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Monetary Policy Across the Wealth Distribution

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MONETARY POLICY ACROSS THE WEALTH DISTRIBUTION*

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Abstract

Using the Distributional Financial Accounts of the United States and VAR models, we show that the effects of interest rate cuts and large-scale asset purchases on net wealth across the wealth distribution are heterogeneous. Expansionary monetary policy initially leads to higher net wealth growth at the bottom of the wealth distribution. However, in the medium-run, these households experience a large fall in net wealth while the rise in net wealth at the top persists, particularly after an interest rate shock. This fall in net wealth for the poorest households is due to the persistent increase in home mortgages generated by the interest rate shock. In contrast, at the top, capital gains play an important role in driving the movements in net wealth. Wealthier households enjoy larger increases in capital gains after both interest rate and asset purchase shocks.

Keywords: Monetary Policy, Wealth Distribution, Household Heterogeneity, Portfolio Composition Channel.
JEL codes: D31, E44, E52

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1 Introduction

Since the Great Recession, unconventional monetary policy tools, such as asset purchases, have become increasingly prominent in the implementation of monetary policy. These tools have helped easing financial conditions and lowering long-term interest rates, but they have also drawn harsh criticism from the public for their potential role in widening wealth inequality. Because low interest rates and asset purchases are associated with higher asset prices, the benefits from expansionary monetary policy would disproportionately accrue to asset owners in form of capital gains.

In this paper, we study the distributional consequences of monetary policy in the United States, and quantify a channel through which monetary policy can affect wealth inequality through its effect on asset prices (portfolio composition channel). The distributional effects of monetary policy are explored using the Distributional Financial Accounts (DFA) of the United States and by distinguishing between interest rate and large-scale asset purchase shocks within a Bayesian VAR framework. The DFA provide estimates of balance sheets the household wealth distribution. The quarterly frequency of the DFA allows us to estimate the effect of monetary policy shocks directly on net wealth and its components. This is an advantage over previous studies which estimate the effect of monetary policy shocks on wealth only indirectly, for few asset classes, and through the response of asset prices (see for example Bartscher et al., 2021).

Our results indicate that both interest rate and asset purchase shocks lead to differences in net wealth growth across the distribution. In the first year, an interest rate shock determines a generalized, and rather homogeneous, increase in net wealth (total assets minus liabilities) across wealth groups. Over the medium-run (four to six years), the responses of net wealth across the wealth distribution diverge. The bottom 50% of the wealth distribution records the largest percentage increase in net wealth over the short-run, but the largest decrease in the medium-run. For households in the richest decile of the wealth distribution, the rise in net wealth lasts longer. However, the medium-term effect of interest rate shocks on net wealth of groups within the top 50% of the distribution carry substantial uncertainty, in particular for the next 40% and top 1%. After an asset purchase shock, instead, net wealth increases in the short-run only for the poorest 50% and for the richest 1%. In the short-run, net wealth increases for the other groups too but this increase is short-lived. Moreover, for all wealth groups, the effects of an asset purchase shock are temporary.

Movements in net wealth after interest rate and asset purchase shocks stem from the combined effect of asset accumulation, borrowing, debt repayment, and capital gains. The medium-run fall in net wealth experienced by the poorest half of households is likely to arise from the persistent increase in home mortgages after an interest rate shock against the temporary rise in real estate assets. Similarly, the rise in pension assets are presumably one of the factor driving the rise in net wealth for households between the 50^{th} and 99^{th} of the wealth distribution, given the importance of pension entitlements for their portfolios. Both the increase in the stock and in the valuation of corporate equities and mutual funds generated by both interest rate and asset purchase shocks represent another factor driving the rise in net wealth at the top of the distribution.

We then study the role of monetary policy in contributing to differential wealth growth across the distribution through its impact on capital gains. When portfolios are heterogeneous, monetary policy unevenly affects wealth accumulation via heterogeneous capital gains. Households whose portfolio consists largely of interest rate-sensitive or long-lived assets will experience larger capital gains on their wealth and, in turn, higher wealth growth relative to other households, everything else equal (portfolio composition channel). After obtaining measures of capital gains across the wealth distribution from aggregate revaluation data, we show that wealthier households enjoy larger increases in capital gains after both interest rate and asset purchase shocks, and that a non-negligible share of variability in capital gains for the wealthiest 1% can be explained by monetary policy shocks - between 7 and 15%, depending on the type of shock.

The response of capital gains to monetary policy shocks suggests that rich- and asset-holders households gain disproportionately from expansionary monetary policy. As pointed out by McKay and Wolf (2023) a decrease in interest rates lowers the expected return on asset, and the net effect on welfare depends on whether households plan to sell or buy the asset. Nevertheless, higher wealth stemming from capital gains shields households from future adverse shocks and provides welfare in terms of higher collateral that can be used to sustain future consumption. Recent evidence suggests that the marginal propensity to consume out of stock market wealth is around 3% (Chodorow-Reich et al., 2021) and it varies between 3% and 7% for unrealized capital gains in the top half of the financial wealth distribution, reaching roughly 23% for the bottom half of the distribution (Di Maggio et al., 2020). In light of this evidence, the increase in capital gains at the top of the distribution resulting from monetary policy will not be spent and will add to existing wealth.

Contribution to the literature. Our paper contributes to the growing literature exploring the link between monetary policy and inequality, a topic that caught the attention of monetary policymakers (Yellen, 2016; Schnabel, 2021).

Studies on the distributional effects of monetary policy rely on various types of data sources such as surveys and administrative data to measure income and wealth across households or individuals within-countries. Cross-countries studies use publicly available databases such as WID and the SWIID (Solt, 2020) and synthetic measures of inequality, mostly income, such as the Gini index. In this paper, we use the Distributional Financial Accounts of the United States, a publicly available dataset created by the Fed Board that provides quarterly estimates of US household wealth since 1989.

A key result stemming from studies using survey data is that a tightening in policy interest rates increases labor earnings and consumption inequality both in the US (Coibion et al., 2017) and in the UK (Mumtaz and Theophilopoulou, 2017), while it reduces the top 1% income share in cross-countries studies (El Herradia and Leroyb, 2021). Moreover, the distributive effects of a monetary tightening are amplified in countries with a high labor share of income and smaller redistribution policies (Furceri et al., 2018). Studies using administrative data, instead, find that a loosening of monetary policy leads to a U-shaped response of total income across the distribution in Sweden (Amberg et al., 2021) and to increasing income, consumption, and wealth inequality in Denmark (Andersen et al., 2023). Other studies focusing on wealth inequality in the US suggest that a loosening of monetary policy increases wealth inequality (Albert et al., 2020; Albert and Gómez-Fernández, 2021), including the racial wealth gap (Bartscher et al., 2021) Feilich (2021), instead, finds that a monetary policy tightening are especially harmful for households at he bottom of the wealth distribution.[1] Concerning non-standard monetary policy, Casiraghi et al. (2018) and Lenza and Slacalek (2021) suggest that asset purchases in Europe reduce income inequality and have neglible effects on wealth inequality. Adam and Tzamourani (2016), using survey data for the euro area, find that capital gains from equity price increases are concentrated among the rich, while housing price increases strongly benefit the middle class. Studying the distributional effects of the QE in the eurozone, De Luigi et al. (2023) find conflicting results according to whether inequality is measures using net wealth or using the Gini index. Examining the consequences of the secular decline in interest rates, Wolff (2021) find that declining interest rates and moderated inflation have contributed to a reduction in wealth inequality.

In general, these studies highlight that the effects of monetary policy on income and wealth inequality can primarily propagate via various channels (McKay and Wolf, 2023): (i) labor income, as households are differently exposed to fluctuations in labor market conditions, and to business cycles more in general; (ii) asset prices, as the heterogeneity in the composition of household portfolios implies heterogeneous capital gains; (iii) nominal wealth redistribution, as surprise inflation redistribute income between savers and borrowers; (iv) mortgage payments, since in the US mortgagors can safeguard against interest rate fluctuations by refinancing their existing mortgage contract. There is less consensus, however, regarding the magnitude and direction of these channels, especially when they involve wealth effects. This is mainly due to the relatively underdeveloped research on the distributional effects of monetary policy on wealth inequality compared to income inequality, which is attributable to the limited availability of easily accessible data on wealth (see Colciago et al., 2019; Kappes, 2021,

[1] Among this literature, Feilich (2021) is the study most similar to ours in terms of data source. However, our papers differs in terms of methodology and scope. We consider both conventional and unconventional monetary policy in a VAR framework. Moreover, we provide a framework to compute capital gains by merging the DFA with the aggregate data on revaluations, and show the quantitative importance of monetary policy for capital gains across the wealth distribution.

for a detailed survey). Recently giant leaps have been made in characterizing the distribution of US household wealth (Saez and Zucman, 2016; Kuhn et al., 2020), allowing researchers to document the trends in the distribution of wealth in the US and its drivers, such as changes in tax policy, the decline of workers' bargaining power, technology and globalization, intergenerational transfers, and institutional and political factors (Saez and Zucman, 2020). In 2019 the Federal Reserve released the Distributional Financial Accounts (Batty et al., 2020) which quarterly frequency make than suitable for studying the distributional consequences of monetary policy.[2]

Lastly, our paper contributes to two strands of the literature studying monetary policy, asset prices and returns, and the drivers of wealth inequality. A first strand of the literature on the impact of monetary policy on various asset prices show that a surprise cut in the federal funds rate leads to an increase in stock prices (Bernanke and Kuttner, 2005; Gürkaynak et al., 2005; Bauer and Swanson, 2022) and a decrease in both term premia and credit spreads (Gertler and Karadi, 2015). Large-scale asset purchases, on the other hand, have a larger impact on long-term Treasuries and with spillover effects on other assets (Swanson, 2011; Krishnamurthy and Vissing-Jorgensen, 2012; Swanson, 2021). Another strand of the literature identifies heterogeneous returns as critical factors driving wealth inequality in the US (Bach et al., 2020; Benhabib et al., 2019; Hubmer et al., 2021).

Road map. The structure of the paper is organized as follows. Section 2 introduces and describes the DFA. Section 3 outlines the econometric strategy and the monetary policy shocks. Section 4 presents the main results and Section 5 explore the role of capital gains. Section 6 concludes.

2 The Distributional Financial Accounts of the United States

To explore the distributional effects of monetary policy we rely on the Distributional Financial Accounts of the United States. The DFA combine household-level data from the Survey of Consumer Finances with the aggregate balance sheet of the household sector from the Financial Accounts to distribute aggregate household wealth since(Batty et al., 2020). This section describes three salient facts about the distribution of household wealth according to the DFA with reference to four wealth groups: bottom 50%, next 40% (or 50^{th}-90^{th} percentile), next 9% (or 90^{th}-99^{th} percentile), and top 1%. First, household wealth is unequally distributed. Second, wealth grew unevenly across the distribution since 1989. Third, wealth groups exhibit persistent portfolio heterogeneity.[3]

[2] In 2022, Blanchet et al. (2022) recently published monthly estimates for the distribution of US household wealth and income (including labor income) from 1976 onward. However, these estimates do not include information on balance sheets.

[3] In this paper, we use the terms *wealth* and *net wealth* interchangeably to denote the total value of assets minus liabilities.

2.1 Wealth inequality according to the Distributional Financial Accounts

Wealth shares suggest that wealth inequality has increased since 1989. On average, between 1989 and 2022, the share of wealth owned by households in the bottom 50% is 2.33% against 28.22% by the top 1% (see also Table A.1). Figure 1 plots the wealth shares according to the DFA during the same period. Overall, the trend in the wealth share of the top 1% is coherent with other studies documenting increasing wealth concentration in the US (Saez and Zucman, 2016; Smith et al., 2023). Between 1989 and 2019, the share of wealth owned by households in the poorest half of the distribution halved, despite the weak but steady increase started in 2010 when net wealth was almost wiped out by the crisis. Similarly, the share of wealth owned by households in the next 40% has also decreased over time, and the pandemic has only exacerbated this trend (differently from the bottom 50% for which the pandemic characterized a rise in the wealth share). Meanwhile, households in the next 9% saw an increase in their wealth share between the mid-1990s and the Great Recession, which has since slowly decreased. In contrast, the share of wealth held by the richest 1% has been constantly increasing although with marked cyclical fluctuations.

2.2 The unequal growth of wealth

Figure 2 compares real wealth growth across the wealth distribution. Until the early 2000s, wealth growth was relatively uniform across all groups except for the top 1%. Since then, the bottom 50% has fallen behind. During the Great Recession, all groups experienced a slowdown in wealth accumulation, albeit with substantial heterogeneity across groups. While wealth was almost wiped out at the bottom, the effect of the crisis on the top 50% was much less dramatic. The richest 1% stands out as the winner of the wealth growth race. Since 1990, these households have more than quadrupled their total wealth, while those in the bottom 50% only doubled it with part of this growth, especially for the bottom 50%, occurring since the pandemic.

2.3 Portfolios heterogeneity

Differences in wealth growth highlighted in Figure 2 result from differences in saving, capital gains, and other returns (e.g., dividends). Changes in asset prices influence the dynamics of wealth inequality through two channels (see for example Kuhn et al., 2020). If households have heterogeneous portfolios, asset price movements lead to heterogeneous capital gains. Moreover, when wealth-to-income ratios are high, the dynamics of the wealth distribution is affected more by asset prices than by saving flows. Changes in asset prices revalue the stock of existing wealth and induce shifts in the wealth distribution beyond changes in savings.

For asset prices to have an impact on the distribution of wealth beyond savings, it is crucial that households' portfolios display persistent heterogeneity in their composition. As shown in Table 1, there is substantial portfolio heterogeneity across the wealth distribution. Moving towards the top of the distribution, households hold more financial assets and less non-financial

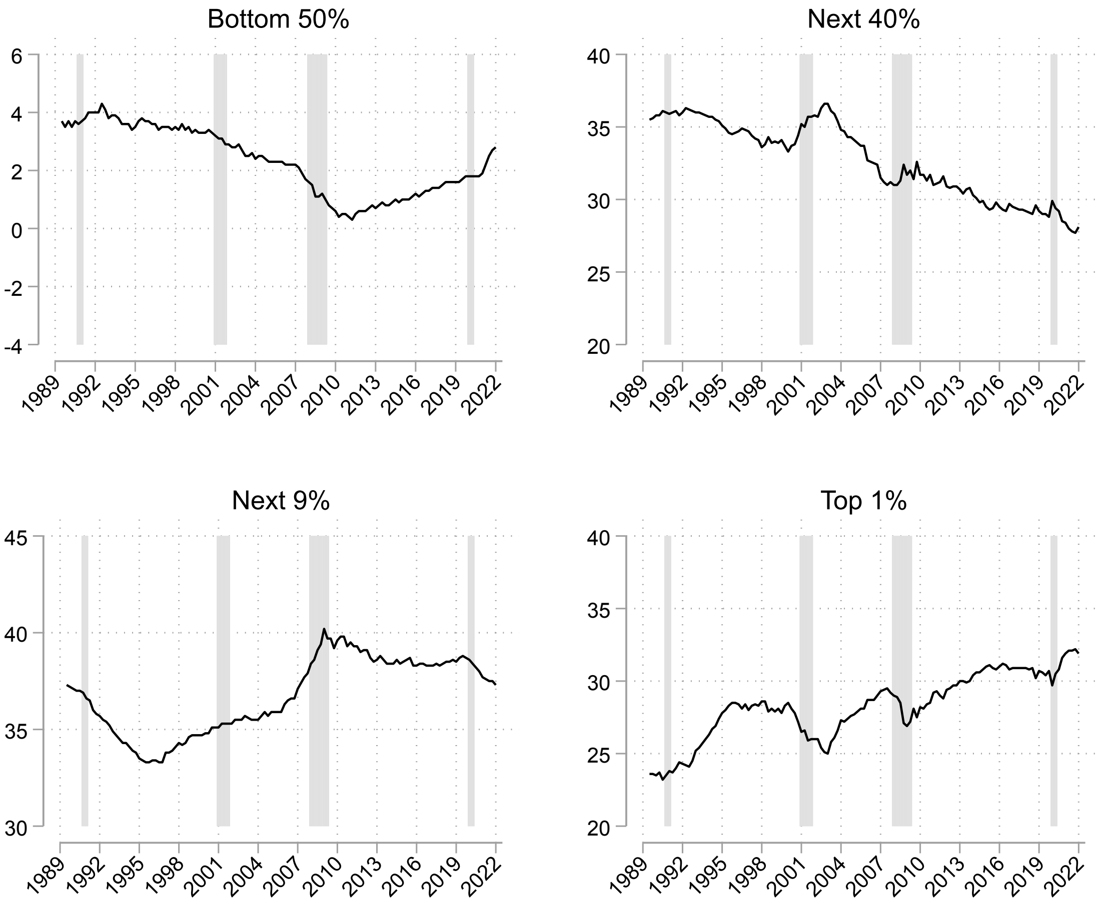


FIGURE 1: WEALTH SHARES

Notes: This figure shows the evolution of wealth shares for the bottom 50%, the next 40%, the next 9%, and the top 1% of the wealth distribution. Table A.1 in Appendix A reports average wealth shares together with the distribution of all components of the balance sheet.

