Monetary Policy and the Dynamics of Wealth Inequality*

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Abstract

I provide new evidence that monetary policy plays a significant role in driving persistent wealth inequality in the United States. Using local projections with the Distributional Financial Accounts and high-frequency identification, I find that contractionary monetary policy disproportionately reduces the net worth of the bottom 50% of households by wealth. Heterogeneous portfolios explain the disparity of responses: the top 1% of households suffer from reduced equity prices while the bottom 50% suffer from leveraged house price declines. I show that monetary contractions generate larger net worth responses than monetary easings of similar magnitude, driving persistent wealth gaps.

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Keywords: Monetary Policy, Household Heterogeneity, Wealth Inequality

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1. Introduction

The average household in the top 0.1% of the U.S. household wealth distribution experienced a staggering 895.5% growth in real net worth between 1976 and 2022, a gain of $130 million in 2023 dollars. By contrast, the average household in the bottom 50% enjoyed a much more modest growth rate of 37.7% over this period, a gain of approximately $300 (Blanchet, Saez and Zucman, 2022).[1] Over the same period, a consensus in academic and policy research has emerged that central banks should serve as first responders in the fight to stabilize business cycle fluctuations and to tame inflation (Romer, 2012; Blanchard and Summers, 2017). In this paper I contend that these two trends may be related. While the canonical trade-off faced by central bankers emerges when the goals of stabilizing employment and inflation come in conflict, I document a second dilemma: in using monetary policy to stabilize the macroeconomy, central banks may be unintentionally driving persistent wealth inequality.[2]

Previous theoretical studies find that the magnitude of wealth inequality in the U.S. is difficult to reconcile with first-generation models of heterogeneous households (Benhabib, Bisin and Luo, 2017; Benhabib and Bisin, 2018).[3] In these models, household wealth inequality arises from the cumulation of idiosyncratic income shocks, rather than from systematic differences in the choice of assets held by households with different levels of wealth. However, a key feature of the cross-section of U.S. household balance sheets is stark heterogeneity in the composition

[1]For thorough descriptions of inequality in the U.S. see Díaz-Giménez, Glover and Ríos-Rull (2011), Kuhn, Schularick and Steins (2020), Saez and Zucman (2020), Smith, Zidar and Zwick (2022), and Heathcote et al. (2023).

[2]Although inequality is not an explicit target of the U.S. Federal Reserve, trends in inequality have been noted as a concern by high-ranking officials. See Bernanke (2015) and Yellen (2016).

[3]See also Cagetti and De Nardi (2008) and Hubmer, Krusell and Smith (2021) for overviews of modeling strategies to account for U.S. wealth inequality.

of assets held and their corresponding returns (Kuhn, Schularick and Steins, 2020). I demonstrate that this portfolio heterogeneity is crucial in explaining how monetary policy shapes the wealth distribution. Specifically, when the stance of monetary policy is altered, the wealth dynamics of households at the bottom of the wealth distribution are driven by the response of house prices and amplified by a relatively high degree of financial leverage. On the other end, the dynamics of households at the top of the wealth distribution are affected through the prices of their financial assets.

A large body of empirical research observes that contractionary monetary policies, including large-scale asset purchases and forward guidance, are associated with declines in a broad variety of asset prices (Swanson, 2015; Gertler and Karadi, 2015; Jordà, Schularick and Taylor, 2020; Paul, 2020). Additionally, theoretical studies have identified key mechanisms by which monetary policy shapes the distributions of income and wealth (Doepke, Schneider and Selezneva, 2015; Kaplan, Moll and Violante, 2018; Auclert, 2019).[4] Taken together, the myriad channels by which monetary policy operates leave ambiguous their ultimate effects on the distribution of household wealth. Further, while the consensus in monetary theory suggests that monetary policy-induced changes in real aggregate macroeconomic variables should be neutral in the long run, we have less of an understanding about how the distributional effects of monetary policies propagate over the long run. I demonstrate that not only does monetary policy drive substantial changes in the distribution of household wealth, but that these changes are persistent.

My work builds on recent advances in empirical macroeconomics for both identifying and estimating the effects of monetary policy on the distribution of household wealth. First, I exploit the novel Distributional Financial Accounts (DFAs),

[4]See also Nakajima (2015), Amaral (2017), and Colciago, Samarina and Haan (2019) for a review of these channels.

which is the first widely available data source to provide quarterly estimates of the distribution of household wealth for the United States (Batty et al., 2019). Second, I employ the method of instrumental variables local projections (IV-LP) to estimate impulse response functions that trace out the dynamic effects of monetary policy on the distributional variables provided by the DFAs (Jordà, 2005). Finally, I draw on the growing literature using high-frequency movements in financial markets to identify monetary policy shocks (Gurkaynak, Sack and Swanson, 2004; Bernanke and Kuttner, 2005).

Finally, several studies document that the effectiveness of monetary policy on macroeconomic aggregates is state dependent, and that central banks have a greater capacity to restrict economic activity than to stimulate it (Tenreyro and Thwaites, 2016; Angrist, Jordà and Kuersteiner, 2018). I demonstrate that this asymmetry is present in the effects of monetary policy on distributional variables—the losses induced by a monetary contraction are dramatically more severe than the corresponding gains enjoyed in a monetary expansion of equal magnitude. This asymmetry implies that monetary policy may drive persistent changes in the household wealth distribution, as households that lose more in contractionary episodes will chronically fall behind.

1.1. Related Literature

My work is closely related to a number of recent studies looking to explain the dramatic rise in U.S. economic inequality experienced since the 1970s. Common explanations for the rise in U.S. income inequality include increased competitive pressure due to globalization (Kanbur, 2015; Rodrik, 2021), a reduction in the progressivity of US. taxation (Saez and Zucman, 2020), the decline in labor unionization (Farber et al., 2021), technological developments that favor skilled workers

(Krusell et al., 2000), and automation of routine tasks (Acemoglu and Restrepo, 2022). What these explanations hold in common is that they pertain to secular phenomena rather than the consequences of short-run stabilization policy. By contrast, I document that a persistent widening of wealth inequality may be partially explained by monetary policy intended to dampen business cycle fluctuations.

Additionally my work builds on that of a small army of researchers who have studied the effects of monetary policy on the distributions of income, earnings, and consumption.[5] The most similar study to my own is that of Coibion et al. (2017), who use the U.S. Consumer Expenditure Survey and find that contractionary monetary policy increases income, earnings, consumption, and expenditure inequality. Furceri, Loungani and Zdzienicka (2018) likewise find that monetary contractions raise income inequality in a panel of 32 countries. In this paper, I sharpen this conclusion by demonstrating that this result extends to household wealth inequality.

Other related studies on include Amberg et al. (2022), who find that the effects of monetary policy on income inequality are more potent for Swedish individuals at the top and bottom of the income distribution, and explore the different channels affecting each.[6] Casiraghi et al. (2018) find a similar U-shaped response of wealth for Italian households, a result that I demonstrate for the U.S. Ampudia et al. (2018) conduct a broad review of the literature for the euro area and conclude that expansionary monetary policy reduces income and wealth inequality.

On the other hand, Andersen et al. (Forthcoming) study Danish households, finding that the gains to softer monetary policy are felt more by households at the top, with holdings of financial assets. Likewise, Mumtaz and Theophilopoulou

[5] See McKay and Wolf (2023) for a review of the literature on the two-way relationship between monetary policy and inequality.

[6] Lenza and Slacalek (2018) and Broer, Kramer and Mitman (2022) find that low-income households have incomes more sensitive to monetary policy as they bear a disproportionate share of unemployment risk.

(2020) conclude that expansionary monetary policy in the wake of the Global Financial Crisis raised wealth inequality in the U.K. due to its effects on the value of property and financial assets. Still, El Herradi and Leroy (2021) find in a panel of 12 OECD economies that contractionary monetary policy, via reduced real asset returns, reduces the income share of the top 1% of households, though its effects on dispersion among the remaining households are more ambiguous.

Taking as given that monetary policies have distributional implications, studies have been conducted to find the optimal monetary policy response to rising inequality. On the one hand, monetary policy that includes level targets or focuses on combating unemployment could provide benefits that disproportionately benefit households at the bottom (Gornemann, Kuester and Nakajima, 2016; Feiveson et al., 2020; Ma and Park, 2021). On the other hand, monetary policymakers already face the difficult task of balancing concerns over employment and inflation with few tools, and may be forced to accept higher inflation to combat rising inequality (O'Farrell and Rawdanowicz, 2017; Borio, 2021; Chang, 2022).

My focus on heterogeneous portfolios aligns with research studying the systematic differences in household portfolios over the wealth distribution. My proposed mechanism draws inspiration from the body of research finding that wealthy households systematically earn higher returns on wealth due to both their disproportionate ownership of equities and a positive correlation between wealth and asset returns within narrow asset classes (Benhabib, Bisin and Luo, 2017; Jordà et al., 2019; Bach, Calvet and Sodini, 2020; Fagereng et al., 2020). Analogously, I find that equity prices are more sensitive to monetary policy than the prices of real estate or consumer durables. Nonetheless, the net worth of households at the bottom of the wealth distribution is disproportionately affected by monetary policy due to their high degree of financial leverage, which serves to amplify the effects of asset price changes.

2. Data

The Distributional Financial Accounts (Batty et al., 2019) are a novel quarterly dataset reporting estimates of the U.S. household wealth distribution since 1989. Table 1 reports average portfolio shares by wealth group for major asset and liability classes, which paint a stark picture of heterogeneity in household wealth portfolios, both by size and by composition. The bottom 50% of households hold very few financial assets which comprise 28% of their total assets on average over the sample. Over half of the value of their assets are held in real estate with 21% in consumer durables. On the other hand, the top 1% own large asset portfolios over 83% of which are financial assets, primarily corporate equities, pension entitlements, and equity in non-corporate businesses. Despite large holdings by the top 1%, real estate comprises just 14% of their asset portfolio on average.

