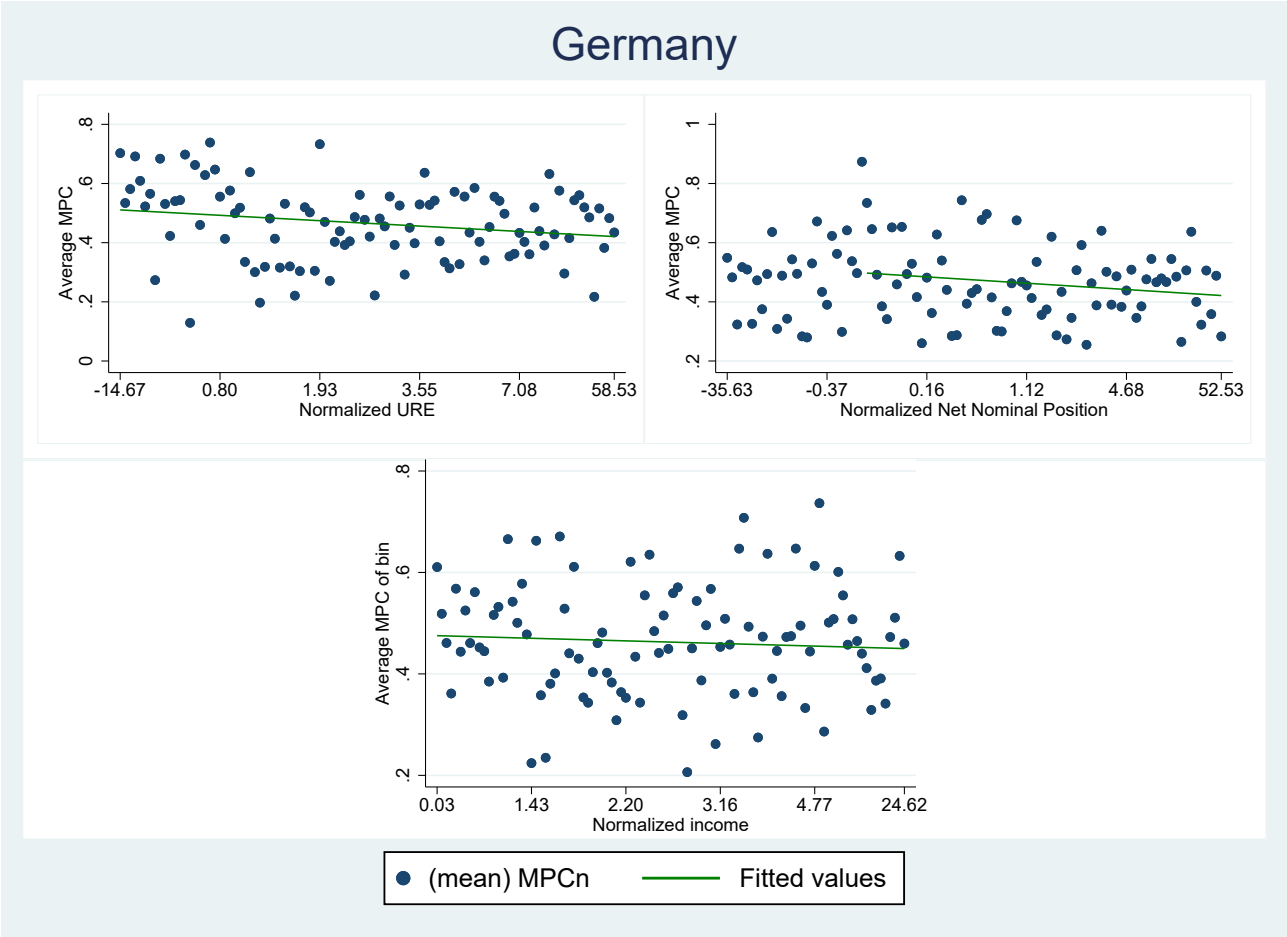


Figure 6: Marginal propensities to consume household balance sheets, Germany
Source: HFCS Fourth wave. The x axes report mean exposure per bin (all exposure measures are normalized by average consumption). The y axis reports mean MPCs for each of the 100 bins.

## 2. Euro area

After having evaluated the redistributionary channels for some individual countries, I now also implement the same exercise for the euro area as a whole. These aggregated results may hide some country-specifics in terms of household balance sheets, but give a good perspective for the overall sign of the redistribution channels in the euro area as a whole. I pursue in the same way - I report the correlations between MPCs and the three redistributionary channels and then calculate the elasticities of the three redistributionary channels. The graphical representations below construct 100 bins to group households along each of the three household exposures. The grouping is done at the country level.

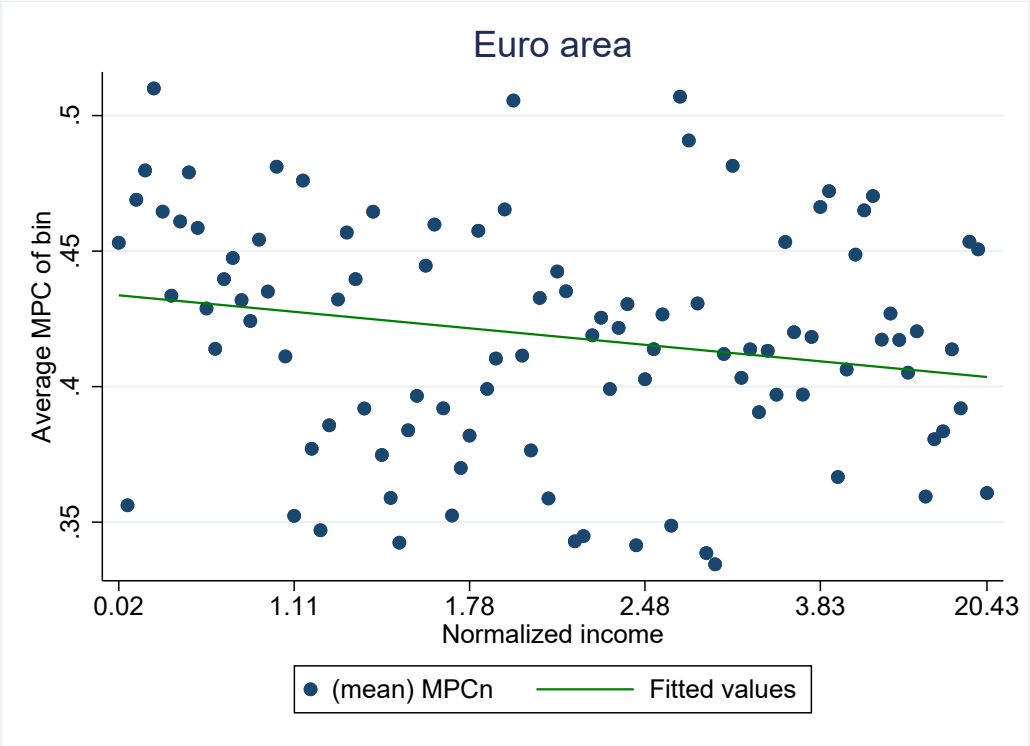


Figure 7: Marginal propensities to consume and total household income, Euro area
Source: HFCS Fourth wave. The x axes report mean exposure per bin (all exposure measures are normalized by average consumption). The y axis reports mean MPCs for each of the 100 bins.

We again observe similar relationships as those for the individual countries. Household MPCs and income pose a clear negative correlation (Figure 7). The same also holds for the unhedged interest rate exposures of households and MPCs (Figure 8), while for the net nominal positions, the negative correlation holds, but particularly so for households with positive net nominal positions (Figure 9). This is due to the way the question is posed in the survey. If households intend to repay back part of their accumulated debt this would not be measured as part of their additional spending which they report for the MPC question. Households with negative net nominal positions - especially if they are heavily indebted with more liabilities than assets, will likely use a certain part of an unexpected transitory income shock to repay back existing liabilities. This does not count as spending according to the way the specific question about MPCs is asked, so these households have a lower MPC on average than the households directly above the zero NNP threshold.