assets. Real estates and consumer durables goods make up half and a fifth of total assets for households in the bottom 50%, respectively. The share of fixed-income assets (e.g., debt securities and money market fund shares) and equities over total assets increases moving towards the top. Pension entitlements, instead, account for almost a third of total assets for households in the next 40% and next 9% of the distribution. Home mortgages make up most of liabilities and their relevance increases with wealth levels, excluding the top 1%. In contrast, the share of consumer credit falls as moving towards the top of the distribution. Figure 3 suggests that, despite cyclical fluctuations, the composition of portfolios is rather constant over time.[4]

[4]Following Bauluz et al. (2022), we organize non-financial and financial assets in the following asset classes: real estates, consumer durable goods, fixed income assets, equities and mutual funds holdings, life insurance and pension funds, and miscellaneous assets. Fixed income assets include: checkable deposits and currency, time deposits and short-term investment, money marker funds, US government and municipal securities, corporate and foreign bonds, loans. Equities and mutual funds holdings include: corporate equities, mutual fund holdings and equity in

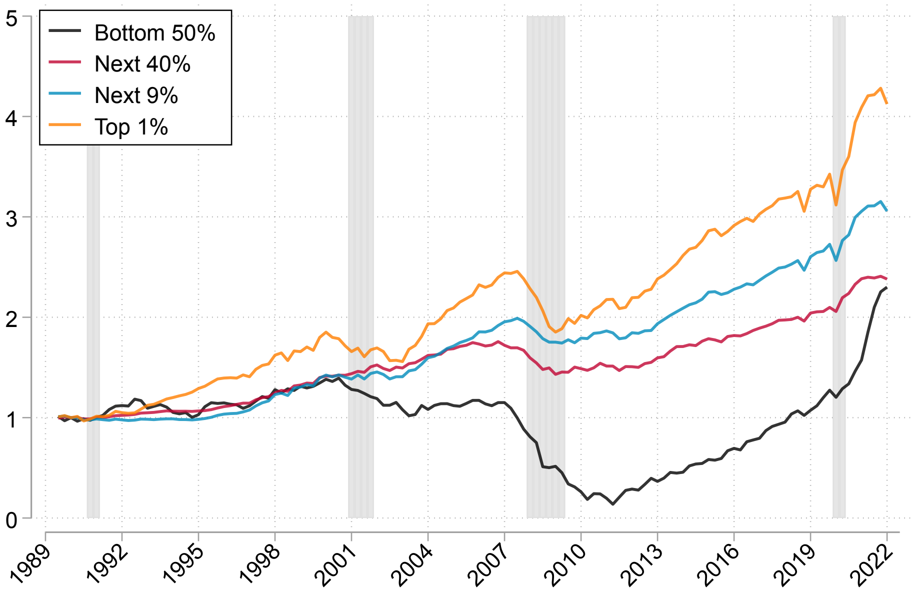


FIGURE 2: REAL WEALTH GROWTH ALONG THE WEALTH DISTRIBUTION SINCE 1990

Notes: This figure shows the evolution of wealth across wealth groups according to the Distributional Financial Accounts. All time series are indexed to 1 in 1990Q1 and deflated using the CPI

To sum up, households across the wealth distribution have very different portfolios. The poorest 50% of households is highly leveraged and holds mostly illiquid assets such as houses and consumer durable goods. Fixed-income and other liquid assets make up only a small share of their portfolio. The portfolio of the next 40% is more diversified. Real estates still make up the largest share of their assets but fixed-income assets and pension entitlements are more predominant. Moving towards the top, the share of financial assets increases significantly, with the richest 1% holding mostly equities and mutual funds. The heterogeneity in the composition of households' assets and liabilities is a crucial element that ultimately makes monetary policy redistributive (Brunnermeier et al., 2012).

3 Econometric methodology

This section outlines the identification strategy and introduces the Bayesian VAR models that we use to estimate the macroeconomic and distributional effects of monetary policy.

3.1 Conventional monetary policy: interest rate shock

A common approach to the identification of monetary policy shocks consists of measuring high-frequency interest rate changes around policy announcements. This strategy is based on the assumption that, around policy announcements, asset prices respond *only* to monetary

noncorporate business. Life insurance and pension funds include: life insurance reserves and pension entitlements.

TABLE 1: PORTFOLIO HETEROGENEITY

	Bottom 50%	50-90%	90-99%	Top 1%
Assets (% of total)				
Nonfinancial assets	71.64	42.31	26.23	17.32
Real estate	51.20	34.71	22.33	13.65
Consumer durable goods	20.44	7.60	3.89	3.67
Financial assets	28.36	57.69	73.77	82.68
Checkable deposits and currency	1.80	1.18	1.07	0.85
Time deposits and short-term investments	4.24	8.15	8.07	6.65
Money market fund shares	0.38	1.34	2.36	2.72
Corporate equities and mutual fund holdings	2.58	7.10	17.14	31.43
Equity in noncorporate business	2.49	4.96	9.52	20.36
Pension entitlements	10.81	29.32	28.53	7.22
Liabilities (% of total)				
Home mortgages	59.36	77.53	81.19	66.63
Consumer credit	36.67	19.49	10.12	8.21
Wealth-to-Asset ratio	27.91	81.21	92.11	97.08

Notes: For each wealth group, the table shows average shares of wealth and type of assets in total assets and type of liabilities in total liabilities. The table report simple averages between 1989Q3 and 2022Q1. Table A.2 in Appendix provides a more detailed version of the heterogeneity in portfolios across the wealth distribution.

policy shocks. Shocks identified in this fashion, however, are not immune to reverse causality and endogeneity problems if the central bank has some private information on the state of the economy (in which case, changes in interest rates and other financial asset prices around policy announcement may still capture an endogenous reaction of monetary policy (Romer and Romer, 2000; Nakamura and Steinsson, 2018; Jarociński and Karadi, 2020)) or if both the central banks and economic agents respond to publicly available economic news (Bauer and Swanson, 2023). Therefore, we use the *pure monetary policy shock* of Jarociński and Karadi (2020) as the proxy for the interest rate shock. The *pure monetary policy shock* is identified when changes in the 3-moth fed fund futures rate and in the S&P500 stock price index co-move negatively around policy announcements.

The *pure monetary policy shock* of Jarociński and Karadi (2020), however, is originally identified using monthly data and for a much shorter sample than the DFA. To use this shock in our application with quarterly data, we implement the following strategy. First, we use the *pure monetary policy shock* as an external instrument in a monthly proxy-SVAR from which we retrieve an implied structural monetary policy shock that matches the length of the DFA.[5] Then,

[5]The monthly proxy-SVAR is estimated from July 1988 to December 2019 in order to cover the sample for which the DFA is available. The model includes: log industrial production, log consumer price index, excess bond premium (Gilchrist and Zakrajšek, 2012), and the 1-year Treasury Rate as policy variable (the model is estimated using

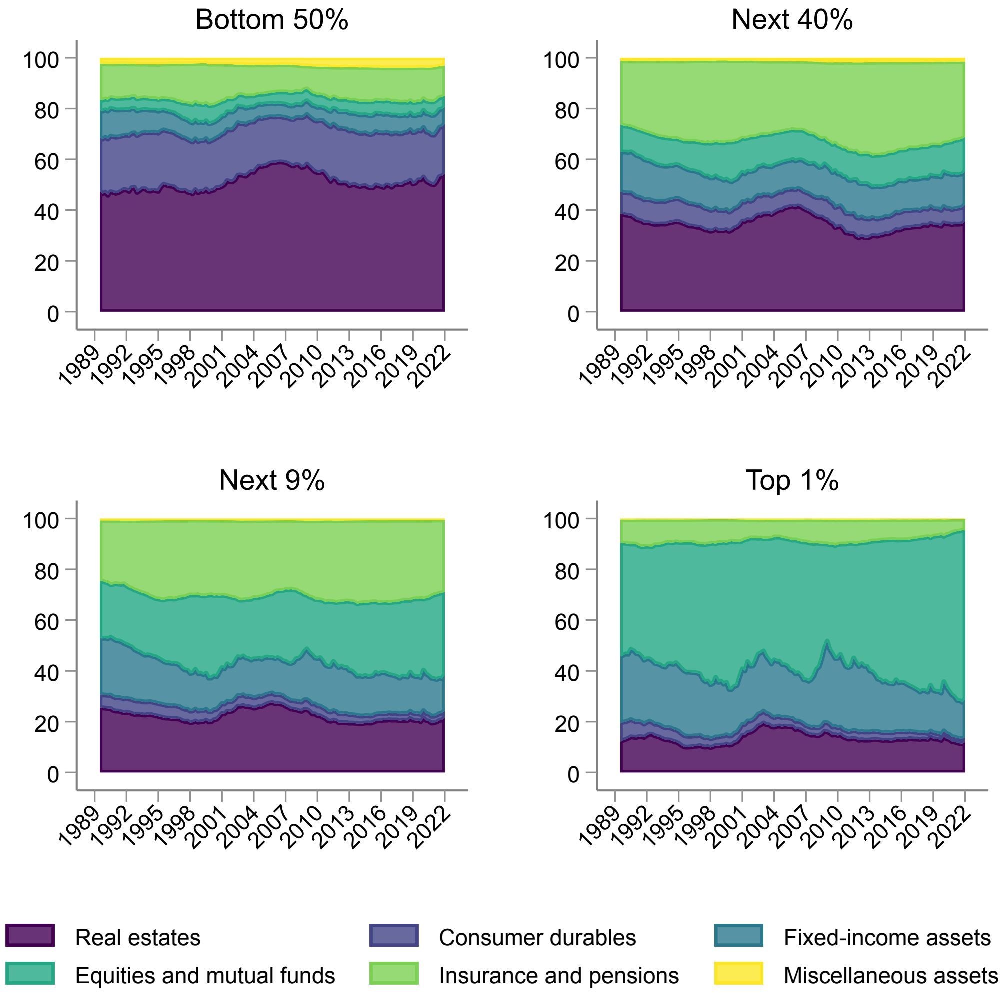


FIGURE 3: PORTFOLIO HETEROGENEITY

Notes: This figure shows the heterogeneity in the asset-side of household portfolios by showing the dynamic composition of major asset classes, as share of total assets, for each wealth group in the Distributional Financial Accounts.

we aggregate the implied structural monetary policy shock to the quarterly frequency and use it as internal instrument to estimate the distributional effects of monetary policy (see Section 4). A more natural strategy would have been to use the *pure monetary policy shock* of Jarociński and Karadi (2020) as proxy in a quarterly VAR. However, this would have come at the cost of giving up the most recent observations from the DFA. Moreover, the relevance condition fails to hold in the proxy-SVAR at quarterly frequency. Hereafter, we refer to this quarterly conventional monetary policy shock as the conventional monetary shock, interest rate shock, or $\hat{s}_t^{FFR}$.

12 lags). The F-statistics in the first stage is at 11.01, above the threshold recommended by Stock et al. (2002).

3.2 Unconventional monetary policy: asset purchase shock

Surprise changes in unconventional monetary policy are identified using the large-scale asset purchase factor constructed by Swanson (2021). The factor is one of the principal components with the greatest explanatory power for asset price changes around monetary policy announcement between July 1991 and June 2019. By construction, the factor is orthogonal to other factors which capture changes in the federal funds rate and forward guidance. Therefore, it can be interpreted as "the component of FOMC announcements that conveys information about asset purchases above and beyond changes in the federal funds rate itself" (Swanson, 2021, p. 37). In line with the literature, changes in the large-scale asset purchase factor have small effects on yields at short maturities while having large impact on long-term rates, particularly on Treasury bonds over 5 years (Vissing-Jorgensen and Krishnamurthy, 2011). Hereafter, we refer to the quarterly large-scale asset purchase factor as the unconventional monetary shock, asset purchase shock, or $\hat{s}_t^{LSAP}$. Both shocks presented in this Section are plotted in the Appendix (Figure B.4).

3.3 Mode, identification, specification

MODEL. The baseline model to estimate the macroeconomic and distributional effects of conventional and unconventional monetary policy shocks is a standard VAR model:

$$\underset{n\times 1}{\mathbf{y}_t} = \underset{n\times 1}{\mathbf{c}} + \sum_{j=1}^{p} \underset{n\times n}{\mathbf{B}_j}\, \mathbf{y}_{t-j} + \underset{n\times 1}{\mathbf{u}_t} \quad \text{with} \quad \mathbf{u}_t \sim \mathcal{N}\left(\underset{n\times 1}{\mathbf{0}}, \underset{n\times n}{\mathbf{\Omega}}\right) \tag{1}$$

where $\mathbf{y}_t$ is a $(n \times 1)$ vector of endogenous variables, $\mathbf{c}$ is a $(n \times 1)$ vector of intercepts, $\mathbf{B}_j$ are $(n \times n)$ matrices of parameters with $j = 1, \ldots, p$, $\mathbf{u}_t$ is a $(n \times 1)$ vector of innovations with zero mean and variance-covariance matrix $\mathbf{\Omega}$. Time is indexed by $t = 1, \ldots, T$, each time period is a quarter, and the maximum lag length p is set to 4 as it is standard in VAR models using US macroeconomic time series. This model may be subject to the "curse of dimensionality" due to the large number of parameters to be estimated relative to the sample length. Hence, we estimate the VAR with Bayesian techniques following the methodology outlined in Giannone et al. (2015).[6]

IDENTIFICATION. To obtain impulse response functions we use the model in equation (1) and the two monetary policy surprise series, outlined in previous sections, as internal instruments following Plagborg-Møller and Wolf (2021). Formally, let z_t be a generic instrument (in our case $\hat{s}_t^{FFR}$ or $\hat{s}_t^{LSAP}$) and ε_t^p be the monetary policy shock and $\boldsymbol{\varepsilon}_t^q$ be a $(n-1) \times 1$ vector with structural shocks other than the policy shock. The internal instrument approach requires the instrument z_t to be correlated with the shock of interest ε_t^p, orthogonal to all other shocks $\boldsymbol{\varepsilon}_t^q$,

[6]This setting treats the hyperparameters, which determine the prior distribution and describe their informativeness for the model coefficients, as random variables and conduct posterior inference on them. This hierarchical approach greatly reduces the importance and numbers of subjective choices and increases the efficiency of impulse responses estimates at the cost of a relatively small bias.

and orthogonal to leads and lags of the structural shocks, that is:

$$\mathbb{E}[z_t \varepsilon_t^{p'}] \neq 0 \tag{2}$$

$$\mathbb{E}[z_t \boldsymbol{\varepsilon}_t^{q'}] = \mathbf{0} \tag{3}$$

$$\mathbb{E}[z_t \boldsymbol{\varepsilon}_{t+k}] = \mathbf{0}, \quad \text{for } k \neq 0 \tag{4}$$

where assumption (2) is the relevance condition, (3) the exogeneity condition, and (4) the orthogonality condition. Under these assumptions, we can estimate the dynamic causal effects of monetary policy by augmenting the VAR with the monetary policy surprise series presented in previous sections. The internal instrument strategy has the favorable property that it leads to consistent estimates of the impulse responses even if the instrument is contaminated with measurement error and the shock is noninvertible (see Li et al., 2021 and Plagborg-Møller and Wolf, 2021 for a formal treatment, and Känzig, 2021 for a recent application).[7] Under the internal instrument approach, the vector of endogenous variables can be partitioned as:

$$\mathbf{y}_t = \left[\hat{s}_t^i, \tilde{\mathbf{y}}_t\right]' \tag{5}$$

where $\hat{s}_t^i$ is, alternatively, the conventional ($\hat{s}_t^{FFR}$) and unconventional ($\hat{s}_t^{LSAP}$) monetary policy shock, and $\tilde{\mathbf{y}}_t$ is a vector containing macroeconomic, financial, and distributional variables. In other words, we proceed as the monetary policy surprise series were the true shock of interest, i.e., we order the instrument $\hat{s}_t^i$ first in the VAR and compute impulse responses to the first orthogonalized innovation.