These figures support the findings of Kuhn, Schularick and Steins (2020), who use historical wealth surveys to highlight the importance of portfolio heterogeneity in explaining differences in returns to wealth between the rich and the poor over time. Non-financial assets, which comprise a disproportionate share of the assets held by the bottom 50%, appreciate more slowly than the financial assets held by the top 1% in greater proportions, whose asset prices inherit risk premia from a heightened exposure to aggregate market risk. As we will see, these trends are mirrored by a higher conditional volatility of asset prices borne by the top 1% in response to monetary policy surprises.

Table 1 additionally reports leverage ratios for each group of households as the ratio of total assets to net worth. Leverage ratios are a useful measure of sensitivity to financial risk, as more leveraged households face larger net worth volatility than households with higher equity ratios in response to asset price fluctuations.

Table 1. Balance Sheets of U.S. Households, 1989-2021

Share of Assets (%)	Bottom 50%	Next 40%	Next 9%	Top 1%
Non-Financial Assets	71.761	42.192	26.268	17.329
Real Estate	51.154	34.567	22.352	13.635
Consumer Durables	20.607	7.625	3.916	3.694
Financial Assets	28.239	57.808	73.732	82.671
Checkable Deposits and Currency	1.767	1.134	1.007	0.783
Time deposits and short-term investments	4.325	8.289	8.227	6.783
Money market fund shares	0.371	1.313	2.323	2.671
Debt securities	0.721	2.088	4.479	10.525
U.S. government and municipal securities	0.575	1.466	3.270	7.875
Corporate and foreign bonds	0.146	0.622	1.209	2.650
Loans	0.092	0.275	0.943	2.159
Other loans and advances	0.032	0.147	0.652	1.848
Mortgages	0.060	0.128	0.291	0.310
Corporate equities	2.376	7.042	16.862	30.513
Life insurance reserves	2.254	1.982	1.364	1.208
Pension entitlements	10.830	29.290	28.325	7.256
Equity in non-corporate business	2.477	4.960	9.498	20.398
Miscellaneous assets	3.025	1.435	0.704	0.374
Net Worth (Capital ratio)	28.338	81.238	92.116	97.059
Share of Liabilities (%)	**Bottom 50%**	**Next 40%**	**Next 9%**	**Top 1%**
Loans	99.910	99.723	99.549	99.050
Home mortgages	60.161	77.725	82.124	68.645
Consumer credit	37.026	19.512	10.191	8.193
Depository institution loans n.e.c.	0.794	0.464	0.461	2.368
Other loans and advances	1.929	2.022	6.773	19.844
Deferred and unpaid life insurance premiums	0.090	0.277	0.451	0.950

Notes: The table reports mean share of each asset in total assets and each liability in total liabilities for each group between 1989 and 2020. Definitions are summarized in the text, and described in detail in Batty et al. (2019) and documentation for Financial Accounts table B.101.h.

Whereas a fully-capitalized household will experience one-to-one changes in net worth when the value of their assets change, a household with a leverage ratio of two will lose two percent of their net worth with a one percent decrease in the value of their assets. Over the sample for which the DFAs are available, the average capital ratio of the bottom 50% of households is barely over one-quarter, while the top 1% of households are nearly fully capitalized on average. These systematic differences in leverage ratios are an important factor in explaining the sensitivity of household wealth to monetary policy shocks. Perhaps unsurprisingly, this leverage primarily appears in housing, where the bottom 50% of households collectively own just under 16% of the value of their homes, while the top 1% hold over 85% of their real estate as home equity. Of course, these numbers mask heterogeneity within these groups of households, which may be substantial especially at the lower tail of the household wealth distribution, where we would see insolvent households with negative home equity.

Figure 1 plots a decomposition of the balance sheets of each household quantile group by wealth over time. The net worth of the bottom 50% of households fluctuates without a discernible trend, falling near zero in the wake of the Global Financial Crisis, while each other quantile group exhibits net worth trending upward. Although all groups experience deep losses during the crisis, the top 1% of households collectively sufferend a loss of just over 21% of their net worth between 2007:Q3 and the trough at 2009:Q1, while the bottom 50% saw over 81% of their net worth erased between 2007:Q1 and the trough, which occurred much later in 2010:Q2. The wealth of the bottom 50% only passed its pre-crisis peak in 2019:Q2, while the top 1% regained their lost wealth by 2012:Q1. Considering unconditional trend growth over the 1989-2021 sample, the top 1% experienced gains in net worth of 4.3% per annum, while the bottom 50% experienced gains of just under 1.3% per annum, consistent with deep portfolio heterogeneity and potentially

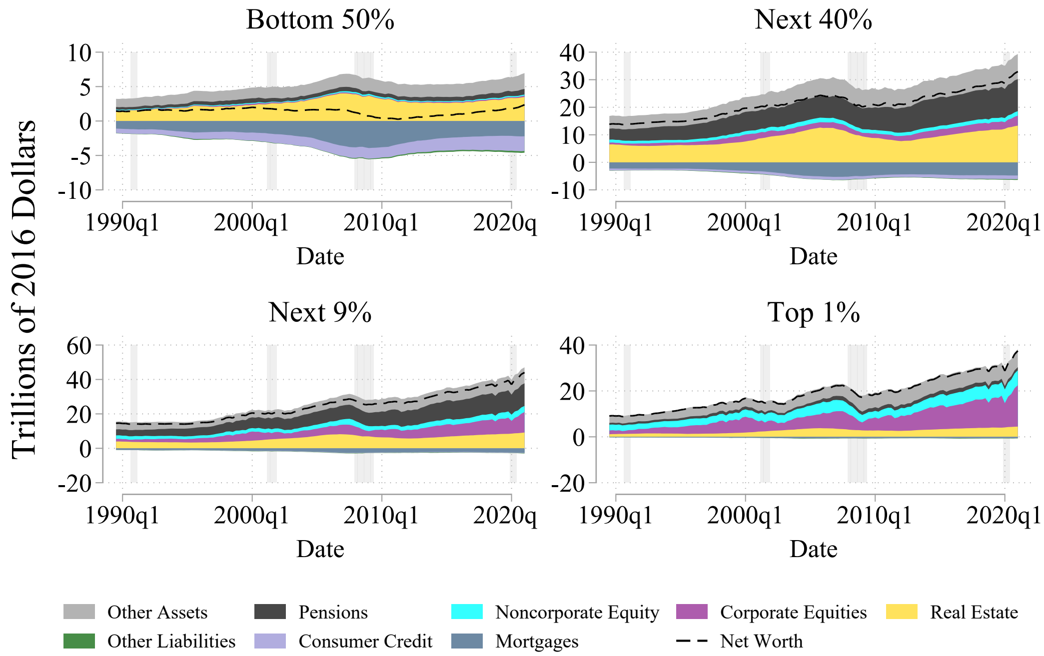

Figure 1. Balance Sheet Decompositions

Notes: Balance sheet decomposition for the bottom 50% and top 10% of households by wealth in the U.S. Shaded region indicates NBER recession.

heterogeneity in returns.

As noted, data availability poses a major challenge to the systematic study of wealth in the U.S., a shortcoming partially remedied by the triennial cross-sectional SCF conducted by the Federal Reserve Board. However, the low frequency of the SCF presents a difficulty in studying movements in wealth in the short run in response to policy changes. Batty et al. (2019) document the procedure used to construct the DFA dataset, which combined the SCF with quarterly aggregate household wealth data provided by the Financial Accounts of the United States. The authors construct measures of wealth for each household quantile group adhering closely to the structure of table B.101.h of the Financial Accounts. The authors employ the temporal disaggregation method proposed by Chow and Lin (1971), by reconciling triennial SCF observations with related quarterly Financial Accounts data.[7]

3. Methods

3.1. IV - Local Projections

In order to trace the dynamic effects of unexpected monetary policy shocks on the wealth distribution, I rely on instrumental variable local projection (IV-LP) estimation following Jordà (2005), which consists of estimating quantile impulse responses via IV regression separately at each horizon. The choice of estimation procedure is a topic of debate in empirical macroeconomics literature. As discussed by (Montiel Olea, Stock and Watson, 2020), local projections perform well in comparison to alternative impulse response function estimation procedures such as a VAR when data are persistent and when forecast horizons are long. Since wealth distributions tend to shift slowly over time, a VAR system with a limited lag structure may not be sufficient to determine whether temporary shocks can generate persistent outcomes. Due to the limited sample length available using the current DFA dataset, a VAR with sufficient lags to determine persistence and a large set of control variables would place pressure on the number of degrees of freedom available to estimate impulse responses.

My baseline IV-LP specification is the system of equations for each horizon $h = 0 \dots H$ and each household quantile group indexed by i, given by

$$\Delta^h y_{i,t+h} = \alpha^{i,h} + \beta^{i,h} \Delta R_t + \boldsymbol{\delta}^{i,h} \boldsymbol{X}_{i,t} + e^i_{t+h} \tag{1}$$

[7] The method consists of assuming that low-frequency observations provided by the SCF are drawn from a latent high-frequency series, and forecasting the "missing" observations by using relevant high-frequency regressors.

where y_t^i is the log of real net worth of group i and R_t is the one-year government bond rate, and $\Delta^h y_{i,t+h} = y_{i,t+h} - y_{i,t-1}$. The impulse response function for group i is given by the series $\{\beta^{i,h}\}_{h=0}^{H}$ As the forecast errors of a standard LP system are likely to be serially correlated, I use a lag-augmented local projection design, which allows for valid inference with standard Eicker-Huber-White standard errors (Montiel Olea and Plagborg-Møller, 2021). Beyond a single lag of y_t, my baseline specification includes no additional controls, which become redundant due to the procedure I use to generate the instrument series.[8]

I consider four household wealth quantile groups: the top 1%, the 1% to the 90%, the 50% to 90%, and the bottom 50%. Following Gertler and Karadi, I use the one-year bond rate as my indicator variable rather than the federal funds rate for two main reasons. First, interest rates with longer maturities are less sensitive than the federal funds rate to the ZLB, which is a challenge given that the federal funds rate remained near zero for almost one-third of my sample (Swanson, 2017). Second, interest rates on bonds with longer maturities reflect the expected path of future short-term interest rates as well as expectations of unconventional tools that operate on term premia. As the Federal Reserve becomes increasingly reliant on large-scale asset purchases and forward guidance to achieve its policy goals, the current stance of the federal funds rate becomes as a weaker measure of the stance of monetary policy, particularly during ZLB episodes.