I then calculate the elasticities of consumption along the three redistributionary channels, as well as the elasticities in regards to the two classical channels of aggregate income and substitution. The

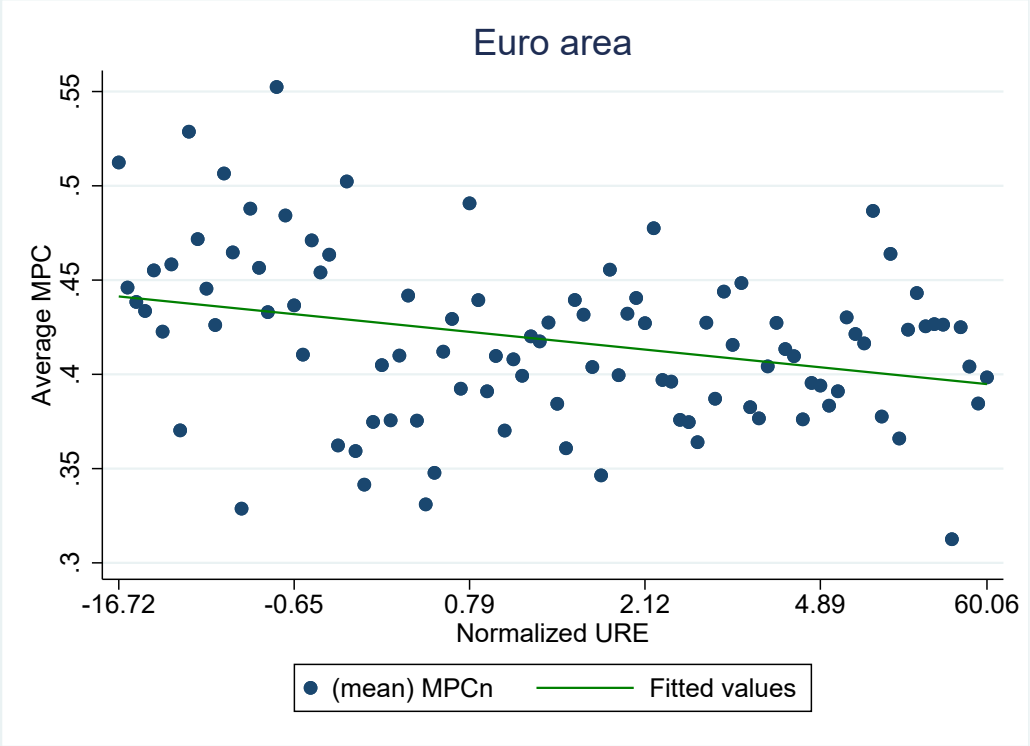


Figure 8: Marginal propensities to consume and unhedged interest rate exposure (URE), Euro area Source: HFCS Fourth wave. The x axes report mean exposure per bin (all exposure measures are normalized by average consumption). The y axis reports mean MPCs for each of the 100 bins.

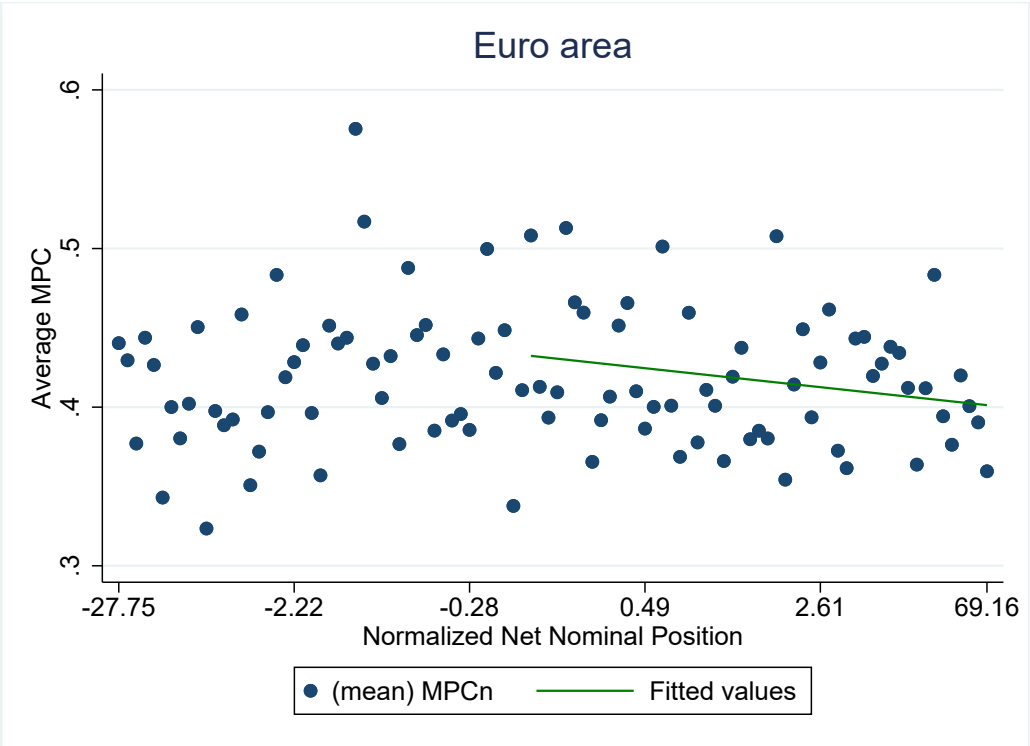


Figure 9: Marginal propensities to consume and the net nominal asset position (NNP), Euro Area Source: HFCS Fourth wave. The x axes report mean exposure per bin (all exposure measures are normalized by average consumption). The y axis reports mean MPCs for each of the 100 bins.

results are reported in Table 8 and compared with the results in Auclert (2019) for Italy. They can be interpreted in the following way. In the euro area, a 1-percentage-point decrease in the real interest

rate, by redistributing wealth from creditors to debtors, increases aggregate consumption by 9 basis points due to the interest rate exposure redistribution channel. This is slightly lower than the result in Auclert (2019).

Since this additional amplification through unhedged interest rates is an addition to the classical effect of interest rate changes through intertemporal substitution, one can compare the magnitudes of the two channels. As derived in (8), to compare the two, the standard substitution channel needs to be scaled down by the intertemporal elasticity of substitution (IES) $\sigma$. One can pin-point a break-even $\sigma$, which makes the two channels equal. For the case of the Euro area, the break-even $\sigma$, which leads to similar magnitudes of the two channels, is 0.16. This value is at the lower end of most assumptions about this parameter, therefore the traditional channel is expected to still be bigger than the URE channel, but depending on the value of the IES parameter it could be relatively close. For the rest of the calculations in this paper I would assume a relatively higher $\sigma = 0.5$ in line an assumption often made in the macro literature.

The other two redistribution channels - through net nominal asset holdings and through earnings heterogeneity, contribute respectively to further 7 and 2 basis points effect of consumption, as MPCs are unequal across the net nominal positions of households and are unequal across the income distribution. The Fisher channel is the same magnitude as in Auclert (2019), while the earnings heterogeneity channel is much lower.

Summing up the results of the three additional channels, redistribution amplifies the monetary policy change and makes the aggregate consumption response 15% higher. While in our representative agent case aggregate consumption will increase by 0.75% after the standard monetary policy change examined above, with household heterogeneity in balance sheet exposures, the total consumption increase is 0.86%.

Table 8: Estimates of the elasticities describing the different channels of monetary policy for the Euro area

| Channel | **Euro area estimate** | Auclert 2019 |
|---|---|---|
| Interest rate exposure $\widehat{E_R}$ | **-0.09** | -0.11 |
| Substitution channel $\widehat{S}$ | 0.58 | 0.55 |
| Fisher channel $\widehat{E_P}$ | **-0.07** | -0.07 |
| Earnings heterogeneity $\widehat{E_Y}$ | **-0.02** | -0.05 |
| Aggregate income $\widehat{M}$ | 1.14 | 0.57 |

Source: HFCS Fourth wave. All statistics are computed using survey weights.

