Crouching Interest Rate, Hidden Inequality: Monetary Policy and Inequality Revisited*

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Abstract

We revisit the distributional consequences of U.S. monetary policy with newly available high-frequency data containing information on both the wealth and income of the so-called super-rich. Although the accelerated rise in inequality since the 1980s has been driven by those who are at the right tail of the distribution amid the accommodative monetary environment, the literature has not provided clear evidence on whether expansionary monetary policy increases inequality. We argue that the lack of consensus in the literature is largely driven by missing out on different factors embedded in the monetary policy. Once we differentiate these factors, we find that unconventional monetary policy (large-scale asset purchases and forward guidance) indeed increases both wealth and income inequality in the United States, especially at the far right tail of the distribution. In contrast, accommodative interest rate-based monetary policy counteracts this force by reducing inequality. The offsetting effects on inequality explain why the literature often found different results regarding this relationship.

JEL Classification: E31; E32; E62; F31; F41

Keywords: Monetary policy shocks; Wealth inequality; Income inequality; Conventional monetary policy; Unconventional monetary policy

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I. Introduction

How does monetary policy affect inequality in wealth and income, especially those at the top? Although the accelerated rise in inequality since the 1980s has been driven by those who are at the far right tail of the distribution amid the accommodative monetary environment overall, the literature has not provided a clear link between this phenomenon and changes in monetary policy. On the one hand, a stream of the literature has found that monetary contraction tends to increase inequality in consumption, earnings, or income (e.g., Romer and Romer, 1999; Coibion et al., 2017; Mumtaz and Theophilopoulou, 2017; Furceri et al., 2018; Guerello, 2018; Auclert, 2019; Samarina and Nguyen, forthcoming). On the other hand, Saiki and Frost (2014), Domanski et al. (2016), Inui et al. (2017), Mumtaz and Theophilopoulou (2020), El Herradia and Leroy (2021), and Andersen et al. (forthcoming) have found that monetary easing tends to raise inequality.[1]

We argue that this discrepancy in the literature is largely driven by (i) different measures of monetary policy shocks and (ii) different metrics of inequality, and carefully address these two issues. First, we use recently-constructed monetary policy shocks by Swanson (2021) spanning both conventional and unconventional monetary policy eras. Swanson (2021) estimates the three orthogonal factors in monetary policy surprises around the FOMC meetings: the changes in the federal funds rate (FFR), forward guidance (FG), and large-scale asset purchases (LSAPs). We show that each of the monetary policy shocks has a distinct effect on macroeconomic outcomes as well as inequality metrics. In particular, monetary easing identified via the FG and LSAP factors increase wealth inequality, while that via the FFR factor tends to reduce wealth inequality.

Second, different findings in the literature are also attributed to the lack of information on the so-called "super rich" due to the self-reported nature of survey data used in most analyses. As a result, despite many recent studies studying the distributional consequence of monetary policy,

[1] Using micro-level U.K. household data, Mumtaz and Theophilopoulou (2017) find that expansionary monetary policy shocks reduce earnings, income, and consumption inequality, whereas the same authors (Mumtaz and Theophilopoulou, 2020) find that the same kind of shocks raise wealth inequality.

most studies focus on inequality metrics like the Gini index and do not pay much attention to how changes in monetary policy affect the fortune of the super-rich. In this sense, the inequality metrics used in our analysis contain information about individual income and wealth at the very right tail of the distribution, the so-called super-rich (e.g., top 0.1% or 0.01%), which was usually not available in previous studies based on a survey. Since capital gains, as well as capital and business income, are major sources of total income for this group, the effect of uncertainty shocks on this group might differ from that on the top 10%, whose income still largely depends on labor income. As a result, the aforementioned distributional effect is particularly large for those at the top, so the response of the super-rich is larger than that of the rich.

Compared with the previous studies discussed above, our work has several additional advantages. First, we consider the distributional consequences of monetary policy shocks on wealth in addition to income and labor income using a standard Vector Autoregression (VAR) model, allowing for a comprehensive understanding of the phenomenon of rising inequality. Due to the lack of high-frequency data especially on wealth inequality spanning a sufficient period required for time-series analysis, the literature paid less attention to wealth inequality than income or consumption inequality and most existing studies have relied on a simulation exercise or scenario analysis (e.g., Doepke and Schneider, 2006; Meh et al., 2010; Adam and Zhu, 2016; O'Farrell and Rawdanowicz, 2017; Hohberger et al., 2020) with an exception of Inui et al. (2017) on Japan and Mumtaz and Theophilopoulou (2020) on the United Kingdom.