SPECIFICATION. We use a version of the VAR model in equation (1) in which the vector of endogenous variables $\mathbf{y}_t$ includes, in the following order: the monetary policy instrument, real GDP, the consumer price index, the excess bond premium (Gilchrist and Zakrajšek, 2012), and the policy variable. In the model for conventional (unconventional) monetary policy, the shock is $\hat{s}_t^{FFR}$ ($\hat{s}_t^{LSAP}$) and the policy variable is the 1-year Treasury yield (term spread). The term spread is the difference between the 10-year and the 3-month Treasury yield. We refer to this specification as the baseline model and summarize all variables, units, and sources in Table 2 (panel A). The model for conventional monetary policy is estimated using quarterly time series from 1989Q3 to 2019Q4 while the estimation sample for the model for unconventional monetary policy runs from 1991Q3 to 2019Q2. All variables but the monetary policy shocks, interest rates and spreads enter in level of their natural logarithm. Interest rates and spreads enter in percent. Nominal variables variables are deflated using the consumer price index and the lag length is 4. To study the distributional effects of monetary policy we augment the baseline model with the components of the balance sheet for each wealth group in the DFA (Table 2, panel B). Nominal wealth variables are deflated using the consumer price index and enter in level of their natural logarithm.

[7] These properties are particular favorable in our application as Miranda-Agrippino and Ricco (2023) show that the large-scale asset purchase factor delivers puzzling impulse responses in a proxy-SVAR.

4 Results

4.1 Macroeconomic effects of monetary policy

Figure 4 plots the impulse responses to conventional and unconventional monetary policy shocks. To compare the results across models, we normalize the impulse response functions to generate a 1% response of real GDP three quarters after the monetary policy shock - that is at the end of the first year from the shock. An interest rate shock induces a 60 basis point decrease in the 1-year Treasury, on impact. Similarly, the asset purchase shock compresses the term spread by about 35 basing points, on impact. The fall in both interest rates and spread is significant and the reversion to zeros occurs earlier for the interest rate shock. Consistent with

TABLE 2: MODELS AND VARIABLES DESCRIPTION

	Series	Unit	Source
Panel A: *Baseline models*			
1	Policy shock:		
	Conventional shock ($\hat{s}_t^R$)		Sections 3.1
	Unconventional shock ($\hat{s}_t^{LSAP}$)		Sections 3.2
2	Real GDP	BoC 2012$	Bureau of Economic Analysis
3	Consumer price index	2015 = 100	Bureau of Economic Analysis
4	Excess bond premium	Percent	Gilchrist and Zakrajšek (2012)
5	Interest rate or spread:		
	1-year Treasury Rate	Percent	McCracken and Ng (2021)
	Term spread	Percent	McCracken and Ng (2021)
Panel B: *Models with Distributional Financial Accounts data for each wealth group i*			
	Baseline model		
6	Consumer durables$_i$	Bil of 2015$	Distributional Financial Accounts
7	Real estate$_i$	Bil of 2015$	Distributional Financial Accounts
8	Deposits and short-term investments $_i$	Bil of 2015$	Distributional Financial Accounts
9	Pension entitlements$_i$	Bil of 2015$	Distributional Financial Accounts
10	Corporate equities and mutual funds $_i$	Bil of 2015$	Distributional Financial Accounts
11	Equity in noncorporate business$_i$	Bil of 2015$	Distributional Financial Accounts
12	Home mortgages$_i$	Bil of 2015$	Distributional Financial Accounts
13	Consumer credit$_i$	Bil of 2015$	Distributional Financial Accounts
14	Net wealth$_i$	Bil of 2015$	Distributional Financial Accounts

Notes: Real estates are owner-occupied real estate including vacant land and mobile homes at market value. Deposits and short-term investments include checkable deposits and currency, time deposits and short-term investments, and money market fund shares. Pension entitlements includes defined contribution (DC) pension plans, accrued benefits to be paid in the future from defined benefit (DB) plans, and annuities sold by life insurers directly to individuals. Corporate equities and mutual funds excluding equities and mutual fund shares owned through DC pensions. Equity in noncorporate business is proprietors' equity in noncorporate business (including non-publicly traded businesses and real estate owned by households for renting out to others). Home mortgages are residential home mortgage loans as reported by lenders. Consumer credit includes credit card, student loan, and vehicle loan balances, and other loans extended to consumers.

several studies on the macroeconomic effects of monetary policy (Ramey, 2016), both shocks determine a significant increase in both real GDP and the price level. The excess bond premium falls in response to both shocks, suggesting that monetary policy transmits to the economy by easing financial conditions (Gertler and Karadi, 2015). Overall, the response of real GDP and the price level to an interest rate shock is larger and more persistent relative to the response to an asset purchase shock.

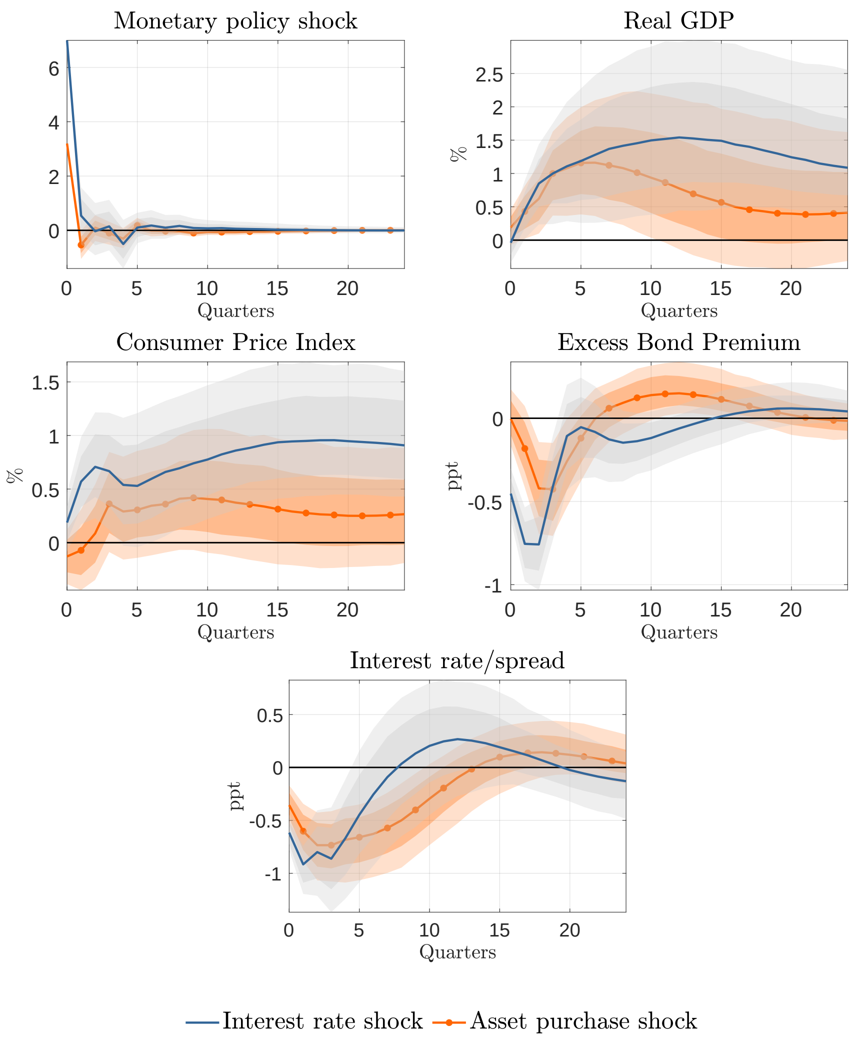


FIGURE 4: *Macroeconomic effects of monetary policy*

Notes: Impulse response functions to an interest rate (blue line) and an asset purchase (orange line with markers) monetary policy shock estimated from the Bayesian VAR described in Table 2, panel A. Point estimates are median impulse responses from the posterior distribution. Impulse responses are normalized to generate a 1% response of real GDP after 3 quarters. Shaded areas are 68% and 90% posterior coverage bands.

4.2 The distributional effects of monetary policy

To study the distributional effects of monetary policy, we augment the baseline models with the components of the balance sheet from the DFA (Table 2, panel B). As in the previous section,

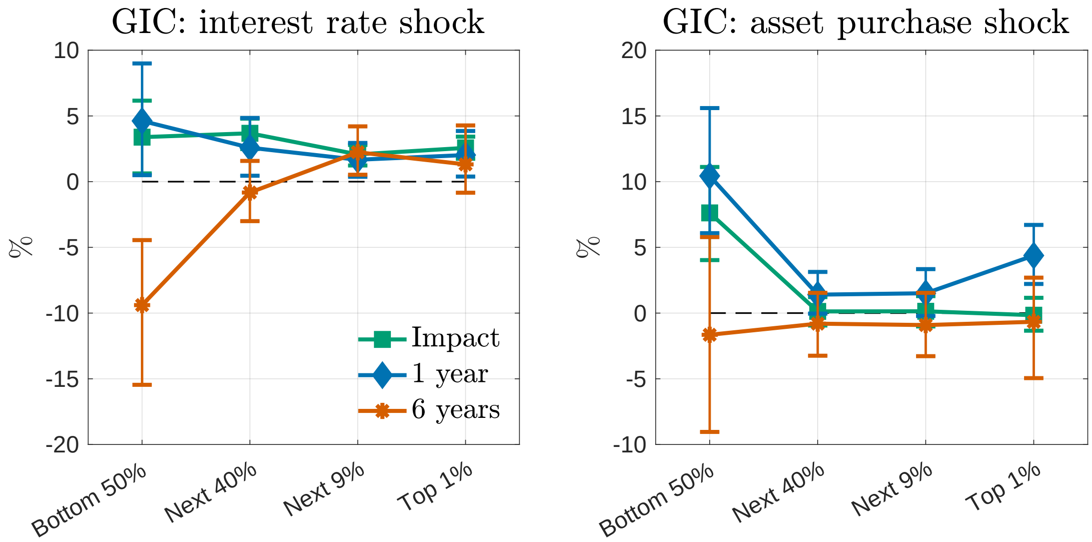


FIGURE 5: *Growth Incidence Curves (GICs) after a monetary policy shock: net wealth*

Notes: The Growth Incidence Curves (GICs) represent the response of real net wealth to an interest rate (left panel) and an asset purchase (right panel) shock estimated from the group-specific Bayesian VAR described in Table 2, panel B. The green line with squared markers is the impact response. The blue line with diamond markers is the response 1 year after the shock. The orange line with stars as markers is the response 6 years after the shock. Net wealth is deflated using the consumer price index. Point estimates are median impulse responses from the posterior distribution. Impulse responses are normalized to generate a 1% response of real GDP after 3 quarters. Intervals are 68% posterior coverage bands.

we estimate a model for each type of monetary policy and for each wealth group. We narrow our attention to consumer durable goods, real estate, deposits and short-term investments, pension entitlements, corporate equities and mutual funds, equity in noncorporate business, home mortgages, consumer credit, and net wealth. These asset classes make up between 88% and 94% of total assets, while home mortgages and consumer credit represent more than 90% of total liabilities across groups, except for the top 1% (72%).

We begin by showing the effect of monetary policy shocks on (real) net wealth across wealth groups, and in doing so we opt for showing these effects using growth incidence curves (GICs). The GICs plot the percentage change in real net wealth for every group of the wealth distribution between two points in time. In Figure 5, we show the percentage change in real net wealth generated by a monetary policy shock for three time intervals; the impact response, the short-run (1 year after the shock), and the medium-run (6 years after the shock). For completeness, we provide the full impulse response functions in Figure A.1 in Appendix A.

THE IMPACT RESPONSE. On impact, an interest rate shock leads to rise in net wealth across groups (Figure 5, left panel, green line with squared markers), and the increase is positive at the 65% credibility interval. This rise in net wealth is rather generalized although slightly larger for the poorest 90% of households. For households in the bottom 50% of the distribution, real net wealth increases by about 3.4 percent while the increase for the top 1% amount to about 2.6%. In contrast, the effect of an purchase shock are more heterogeneous across wealth groups with the poorest 50% recording the largest gains (Figure 5, right panel, green line with squared markers).

THE SHORT-RUN. The increase in real net wealth following an interest rate shock persists over a year (Figure 5, left panel, blue line with diamond markers). At the 68% credibility interval, the effect of an interest rate shock on net wealth is still positive and significant for all groups albeit slightly larger for the poorest 90% of households. One year after the asset purchase shock, real net wealth increase significantly only for the poorest 50% and for the richest 1% of households. The gains in terms of real net wealth are substantial; +10.4% for the poorest 50% and +4.8% for the richest 1% of households over the first year after the shock.

THE MEDIUM-RUN. In the medium-run (six years after the shock), the interest rate shock has very different effects on real net wealth across groups relative to the short-run. At the top, the increase in real wealth persists only for the next 9% (+2.2%) while the poorest 50% of households undergo a dramatic fall in real net wealth (-9.4%). For the latter group, the fall in real net wealth occurs already in the fourth year after the shock. An asset purchase shock, instead, has a much more homogeneous impact in the medium-run as real net wealth for all groups returns to its pre-shock level. For the poorest 50% of households, however, the return to the pre-shock level occurs after a fall in real net wealth starting three years after the shock, although not significant.

PEAK EFFECTS AND PERSISTENCE. The GICs in Figure 5 masks the dynamics of real net wealth following the monetary policy shocks. To this purpose, Table 3 collects the peak effects of monetary policy on real net wealth for group and type of shock, together with an indication of when the peak is reached (in terms of quarters from the shock). Moreover, we report statistically significance; bold (italic) figures denote that the peak effect is statistically significant at the 90% (68%) credibility interval. The table provides also an indication of how persistent is the increase in real net wealth after each shocks. Here, persistence is measured as the number of quarters necessary for the effects of monetary policy shocks on real net wealth to die out, that is the number of quarters real net wealth needs to return back to its pre-shock level. Overall, the peak effect of monetary policy shocks occurs rather early and the persistence varies substantially across groups. The poorest 50% of households record the largest peak increase in real net wealth after both interest rates and asset purchase shocks. Such an increase is substantial, particularly after an asset purchase shock, but this group records the largest drop in real net wealth in the medium run (Figure 5). For the richest 50% of households, the effect of an interest rate shock on net wealth is rather persistent over time, in particular for the top 10% for which no reversion is observed. In contrast, for this same group, the effect of an asset purchase shocks quickly fades away.