## 3. The Power of Monetary Policy Revisited

To put the magnitude of these different channels of monetary policy into perspective, I now calculate the individual contribution of each of them as a share of the total aggregate consumption response. To compare the relative importance of each channel, we can use the reduced form formula from (8). To do that, I need to make assumption about the overall size of the change in macroeconomic aggregates $dP$ and $dY$ due to the 1% interest rate decrease. In line with our simplified assumption above, I assume an effects on aggregate prices and aggregate output are 0.2 on $dP$ and 0.4 on $dY$ respectively. To fill in the rest of the reduced form formula, I only need to assume values for the IES $\sigma$, for which

I take the value of 0.5, and for the relative change of individual income in relation to changes in aggregate income $\gamma$, for which I assume a constant value for all households so that all are affected proportionally and one-to-one to the change in $dY$. Then I use the above results for the euro area regarding the three redistribution elasticities, as well as the aggregate income and the substitution elasticity, reported in Table 9. I compute the individual contributions from each of the channels on consumption and compute their share of the overall change in aggregate consumption due to the interest rate experiment. Table 9 and Figure 10 report the relative share of each of the five channels as a % of the overall monetary policy effect on consumption.

Table 9: Model-free decomposition of the relative power of each channel of monetary policy

| Channel | Italy |
|---|---|
| Aggregate income $\widehat{E_R}$ | 53% |
| Earnings heterogeneity $\widehat{S}$ | 1% |
| Fisher channel $\widehat{E_P}$ | 2% |
| Interest rate exposure $\widehat{E_Y}$ | 11% |
| Substitution channel $\widehat{M}$ | 34% |

Source: HFCS Fourth wave. Results estimated for Italy.

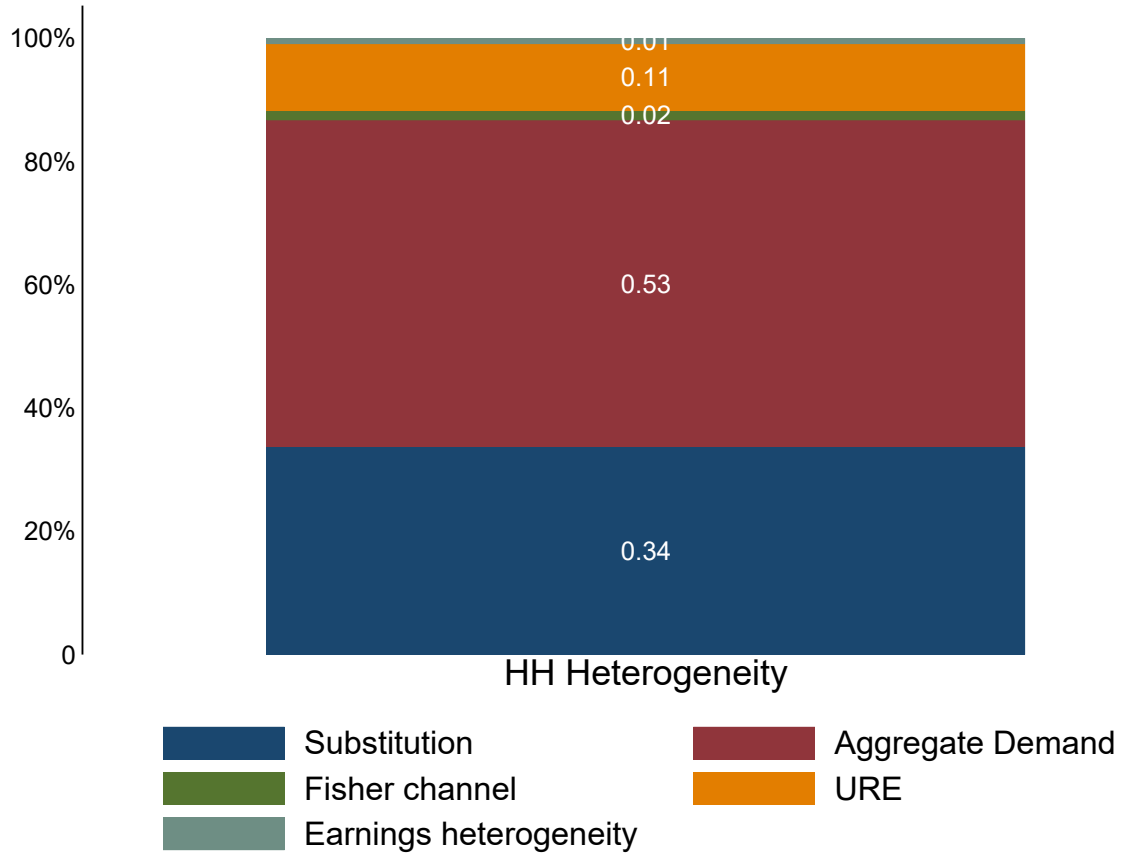


Figure 10: Relative power of monetary policy - contribution of each channel to the overall consumption response of a monetary policy change, Euro area.
Note: Percentages of the total consumption response

The results show that the three redistributionary channels together account for 14 % of the change in consumption after the monetary policy change. The classical aggregate demand channel contributes to 53 %, while the intertemporal subsitution channel, which is the main mechanism in representative agent standard New Keynesian models, contributes only by 33 % to the aggregate consumption change. These results can then be compared to other recent studies regarding the transmission of monetary policy under household heterogeneity. Interestingly, the magnitude of the substitution channel is partly in line with one of the main findings from Kaplan, Moll, and Violante (2018). Kaplan, Moll, and Violante (2018) document that in their two-asset heterogeneous agents model the transmission of interest rate changes to consumption works predominantly through the indirect channels in contrast to the traditional case of the representative agent model where it is through intertemporal substitution. While with an RA model 95% of the effect on consumption comes through intertemporal substitution, in HANK this effect falls to only around 20%. My estimate of about 33% thus is of similar magnitude when using the sufficient statistics approach to compute the relative importance of the classical intertemporal substitution channel. With household heterogeneity in my framework, the indirect effects are the main driving factors for consumption responses to monetary policy changes - they make up 67% of the overall consumption response. Out of these, 14 % are due to the three redistributionary channels we explored above. In terms of robustness, these results are robust across datasets - exploring the same calculation in the third wave of the HFCS delivers results, which are broadly in line with the above.

## 4. All Euro area countries

Furthermore, I also compute the relationships between MPCs and the three different exposures for all euro area countries, which are part of the HFCS. In many of the countries the negative correlations can again be reported. Cross country comparisons are however also partly difficult due to specific institutional settings in each country, as well as possible differences in how different households positions are reported in different countries. A first review of the results however shows that for the correlation between MPCs and gross income, the expected negative relationship is observed in around half the countries - Austria, Germany, Greece, Croatia, Italy, Luxembourg, Latvia, Malta, Portugal, Slovenia and Slovakia. In the rest, a relatively flat relation can be observed.

For the correlation between MPCs and the net nominal position, the expected negative relationship is observed in less countries - Germany, Greece, Croatia, Italy, and Slovenia. In the rest, mostly a relatively flat line can be observed. There are however a number of countries where there seems to be a peak around the middle of the distribution or around zero. We again observe the hump-shaped relationship between the net nominal positions and household MPCs, with households with low, but positive net wealth, having the highest MPCs in many of the countries. Households, which are in debt, use the extra income to pay back their debt and not to consume, thereby leading to them having the lowest MPCs of all groups. This behavior is also documented by Kaplan, Violante, and Weidner (2014) through the stylized fact they report that "wealthy hand-to-mouth" households have relatively high MPCs.

Finally, for the correlation between MPCs and the unhedged interest rate exposure (URE), a clearly negative relationship is observed in a number of countries - Germany, Greece, Italy, Latvia and Slovenia. In all other countries, this relationship is relatively flat, with some bunching again around the middle of the distribution again (e.g. Portugal), similar to the wealthy-hand-to-mouth behavior doc-

umented for the nominal assets.