The stance of monetary policy is, of course, determined endogenously in response to macroeconomic conditions. This is a standard identification problem common to empirical macroeconomic studies (Nakamura and Steinsson, 2018). As a result, estimates from equation 1 derived by OLS will be biased and inconsistent

[8]Valid inference for IV-LP requires, among other things, strict lead-lag exogeneity of the instrument. This can be bought by augmenting the LP system with additional controls rendering that restriction conditionally true.

due to the contemporaneous correlation between ΔR_t and e_{t+h}. This bias may be corrected by using a valid instrument. As Stock and Watson (2018) and Miranda-Agrippino and Ricco (2019) document, correct inference with an IV-LP specification such as the system of equations (1) requires a set of instruments Z_t satisfying the following conditions:

$$\mathbb{E}[e_t^1 Z_t'] = \phi' \neq 0 \text{ (relevance)},$$
$$\mathbb{E}[e_t^i Z_t'] = 0 \text{ (contemporaneous exogeneity)},$$
$$\mathbb{E}[e_{t+j} Z_t'] = 0 \text{ for } j \neq 0 \text{ (lead-lag exogeneity)},$$

where e_t^1 is the error of the equation corresponding to the indicator variable. I describe the procedure for developing such an instrument below.

3.2. Identification

In order to capture exogenous innovations to monetary policy, I follow Mertens and Ravn (2013) and Stock and Watson (2018) by employing an external instruments approach to identification. My choice of instrument is the high-frequency fed funds futures surprise series examined by Gurkaynak, Sack and Swanson (2004) and Bernanke and Kuttner (2005). This instrument is defined as the difference in three-month fed funds future rates beginning ten minutes prior to an announcement by the Federal Open Market Committee (FOMC) and ending twenty minutes after. Since fed funds futures rates prior to an FOMC announcement incorporate expectations about monetary policy actions, any movement within this time frame must reflect news contained in the announcement that are not anticipated by market participants. The key identifying assumption of this approach is that within this thirty-minute window, any change in fed funds futures rates reflects the FOMC announcement alone, rather than any other source of information. This assumption is equivalent to the contemporaneous exogeneity condition described above.

Rather than using the fed funds futures surprises to directly estimate impulse response functions, I follow Gertler and Karadi (2015) in using these surprises as an external instrument to identify latent monetary policy shocks in an estimated proxy VAR. The primary benefit of using the Gertler and Karadi proxy VAR approach is that structural monetary policy shocks can be identified over a longer sample than that for which the external instrument is available. In the present case, the DFA dataset spans 1989 to 2021, while the Gurkaynak, Sack and Swanson high-frequency instrument set spans 1988 through 2016. Consequently, the Gertler and Karadi method allows for the addition of nearly five years of additional structural shock data beyond what would be available with the high-frequency instrument.

Furthermore, by running the Fed funds futures instrument through the proxy VAR, Cloyne et al. (2018) note that any residual predictability of the instrument is purged.[9] As noted by Ramey (2016), the raw fed funds futures instrument suffers from serial correlation, which would violate the lead-lag exogeneity condition needed for a valid instrument. However, the structural shock series implied by the proxy VAR is purged of this serial correlation, producing a Durbin-Watson d-statistic of 1.98, while a Breusch-Godfrey test results in a p-value of 0.3368, failing to reject the null hypothesis of no serial correlation.

I consider a monthly VAR with twelve lags including the following variables: the log of industrial production, the log of the consumer price index, the one-year government bond rate, and the Gilchrist and Zakrajšek (2012) excess bond premium. I then sum the shocks into a quarterly series to conform with the frequency

[9] This result allows me to estimate equation (1) without controls as long as they are included in the proxy SVAR used to identify the shock series.

of the DFA data. The structural form of the proxy VAR is given by

$$\mathbf{Y}_t = \sum_{j=1}^{J} \mathbf{B}_j \mathbf{Y}_{t-j} + \mathbf{s}\varepsilon_t \tag{2}$$

where **s** is the structural impact matrix that maps latent structural shocks into reduced form surprises. Ordinarily, the structural impact matrix cannot be identified without additional restrictions. Common methods used in the literature include imposing recursive ordering restrictions (Blanchard and Perotti, 2002; Christiano, Eichenbaum and Evans, 2005; Auerbach and Gorodnichenko, 2012), narrative approaches (Romer and Romer, 2004, 2010; Cloyne and Hürtgen, 2016), and sign restrictions (Jarociński and Karadi, 2020). However, the exclusion restriction satisfied by the fed funds future surprise series provides sufficient restrictions to identify the mapping between reduced form interest rate surprises and structural monetary policy shocks.[10] Figure 2a plots the raw fed funds future surprises.

Figure 2b presents the implied structural shock series that I use as an instrument in estimating equation (1). Of note, the plot captures a series of large contractionary shocks corresponding to the onset of the Great Recession. These shocks can be interpreted as evidence that between Q4 2007 and Q4 2008, market participants anticipated a greater degree of monetary easing than the FOMC provided. This interpretation is supported by the slow response of the FOMC to the beginning of the financial crisis in mid-2007 until December 2008. Notably, FOMC statements continued to cite inflationary concerns in maintaining a positive target for the Federal funds rate until their October 28th-29th meeting in 2008.

As a point of reference, I estimate equation (1) using a set of monthly macroeco-

[10] With partial identification, the structural impact matrix becomes block invertible. In practice, the identified mapping can then be found by a three-step procedure outlined by Mertens and Ravn (2013) on page 5.

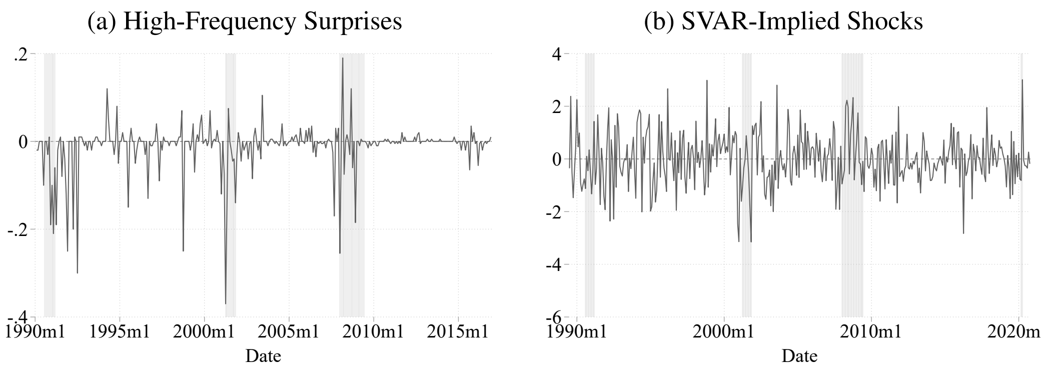

Figure 2. Monetary Policy Shocks

Notes: Shaded region indicates NBER recession. See text.

nomic variables commonly studied as outcomes in the literature. Figure 3 presents impulse responses of these variables to the shock series. Outcome variables are measured as a percent of their year-0 level, except in the case of interest rates, which are measured in percentage points. I estimate a contraction in industrial production of 3.2pp associated a gradual rise in the unemployment rate of 1.2pp after forty months, while the CPI falls by 1.2 pp out to four years. These results are broadly comparable to those of previous literature. Gertler and Karadi estimate impulse responses directly from their proxy VAR and find that a 0.2pp increase in the one-year rate results in a roughly 0.4pp reduction in IP after two years, with a roughly 0.1pp drop in the CPI. Paul (2020) likewise finds that a 0.1pp increase in the Federal funds rate is associated with a 0.5pp drop in IP and a statistically insignificant drop in the CPI. As a point of departure with Gertler and Karadi, the local projections approach estimates a more persistent increase in the one-year Treasury rate than that obtained via the proxy VAR, which explains a more persistent response of macroeconomic variables and asset prices.[11]

[11] Although it confounds comparisons to previous studies, this persistence is thankfully not a result of autocorrelation in the instrument series.

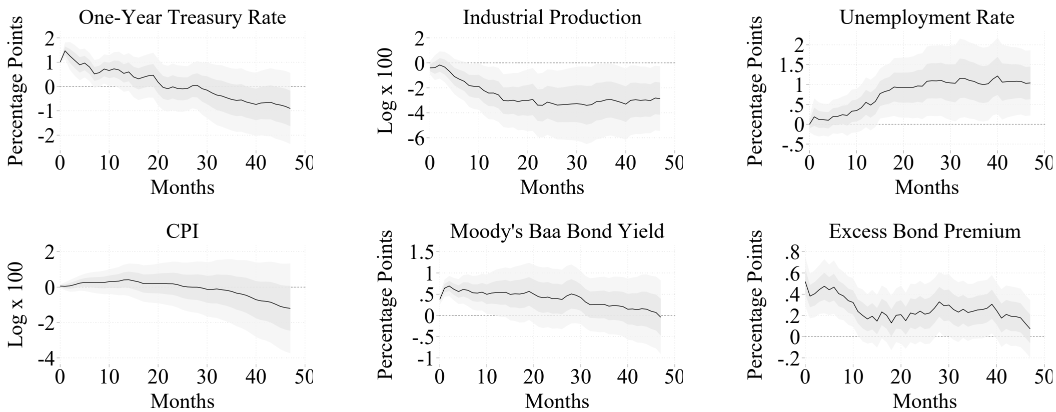

Figure 3. Macroeconomic Variables

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point increase in the one-year Treasury rate, estimated from equation (1). Presented with one- and two-standard error confidence bands. See text.