Overall, both interest rate and asset purchase shocks, that have expansionary effects for the aggregate economy, have heterogeneous consequences on real net wealth across the wealth distribution. At the peak, both shocks lead to large gains for households at the bottom of the distribution, consistent with evidence by Doepke and Schneider (2006). The richest 1% also

TABLE 3: RESPONSE OF NET WEALTH TO MONETARY POLICY: PEAK EFFECTS AND PERSISTENCE

	Peak response				Persistence	
	INTEREST RATE		ASSET PURCHASE		INTEREST RATE	ASSET PURCHASE
	Quarter	%Δ	Quarter	%Δ	Quarters	Quarters
Bottom 50%	1	**6.39**	6	**11.56**	18	15
Next 40%	0	**3.68**	2	*1.99*	22	8
Next 9%	1	**2.49**	2	*2.00*	-	8
Top 1%	2	**3.21**	2	**4.39**	-	11*

Notes: For each type of monetary policy shock and wealth groups, the table reports the peak percentage change in real net wealth and the quarter when the peak is reached. Quarter equal to 0 refers to the impact response, that is the peak is reached within the same quarter of the policy shock. Δ stands for percentage change relative to the pre-shock level. Bold figures denotes that the peak effect is statically significant at the 90% credibility interval. Italic figures denotes that the peak effect is statically significant at the 68% credibility interval. Persistence is defined as the distance in time between the time of the shock and the quarter when real net wealth needs to return back to its pre-shock level. The symbol (-) denotes that the response of real net wealth is always positive within the forecasting horizon of the impulse response function.
*: Persistence for the top 1% is obtained by omitting the first quarter when the impact response of real net wealth to an asset purchase shock is negative and not significant.

records substantial gains, mostly an asset purchase shock. The bottom 50%, however, suffer a dramatic fall in real net wealth over the medium run. These responses reflect the combined effect of different factors affecting real net wealth, such as asset accumulation, borrowing, debt repayments, and revaluation effects that affect wealth through capital gains. In what follows, we delve into the effects of monetary policy on the components of the balance sheet across the wealth distribution. In the next section, we focus on capital gains as a factor driving changes in real net wealth observed after the monetary policy shock.

4.2.1 Beyond net wealth: real assets and corresponding liabilities

Real assets (real estates and consumer durables) are a major component of total gross assets for the bottom 90% of the distribution. For the poorest half half of households, real assets amount to more than 70% of total gross assets. Moreover, this group is highly leveraged with a wealth-to-asset ratio of about 28% (see Table 1). Therefore, for wealth groups whose assets are predominantly represented by tangibles, changes in real assets and in their financing may drive the effect of monetary policy shocks on real net wealth. Figure 6 plots the response of real assets and liabilities to an interest rate shock, while in Figure 7 displays the response of these same balance sheet items to an asset purchase shock. In both, we plot also the response of real net wealth.

CONSUMER DURABLES AND CREDIT. Consumer durables represent 1/5 of total assets for the poorest half of households according to the DFA. For households in this group, both interest rate and asset purchase shocks undoubtedly raise the stock of consumer durables, and part if this increase is presumably finances through consumer credit (see Figure 6 and 7). A similar increase in consumer durables is observed for the richest 1% after both shocks. Overall, an interest rate shock increases consumer credit for most of groups across the distribution, which increase, in turn, has negative effect on real net wealth after the shock, everything else equal.

HOUSING. Housing is a critical sector through which monetary policy transmits to the economy (Mishkin, 2007; Cloyne et al., 2020; Amromin et al., 2020) and the dynamics of house prices has a significant impact on home equity and on net wealth (Kuhn et al., 2020; Mian et al., 2013). After an interest rate shock, the bottom 90% of household experience a rather long-lasting increase in real estates, and a persistent rise in home mortgages (Figure 6). The increase in real estate for this large group of households largely follows the response of house prices to an interest rate shock (Figure B.3) which resonates with recent findings by Andersen and Leth-Petersen (2021) that an unexpected rise in house prices leads to a greater uptake of mortgage debt, particularly among more financially constrained homeowners. In the medium-run, while real estate returns to the initial level, the increase in home mortgages still persists, and that could explain the decline in net wealth in Figure 5. At the top 10%, where the increase in real net wealth is persistent, real estate increases after an interest rate shock while home mortgage are not very responsive to the shock. Hence, the ultimate effect of an interest rate shock on net wealth through housing for this group is positive, especially for the richest 1%. The effect of an asset purchase shock on real estate and home mortgages appears to be more heterogeneous across wealth groups (Figure 7). Real estate falls for the bottom 90% of households, but the fall occurs later for households in the bottom 50%. For the latter group, however, home mortgages quickly fall after the shock, and this could explain the large increase in real net wealth recorded by the poorest half of households in Figure 5 (right panel).

4.2.2 Beyond net wealth: financial assets

Contrary to real assets, financial assets are a major component of total assets households outside the bottom 50%. For the richest 1%, for example, financial assets represent more than 80% of total assets. Therefore, understanding their behavior may shed light on the drivers of changes in net wealth after monetary policy shocks.

DEPOSITS AND SHORT-TERM INVESTMENTS. Deposits and short-term investments is a rather diverse category that includes also money market funds and other short-term investment. After an interest rate shock, deports and short-term investments fall for the bottom 50% while they are virtually unresponsive for the top 10%. For the next 40%, in contrast, the shock leads to an increase in the level of deposits and short-term investment by almost 10%, thus overperforming the rise in net wealth. The effect of an asset purchase shocks on deposits and short-term investments, instead, is initially negative in the short-run but then turns positive for all groups but the bottom 50%. For this group, deposits increase presumably as a result of the expansionary macroeconomic effects of the asset purchase shock.

PENSION ENTITLEMENTS. Most of pension entitlements are owned by households in the next 49% group of the wealth distribution (see Table A.1). For these same groups, pension entitle-

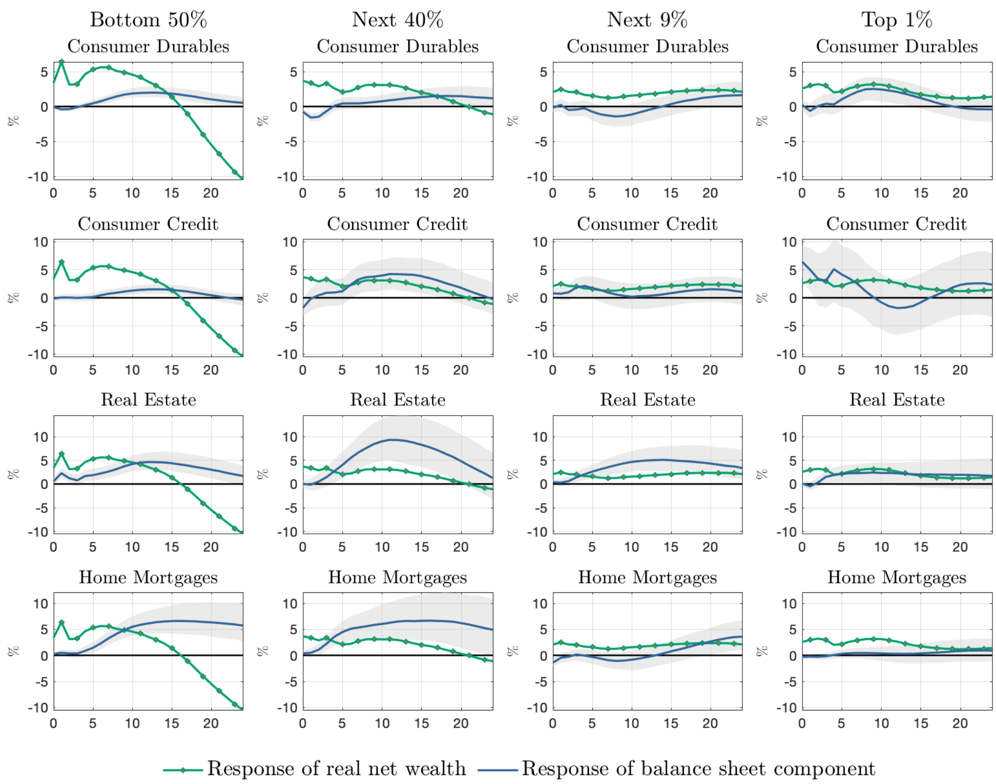


FIGURE 6: *The effects of conventional monetary policy on real assets and corresponding liabilities*

Notes: Point estimates are median impulse responses from the posterior distribution. Impulse responses are scaled to imply a 1% response of real GDP. Shaded areas are 68% posterior coverage bands.

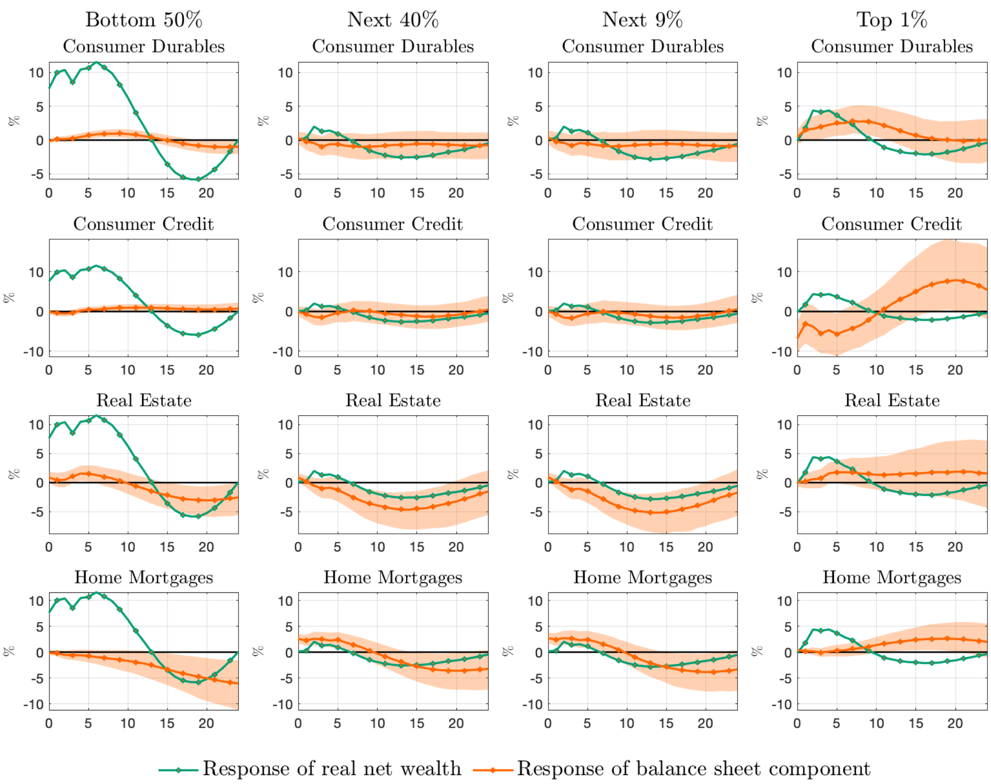


FIGURE 7: *The effects of unconventional monetary policy on real assets and corresponding liabilities*

Notes: Point estimates are median impulse responses from the posterior distribution. Impulse responses are scaled to imply a 1% response of real GDP. Shaded areas are 68% posterior coverage bands.

ments represent almost a third of total assets. As a result, the response of pension entitlements to both interest rate and asset purchase shocks for the next 40% and for the next 9% tracks extremely well the response of net wealth, both in shape and size (see Figure 6 and Figure 7). This suggests that the rise in net wealth following an interest rate shock is presumably driven by rising pension entitlements and by their revaluation.

CORPORATE EQUITIES AND MUTUAL FUNDS. Corporate equities and mutual funds are among the most unequally distributed financial assets in the DFA, and their importance increases with wealth. The returns generated by these assets (e.g., capital gains and dividends) are important drivers of wealth inequality dynamics (Hubmer et al., 2021). Moreover, many of these assets are traded in financial markets, whose reaction to monetary policy is at the center of many theories of the transmission mechanism. Both shocks raise corporate equities and mutual funds across the distribution although the magnitude of the increase differs across wealth groups, especially for an interest rate shock (see Figure 6 and Figure 7). For the top 50%, the rise in corporate equities and mutual funds generated by both outperforms the response of net wealth suggesting that this asset class contributes positively to net wealth growth after the shock, especially in the short-run. Moreover, the rise in corporate equities and mutual funds outperforms the response of stock prices which suggests that expansionary monetary policy triggers both an increase in the accumulation of these assets and an increase in they market value (see Figure B.3 in the Appendix).

EQUITY IN NONCORPORATE BUSINESS. Equities in noncorporate business (or noncorporate equities) is a very heterogeneous asset class, it includes non-publicly traded business assets and real estate owned by households for renting out to others, and its valuation is not straightforward.[8] Moreover, their distribution is very similar to that of corporate equities and mutual funds, and their importance increases with net wealth. Both shocks lead to an increase in equity in noncorporate business, except for the poorest half of households which record an increase only after an immediate fall.

4.3 Robustness

In this section, we discuss the potential pitfalls of the econometric methodology we use and show that the results are robust to deviations from the baseline model. The results of the robustness checks are reported in the Appendix.

ASSET PURCHASE SHOCK. Unconventional monetary policy is measured using the large-asset purchase factor constructed by (Swanson, 2021). The drawback of using the large-asset purchase factor is that it takes non-zero values in the years prior the Great Recession, when the

[8]For example, real estates other than dwellings such as rental properties are recorded at market value. Instead, the valuation of business assets reported in the DFA is an average between market value and cost basis. Although the choice of the valuation basis has minimal distributional implications according to Batty et al. (2020), the implication for monetary policy of using different evaluation can be dramatic. After all, monetary policy changes the discount rate at which assets are evaluated and financial markets are very sensitive to changes in monetary policy.

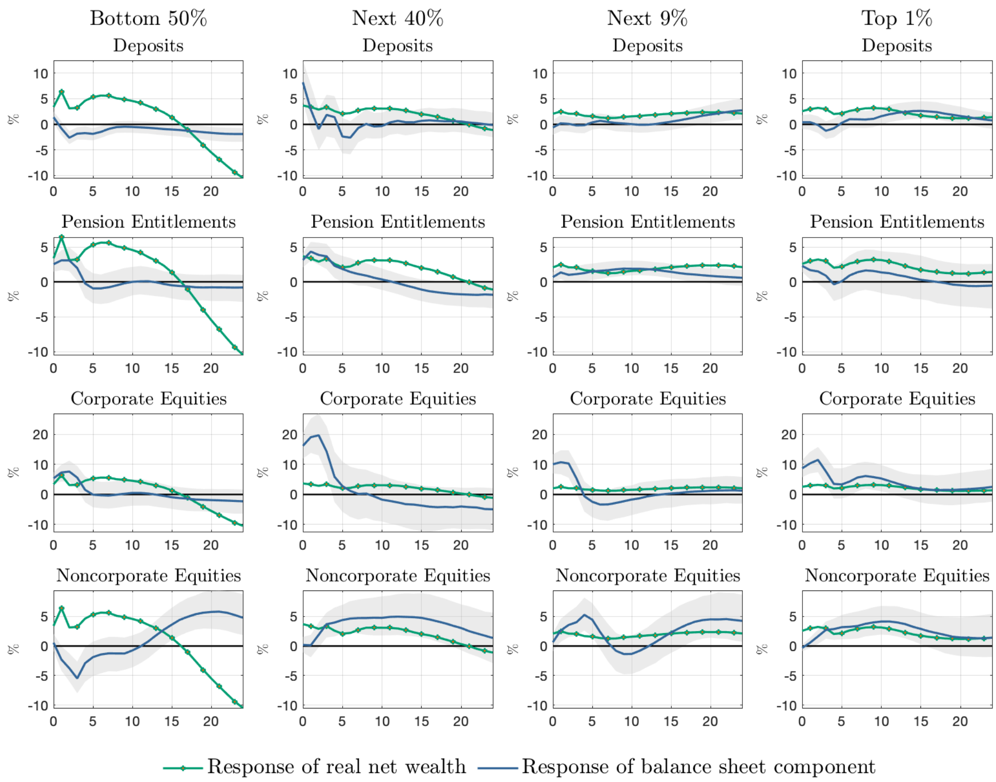


FIGURE 8: *The effects of conventional monetary policy on financial assets*

Notes: Point estimates are median impulse responses from the posterior distribution. Impulse responses are scaled to imply a 1% response of real GDP. Shaded areas are 68% posterior coverage bands.