Importantly, the results in terms of the decomposition of the channels of monetary policy under household heterogeneity and implicit redistribution, hold in most of the sample countries. Examining the differences that underlie country specific differences is an important area of future research.

# VI. Heterogeneous Earnings Elasticities

All households are affected in the same extent and magnitude by economic growth. This is an implicit assumption made in the calculations above when assuming that the earnings elasticity $\gamma$ across the income distribution is constant. I now relax this very strong assumption to explore how it will affect my results above.

I therefore explore a further redistributionary channel - through the relative earnings changes of different income groups to aggregate GDP changes. This additional mechanism has not been explored in the calculations above since I have assumed that after the change in aggregates, $dY$, all individual incomes react in the same magnitude $dY_i$. This is a crucial assumption also made by Auclert (2019), which I relax now to explore whether unequal income changes have a quantitatively meaningful effect on monetary policy transmission similarly to the other redistributionary channels. Theoretically, the elasticity of individual household earnings to aggregate GDP fluctuations is a crucial moment for models with household heterogeneity as consumption reacts differently with household heterogeneity and when all households are the same. This point has been discussed at length by Bilbiie (2008) and Werning (2015), which show that the amplification of aggregate shocks through aggregate demand with household heterogeneity crucially depends on the relative sensitivity of different household groups to output fluctuations. The amplification would be strengthened if lower income households, which typically have higher MPCs, are more affected in terms of labour market outcomes and wages to aggregate output changes - that is, if they e.g. lose more in terms of income during recessions than rich households and vice versa. In the estimations above, I have assumed a constant value for the relative earnings elasticity $\gamma$ throughout the distribution. This is a strong assumption and in what follows I relax it and calculate the redistribuionary channels of monetary policy when households have different individual earnings elasticities.

In the baseline case, to relax the assumption of homogenous earnings elasticities $\gamma$ the data needed is about earnings changes of households from one survey wave to the other and aggregate output changes and the MPC of the same households. The HFCS has a panel component in some of the countries in each wave. In an accompanying paper (Pekanov (2024)) I estimate the magnitude of these earnings elasticities $\gamma_i$ from three different datasets for the ten income deciles. I show using three different datasets that the earnings elasticities $\gamma_i$ of different income groups are not homogenous, but vary with the income. I find a pattern consistent throughout all three datasets that the earnings elasticities are higher for lower income groups.

I can then impute my HFCS estimates of $\gamma_i$ by deciles from Pekanov (2024) to assume a certain magnitude for the $\gamma$ of each household. I therefore extend the estimations by Auclert (2019) and show that the relation between earnings elasticities and MPCs is important by amending his theorem to include the covariance between MPCs and the individual income level, but also the individual income elasticity.

To show how individual income elasticities alter the results from the decomposition in (8), let us return one step back in the derivation. In (8) we have assumed that $\gamma$ is constant across all households. This means after a certain aggregate GDP change, the income of all households changes in the same magnitude. We now relax this assumption. Starting from the theorem derived by Auclert (2019) and described in (7), we can rewrite the covariance term

$$Cov(MPC_i, dY_i - Y_i\frac{dY}{Y}). \tag{15}$$

back to its initial form, which is:

$$E(MPC_i * (dY_i - Y_i\frac{dY}{Y})) \tag{16}$$

The transformation from this expected value to the covariance works because the expected value of the second term $E(dY_i - Y_i\frac{dY}{Y})$ is zero in the case of $\gamma = 0$. If we do not assume this case, we can use the expected value term directly in the theorem (7). For the final transformation of this redistributionary channel, we use the relationship derived by Auclert (2019) in Appendix A.8:

$$E(MPC_i * (dY_i - Y_i\frac{dY}{Y})) \tag{17}$$

Next, by total differentiation it can be shown that:

$$dY_i - Y_i\frac{dY}{Y} = Y d\left(\frac{Y_i}{Y}\right) \tag{18}$$

I then specify two objects - one is a classical earnings elasticity $\beta$ and the other one is a relative earnings elasticity $\gamma = 0$. The two are related via a simple transformation.

$$\beta = \frac{\partial Y_i}{\partial Y}\frac{Y}{Y_i}. \tag{19}$$

$$\gamma = \frac{\partial (Y_i/Y)}{\partial Y}\frac{Y}{Y_i/Y} = \beta - 1 \tag{20}$$

Next we substitute (20) in (18)

$$dY_i - Y_i\frac{dY}{Y} = \gamma_i Y_i\frac{dY}{Y}. \tag{21}$$

This means we can transform the expression in (16) to

$$E(MPC_i * (dY_i - Y_i\frac{dY}{Y})) = E(MPC_i * \gamma_i Y_i\frac{dY}{Y}) = E(MPC_i * \gamma_i Y_i)\frac{dY}{Y}. \tag{22}$$

This is the expression that matters for us when earnings elasticities are not constant across the income distribution - when they are different for each household. Using the HFCS I can now estimate this measure instead of the redistributionary earnings channel given by $Cov(MPC_i, Y_i)$. I construct two different measures of $\gamma_i$. In Pekanov (2024) I obtain aggregated earnings elasticities by income decile $\gamma_d$. I can impute these in the above equation. Furthermore, instead of the aggregated $\gamma_d$ by deciles, I also calculate these at the individual household level. To do that, I make use of the fact that the HFCS has a panel component in selected Member States - around half of the respondents from the previous survey are asked again in the next wave of the survey. Using the households participating in both the 3. and 4. wave of the HFCS, I compute their earnings changes between the two periods. I then compute the earnings elasticity by relating their real income change to the real GDP growth for the same period. The earnings elasticity in both the aggregated and the individual level $\gamma$ is given by:

$$\gamma = \frac{\partial(Y_i/Y)}{\partial Y}\frac{Y}{Y_i/Y} \tag{23}$$

The values obtained from the estimation on aggregated earnings elasticities by decile in Pekanov (2024) and the histogram of individual earnings elasticities from the panel component of the HFCS is reported in Figure 11. This term is then renormalised and can be used in a direct comparison to the above estimate of $Cov(MPC_i, Y_i)$ where $\gamma$ is assumed to be constant and therefore does not play a role.