I also consider four additional price indices in figure 4 for reasons that will become clear in section 4.1. The CPI for durable goods exhibits an impulse response that is not statistically significant past the first year. This insensitivity will be an important factor in helping us understand the dynamics of wealth for the bottom 50% of households, who hold a disproportionate share of their assets in durables. I consider stock prices measured by the S&P 500 Index, which falls in response to the monetary policy shock in line with asset pricing theory. I find that stock prices fall by roughly 5.0pp on impact, reaching a 18.8pp drop within one year, and approaching a trough after nearly four years corresponding to a drop of 28.2pp. I consider the S&P Case-Shiller U.S. Home Price Index as a proxy for the price of real estate. As noted in section 2, middle-class households hold the lion's share of their wealth in their homes. As a result, the dynamics of house prices will be critical for explaining the responses of wealth for this group. I estimate that a 1pp shock to the one-year rate causes a gradual decline in house prices that reaches a trough of a 9.6pp drop at fifteen quarters. Finally, I use price return data from the

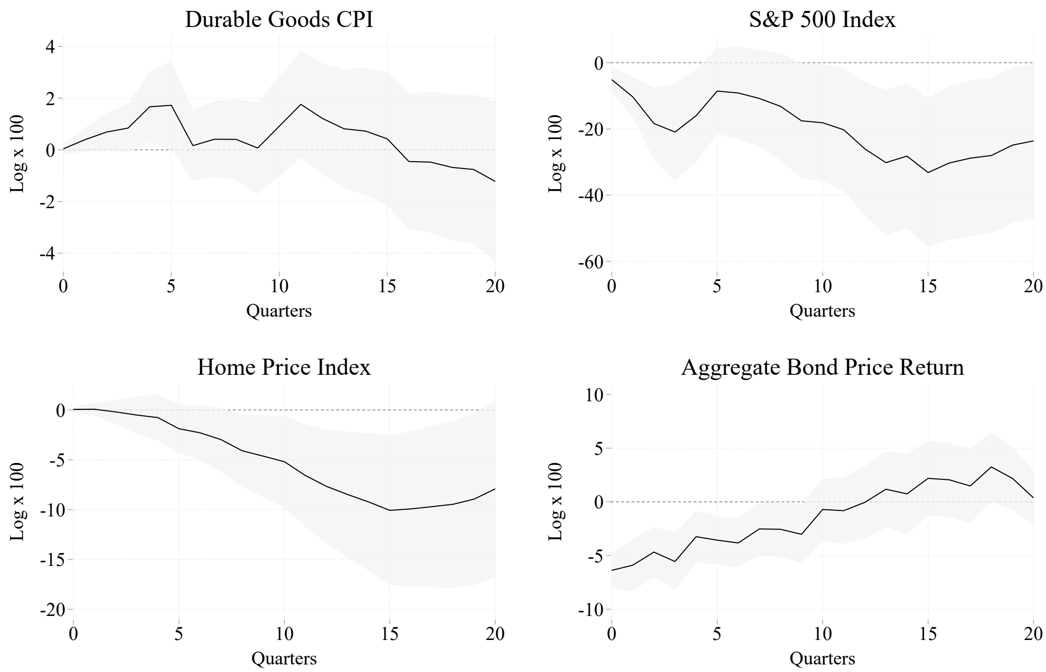

Figure 4. Price Indices

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point increase in the one-year Treasury rate, estimated from equation (1). Presented with one standard error confidence bands. See text.

Bloomberg-Barclays Aggregate Bond Index as a proxy for bond prices, which falls by 6.2pp on impact before returning to the mean.

These estimates are well in line with the literature on the effects of monetary policy on asset prices. For comparison, Bernanke and Kuttner (2005) find that a 1pp shock to the Federal funds rate depresses stock prices by between 2pp and 5pp on impact, while Gurkaynak, Sack and Swanson (2004) find that a 0.25pp increase in the one-year rate depresses stock prices by roughly 1pp on impact. Paul (2020) finds that a 0.1pp increase in the Federal funds rate is associated with a 2pp drop in stock prices within one year, and a 1/3pp drop in house prices out to forty months. On the other hand, the results I obtain via local projections produce impulse responses that are noticeably more persistent than would obtain under comparable VAR specifications.

4. Results

Moving forward with my analysis of household wealth, I present impulse responses of the net worth of each group to the implied monetary policy shock in figure 5. A monetary policy surprise inducing a 1 percentage point increase in the one-year Treasury rate induces a significant and persistent reduction in net worth for all household groups, with a disproportionate loss of wealth borne by the bottom 50% and top 1%. The bottom 50%, suffer a 2.8% loss on impact, which balloons to a 43.0% loss out to nineteen quarters. On impact, the top 1% of households suffer a loss of 2.2% of their net worth, with a peak loss of 19.9% out to thirteen quarters. Responses are more moderate for the middle groups. The next 40% suffer a peak loss of 7.9% at the fifteen-quarter horizon, and the next 9% suffer a peak loss of 10.7% at the thirteen-quarter horizon.

Of note, estimated responses for the bottom 50% are substantially noisier than those of the other quantile bins owing to their low average wealth. As a result, proportional changes in wealth exhibit a high variance in response to shocks of a given magnitude. Despite this, we can firmly reject the hypothesis that responses are equivalent between the bottom 50% and the remaining groups.

4.1. Inspecting the Mechanism: Revaluation and Saving

A change in net worth can result from a number of causes. First, a reduction in the prices of assets or an increase in the prices of liabilities both reduce the value of household portfolios given a fixed quantity of assets and liabilities. To the extent

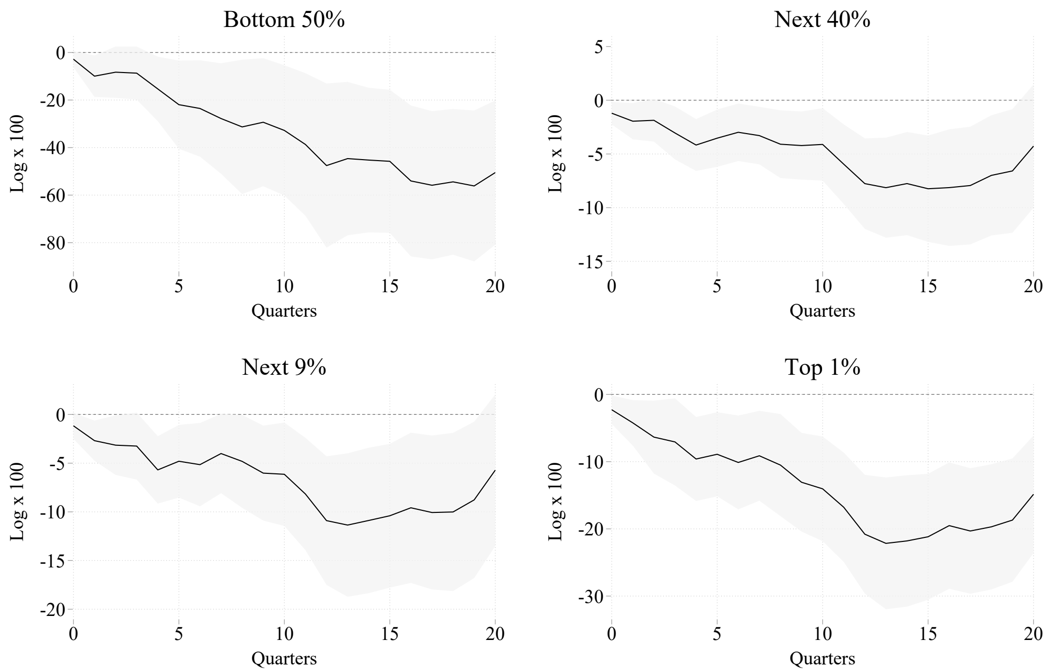

Figure 5. Net Worth

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point increase in the one-year Treasury rate, estimated from equation (1). Presented with one standard error confidence bands. See text.

that households across the wealth distribution systematically choose to hold different portfolios, differentials in rates of capital gain (or loss) across assets will induce heterogeneous responses to monetary policy shocks across groups. In the U.S., the majority of household liabilities take the form of fixed-rate mortgages. As a result, monetary policy will result in diminished wealth effects relative to a country such as the U.K. for which mortgages are institutionally refinanced at regular rates (Cloyne, Ferreira and Surico, 2020). Considering consumer credit, at any given point, the ratio of non-revolving to revolving consumer credit ranges from 1.5 to 3.3. Further, since its rapid rise in the early 2000s, no less than 80% of student loan debt has been originated by the federal government, which exclusively offers fixed-rate contracts.

Taken together, these factors suggest that capital gains will primarily be a feature of the assets side of household balance sheets.

Second, households can respond to contractionary shocks by altering the size or composition of their portfolios. This behavior may reflect households saving or dissaving to stabilize consumption. Of course, changes in the size and composition of household portfolios do not necessarily induce changes in net worth. A household that responds to an adverse shock by selling their car has only traded one asset for another of presumably equal value (cash). On the other hand, a household with an underwater mortgage may discharge their debts in bankruptcy, which will increase their net worth by resolving negative equity. For a change in the quantity of assets held to produce a change in net worth *within a period of time*, households must either be selling assets or incurring new liabilities without a corresponding asset purchase.[12]

To understand how saving behavior and capital gains contribute to the responses of wealth for each group, consider the standard budget constraint of a household earning labor income y_t, with a choice over consumption, c_t, and two assets. The first asset, K_t, has price q_t, earns a rental rate of r_t and faces depreciation at rate δ. The second asset, B_t, has price p_t, and pays a dividend of d_t.

$$c_t + q_t K_{t+1} + p_t B_{t+1} = (1 + r_t - \delta) q_t K_t + (p_t + d_t) B_t + y_t$$

The household's wealth at the end of period t is $W_t \equiv q_t K_{t+1} + p_t B_{t+1}$. The change in wealth is then given by

$$\Delta W_t = y_t + (r_t - \delta) q_t K_t + d_t p_t B_t - c_t + (q_t - q_{t-1}) K_t + (p_t - p_{t-1}) B_t,$$

[12] However, to the extent that households may exchange one asset for another with different return dynamics, the wealth dynamics of the household will be affected even if there is no contemporaneous change in net worth.

and I define household saving inclusive of asset returns and dividends as $S_t = y_t + (r_t - \delta)q_t K_t + d_t p_t B_t - c_t$ and capital gains by the change in the prices of the assets, $\Pi_t = (q_t - q_{t-1})K_t + (p_t - p_{t-1})B_t$. The budget constraint then becomes

$$\Delta W_t = S_t + \Pi_t.$$

One additional factor must be considered when accounting for the differential wealth dynamics across household groups: households at different points on the wealth distribution have systematically different degrees of leverage. As noted in section 2, the sample average capital ratio for the bottom 50% of households is 28.3%, meaning that any change in the value of assets held by this group will be multiplied by a factor of nearly 4 when evaluating its impact on net worth.