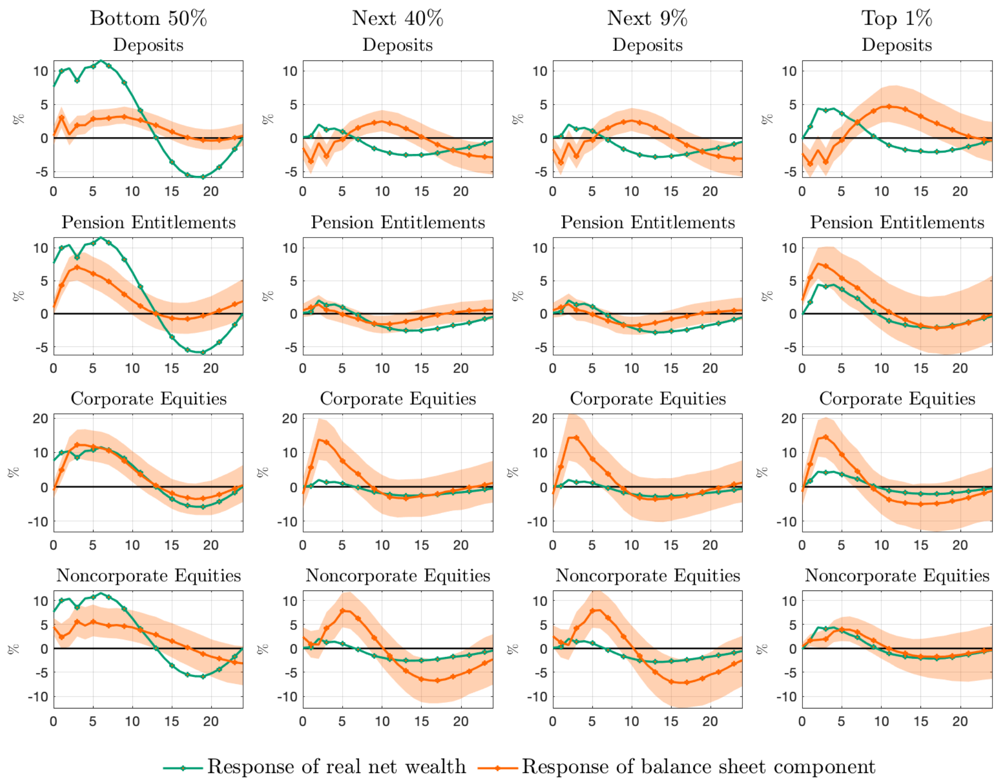


FIGURE 9: *The effects of unconventional monetary policy on financial assets*

Notes: Point estimates are median impulse responses from the posterior distribution. Impulse responses are scaled to imply a 1% response of real GDP. Shaded areas are 68% posterior coverage bands.

Federal Reserve did not use its balance sheet to conduct monetary policy. To exclude the possibility that are results are driven by pre-2008 variation in the large-asset purchase factor which do not reflect economic events, we set the factor to zero for the quarters prior to 2008. Figure B.5 shows that the macroeconomic effects of an asset purchase shock are not driven by pre-2008 fluctuations in the large-asset purchase factor.

MODELING CHOICE. Local projections are an alternative and popular method to estimate the response of macroeconomic variables to a monetary policy shock (Jordà, 2005). According to Montiel Olea and Plagborg-Møller (2021), when the data are slow-moving (e.g., wealth data) and the forecast horizons are long, local projections should be preferred to VARs for obtaining impulse response functions. To exclude that our results on the distributional effects of monetary policy are sensitive to the choice of using a VAR model, we estimate the effect of monetary policy on real net wealth across groups using local projections. In a local projection framework, the impulse response function is the series of regression coefficients β_h associated with the set of h-step ahead predictive regressions. Formally:

$$y_{t+h} = \alpha_h + \beta_h \text{shock}_t + \Phi_h(L)x_{t-1} + u_{t+h} \quad \text{for} \quad h = 0, 1, 2, \ldots, 24 \tag{6}$$

where y is a dependent variable of interest (real net wealth), x is a vector of control variables, $\Phi(L)$ is a polynomial in the lag operator, and *shock* a the specific monetary policy shock. For the sake of comparability, we keep the specification of the local projections as close as possible to its VAR counterpart. Because impulse responses estimated with local projections as are often less precise and sometimes erratic, we estimate a smooth local projection version of equation 6 (Barnichon and Brownlees, 2019). Figure B.6 shows that both local projections and smooth local projections produce impulse responses that are coherent with those estimated with the VAR, with the local projections impulse responses falling largely within the 90% posterior distribution of the VAR model.

5 Monetary policy and heterogeneous capital gains

In the previous section, it has been shown that monetary policy shocks lead to differences in net wealth growth across the distribution. An interest rate shock raises the level of wealth for all groups, in particular at the bottom. The bottom 50%, however, suffers the largest percentage reduction in net wealth over the medium-run. Instead, the percentage increase in net wealth generated by an asset purchase shock is U-shaped and temporary. In this section, we provide a framework to compute capital gains across the wealth distribution using the DFA and aggregate data on revaluations. We then use this framework to shed light on the contribution of monetary policy in driving heterogeneous capital gains across the distribution and its implication for wealth inequality.

5.1 Measuring capital gains

To isolate the role of capital gains, we begin by underlying the role of capital gains in a simple law of motion for net wealth:

$$W^i_{t+1} = W^i_t + \Pi^i_t + O^i_t \tag{7}$$

where W^i_t is wealth of group i at time t, Π^i_t stands for total capital gains of group i between t and $t+1$, and O^i_t captures any other factor affecting wealth at time t (e.g., saving , other returns, dividends, bequests).[9] The law of motion can be extended to any (gross) asset A^i_j on the balance sheet of group i:

$$A^i_{j,t+1} = A^i_{j,t} + \Pi^i_{j,t} + O^i_{j,t} \tag{8}$$

where $A^i_{j,t}$ is the level of asset j of group i at time t, $\Pi^i_{j,t}$ stands for capital gains generated by that asset between t and $+1$, and $O^i_{j,t}$ captures any other factor contributing to the accumulation of that asset.[10] Both laws of motion highlight that capital gains, stemming from asset price changes, contribute to asset and net wealth accumulation. Formally, letting $\left\{A^i_{j,t}\right\}^J_{j=1}$ be a portfolio of assets $j = 1, \ldots, J$ owned by households in wealth group i at time t, total (dollar) capital gains between t and $t+1$ can be obtained as $\Pi^i_t = \sum^J_{j=1} \Pi^i_{j,t} = \sum^J_{j=1} \left(p_{j,t+1}/p_{j,t} - 1\right) A^i_{j,t}$ where $p_{j,t}$ is a price index for asset j under the assumption that different wealth groups face the same price index. In the literature, this formula is used to obtain asset-specific capital gains (Kuhn et al., 2020) but its extension to total capital gains comes at the cost of arbitrary choosing a price index for all assets on the balance sheet, including for those that are not traded on financial markets. In this paper, we take a different approach.

To compute capital gains, we start from the observation that, at the aggregate level, changes in any asset between (the beginning of) time t and (the beginning of) time $t+1$ can be decomposed as follows:

$$\underbrace{A_{j,t+1} - A_{j,t}}_{\text{Economic flow}} = \underbrace{F_{j,t}}_{\text{Transactions}} + \underbrace{R_{j,t}}_{\text{Revaluations}} + \underbrace{V_{j,t}}_{\substack{\text{Other changes}\\ \text{in volume}}} . \tag{9}$$

The economic flow is the change in the level across periods, transactions measure the exchange of assets, revaluations measure holding gains and losses (capital gains), and other changes in volume measure any other variation. The accounting identity in equation 9 holds for aggregate wealth too with R_t measuring changes in wealth due to nominal holdings gains and losses. Therefore, to measure total capital gains, we distribute the aggregate revaluation R_t using the

[9]The law of motion is a simplified version of those appearing in Blanchet and Martínez-Toledano (2022); Kuhn et al. (2020); Saez and Zucman (2016). As in these papers, other factors affecting wealth changes are *synthetic*, that is they are computed as residual. Moreover, we assume that capital gains and other factors affecting wealth accumulation accrue together.

[10]In principle, $O^i_{j,t}$ includes any factor different from unrealized capital gains that determines wealth and asset accumulation. In practice, due to the approach we use to measure capital gains, this factor can include *some* unrealized capital gains in the form of a premium for holding assets of different qualities within the same asset class.

wealth shares of each group as weights:

$$\Pi_t^i = \left(\frac{W_t^i}{W_t}\right) R_t. \tag{10}$$

Aaggregate changes in net wealth due to holding gains and losses (R_t) are retrieved from Table R.101 in the Financial Accounts of the United States. This approach is simple but it allows to measure total capital gains without assuming a price index for each asset class on the balance sheet. We can compare our approach with the traditional formula for the case of single asset. In Appendix C, we compare capital gains on real estates obtained using both a home price index and the revaluation account, and show that the two measures obtained track each other fairly well (see Figure C.1). This evidence reinforces our confidence that distributing the aggregate revaluation can provide a good measure of capital gains without assuming a specific price index.

Capital gains are heterogeneous across the wealth distribution. To show this point, compute capital gains as share of total assets for each wealth group i using the following formula $r_t^i = \Pi_t^i / A_{t-1}^i$. As in Fagereng et al. (2020), we choose total assets (or gross wealth) as denominator instead of net wealth to avoid inflating the ratio for groups with very little wealth. The formula for capital gains to total assets can be interpreted as quantifying how much income is generated out of each dollar of asset. However, we can not interpret this ratio as a return on assets because in our setting neither dividends and realized capital gains nor the cost of servicing debts are observed. Figure 10 (left panel) plots average capital gains to total assets between 1989-2022 across the wealth distribution. Capital gains feature *scale dependence*: richer households (in terms of wealth) enjoy higher capital gains. Scale dependence in returns to wealth has been found also in Norway (Fagereng et al., 2020), Sweden (Bach et al., 2020), and US (Xavier, 2021). We also compute capital gains to assets for a selected number of asset classes (real estate, pension entitlements, corporate equities and mutual funds, equity in noncorporate business). These capital gains are displayed in Figure 10 (right panel). Asset-specific capital gains are relatively higher for groups which portfolios are relatively more exposed to that asset. For example, capital gains from real estate are higher for the poorest half of households.

5.2 Monetary policy and heterogeneous capital gains

Scale dependence in capital gains can contribute to wealth inequality (Piketty, 2014). Capital gains stem from fluctuations in asset prices, and monetary policy is known to have large effects on asset prices (Bernanke and Kuttner, 2005; Jarociński and Karadi, 2020). Expansionary monetary policy lowers the discount rate and increases the present value of future cash flows generated by long-lived assets. Similarly, asset purchases lower long-term yields and increases valuations. When portfolios are heterogeneous and asset prices are responsive to monetary policy, both interest rate and asset purchase shocks can affect wealth inequality via heterogeneous capital gains. If an interest rate cut boosts asset prices, then wealth would increase more

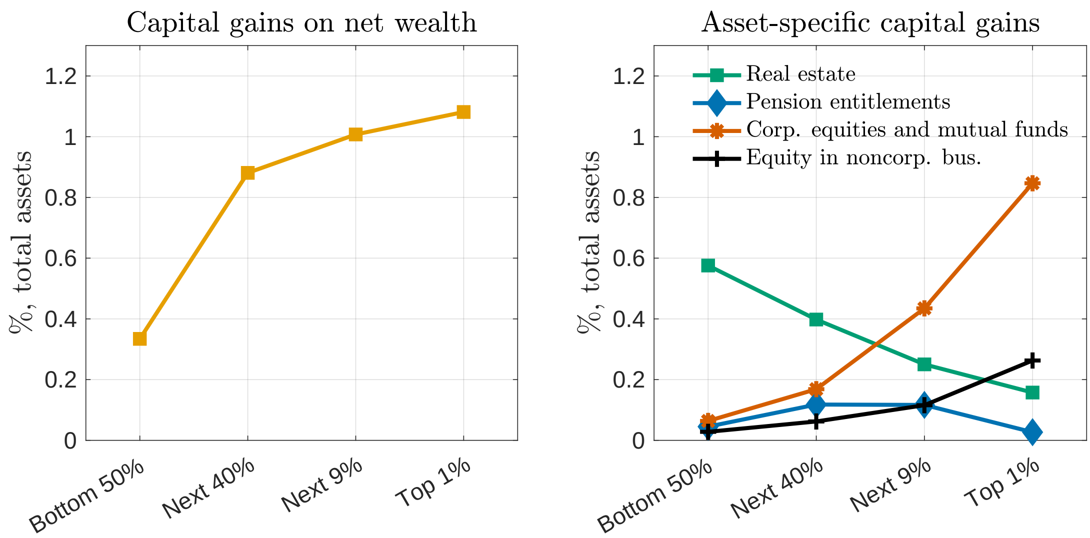


FIGURE 10: *Scale dependence (average capital gains to total assets, 1989-2022)*

Notes: The figure plots average capital gains on (lagged) total assets for each wealth group. The average is computed over the full sample (1989-2022). Capital gains on net wealth foe group i are computed as $r^i_t = \Pi^i_t/A^i_{t-1}$ *with* $\Pi^i_t = \left(W^i_t/W_t\right) R_t = \sum_1^J \left(A^i_{j,t}/A_{j,t}\right) R_{j,t}$*, with W being net wealth, A being total assets,* A_j *identifying asset j, and* R_j *being revaluations on asset j. Asset-specific capital gains are computed as* $r^i_{j,t} = \Pi^i_{j,t}/A^i_{t-1}$ *with with* $\Pi^i_{j,t} = \left(A^i_{j,t}/A_{j,t}\right) R_{j,t}$ *for each asset j.*

at the top than at the bottom as households at the top hold more price-sensitive assets and enjoy higher capital gains (scale dependence).[11]

Having clarified the role of capital gains in wealth accumulation, we can quantify the role of monetary policy in generating heterogeneous capital gains across the distribution. To this end, we estimate a baseline VAR model (see Panel A in Table 2) augmented with capital gains to total assets (Π^i_t/A^i_{t-1}) for each wealth group i. As before, we estimate a model for each type of monetary policy. Identification and estimation follows the same approach outlined in Section 3. Figure 11 shows the effect of monetary policy on capital gains to total assets along the wealth distribution at different horizons (impact response and the response after one year). Overall, the effect of both interest rate and asset purchase shocks on capital gains increases across the wealth distribution. Interestingly, most of the heterogeneity in effect of monetary policy is observed between the bottom 50% and the top 50%, and little heterogeneity exists within the richest half of households. For example, after an interest rate shock, the instantaneous gains for the richest 1% are almost 4 times larger than the gains for the poorest 50% while they are just 1.2 times larger than the gains for the next 40.

To gain insights into the importance of monetary policy in driving heterogeneous capital gains across the wealth distribution, Figure 12 plots the forecast error variance decomposition for both interest rate and asset purchase shocks. The forecast error variance decomposition

[11] Our measures of capital gains based on revaluations data from the national accounts do not directly account for the heterogeneous compositions of portfolios. However, it can be shown that capital gains to total assets reflect portfolio heterogeneity. Namely, $r^i_t = \Pi^i_t/A^i_{t-1} = \sum_1^J \left(A^i_{j,t}/A^i_{t-1}\right)\left(R_{j,t}/A_{j,t-1}\right)$ where $\left(A^i_{j,t}/A^i_{t-1}\right)$ reflects the exposure of group i to asset j and this exposure changes across groups (portfolio heterogeneity).