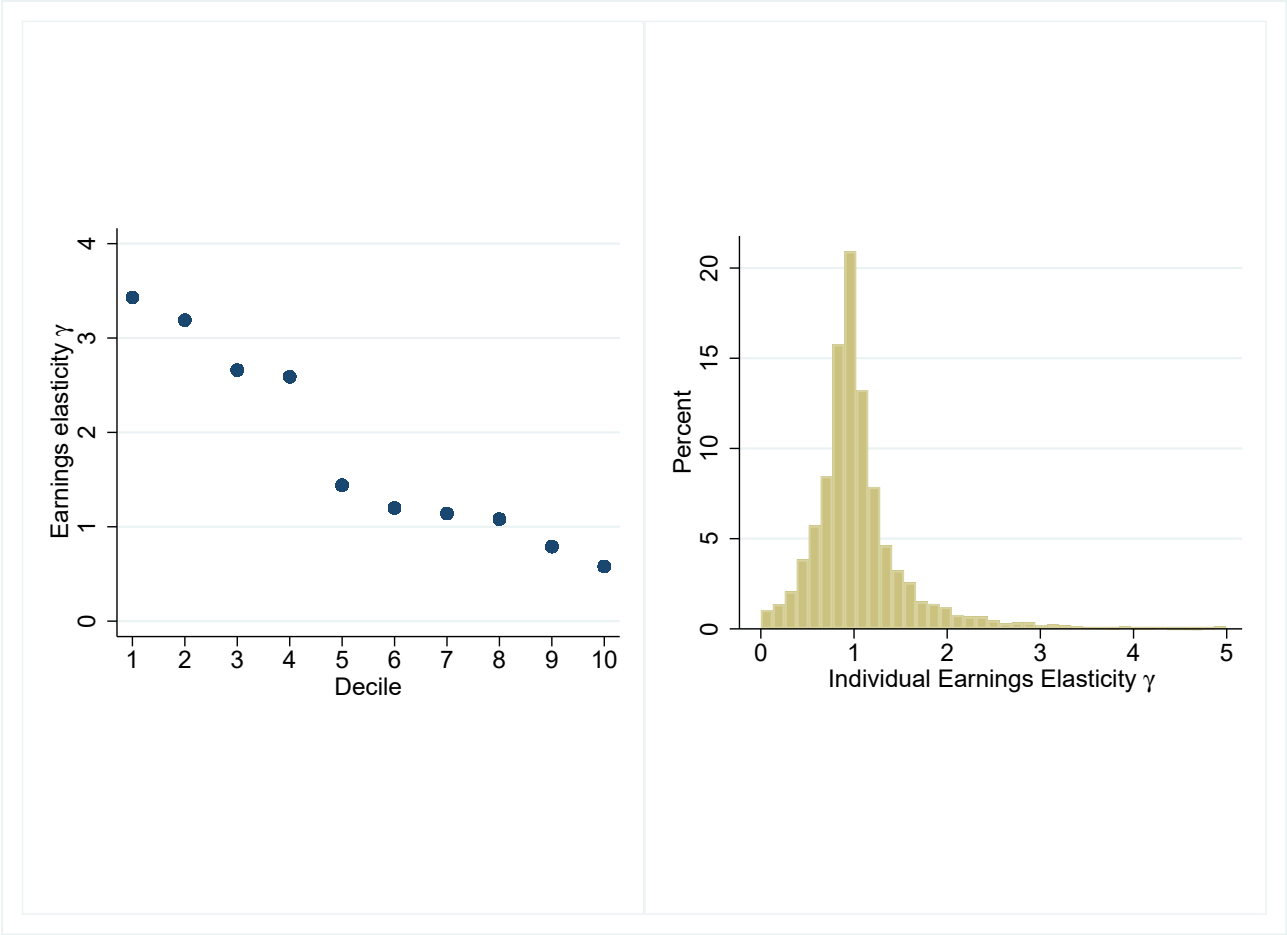


Figure 11: Individual household earnings elasticities in the euro area.
Note: Left bar presents the earnings elasticities estimated with the HFCS per decile in Pekanov (2024). Right bar presents earnings elasticities calculated from the earnings changes of each individual household from the panel component of the HFCS in the third and fourth wave.

I now use these two measures of $\gamma$ to re-evaluate the results from the previous section. I calculate the expected value $E(MPC_i * \gamma_i Y_i)$, given in (22) and compare it with the covariance estimated for the earnings heterogeneity channel above. Due to the difference in individual earnings sensitivity, the income channel of redistribution becomes much stronger when using the estimated earnings elasticities by decile from Pekanov (2024). While the $Cov(MPC_i, Y_i)$ in the euro area was estimated at a mere 0.02, the object equal to it in the model with heterogenous earnings elasticities - $E(MPC_i * \gamma_i Y_i)$ equals to 0.20. Moving to the completely individual earnings elasticities calculated by using earnings changes between the third and fourth wave of the HFCS, this result is reiterated and becomes even stronger.

Table 10 and Figure 11 presents the results with and without heterogenous earnings elasticities for the euro area. The table reports the relative share of each of the five channels as a % of the overall monetary policy effect on consumption. The relative magnitude of the redistributionary channel of earnings heterogeneity becomes much more important in the overall decomposition - from a mere 1% when earnings elasticities are constant, it increases to 9% when using my estimated earnings elasticities per decile. When we use the individual earnings elasticities $\gamma_i$ instead it increases even further and makes up 17% of the overall consumption response. The earnings heterogeneity channel therefore becomes much more powerful through the heterogeneous response of individual earnings to aggregate GDP changes and the strong relationship between these elasticities and the MPCs of households, as discussed in Pekanov (2024).

Summing up the results of the three additional channels with earnings elasticity heterogeneity, redistribution contributes to an even more potent response of consumption to the monetary policy experiment - the total aggregate consumption change is now between 0.94% and 1.02%. This constitutes an increase to the representative agent case with between 26% and 37%.

Table 10: Relative power of channels of monetary policy with and without earnings elasticity heterogeneity

| Channel | $\gamma$ constant | $\gamma$ decile heterogeneity | $\gamma$ individual heterogeneity |
|---|---|---|---|
| Aggregate income $\widehat{E_R}$ | 53% | 49% | 45% |
| Earnings heterogeneity $\widehat{S}$ | **1**% | **9**% | **17**% |
| Fisher channel $\widehat{E_P}$ | 2% | 1% | 1% |
| Interest rate exposure $\widehat{E_Y}$ | 11% | 10% | 9% |
| Substitution channel $\widehat{M}$ | 33% | 31% | 28% |

Source: HFCS Fourth Wave. Results estimated for Euro area.

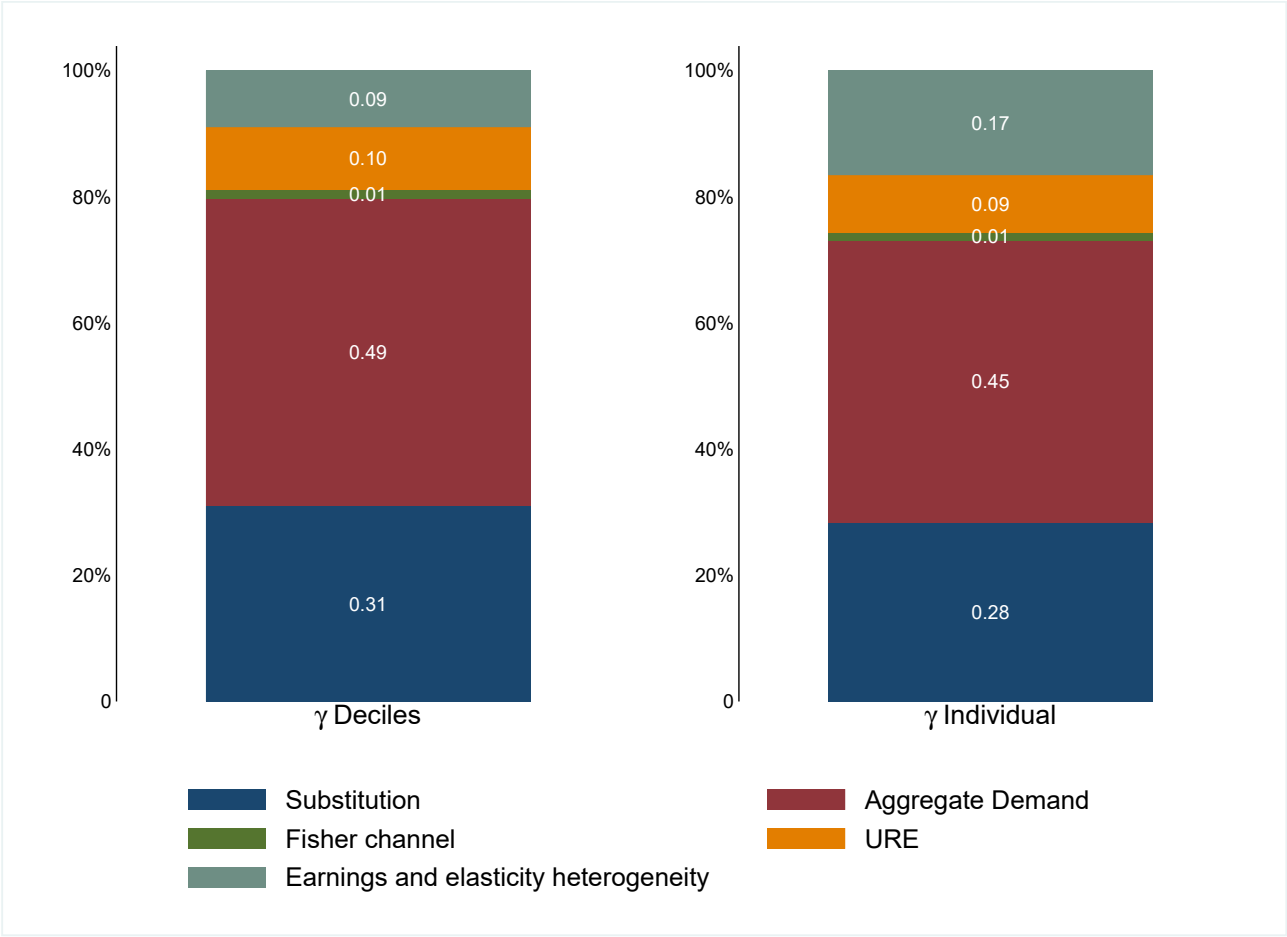


Figure 12: Power of Monetary Policy with earnings elasticity heterogeneity.
Note: Left bar presents results with earnings elasticities estimated with the HFCS per decile in Pekanov (2024). Right bar presents the results with earnings elasticities calculated from the earnings changes of each individual household from the panel component of the HFCS in the third and fourth wave.