In order to disentangle the effects of revaluations and saving behavior, I follow Kuhn, Schularick and Steins (2020) in using the following formula to capture group-specific capital gains (or losses):

$$\Pi_t^i = \sum_{j=1}^{J} \left(\frac{p_{j,t+1}}{p_{j,t}} - 1 \right) \frac{A_{j,t}^i}{W_t^i}, \tag{3}$$

where Π_t^i is the revaluation of wealth for group i due to capital gains, $p_{j,t}$ is the price of asset (or liability) j, and ${A_{j,t}^i}/{W_t^i}$ is the share of asset j in group i's portfolio.

Table 2 presents the price index I use for each class of assets present in the DFAs. For dividend-bearing assets I consider only measures of price returns. To price household pension entitlements, I rely on the OECD Global Pension Statistics database, which aggregates data from the Federal Reserve Board and the U.S. Department of Labor, which reports yearly estimates of the composition of pension holdings by asset class. I form an index using the weights provided and the prices specified for each component asset class. For asset classes with a fixed nominal price including checkable deposits, currency, time deposits, money market fund shares, and loans held as assets the price is normalized to one. Finally, the resulting price index is deflated by the consumer price index.

Impulse responses of group-specific capital gains are presented in figure 6. A monetary contraction induces capital losses for each group, but the magnitude of the drop increases with wealth. This largely reflects the fact that the portfolio share of policy-sensitive equity assets increases in wealth. The bottom 50% experience a capital loss of 9.7% within fifteen quarters, while the top 1% experience a loss of 16.0% over the same horizon.

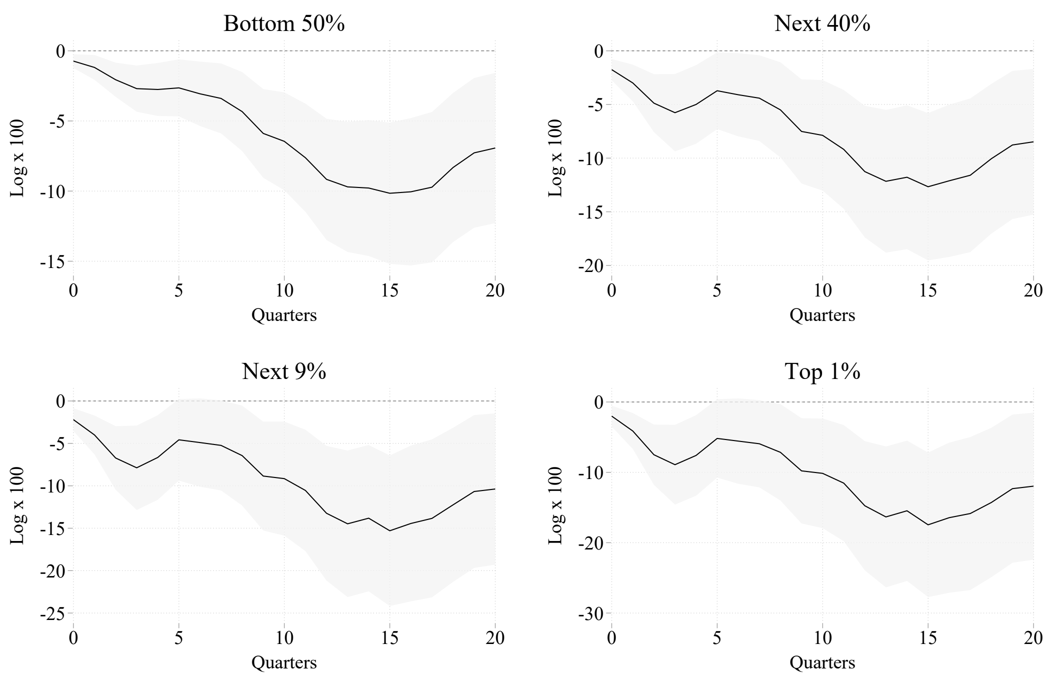

Figure 6. Group-Specific Capital Gains

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point increase in the one-year Treasury rate, estimated from equation (1). Presented with one standard error confidence bands.

On its face, these results seem to contradict the evidence that wealth declines

Table 2. Asset Price Indices

Asset Class	Price Index	Source
Real Estate	S&P CoreLogic Case-Shiller Home Price Index	S&P Dow Jones Indices
Consumer Durables	Consumer Price Index for All Urban Consumers: Durables in U.S. City Average	U.S. Bureau of Labor Statistics
U.S. government and municipal securities	S&P U.S. Government Bond Index	S&P Dow Jones Indices
Corporate and foreign bonds	Bloomberg Barclays Aggregate Bond Index	Bloomberg and Barclays
Corporate equities	S&P 500 Index	S&P Dow Jones Indices
Equity in non-corporate business	S&P 500 Index	S&P Dow Jones Indices

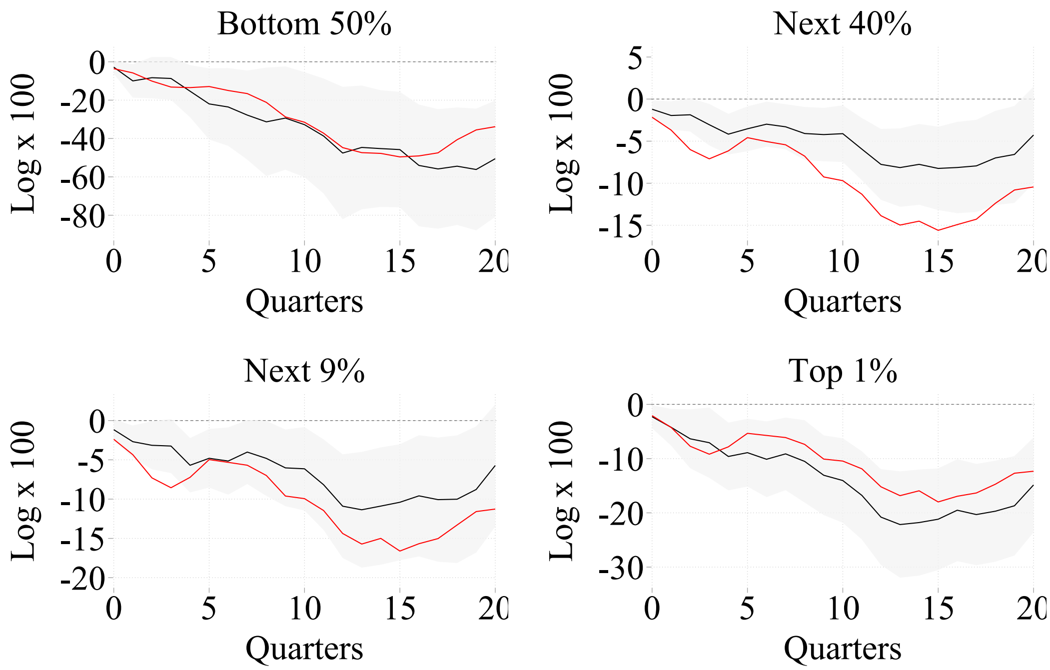

Figure 7. Net Worth

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point increase in the one-year Treasury rate, estimated from equation (1). Presented with one standard error confidence bands. Red lines are the responses of the group-specific price index.

more sharply for the bottom 50% of households than the remaining groups, as presented in figure 5. However, as discussed, the movement of capital gains explains only part of the story. Next, I decompose the impulse responses of net worth for each household group into these two channels: net saving and revaluations. Figure 7 superimposes the impulse responses of group-specific revaluations *multiplied by the group-specific average leverage ratio* and overall net worth. I multiply the revaluation response by the group-specific average leverage ratio to allow us to see the contribution of levered asset price changes to net worth. The difference between these two impulse responses can be interpreted as net saving in the given asset. Despite the relatively small capital loss among the bottom 50%, of this group of 10% out to four years, the trough of net worth is a reduction of 43% which can be largely attributed to leverage amplifying the effects of capital losses. Further, a gap between the net worth response and the revaluation response indicates that net (dis-)saving accounts for the remaining share of the response. On the other hand, the top 1% of households face larger capital losses. However, the leverage of this group is substantially lower, which mitigates the impact of unfavorable asset price movements on overall net worth. Furthermore, the response of the top 1% can be almost entirely accounted for by their capital losses, indicating no change in net saving behavior.

4.2. Balance Sheet Decomposition

To shed further light on the transmission of monetary policy to household balance sheets, I further decompose the impulse responses of each asset class into the same revaluation and saving channels outlined above.[13] To begin, I study the dynamic response of corporate equities by group to monetary policy presented in figure 8a. Responses of equities across groups follow a broadly similar pattern. The bottom 50% of households face a drop in the value of their equities of 31.4% at a horizon of nineteen quarters, while the top 1% experience a drop of nearly 41.2% at a horizon of thirteen quarters. The responses of the S&P 500 index drive the bulk of the response for each group, while the higher sensitivity of the equity portfolios of the top 10% of households may reflect a heightened preference for riskier assets among wealthier households.