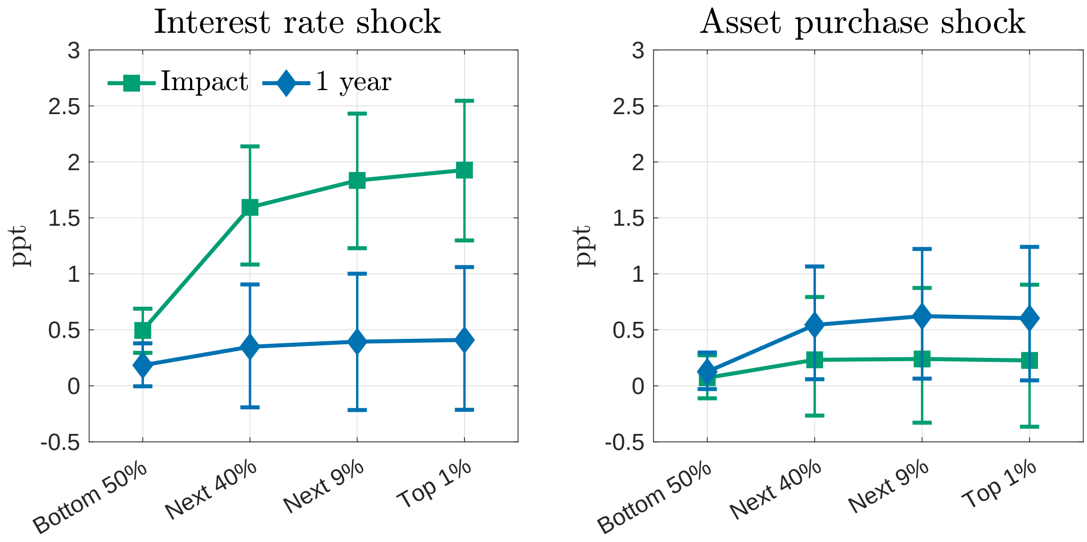


FIGURE 11: *Effect of monetary policy on total capital gains as share of assets*

Notes: The impulse responses for each wealth group are retrieved from a baseline VAR model augmented with capital gains to total assets for each wealth group. Impulse responses are scaled to imply a 1% response of real GDP. Intervals are 68% posterior coverage bands.

quantifies how much of the variability - between the time of the shock and some quarter in the future - in capital gains can be explained by monetary policy shocks. We narrow our attention on the average forecast error variance decomposition during the first four quarters from the shock which we interpret as the short-term contribution of monetary policy to fluctuations in capital gains.The contribution of monetary policy shocks to capital gains increases with net wealth. Interest rate shocks, for example, explains less than 0.5% of fluctuations in capital gains for the bottom 50%, while this share increases to 7.2% for the top 1%. Heterogeneity is even starker for the asset purchase shock. In this case, the shock explains less than 0.5% of fluctuations in capital gains during the first year for the bottom 50% but it explains up to 14.2% for the top 1%.

If households had the same composition of the portfolios, then the effect of monetary policy on capital gains would be uniform across the wealth distribution and monetary policy would not have distributional consequences. However, this is not the case. Capital gains feature scale dependence: richer households enjoy higher capital gains. The effects of monetary policy shocks on capital gains exhibit scale dependence too: richer households enjoy larger increases in capital gains after the shock. The channel from monetary policy shocks to heterogeneous capital gains involves portfolio heterogeneity: the differences in the response of capital gains mirrors the heterogeneity in the composition of portfolios across the wealth distribution. Households owning relatively more long-dated assets like the top 1% enjoy higher capital gains after a monetary policy shock because their portfolio exhibits a longer duration (Greenwald et al., 2021).

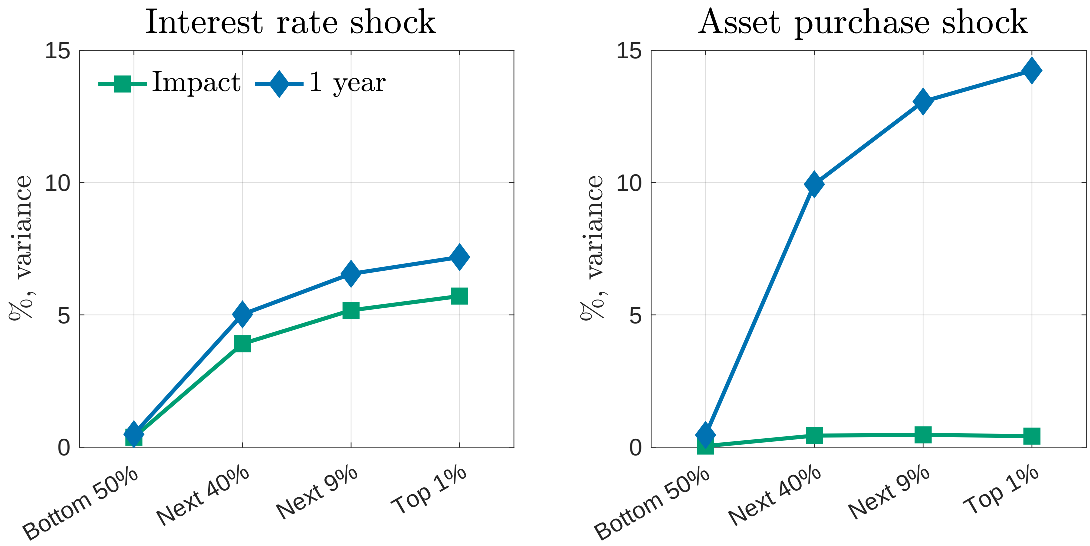


FIGURE 12: *Explanatory power of monetary policy for total capital gains*

Notes: The explanatory power of monetary policy on total capital gains is the impact and 1-year forecast error variance decomposition. The forecast error variance decomposition is retrieved from a baseline VAR model augmented with capital gains to total assets for each wealth group.

6 Conclusions

In this paper, we use the Distributional Financial Accounts of the United States to study the distributional effects of monetary policy. In the short-run, a shock that lowers interest rates or increases asset purchases raises net wealth across the wealth distribution. In the medium-run, the effects of an asset purchase shock vanish, whereas those of an interest rate shock result in a significant fall of net wealth of the poorest half of households. Movements in net wealth resulting from monetary policy reflect the combined effect of difference forces such as changes in balance sheets and revaluations. Balance sheet adjustments, mostly stemming from real estates and mortgages, drive the response of net wealth for the poorest half of households. Instead, both balance sheet adjustments and price effects are responsible for the movements in net wealth t the top. When portfolios are heterogeneous, monetary policy unevenly affects wealth accumulation via heterogeneous capital gains. After computing capital gains across the wealth distribution, we show that richer households enjoy larger increases in capital gains after both interest rate and asset purchase shocks, and that a non-negligible share of fluctuations in capital gains for the richest 1% can be explained by monetary policy.

Summing up, we provide evidence that the effects of monetary policy differ across the wealth distribution. Movements in net wealth stemming from interest rate and asset purchase shock suggests that, in the short-run, monetary policy has equalizing effects on the distribution of wealth. Indeed, net wealth grows more at the bottom than at the top. In the medium-run, however, these equality-inducing effects are offset by a large fall in net wealth recorded by the poorest half of the distribution. Our results also suggest that the transmission of monetary to policy to net wealth via asset prices is quantitatively relevant only for households in top half of the distribution, and in particular for those in the top decile. The heterogeneous response of capital gains we uncover suggests that the monetary policy may contribute to wealth inequality by inducing revaluation of wealth at the top.

Nevertheless, inequality has a multidimensional nature and involves income, consumption, race, gender, in addition to wealth. The data (aggregate rather than at individual or household level) and the econometric approach we use in this paper allow us to provide only a partial assessment on the distributional consequences of monetary policy. Monetary policy, in fact, affects other dimensions of inequality, mostly of income and consumption, and these dimensions shall be taken into account when evaluating the distributional effects of monetary policy. This is where we believe this line of research should go.

References

Adam, Klaus and Panagiota Tzamourani, "Distributional consequences of asset price inflation in the euro area," *European Economic Review*, 2016, *89*, 172–192. 4

Albert, Juan-Francisco and Nerea Gómez-Fernández, "Monetary Policy and the Redistribution of Net Worth in the US," *Journal of Economic Policy Reform*, 2021, *25* (4), 420–434. 4

—, Antonio Peñalver, and Alberto Perez-Bernabeu, "The effects of monetary policy on income and wealth inequality in the US Exploring different channels," *Structural Change and Economic Dynamics*, 2020, *55*, 88–106. 4

Amberg, Niklas, Thomas Jansson, Mathias Klein, and Anna Rogantini Picco, "Five Facts about the Distributional Income Effects of Monetary Policy Shocks," *American Economic Review: Insights*, 2021, (Forthcoming). 4

Amromin, Gene, Neil Bhutta, and Benjamin J Keys, "Refinancing, monetary policy, and the credit cycle," *Annual Review of Financial Economics*, 2020, *12*, 67–93. 18

Andersen, Asger Lau, Niels Johannesen, Mia Jørgensen, and José-Luis Peydro, "Monetary policy and inequality," *Journal of Finance (Forthcoming)*, 2023. 4

Andersen, Henrik Yde and Søren Leth-Petersen, "Housing wealth or collateral: How home value shocks drive home equity extraction and spending," *Journal of the European Economic Association*, 2021, *19* (1), 403–440. 18

Bach, Laurent, Laurent E Calvet, and Paolo Sodini, "Rich pickings? risk, return, and skill in household wealth," *American Economic Review*, 2020, *110* (9), 2703–47. 5, 26

Barnichon, Regis and Christian Brownlees, "Impulse response estimation by smooth local projections," *Review of Economics and Statistics*, 2019, *101* (3), 522–530. 24

Bartscher, Alina K, Moritz Kuhn, Moritz Schularick, and Paul Wachtel, "Monetary Policy and Racial Inequality," 2021, *Federal Reserve Bank of New York Staff Reports, no. 959.* 2, 4

Batty, Michael, Jesse Bricker, Joseph Briggs, Sarah Friedman, Danielle Nemschoff, Eric Nielsen, Kamila Sommer, and Alice Henriques Volz, "The Distributional Financial Accounts of the United States," in "Measuring and Understanding the Distribution and Intra/Inter-Generational Mobility of Income and Wealth," University of Chicago Press, 2020. 5, 21

Bauer, Michael D and Eric T Swanson, "A Reassessment of Monetary Policy Surprises and High-Frequency Identification," *NBER Macroeconomics Annual*, 2022, *37.* 5

— and —, "An Alternative Explanation for the "Fed Information Effect"," *American Economic Review (forthcoming)*, 2023. 9

Bauluz, Luiz, Filip Novokmet, and Moritz Schularick, "The Anatomy of the Global Saving Glut," 2022. 7

Benhabib, Jess, Alberto Bisin, and Mi Luo, "Wealth Distribution and Social Mobility in the US: A Quantitative Approach," *American Economic Review*, May 2019, *109* (5), 1623–47. 5

Bernanke, Ben S and Kenneth N Kuttner, "What explains the stock market's reaction to Federal Reserve policy?," *The Journal of finance*, 2005, *60* (3), 1221–1257. 5, 26

Blanchet, Thomas and Clara Martínez-Toledano, "Wealth inequality dynamics in europe and the united states: Understanding the determinants," *Journal of Monetary Economics*, 2022. 25

—, Emmanuel Saez, and Gabriell Zucman, "Real-Time Inequality," 2022. 5, 37, 38

Brunnermeier, Markus K, Yuliy Sannikov et al., "Redistributive monetary policy," in "Jackson hole symposium," Vol. 1 Federal Reserve Bank of Kansas City Kansas City, KS 2012, pp. 331–384. 8

Casiraghi, Marco, Eugenio Gaiotti, Lisa Rodano, and Alessandro Secchi, "A "Reverse Robin Hood"? The distributional implications of non-standard monetary policy for Italian households," *Journal of International Money and Finance*, 2018, *85*, 215–235. 4

Chodorow-Reich, Gabriel, Plamen T Nenov, and Alp Simsek, "Stock market wealth and the real economy: A local labor market approach," *American Economic Review*, 2021, *111* (5), 1613–1657. 3

Cloyne, James, Clodomiro Ferreira, and Paolo Surico, "Monetary policy when households have debt: new evidence on the transmission mechanism," *The Review of Economic Studies*, 2020, *87* (1), 102–129. 18

Coibion, Olivier, Yuriy Gorodnichenko, Lorenz Kueng, and John Silvia, "Innocent Bystanders? Monetary policy and inequality," *Journal of Monetary Economics*, 2017, *88*, 70–89. 4

Colciago, Andrea, Anna Samarina, and Jakob de Haan, "Central bank policies and income and wealth inequality: A survey," *Journal of Economic Surveys*, 2019, *33* (4), 1199–1231. 4

Doepke, Matthias and Martin Schneider, "Inflation and the redistribution of nominal wealth," *Journal of Political Economy*, 2006, *114* (6), 1069–1097. 16

Fagereng, Andreas, Luigi Guiso, Davide Malacrino, and Luigi Pistaferri, "Heterogeneity and persistence in returns to wealth," *Econometrica*, 2020, *88* (1), 115–170. 26

Feilich, Ethan, "Monetary policy and the dynamics of wealth inequality," 2021. 4

Furceri, Davide, Prakash Loungani, and Aleksandra Zdzienicka, "The effects of monetary policy shocks on inequality," *Journal of International Money and Finance*, 2018, *85*, 168–186. 4

Gertler, M. and P. Karadi, "Monetary policy surprises, credit costs, and economic activity," *American Economic Journal: Macroeconomics*, 2015, *7(1)*, 44–76. 5, 14

Giannone, Domenico, Michele Lenza, and Giorgio E Primiceri, "Prior selection for vector autoregressions," *Review of Economics and Statistics*, 2015, *97* (2), 436–451. 11

Gilchrist, Simon and Egon Zakrajšek, "Credit spreads and business cycle fluctuations," *American Economic Review*, 2012, *102* (4), 1692–1720. 9, 12, 13

Greenwald, Daniel L, Matteo Leombroni, Hanno Lustig, and Stijn Van Nieuwerburgh, "Financial and total wealth inequality with declining interest rates," Technical Report, National Bureau of Economic Research 2021. 28

Gürkaynak, Refet, Brian Sack, and Eric Swanson, "Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements," *International Journal of Central Banking*, 2005, *1* (1). 5

Herradia, Mehdi El and Aurélien Leroyb, "Monetary Policy and the Top 1%: Evidence from a Century of Modern Economic History," *International Journal of Central Banking*, 2021, *18* (5), 237–277. 4

Hubmer, Joachim, Per Krusell, and Anthony A Smith Jr, "Sources of US wealth inequality: Past, present, and future," *NBER Macroeconomics Annual*, 2021, *35* (1), 391–455. 5, 21

Jarociński, Marek and Peter Karadi, "Deconstructing monetary policy surprises—the role of information shocks," *American Economic Journal: Macroeconomics*, 2020, *12* (2), 1–43. 9, 10, 26

Jordà, Òscar, "Estimation and inference of impulse responses by local projections," *American economic review*, 2005, *95* (1), 161–182. 24

Känzig, Diego R, "The economic consequences of putting a price on carbon," *Available at SSRN 3786030*, 2021. 12

Kappes, Sylvio Antonio, "Monetary Policy and Personal Income Distribution: A Survey of the Empirical Literature," *Review of Political Economy*, 2021, pp. 1–20. 4

Krishnamurthy, Arvind and Annette Vissing-Jorgensen, "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy," *Brookings Papers on Economic Activity Fall 2011*, 2012, p. 215. 5

Kuhn, Moritz, Moritz Schularick, and Ulrike I Steins, "Income and wealth inequality in america, 1949–2016," *Journal of Political Economy*, 2020, *128* (9), 3469–3519. 5, 6, 18, 25

Lenza, Michele and Jirka Slacalek, "How Does Monetary Policy Affect Income and Wealth Inequality? Evidence from Quantitative Easing in the Euro Area," 2021, *CEPR Discussion Paper 16079.* 4

Li, Dake, Mikkel Plagborg-Møller, and Christian K Wolf, "Local Projections vs. VARs: Lessons From Thousands of DGPs," *arXiv preprint arXiv:2104.00655*, 2021. 12

Luigi, Clara De, Martin Feldkircher, Philipp Poyntner, and Helene Schuberth, "Quantitative Easing and Wealth Inequality: The Asset Price Channel," *Oxford Bulletin of Economics and Statistics*, 2023. 4

Maggio, Marco Di, Amir Kermani, and Kaveh Majlesi, "Stock market returns and consumption," *The Journal of Finance*, 2020, *75* (6), 3175–3219. 3

McCracken, Michael W and Serena Ng, "FRED-QD: A Quarterly Database for Macroeconomic Research," *FRB of St. Louis Working Paper No. Forthcoming*, 2021. 13

McKay, Alisdair and Christian K Wolf, "Monetary Policy and Inequality," *Journal of Economic Perspectives*, 2023, *37* (1), 121–44. 3, 4

Mian, Atif, Kamalesh Rao, and Amir Sufi, "Household balance sheets, consumption, and the economic slump," *The Quarterly Journal of Economics*, 2013, *128* (4), 1687–1726. 18

Miranda-Agrippino, Silvia and Giovanni Ricco, "Identification with external instruments in structural VARs," *Journal of Monetary Economics (forthcoming)*, 2023. 12