## 1. The Power of Monetary Policy Revisited Again

I now report all results obtained. As a way to compare my results for the effects of the redistributionary channels of monetary policy when households are heterogeneous, I also report the shares of the different channels of monetary policy in the standard representative agent New Keynesian (RANK). Figure 13 reports the total consumption response and the five separate channels. Figure 14 reports the composition of different channels of the consumption response, summing up to 1.

In RANK, the substitution channel dominates and the aggregate demand channel is very limited. In a HANK model, as in Kaplan, Moll, and Violante (2018), the opposite is true and indirect channels dominate. Even though they are generalised under the aggregate channel definition, the redistributionary channels implicitly act in the background in HANK. The approach I used in this paper then enables me to quantify the contribution of these redistributionary channels for the overall consumption response. Starting with the three redistributionary channels as explored in Auclert (2019), they contribute to 14% of the aggregate consumption response to an interest rate decrease in the euro area. In this baseline model, it is the unhedged interest rate (URE) channel which makes up most of this change. When we relax the strong assumption that all household incomes react in the same proportion to aggregate GDP changes, the earnings heterogeneity channel becomes much more potent - it increases to 9% of the total response when using earnings elasticities per decile. When we use the

individual earnings elasticities $\gamma_i$ it increases even further to 17% of the total consumption response. The estimations made with the models of household heterogeneity reduced form formula above show a clear and significant role for the redistributionary channels of monetary policy. These three redistributionary channels in the euro area make up between 14% and 27% of the total consumption response.

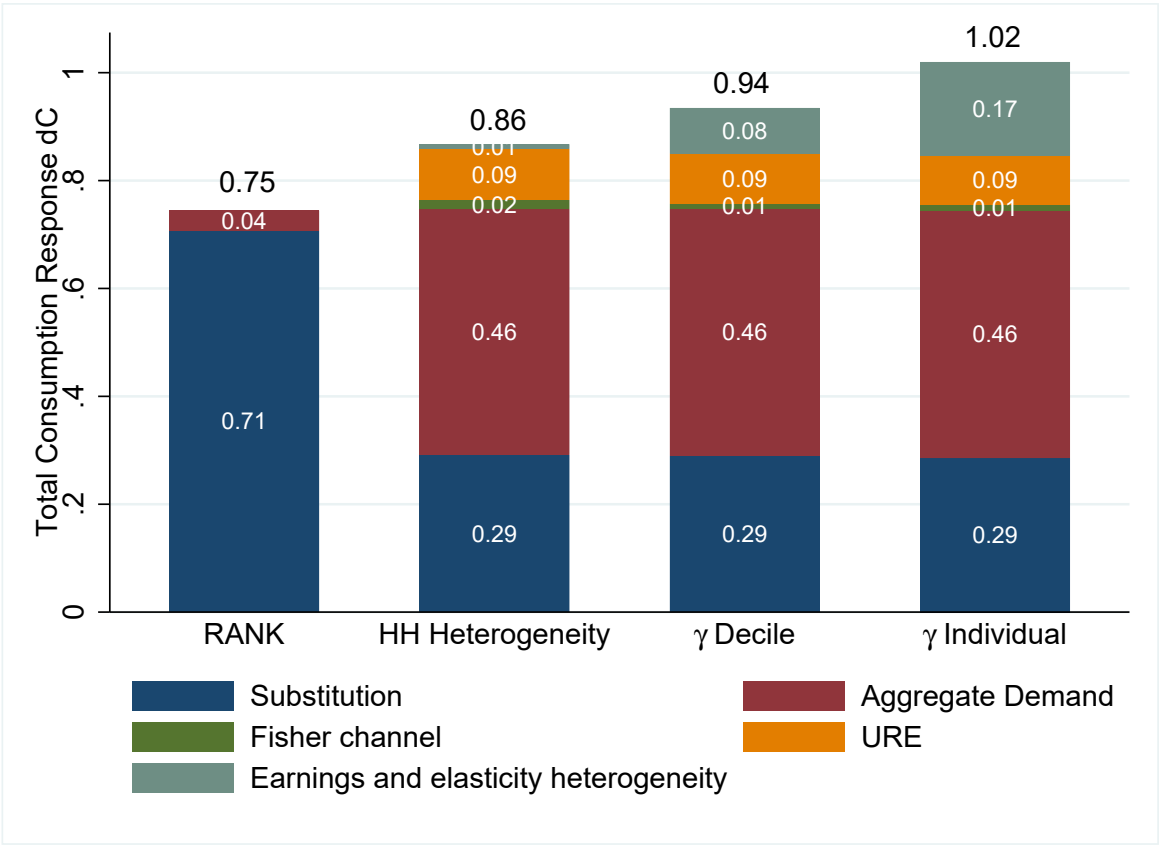


Figure 13: The Power of Monetary Policy Compared in different models with and without heterogeneity. Total Consumption Response.
Note: RANK is calibrated using standard parameters from the literature. The models with household heterogeneity and redistributionary channels are estimated above using Euro area data from the HFCS.