Examining the responses of real estate shows a different pattern. As presented in figure 8b, the responses of the bottom 90% of households are nearly identical to those of the house price index, while the top 1% show a response that is statis-

[13]Though since I consider each asset in isolation, rather than net worth, I do not need to adjust responses for differential leverage.

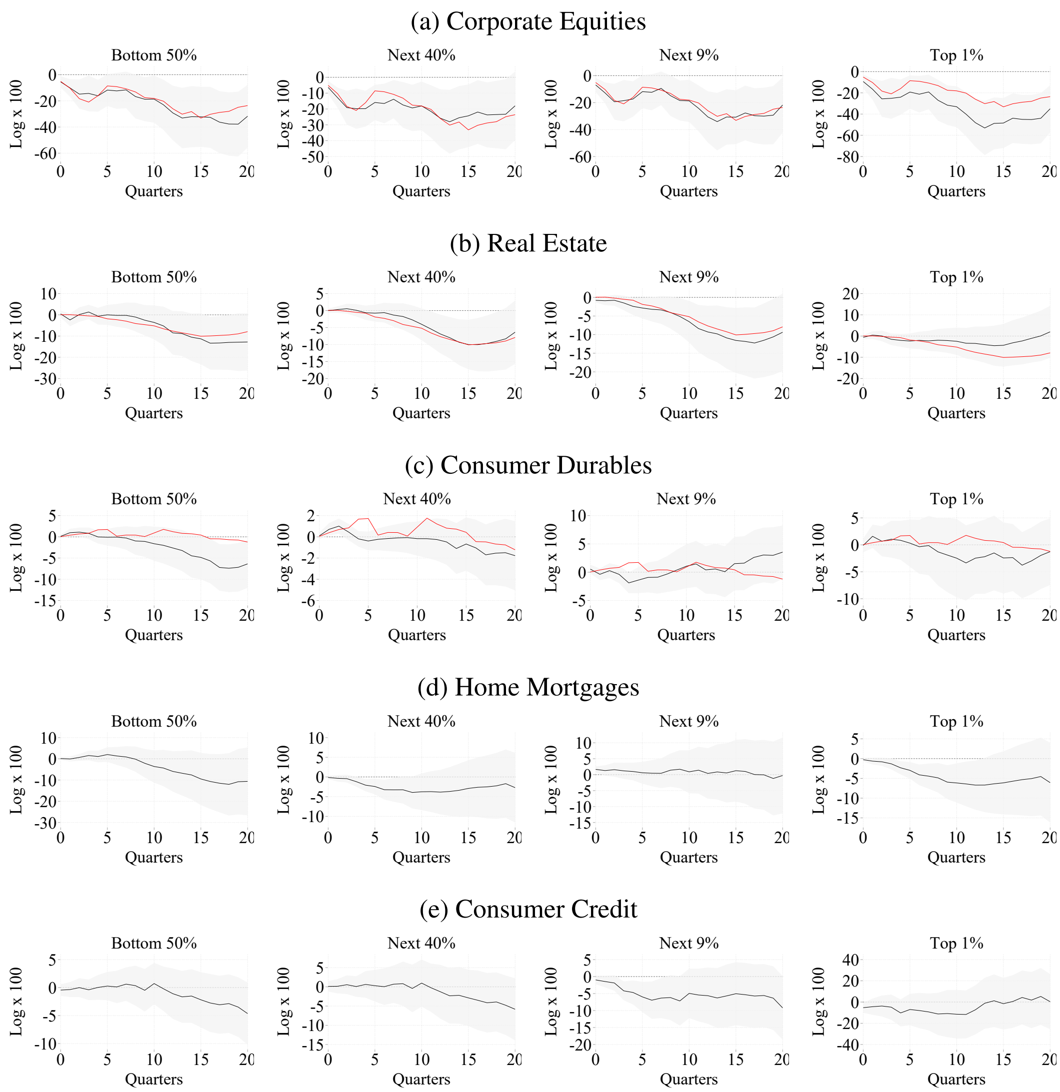

Figure 8. Balance Sheet Decomposition

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point increase in the one-year Treasury rate, estimated from equation (1). Presented with one standard error confidence bands. Red lines are the response of the corresponding price index.

tically insignificant. After the first year, the response of this group diverges from the path of home prices, suggesting an increasing role for saving choices in housing. This may reflect wealthier households capitalizing on reduced house prices by purchasing more valuable homes.

Consumer durables, presented in figure 8c, show a similar pattern to real estate. All except for the bottom 50% of households face no statistically distinguishable response to their durables holdings, which comprise a small share of their overall portfolios. As noted in section 2, the bottom 50% of households hold nearly 30% of the value of their asset portfolio in consumer durables. Although the consumer price index for durables does not respond significantly to monetary policy, the bottom 50% face a loss of nearly 10% of the value of their durables which can be attributed almost entirely to dissaving.

As I argue above, the total response of wealth to monetary policy is largely determined by the assets side of household balance sheets. Figure 8d reports the responses of mortgage debt to monetary policy. The bottom 50% and top 1% experience declines in the outstanding home mortgage debt. This decrease likely reflects two causes. First, households with low home equity may declare bankruptcy in response to a reduction in their incomes, discharging their mortgage debts. Second, as contractionary monetary policy raises rates on adjustable-rate mortgages, households may substitute towards rental housing or lower-cost housing. Figure 8e reports impulse responses of consumer credit, which appears to fall for the bottom 90% of households in the wake of a monetary contraction, although the response is largely statistically insignificant.

In sum, the bottom 50% of households face a large drop in net worth in response to the monetary policy shock, with a peak point estimate of a 43% loss, largely driven by leveraged losses in real estate. Unlike the top 50% of households, the revaluation response for the bottom 50% is more muted, owing to their high portfolio share of low-return assets including housing and consumer durables, with prices less sensitive to monetary policy than the equity-rich portfolios held by the top 50%. However, when we consider the degree of leverage of the bottom 50%, explaining the magnitude of the loss becomes more simple. Further, I provide evidence that on top of leveraged capital losses, the bottom 50% respond to monetary policy shocks by dissaving, particularly out of consumer durables.

4.3. The Distribution of Wealth

To determine whether monetary policy is neutral with respect to the distribution of wealth, I estimate response of the share of wealth held by households of a given group to monetary policy shocks. Traditionally, fractional outcomes present a challenge for econometricians when the outcome is bounded. However, there are good reasons to believe that wealth shares need not be bounded. Households on the lower tail of the wealth distribution would be expected to hold negative equity whether due to underwater mortgages, the use of credit to finance current consumption, or due to financing of non-marketable human capital through student loans. Consequently, the total share of wealth held by the remaining households must exceed one. Accordingly, few alterations are needed to the system of equations defined by (1). In the DFA sample, the bottom 50% of households by wealth own the lowest share of wealth of any group studied but never collectively report negative wealth in any quarter spanning 1989-2020. The results of this exercise are provided in figure 9.

Reflecting results in levels, the top 1% experience a persistent decline in their overall wealth share by nearly 2% within five years. The bottom 50% experience a decline in their wealth share, exceeding 0.5% within five years, that does not recover within five years. It is worth noting again that the very low average share of total household wealth held by the bottom 50% results in a relatively small drop in their

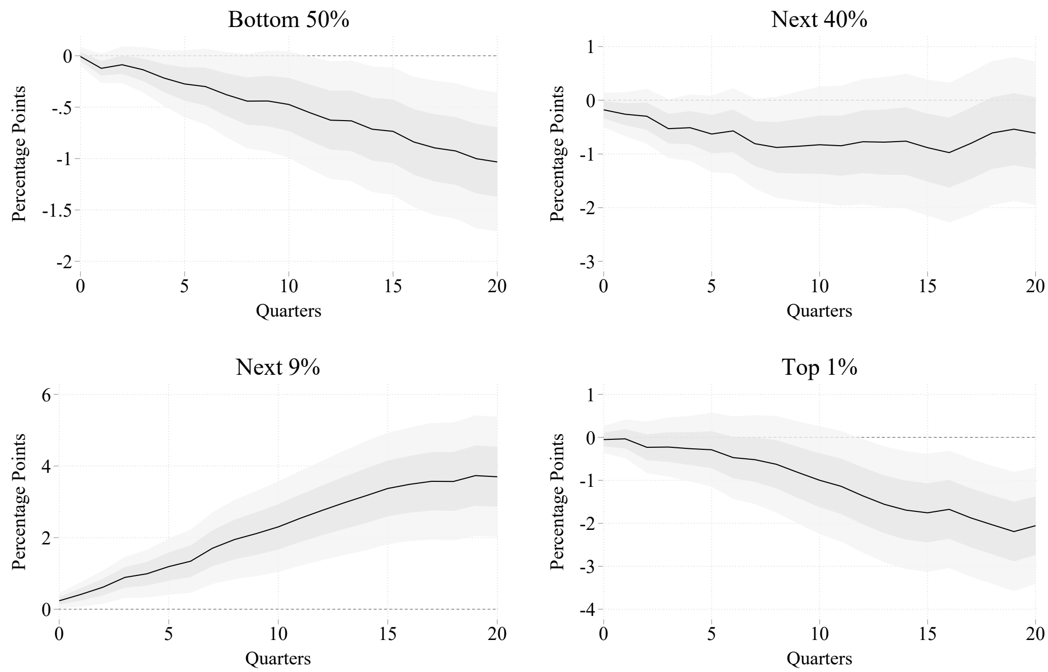

Figure 9. Wealth Shares

Notes: Impulse responses of the share of wealth held by each group to a monetary policy shock inducing a 1 percentage point increase in the one-year Treasury rate, estimated from equation (1). Presented with one- and two- standard error confidence bands.

wealth share. Correspondingly, the next 40% and next 9% of households gain over 1% relative to their initial share of wealth, mirroring the decline in shares held by the top 1% and bottom 50%. Taken together, these results suggest that the distribution of household wealth suffers a large negative mean shock, with relative redistribution from the top 1% and bottom 50% to the remaining 49% of households.