Mishkin, Frederic S, "Housing and the monetary transmission mechanism," 2007. 18

Mumtaz, Haroon and Angeliki Theophilopoulou, "The impact of monetary policy on inequality in the UK. An empirical analysis," *European Economic Review*, 2017, *98*, 410–423. 4

Nakamura, Emi and Jón Steinsson, "High-frequency identification of monetary non-neutrality: the information effect," *The Quarterly Journal of Economics*, 2018, *133* (3), 1283–1330. 9

Olea, José Luis Montiel and Mikkel Plagborg-Møller, "Local projection inference is simpler and more robust than you think," *Econometrica*, 2021, *89* (4), 1789–1823. 24

Piketty, Thomas, "Capital in the twenty-first century," in "Capital in the twenty-first century," Harvard University Press, 2014. 26

Plagborg-Møller, Mikkel and Christian K. Wolf, "Local projections and VARs estimate the same impulse responses," *Econometrica*, 2021, *89* (2), 955–980. Publisher: Wiley Online Library. 11, 12

Ramey, Valerie A, "Macroeconomic shocks and their propagation," *Handbook of macroeconomics*, 2016, *2*, 71–162. 14

Romer, Christina D and David H Romer, "Federal Reserve information and the behavior of interest rates," *American economic review*, 2000, *90* (3), 429–457. 9

Saez, Emmanuel and Gabriel Zucman, "Wealth inequality in the United States since 1913: Evidence from capitalized income tax data," *The Quarterly Journal of Economics*, 2016, *131* (2), 519–578. 5, 6, 25

_ and _ , "The rise of income and wealth inequality in America: Evidence from distributional macroeconomic accounts," *Journal of Economic Perspectives*, 2020, *34* (4), 3–26. 5

Schnabel, Isabel, "Monetary policy and inequality," *Speech at a virtual conference on "Diversity and Inclusion in Economics, Finance, and Central Banking"*, 2021, *Available at:* *https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp211109_2~cca25b0a68.en.html*. 3

Smith, Matthew, Owen Zidar, and Eric Zwick, "Top Wealth in America: New Estimates Under Heterogeneous Returns," *The Quarterly Journal of Economics*, 2023, *138* (1), 515–573. 6

Solt, Frederick, "Measuring income inequality across countries and over time: The standardized world income inequality database," *Social Science Quarterly*, 2020, *101* (3), 1183–1199. 3

Stock, James H, Jonathan H Wright, and Motohiro Yogo, "A survey of weak instruments and weak identification in generalized method of moments," *Journal of Business & Economic Statistics*, 2002, *20* (4), 518–529. 10

Swanson, Eric T, "Let's twist again: a high-frequency event-study analysis of operation twist and its implications for QE2," *Brookings Papers on Economic Activity*, 2011, *2011* (1), 151–188. 5

—, "Measuring the effects of Federal Reserve forward guidance and asset purchases on financial markets," *Journal of Monetary Economics*, 2021, *118*, 32–53. 5, 11, 21

Vissing-Jorgensen, Annette and Arvind Krishnamurthy, "The effects of quantitative easing on interest rates: Channels and implications for policy," *Brookings Papers on Economic Activity*, 2011, *43* (2), 215–287. 11

Wolff, Edward N, "Inflation, Interest, and the Secular Rise in Wealth Inequality in the US: Is the Fed Responsible?," 2021, *NBER Working Paper 29392.* 4

Xavier, Inês, "Wealth inequality in the US: the role of heterogeneous returns," *Available at SSRN 3915439*, 2021. 26

Yellen, Janet L, "Perspectives on inequality and opportunity from the survey of consumer finances," *RSF: The Russell Sage Foundation Journal of the Social Sciences*, 2016, *2* (2), 44–59. 3

Appendix

A Additional charts and tables

TABLE A.1: DISTRIBUTION OF ASSETS, LIABILITIES AND WEALTH (1989-2022)

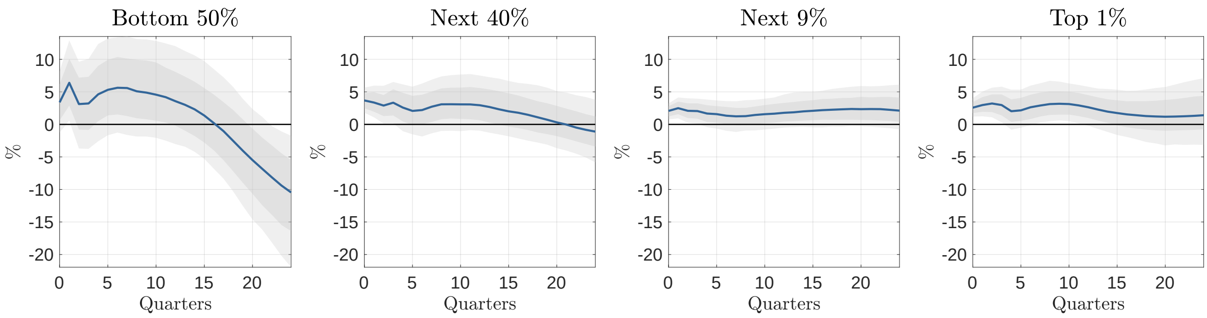
	Bottom 50%	Next 40%	Next 9%	Top 1%	99-99.9%	Top 0.1%
Assets	6.98	34.29	33.97	24.77	15.15	9.62
Nonfinancial assets	15.27	44.42	27.24	13.07	9.19	3.88
Real estate	13.50	45.04	28.70	12.76	9.52	3.24
Consumer durable goods	22.94	41.97	20.92	14.16	7.63	6.54
Financial assets	2.95	29.40	37.24	30.41	18.04	12.37
Checkable deposits and currency	11.45	37.52	32.34	18.69	12.36	6.34
Time deposits and short-term investments	3.99	37.65	36.46	21.91	14.07	7.84
Money market fund shares	1.37	23.65	41.45	33.52	22.24	11.29
US government and municipal securities	1.16	15.00	31.40	52.43	27.59	52.43
Corporate and foreign bonds	0.82	15.63	30.92	52.63	24.22	28.41
Loans	0.64	10.21	32.77	56.37	31.62	24.75
Corporate equities and mutual fund holdings	1.15	15.28	35.83	47.74	27.94	19.80
Equity in noncorporate business	1.73	16.89	31.87	49.51	26.96	22.55
Life insurance reserves	9.80	42.08	28.74	19.39	13.56	5.83
Pension entitlements	3.40	45.02	43.62	7.96	6.44	1.52
Miscellaneous assets	20.08	47.62	23.37	8.93	6.61	2.31
Liabilities	33.48	43.56	18.13	4.85	4.13	0.72
Home mortgages	27.73	47.17	20.58	4.52	4.04	0.47
Consumer credit	53.23	37.09	7.96	1.72	1.37	0.35
Deposit institution loans n.e.c.	29.90	29.52	16.01	24.57	15.81	8.76
Other loans and advances	22.69	21.63	31.30	24.38	18.76	5.62
Deferred and unpaid life insurance premiums	10.33	42.76	29.19	17.72	14.03	3.69
Wealth	2.33	32.70	36.75	28.22	17.07	11.16

Notes: The table shows average shares of wealth, assets, liabilities and their components owned or by each wealth group. The table report simple averages between 1989Q3 and 2022Q1.

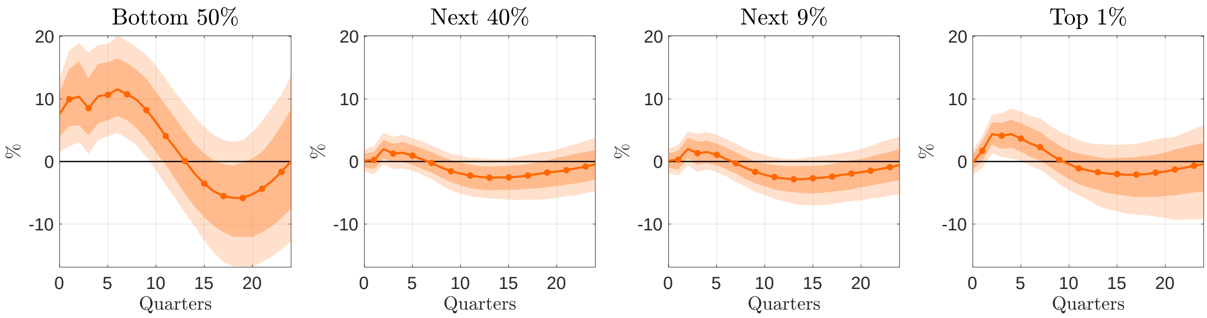
TABLE A.2: PORTFOLIO HETEROGENEITY

	Bottom 50%	50-90%	90-99%	Top 1%	99-99.9%	Top 0.1%
Assets (% of total)						
Nonfinancial assets	71.64	42.31	26.23	17.32	19.83	13.34
Real estate	51.20	34.71	22.33	13.65	16.59	8.99
Consumer durable goods	20.44	7.60	3.89	3.67	3.24	4.35
Financial assets	28.36	57.69	73.77	82.68	80.17	86.66
Checkable deposits and currency	1.80	1.18	1.07	0.85	0.92	0.74
Time deposits and short-term investments	4.24	8.15	8.07	6.65	7.03	6.05
Money market fund shares	0.38	1.34	2.36	2.72	2.90	2.47
US government and municipal securities	0.58	1.49	3.20	7.53	6.26	9.56
Corporate and foreign bonds	0.12	0.46	0.89	2.14	1.52	3.13
Loans	0.08	0.28	0.92	2.17	1.99	2.49
Corporate equities and mutual fund holdings	2.58	7.10	17.14	31.43	29.97	33.74
Equity in noncorporate business	2.49	4.96	9.52	20.36	18.18	23.77
Life insurance reserves	2.25	1.97	1.36	1.22	1.40	0.94
Pension entitlements	10.81	29.32	28.53	7.22	9.54	3.53
Miscellaneous assets	3.02	1.44	0.70	0.37	0.45	0.25
Liabilities (% of total)						
Home mortgages	59.36	77.53	81.19	66.63	70.17	48.63
Consumer credit	36.67	19.49	10.12	8.21	7.60	11.11
Deposit institution loans n.e.c.	0.86	0.52	0.46	2.35	1.84	5.02
Other loans and advances	3.02	2.19	7.79	21.86	19.50	33.89
Deferred and unpaid life insurance premiums	0.09	0.27	0.45	0.95	0.89	1.35
Wealth-to-Asset ratio	27.91	81.21	92.11	97.08	95.95	98.88

Notes: For each wealth group, the table shows average shares of wealth and type of assets in total assets and type of liabilities in total liabilities. The table report simple averages between 1989Q3 and 2022Q1.



(A) *Interest rate shock*



(B) *Asset purchase shock*

FIGURE A.1: *Distributional effects of monetary policy: real net wealth*

Notes: Impulse response functions to an interest rate (blue line) and an asset purchase (orange line with markers) monetary policy shock estimated from the group-specific Bayesian VAR described in Table 2, panel B. Net wealth is deflated using the consumer price index. Point estimates are median impulse responses from the posterior distribution. Impulse responses are normalized to generate a 1% response of real GDP after 3 quarters. Shaded areas are 68% and 90% posterior coverage bands.

B Comparison with alternative estimates of wealth in the US

A widely established source of data on the distribution of household wealth in the US is Blanchet et al. (2022) (BSZ, hereafter). Differently from the DFA, these series recover the wealth distribution using the income capitalization method applied to income tax data. In contrast, the DFA rely on estimates of wealth obtained from triennial waves of the Survey of Consumer Finances, supplemented with wealth estimates from Forbes 400. Trough interpolation between the survey waves, the DFA allocate quarterly aggregate wealth to different wealth groups.

Other differences between the DFA and BSZ concern *(i)* the treatment of consumer durables and pension entitlements, and *(ii)* the unit of observation (households vs. individuals). In the DFA, pension entitlements include the balances of defined contribution pension plans, accrued benefits to be paid in the future from defined benefit plans (which component includes total accrued benefits from private-sector, state-and-local government, and federal employment), and annuities sold by life insurers directly to individuals. The BSZ series, in contrast, excludes unfunded pensions because these are promises of future transfers that are not backed by actual wealth BSZ. Similarly, durables are treated as non-financial assets only in the DFA. As a result, the top wealth shares according to the DFA are lower than those in BSZ (Figure 1). Moreover, since the DFA rely on the Survey of Consumer Finances, the units of observation are households instead of individuals.

To highlight the implication of using different wealth concepts, we compare the wealth shares from the DFA with those of BSZ (Figure 1). Excluding consumer durables and unfunded

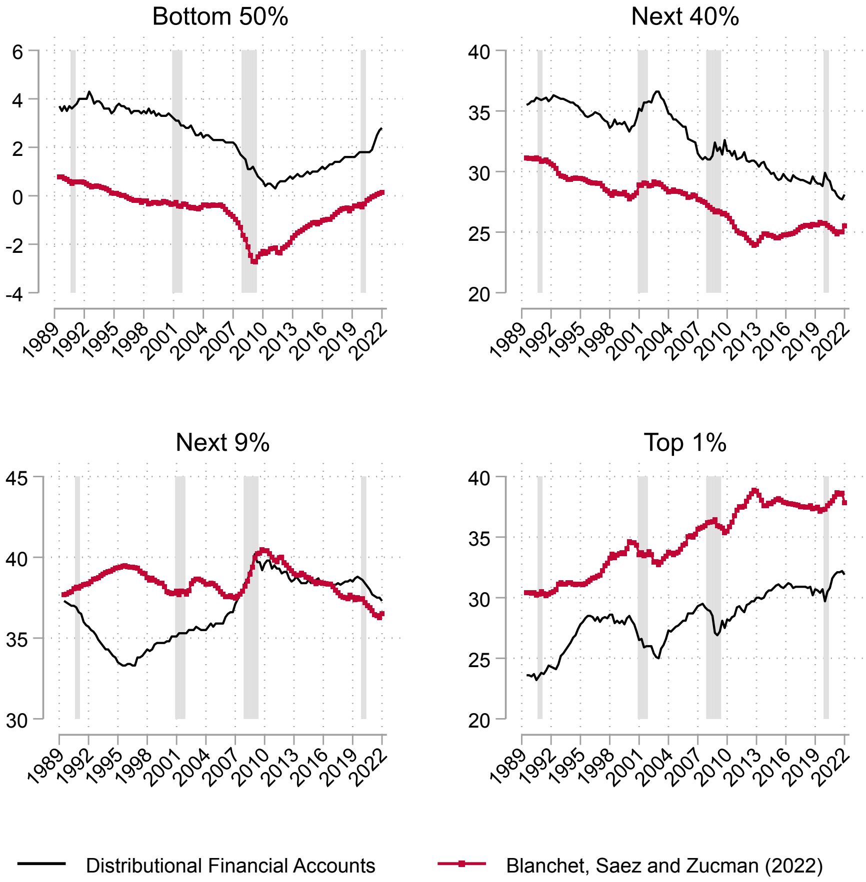


FIGURE B.1: WEALTH SHARES

Notes: This figure compares the evolution of wealth shares for the bottom 50%, the next 40%, the next 9%, and the top 1% of the wealth distribution across different sources. The alternative series have been downloaded from Realtime Inequality which provides monthly and quarterly estimates of the distribution of income and wealth in the US (see Blanchet et al. (2022) for a companion paper). The original series, however, are expressed in real terms and the wealth series for the next 9% of the distribution are not reported. To ensure comparability with the DFA series, we use households as the units of observations, obtain nominal wealth using the same deflator used in BSZ, and calculate the wealth of the next 9%.

pension entitlements reduces the wealth share of the bottom 50% substantially. In particular, according to the BSZ series, the wealth of households in this group would have reached negative territory already in the mid-1990s as household debt rose. A further difference between the DFA and BSZ concepts of wealth arises during the pandemic period. According to the DFA, households in the bottom 50% of the wealth distribution saw their wealth share increasing much more than it is recorded by BSZ. Overall, the exclusion of consumer durables and pension entitlements increases wealth inequality.