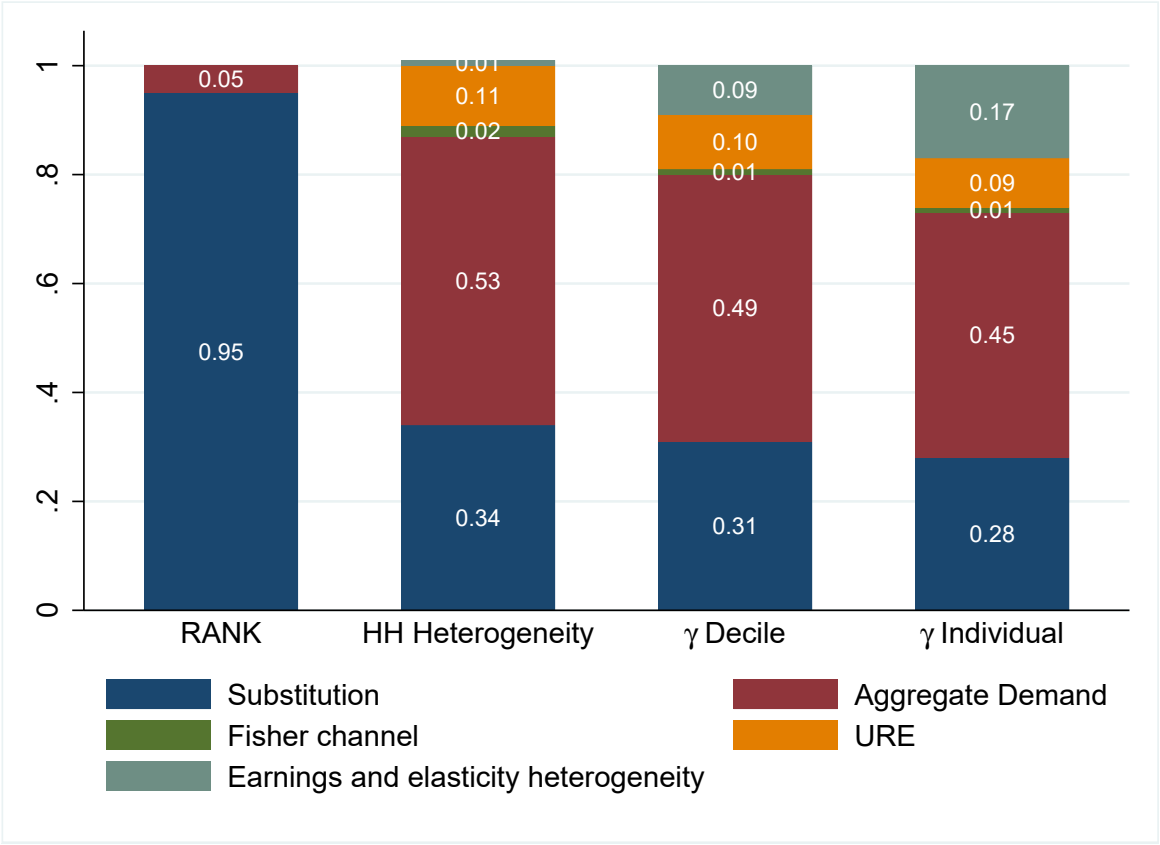


Figure 14: The Power of Monetary Policy Compared in different models with and without heterogeneity. Composition of Consumption Response.
Note: RANK and HANK are calibrated using standard parameters from the literature. The models with household heterogeneity and redistributionary channels are estimated above using Euro area data from the HFCS.

# VII. Conclusions

In this paper, I evaluate how inequality in terms of differences in household income, wealth and interest rate exposures, together with the heterogeneity of marginal propensities to consume (MPCs), affect the transmission of monetary policy through consumption. Three channels of redistribution determine how monetary policy is amended when households have different MPCs and are different in their household portfolios - an unhedged interest rate (URE) channel, an idiosyncratic income heterogeneity channel and a net nominal positions (NNP) channel. I construct a new dataset that combines the ECB HFCS and the Eurostat HBS to obtain a representative sample with detailed information on household balance sheets and consumption. A new question in the ECB Household Finance and Consumption Survey enables me to explore how the implicit redistribution between households along these exposures after a monetary policy change, through these three channels, amends the standard consumption response.

As expected from theoretical considerations, the relationship between MPCs and the three redistributionary channels is negative in most countries observed. In Italy and Germany, MPCs are lower with higher incomes, with higher net nominal positions and with higher unhedged interest rate exposure. The negative covariance between MPCs and the three important dimensions - income, net nominal positions (NNPs) and unhedged interest rate exposures (URE), all hold. The same holds in most of the other countries in the sample. A hump-shaped relationship between MPCs and some of the three channels however is found for a number of countries, which is in line with previous findings regarding the behavior of wealthy hand-to-mouth households, as well as regarding the behavior of net debtors to income changes. This behavior boils down to highly indebted individuals, even if rich in nominal assets, tend to have relatively low MPCs, since they spend any additional income on repaying debt instead of on consumption expenditure.

These negative relationships also hold when we explore the euro area as a whole. I calculate the elasticities of consumption along the three redistributionary channels, as well as regarding the two classical channels of aggregate income and substitution. In the euro area, a 1-percentage-point decrease in the real interest rate, which redistributes wealth from creditors to debtors, increases aggregate consumption by 9 basis points. This channel can be similar in magnitude to the traditional substitution channel if the intertemporal elasticity of substituion is low and below 0.20. The other two redistribution channels - of net nominal asset holdings and earnings heterogeneity, contribute to further 7 and 2 basis points effect of consumption, as MPCs are unequal across the net nominal wealth positions of households and are unequal across the income distribution. Summing up the results of the three additional channels, redistribution amplifies the monetary policy change and makes the aggregate consumption response 15% higher than in the case without household heterogeneity. While in a stylized representative agent case aggregate consumption will increase by 0.75% after a standard interest rate decrease, with household heterogeneity in balance sheet exposures, the total consumption increase is 0.86%.

I use these estimated effects to compute the contribution of each channel to the total consumption response to a theoretical monetary policy change. The relative power of different channels of monetary policy differs significantly from the standard representative household model - the substitution channel with household heterogeneity contributes only by 33% to the consumption change, while in standard RANK models it makes up more than 95%. The aggregate demand and the redistributionary channels on the other hand are now important and amount to respectively 53% and 14% of the total change in

consumption. In the baseline model, the redistribution channel of monetary policy is driven mainly by the unhedged interest rate exposure of households.

Households however are not affected equally by aggregate GDP changes as assumed above. I relax the assumption that the relative earnings of different household types move 1-to-1 with the aggregate output change from other papers in the literature. Using the panel component of the HFCS, I obtain the earnings changes of households in my dataset and calculate the earnings elasticities to GDP changes $\gamma$ for each household, as well as aggregated per income decile. The earnings heterogeneity redistribution channel is amended thus to take into account earnings elasticity heterogeneity. The negative covariance between income and MPCs documented above is now amplified significantly, since households with higher MPCs not only have lower incomes, but also have a higher sensitivity of their income to aggregate GDP changes. Summing up the results of the three additional channels with earnings elasticity heterogeneity, redistribution contributes to an even more potent response of consumption to the monetary policy experiment - the total aggregate consumption change is now between 0.94% and 1.02%. This constitutes an increase to the representative agent case by between 26% and 37%.

The earnings heterogeneity channel therefore becomes much more powerful through the heterogeneous response of individual earnings to aggregate GDP changes and the strong relationship between these elasticities and the MPCs of households, as discussed in Pekanov (2024). Introducing heterogeneous individual earnings elasticities enhances significantly the magnitude of the redistribution channel of earnings heterogeneity from a mere 1% to between 9% and 17%. It therefore increases the importance of implicit redistribution as an effect of monetary policy changes on consumption - the three redistributionary channels make up between 14% and 27% of the total consumption response of an interest rate decrease. Overall, my results point that the redistributive channels are important elements of the transmission of monetary policy to consumption which is neglected in models without heterogeneity.