4.4. Asymmetric Effects of Positive and Negative Shocks

As noted in section 1.1, large and heterogeneous effects of monetary policy on household wealth may be consistent with a stable long-run wealth distribution if shocks are mean zero and induce symmetrical effects whether shocks are expan-

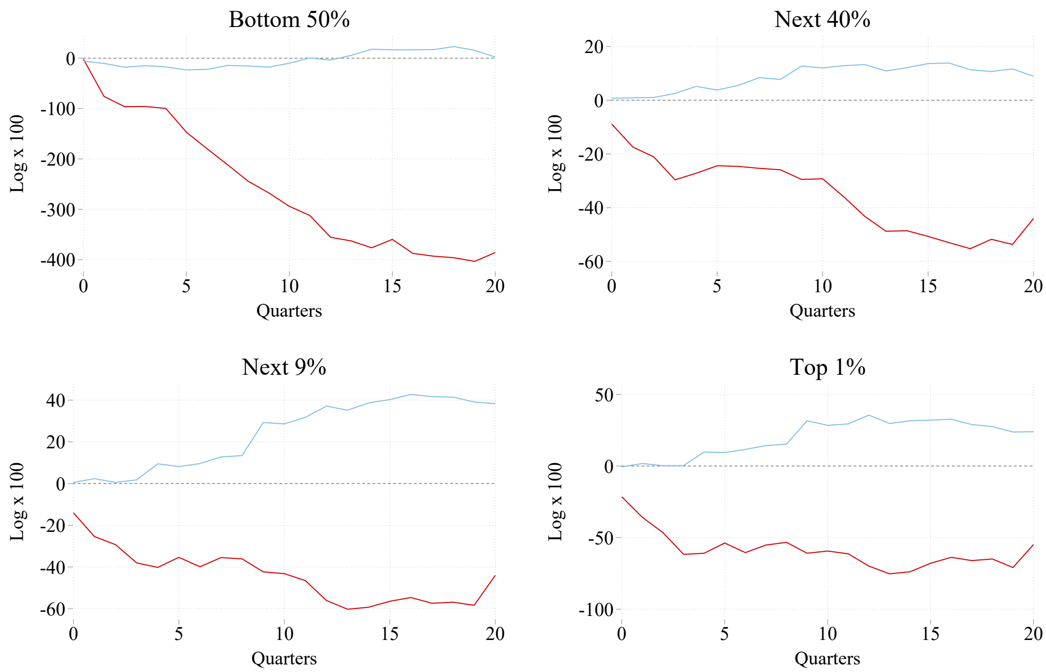

Figure 10. Asymmetric Effects of Monetary Policy

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point change in the one-year Treasury rate. Red lines indicate responses to a contractionary shock, and blue lines indicate responses to an expansionary shock.

sionary or contractionary. In order to test for symmetry of outcomes, I estimate equation (1) separately over the subsamples on which the fed fund futures instrument is positive, and subsequently where it is negative. Figure 10 reports impulse responses of net worth for all groups for both subsamples.

These estimates show a clear asymmetry for the bottom 50% and next 40% of households, with larger effects in the wake of a contractionary monetary policy shock. These results are in line with Furceri, Loungani and Zdzienicka (2018) among others who find asymmetric effects of monetary tightenings and loosenings on income inequality. This asymmetry is particularly pronounced for the bottom 50%, who are estimated to suffer a 98.2% loss after nineteen quarters following a contractionary shock, while experiencing a peak gain of 20.6% in the eighteenth quarter following an expansionary shock. Although present, the magnitude of the asymmetry is reduced for the top 1%, who suffer a peak loss of 52.9% in thirteen quarters following a contractionary shock, but gain 29.9% three years after an expansionary shock.

Practically speaking, the large asymmetry in the response of the bottom 50% is consistent with dissaving in the wake of tightening episodes to finance current consumption, which precludes those same households from accumulating wealth when subsequent loosenings boost asset prices. Additionally, the high leverage ratio of this group implies that similarly sized reductions in the value of assets result in outsized changes in net worth. The other groups, by contrast, primarily suffer due to price changes after a contraction, but broadly maintaining the same quantities in their portfolios. As a result, these households are well placed to enjoy capital gains on appreciating assets with a subsequent loosening. These results provide a complementary analysis to Angrist, Jordà and Kuersteiner (2018) and Tenreyro and Thwaites (2016), who find that monetary policy is more effective in reducing economic activity than providing stimulus, and that monetary policy is less effective in a recession than in an expansion.

As noted, this wide asymmetry opens the door for long-term effects of monetary policy on the wealth distribution. To understand how asymmetry relates to persistent outcomes, consider a monetary policy authority following a standard Taylor-type rule with symmetric, Gaussian errors. In this economy, the monetary authority is equally likely to err on the side of expansionary policy as contractionary. However, the average response of the bottom 50% of households is biased downward relative to the average response of the top 1%. Consequently, the accumulation of losses in response to a given history of monetary shocks can cause a substantial widening of the wealth distribution, a phenomenon for which I test below.

4.5. The Contribution of Monetary Policy

Given the asymmetry of wealth responses, it is important to ask whether the Federal Reserve makes an economically meaningful contribution to changes in the wealth distribution. Macroeconomists have made strides in determining how much discretion central bankers really exert over monetary policy. Jordà and Taylor (2019), for instance, find that interest rates across major advanced economies have been driven primarily by the endogenous response of central bankers to forces outside of their control, including changing demographics and sluggish productivity growth. Furthermore, to the extent that macroeconomists employ parametric reaction functions to describe central bank behavior theoretically, we concede that a significant portion of observed variance in interest rates reflects the systematic response of central bankers in attempting to meet their policy mandates.

These considerations should lead us to believe that the sorts of monetary policy shocks I consider comprise a relatively small share of variance in overall monetary policy actions, and further explain a small share of the variance of household wealth. To test this theory, I perform a forecast error variance decomposition using the R^2 method of Gorodnichenko and Lee (2020). By this procedure, the share of forecast-error variance attributable to the monetary policy shock is estimated by the R^2 of a series of regressions of the form

$$\hat{f}_{t+h} = \sum_{i=0}^{h} \phi^{h,i} z_{t+i} + \nu_{t+h} \tag{4}$$

where $\hat{f}_{t+h}$ is the forecast error of wealth obtained by regressing $y_{t+h} - y_{t-1}$ on all control variables used in equation 1, and z_t is the period-t realization of the monetary policy shock. A constant is unnecessary in this regression, as both the forecast error and shocks have a zero mean.

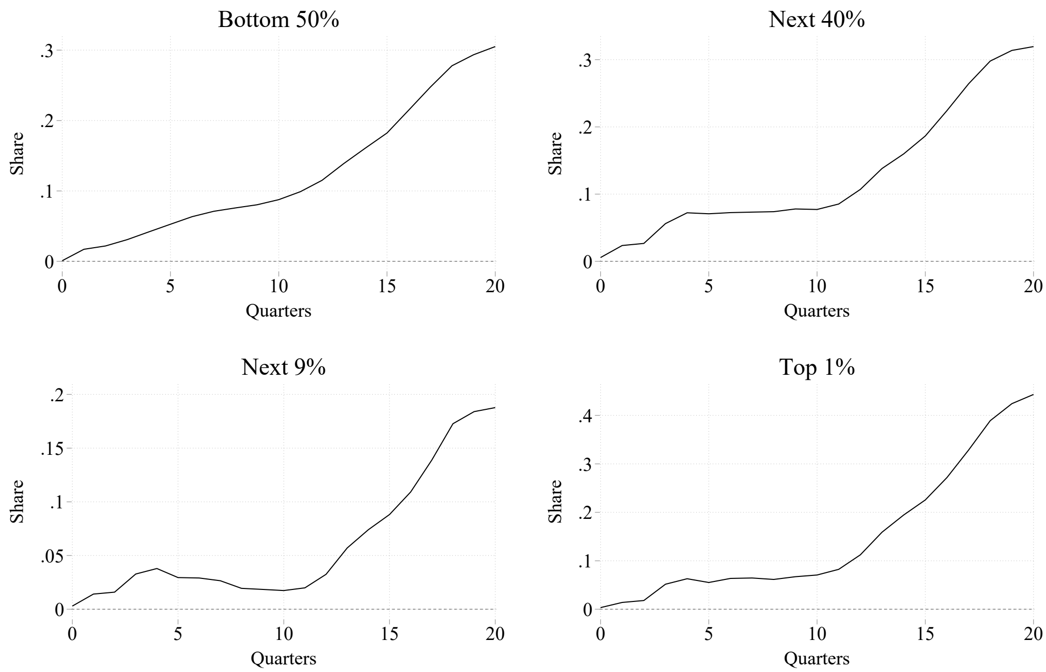

Figure 11. Forecast Error Variance Decomposition

Notes: Forecast error variance decomposition measuring the share of forecast error variance explained by monetary policy shocks at each horizon.

The results of this exercise suggest that a substantial share of forecast error variance of household wealth can be attributed to monetary policy surprises. Out to five years, monetary policy shocks are estimated to explain approximately 30% of forecast error variance for all groups except for the top 1% to 10% group. This result seems large, but previous literature helps us place it in context. Coibion et al. (2017) perform a similar decomposition for income, earnings, and consumption inequality and find that over 10% of forecast error variance for income inequality can be attributed to monetary policy shocks out to five years, with shares exceeding 20% for expenditures and consumption. By contrast, wealth exhibits less volatility than income or consumption, but more sensitivity to changes in asset prices including those caused by monetary policy shocks.

5. Conclusion

The recent rise in economic inequality in the U.S. has been met with public perceptions and macroeconomic research that suggest a role for policymakers. I provide evidence that monetary policy plays a more substantial role in determining the distribution of household wealth than previously believed. Contractionary monetary policy shocks disproportionately reduce the net worth of the bottom 50% of households and reduce their ownership share of total wealth. I demonstrate that the bottom 50% of households suffer disproportionate losses due to capital losses on real estate amplified by their leveraged positions. The top 1% also suffer large losses, primarily through capital losses on financial assets.