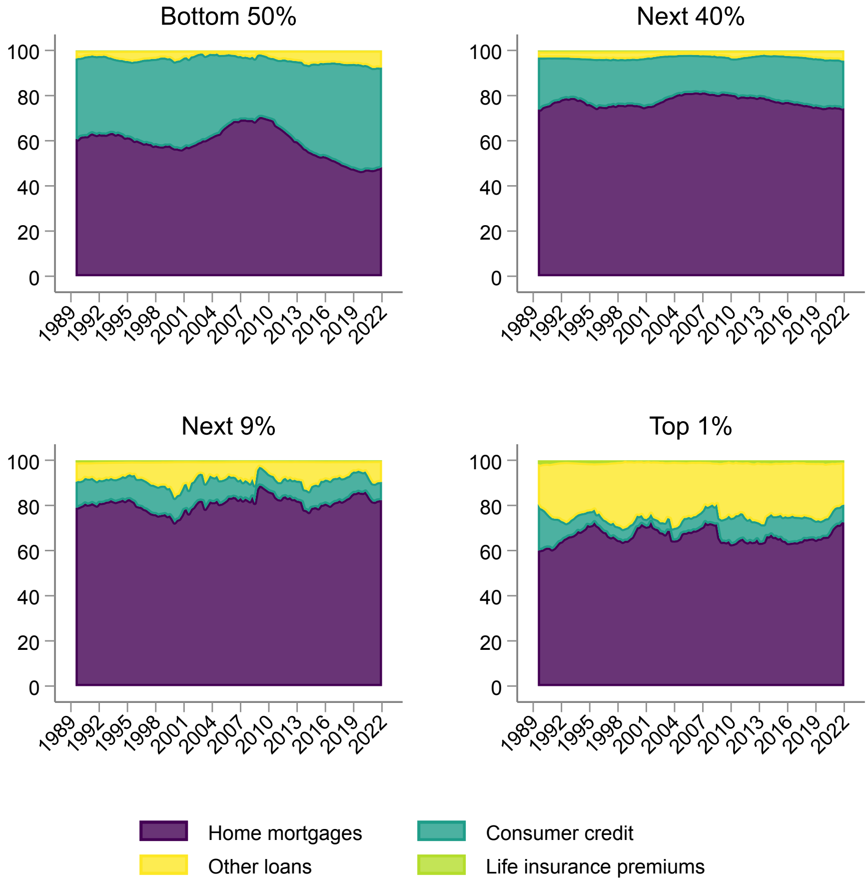


FIGURE B.2: COMPOSITION OF LIABILITIES ACROSS GROUPS

Notes: This figure shows the heterogeneity in the liability-side of household balance sheet by showing the dynamic composition of major liabilities, as share of total liabilities, for each wealth group in the Distributional Financial Accounts.

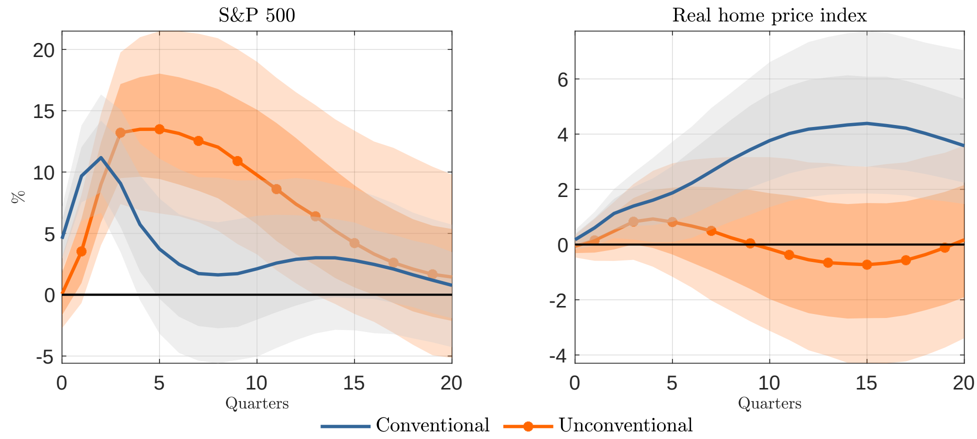


FIGURE B.3: RESPONSE OF STOCK AND HOUSE PRICES TO MONETARY POLICY

Notes: The house price index is the S&P/Case-Shiller National Home Price Index, while the stock price index is the S&P500 stock price index. The responses are derived by including both price indeces in the baseline model (2, Panel A). Point estimates are median impulse responses from the posterior distribution. Impulse responses are scaled to imply a 1% response of real GDP three quarters following the shock. Shaded areas are 68% and 90% posterior coverage bands.

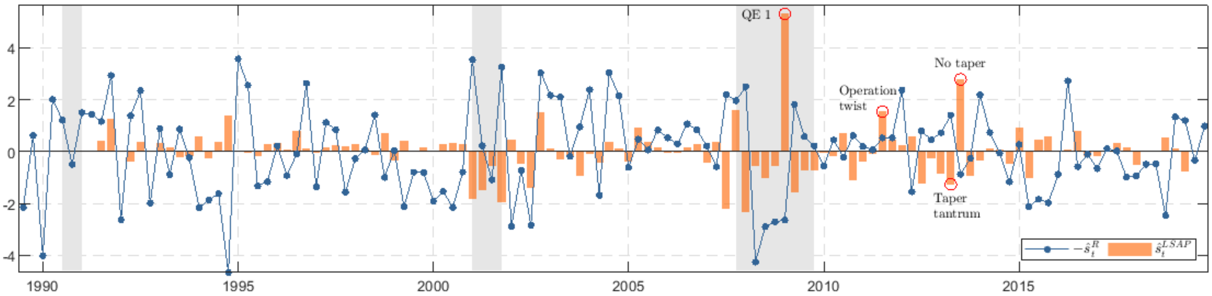


FIGURE B.4: *Monetary policy shocks*

Notes: This figure plots both monetary policy shocks presented in section 3 used to estimate the macroeconomic and distributional effects of monetary policy.

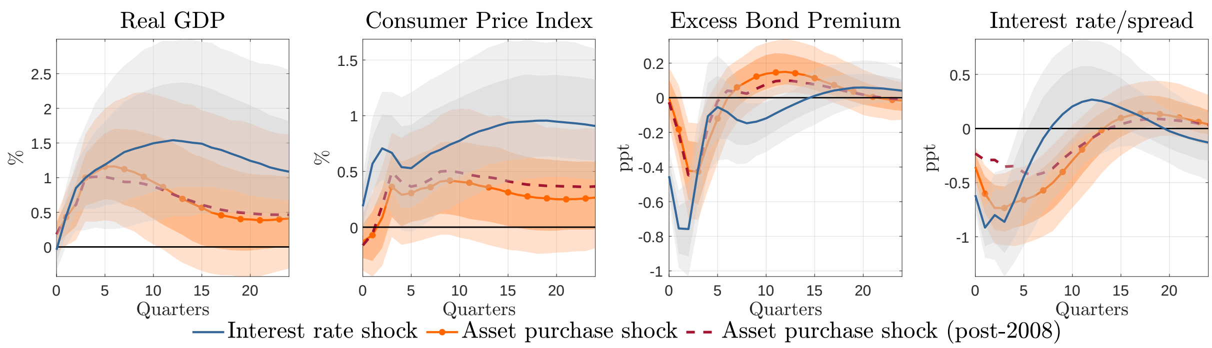
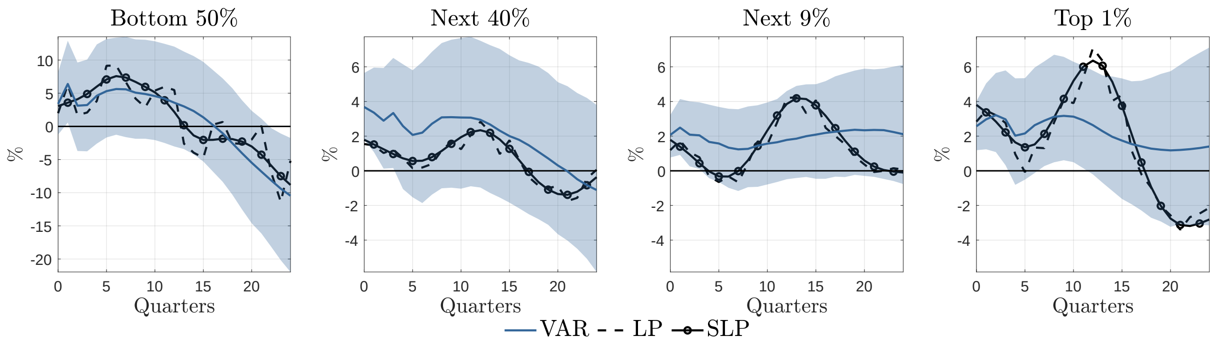
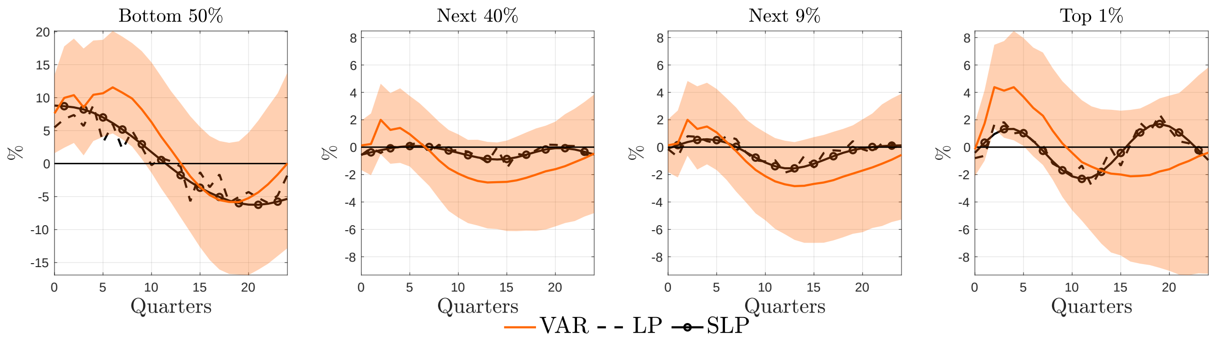


FIGURE B.5: *Macroeconomic effects of monetary policy shocks*

Notes: Impulse responses to an interest rate (blue line), asset purchase (orange line), and post-2008 asset purchase (red line) monetary policy shock from a Bayesian VAR. Point estimates are median impulse responses from the posterior distribution. Impulse responses are scaled to induce a 1 percentage point increase in real GDP. Shaded areas are 68% and 90% posterior coverage bands and are not reported for the post-2008 asset purchase shock.



(A) *Interest rate shock*



(B) *Asset purchase shock*

FIGURE B.6: *Distributional effects of monetary policy: net wealth*

Notes: Impulse response functions to an interest rate (panel A) and an asset purchase (panel B) monetary policy shock estimated from the Bayesian VAR described in Table 2 (panel A) Local Projectionas (dashed black line) and Smooth Local Projections (solid black line with markers) . Impulse responses are normalized to generate a 1% response of real GDP. Shaded areas are 90% posterior coverage bands and are shown for the baseline VAR.

C Estimating capital gains: details and comparison

Aggregate capital gains are obtained from the Table R.101 in the Financial Accounts of the United States. In particular:

- Total capital gains (capital gains on net wealth) = Households and Nonprofit Organizations: Assets Less Liabilities with Revaluations, Revaluation (FR158000005Q) - Nonprofit Organizations; Equipment, Current Cost Basis, Revaluation (FR165015205Q) - Nonprofit Organizations; Nonresidential Intellectual Property Products, Current Cost Basis, Revaluation (FR165013765Q).
- Capital gains from holding real estate = Households and Nonprofit Organizations; Real Estate at Market Value, Revaluation (FR155035005Q).
- Capital gains from holding corporate equities and mutual funds: Households and Nonprofit Organizations; Corporate Equities; Asset, Revaluation (FR153064105Q) + Households and Nonprofit Organizations; Mutual Fund Shares; Asset, Revaluation (FR153064205Q).
- Capital gains from holding equity in noncorporate business = ouseholds and Nonprofit Organizations; Proprietors' Equity in Noncorporate Business, Revaluation (FR152090205Q).
- Capital gains from holding pension entitlements = Households and Nonprofit Organizations; Pension Entitlements; Asset, Revaluation (FR153050005Q).

It is instructing to compare capital gains obtained using the Revaluation Account with capital gains obtained using the traditional formula:

$$\Pi_t^i = \sum_{j=1}^{J} \left(\frac{p_{j,t+1}}{p_{j,t}} - 1 \right) A_{j,t}^i \tag{C.1}$$

We make this comparison for real estate assets (A_H) and compute price-based capital gains from holding real estate as share of total assets:

$$\pi_{H,t} = \left(\frac{p_{H,t+1}}{p_{H,t}} - 1 \right) \left(\frac{A_{H,t}^{\text{bottom 50\%}} + A_{H,t}^{\text{next 40\%}} + A_{H,t}^{\text{next 9\%}} + A_{H,t}^{\text{top 1\%}}}{A_t} \right) \tag{C.2}$$

where A stands for total assets of the household sector and $p_{H,t}$ is the Case-Shiller house price index. Aggregate capital gains from holding real estate based on the Revaluation Account as share of total assets:

$$\begin{aligned} r_{H,t} &= \frac{R_{H,t}}{A_t} \\ &= R_{j,t}^{\text{bottom 50\%}} + R_{j,t}^{\text{next 40\%}} + R_{j,t}^{\text{next 9\%}} + R_{j,t}^{\text{top 1\%}} \\ &= \frac{1}{A_t} \left[\left(\frac{A_{H,t}^{\text{bottom 50\%}}}{A_{H,t}} \right) R_{H,t} + \left(\frac{A_{H,t}^{\text{next 40\%}}}{A_{H,t}} \right) R_{H,t} + \left(\frac{A_{H,t}^{\text{next 9\%}}}{A_{H,t}} \right) R_{H,t} + \left(\frac{A_{H,t}^{\text{top 1\%}}}{A_{H,t}} \right) R_{H,t} \right] \end{aligned} \tag{C.3}$$

where $R_{H,t}$ is (aggregate) nominal holding gains from real estate. We plot price-based ($\pi_{H,t}$) and Revaluation Account-based ($r_{H,t}$) capital gains, as share of total assets, in Figure C.1.

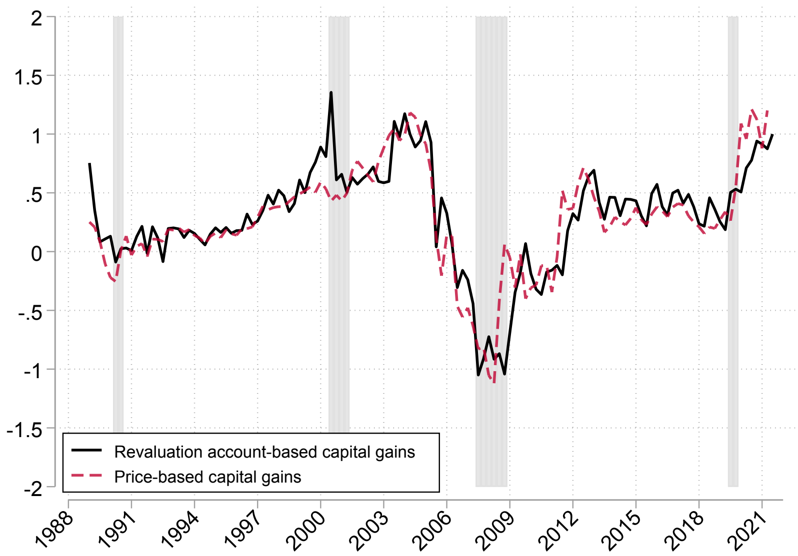


FIGURE C.1: *Total capital gains from holding real estates (% total assets)*

Notes: The figure compares two measures of capital gains from holding real estate assets for the household sector as a whole. For computing Revaluation Account -based capital gains from holding real estate we use the Households and Nonprofit Organizations; Real Estate at Market Value, Revaluation (FR155035005) series from the R.101 Change in Net Worth of Households and Nonprofit Organizations Table of the Z.1 Financial Accounts of the United States. For computing price-based capital gains we use the Case-Shiller House Price Index as the relevant index for real estates. Both measures are expressed in share of total assets.