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# VIII. Appendix

## 1. A1. MPCs for all countries

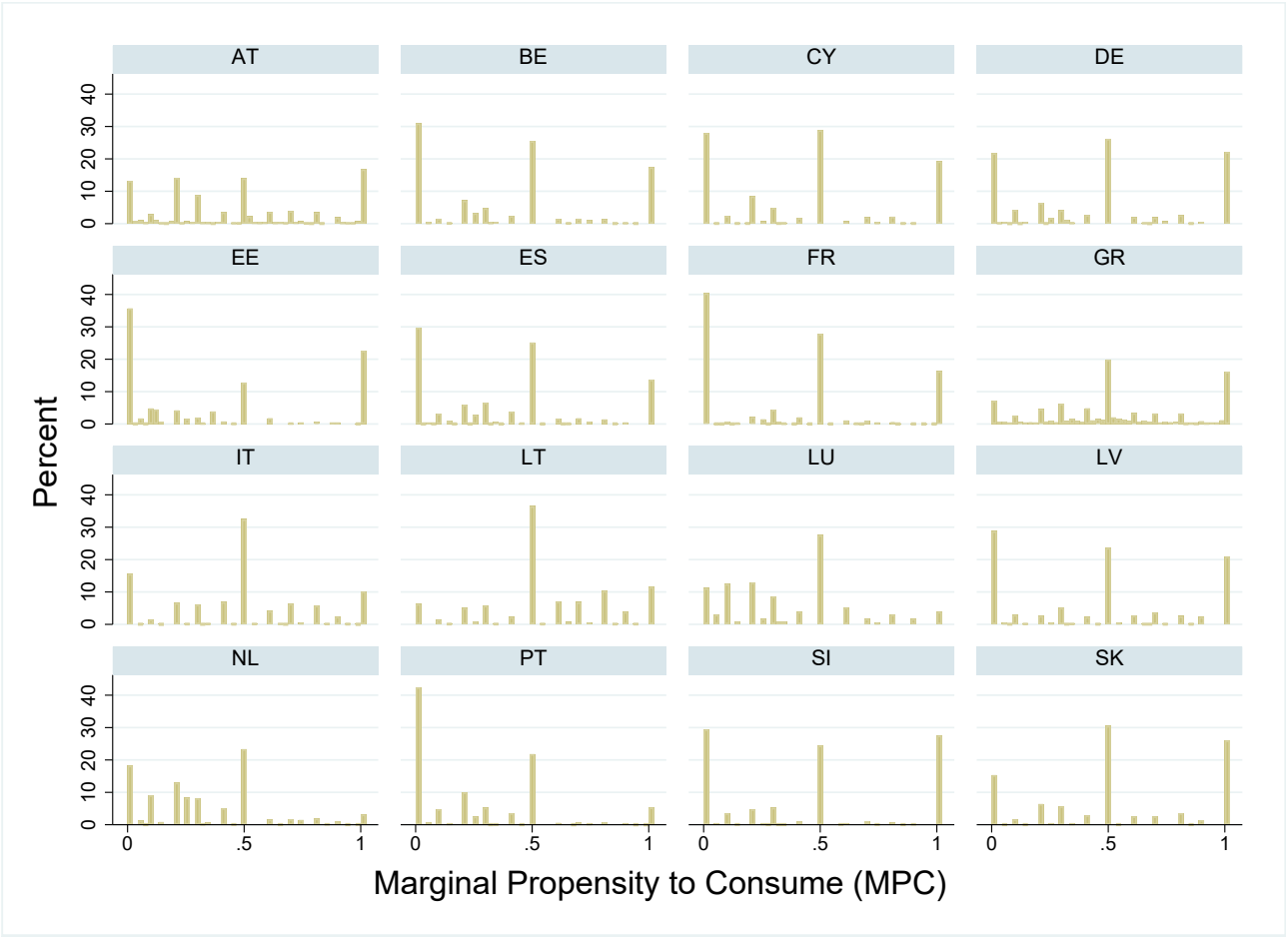


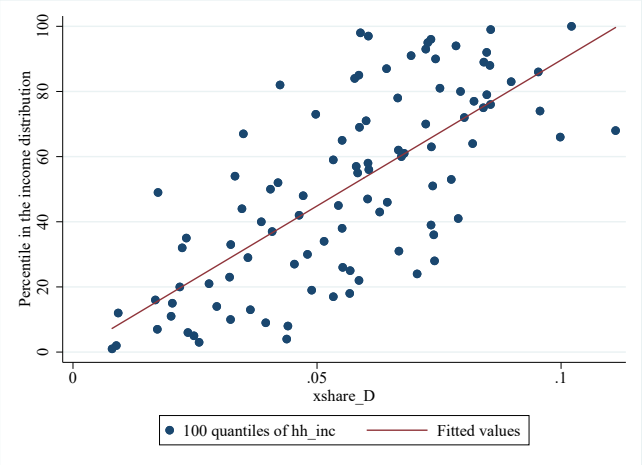

Figure 15: Distribution of the marginal propensity to consume of households in all countries.

## 2. Consumption expenditure shares by consumption category

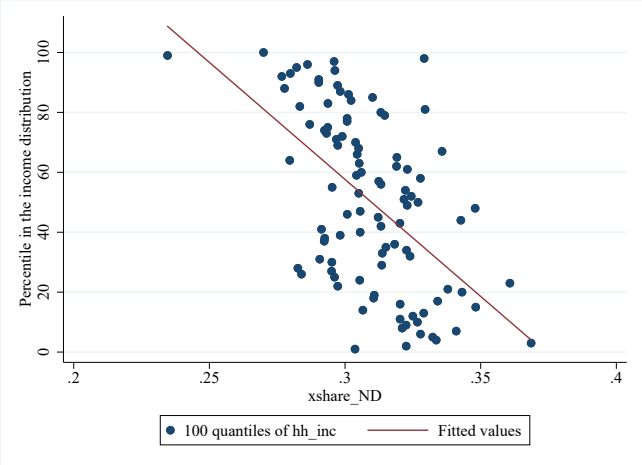
**A2. Aggregate consumption expenditures by category as a share of overall expenditures, Source: Eurostat**

| 2017 | Durable | Semi-durable | Non-durable | Services |
|---|---|---|---|---|
| Belgium | 7.55% | 8.01% | 30.38% | 54.06% |
| Czechia | 8.98% | 6.70% | 39.43% | 44.89% |
| Germany | 11.58% | 9.35% | 27.04% | 52.02% |
| Estonia | 7.53% | 10.24% | 42.97% | 39.27% |
| Ireland | 6.63% | 6.42% | 29.49% | 57.45% |
| Greece | 3.76% | 6.09% | 33.33% | 56.81% |
| Spain | 7.17% | 7.05% | 27.38% | 58.41% |
| France | 8.37% | 7.69% | 29.90% | 54.04% |
| Italy | 7.99% | 8.91% | 30.49% | 52.60% |
| Cyprus | 7.31% | 6.66% | 30.60% | 55.43% |
| Latvia | 6.54% | 8.77% | 40.09% | 44.60% |
| Lithuania | 8.46% | 11.48% | 49.74% | 30.31% |
| Luxembourg | 8.04% | 8.23% | 31.46% | 52.28% |
| Hungary | 6.39% | 7.97% | 40.79% | 44.85% |
| Malta | 6.85% | 8.29% | 28.28% | 56.58% |
| Netherlands | 8.65% | 8.99% | 26.85% | 55.52% |
| Austria | 10.03% | 9.65% | 25.47% | 54.86% |
| Poland | 7.16% | 9.26% | 43.50% | 40.08% |
| Portugal | 8.79% | 7.76% | 31.52% | 51.93% |

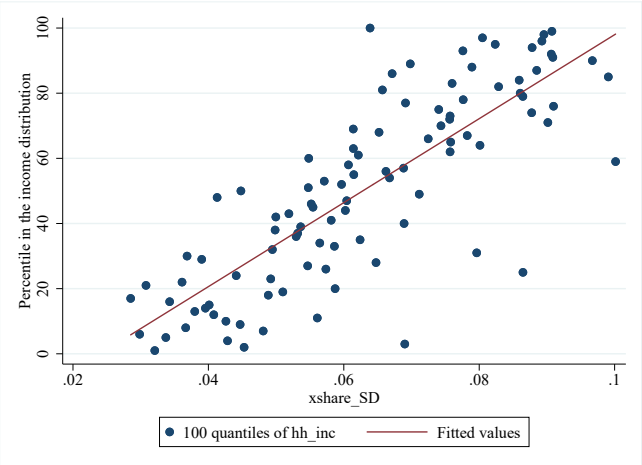
**A3. Consumption expenditures by category for household by income percentile, Source: Household Budget Survey**



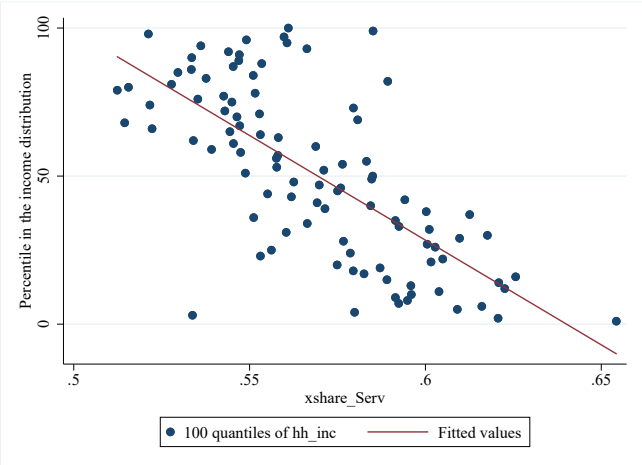

Share of durable expenditure to overall expenditure by income percentile, Belgium; Source: HBS




Share of non-durable expenditure to overall expenditure by income percentile, Belgium; Source: HBS




Share of semi-durable expenditure to overall expenditure by income percentile, Belgium; Source: HBS




Share of service expenditure to overall expenditure by income percentile, Belgium; Source: HBS