Furthermore, I find that monetary policy has historically played a large role in shaping the wealth distribution, accounting for 30% to 40% of forecast error variance of wealth for each group of households. This finding suggests that the wealth distribution is not solely determined by forces exogenous to policy and highlights the need for policymakers to take seriously their role in shaping wealth inequality.

Finally, I find that larger wealth responses result from a monetary tightening than loosening, a result most pronounced for the bottom 50%, who scarcely gain wealth in loosening episodes. As a consequence, households that fall behind in tightening episodes will struggle to make up their lost wealth.

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Appendix A. Robustness

Due to the recency of the DFA becoming public and the nature of my identification strategy, it's worth noting substantial uncertainty associated with these measures. As noted in section 3.2, the system of equations I estimate with local projections doesn't require any control variables as long as the instrument satisfies an instrument validity assumption. In extracting my instrument from the structural form of a Gertler and Karadi (2015) VAR, the instrument will be purged of any predictability by the control variables included in the VAR. However, as a further test of endogeneity, I alter the system of equations in equation 1 to include additional lags of the outcome variable. Results are presented in figure A1 for two, four, six, and eight lags. Overall, each added specification shows a path very similar to that of the impulse responses estimated using the baseline local projections. The similarity of these results gives some comfort that the proxy VAR-implied shock series is a valid instrument.

In my baseline specification, I estimate both the proxy VAR and equation (1) using the one-year Treasury rate. As an additional robustness test, I repeat this procedure using the federal funds rate as well as the two- and five-year Treasury rates as indicator variables. Due to the term structure of interest rates, a surprise in the fed fund futures market that is expected to induce temporary movements in short-term interest rates will have a diminished effect on interest rates on bonds with long maturities. This fact confounds impulse responses estimated using an instrumental variables approach, as each is mechanically scaled to induce a one percentage point increase in the indicator variable on impact. To reflect structural shocks of a comparable magnitude I rescale impulse responses to reflect a one percentage point increase in the one-year Treasury rate.

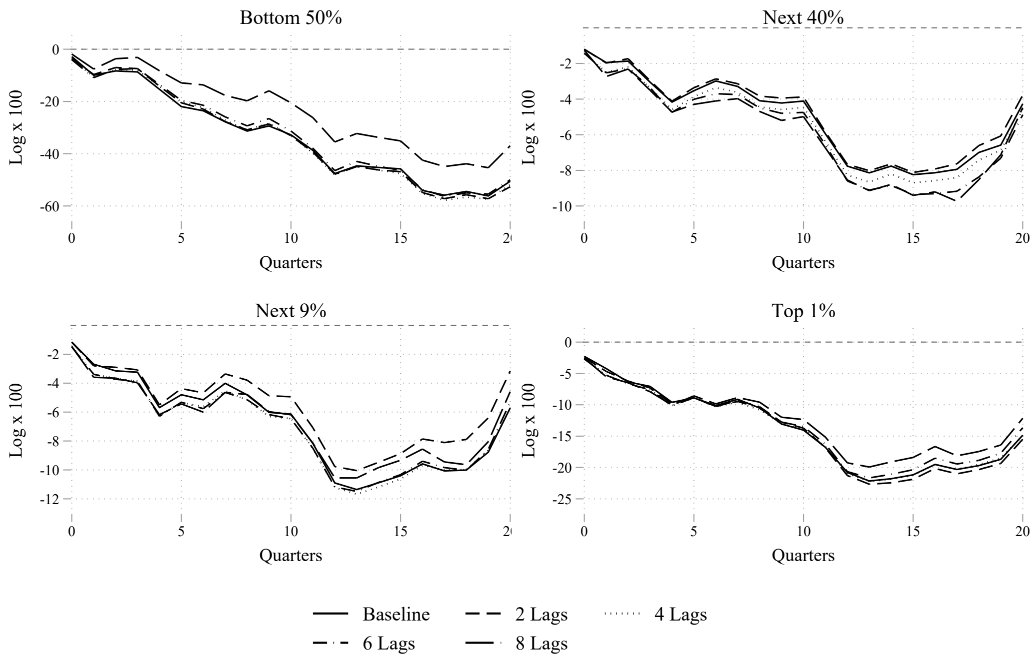

Figure A1. Alternative Lag Lengths

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point change in the one-year Treasury rate.

Results are reported in figure A2. Impulse responses are broadly similar to those estimated using the baseline using the one-year Treasury rate, with the exception of the specification using the five-year rate. This is likely due to movements in term premia that cannot be resolved by rescaling the impact point estimate. Even still, the impulse responses are very closely matched in the immediate aftermath of the shock, and in the longer term.

Finally, I consider whether my results are sensitive to outlier events, with the most salient being the Great Recession. To do so, I re-estimate equation (1) dropping successive, overlapping three-year periods from the sample. As my full sample spans 1989-2021, there are 31 such subsamples. Results are reported in figure A3. Despite the dispersion of estimated impulse responses, the qualitative nature of the

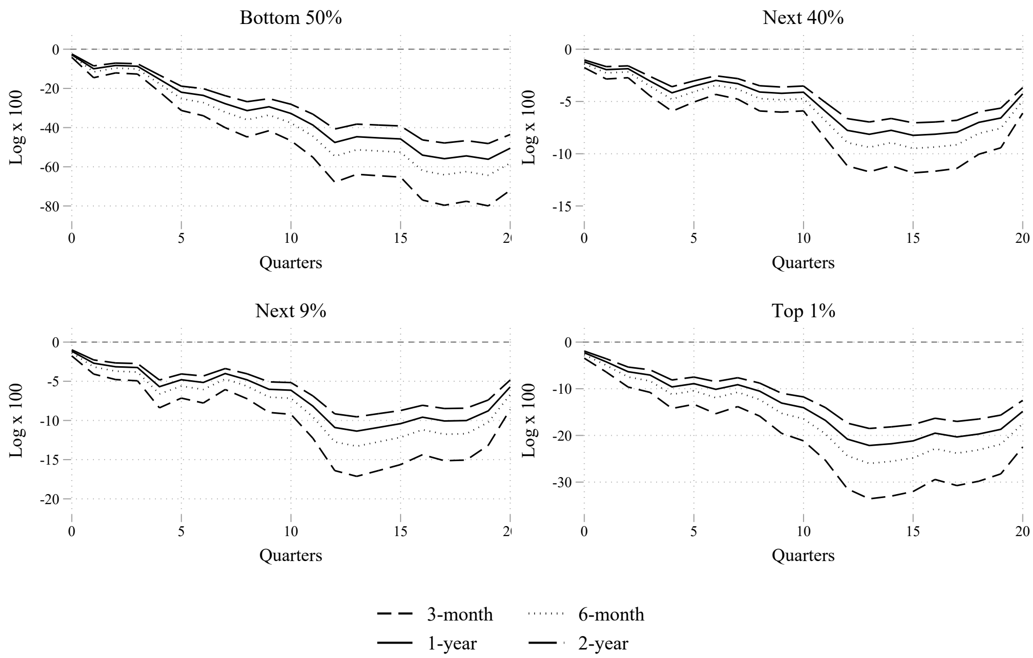

Figure A2. Alternative Indicators

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point change in the one-year Treasury rate.

responses remains consistent across subsamples. I direct attention specifically to the thick lines in figure A3, which indicate the impulse responses obtained on subsamples excluding the three-year periods beginning in 2005, 2006, 2007, 2008, and 2009, thus excluding the Great Recession. Notably, these impulse responses exhibit wealth declines that are close to those of the full sample, and as varied, with larger losses experienced by the bottom 50% and top 1%.

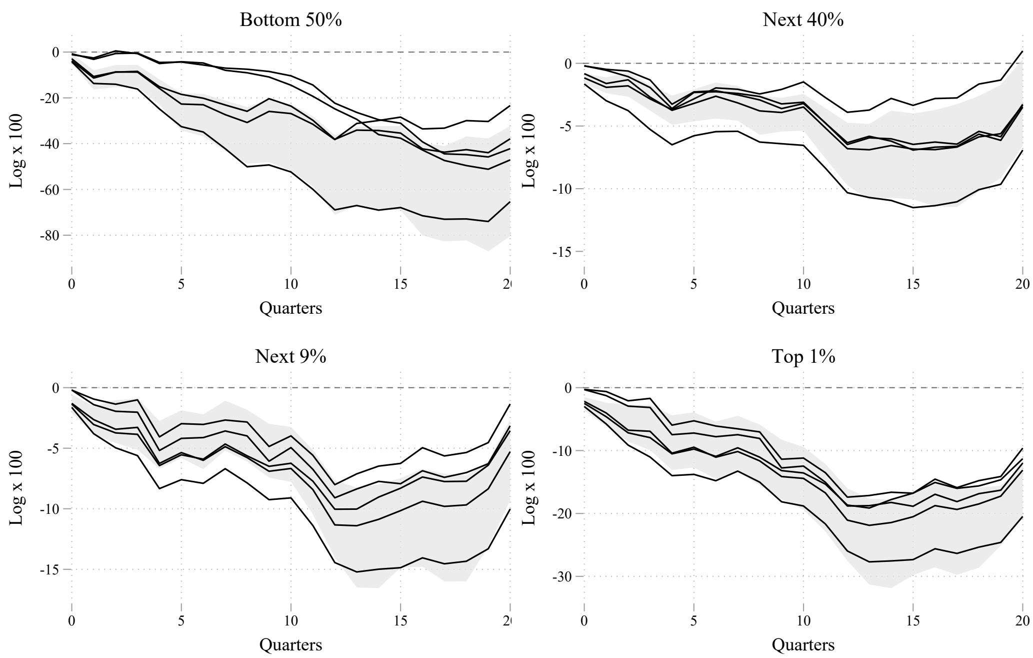

Figure A3. Subsample Stability

Notes: Impulse responses to a monetary policy shock inducing a 1 percentage point change in the one-year Treasury rate. The black lines represent the impulse responses of the five subsamples that exclude the Great Recession. The grey region represents the range of responses in the remaining subsamples.