Second, the measures of inequality in our analysis are available at a monthly frequency, yielding substantially more observations than those used in previous studies. Such monthly frequency data also alleviate the concern about identifying structural shocks when using Cholesky ordering in the VAR model and help reveal interesting short to medium-run dynamics of inequality following the monetary policy shock.

Lastly and most importantly, we evaluate the distributional effects of both conventional and unconventional monetary policy in a unified framework. Compared with the voluminous literature on the relationship between conventional monetary policy and inequality, the literature on unconventional monetary policy is still limited. Moreover, the analyzed nonstandard policy measures are mainly based on large-scale asset purchases alone, while other measures like forward guidance have not received much attention. We fill this gap in the literature by providing a systematic analysis of monetary policy spanning a full dimension: policy rate, forward guidance, and large-scale asset purchases.

We analyze the dynamic effect of monetary policy shocks on wealth and income inequality by estimating a structural vector autoregression (VAR) model of the U.S. economy from 1991M7 to 2019M6. In addition to the standard real, nominal, and financial variables characterizing the U.S. economy, our VAR model includes the real wealth and income share of different groups. These inequality measures were taken from Blanchet et al. (2022), who recently constructed distributional data on income and wealth at a monthly frequency, building on their prior work using annual data (Saez and Zucman, 2016; Piketty et al., 2018).

We revisit the distributional consequences of monetary policy shocks studied in the literature by applying a standard identification approach (e.g., recursive VAR identification or narrative identification) to newly available high-frequency data on inequality. We indeed find that standard monetary policy shocks fail to provide a consensus on the monetary policy–inequality relationship. Moreover, the distributional effect on the right tail of the distribution (i.e., for the super-rich) is often different from that on the entire distribution, consistent with the claim by El Herradia and Leroy (2021) and Amberg et al. (forthcoming). This finding requires caution for interpreting the results based just on a single statistic like the Gini index as a measure of inequality.

We argue that such a failure is largely attributed to ignoring different dimensions of monetary policy when using the policy rate as a stance of monetary policy. In particular, to the extent that the low-interest rate environment has prevailed over the last two decades, yielding only a few exogenous policy rate changes, focusing only on the conventional monetary policy may mask important distributional implications of monetary policy in the recent period. In contrast, our main analysis separately investigating different factors of monetary policy provide a consistent narrative on the monetary policy–inequality relationship. While the expansionary monetary policy in a conventional manner reduces inequality, unconventional monetary easing, such as forward guidance and large-scale asset purchases increases inequality, which is particularly strong for the wealth inequality at the right tail of the distribution.

The remainder of this paper is organized as follows. Section II explains the main data, including new high-frequency metrics of wealth and income inequality and three monetary policy factors identified by Swanson (2021), then introduces the empirical model. Section III presents the main findings and provides a series of robustness checks. Section IV summarizes potential theoretical channels and tests their empirical relevance in the monetary policy–inequality relationship. Section V concludes.

II. Empirical Framework

A. Data

In this section, we describe the data used for our empirical analysis of the U.S. economy, with special attention to newly available high-frequency inequality data and a newly constructed monetary policy shock series spanning periods of both conventional and unconventional monetary policy.

Measures of inequality. Our measures of inequality are based on monthly income and wealth distribution data, recently constructed by Blanchet et al. (2022). These data are publicly available at https://realtimeinequality.org/ and are updated regularly after the main national income statistics become available. They are analytic micro-level data that match national accounts the underlying data sources of which include the Internal Revenue Service (IRS), Bureau of Labor Statistics (BLS), Bureau of Economic Analysis (BEA), and Department of Labor (DOL). Using these data, one can track the monthly national income and wealth distribution. The series is adjusted for inflation, using 2021 as the base year, resulting in real values of income and wealth.

Blanchet et al. (2022) take a moving average of distributional national accounts annual microdata and rescale each income and wealth component to monthly data. This method is suitable for non-labor income parts because short-term gross changes mostly cover the distributional changes for each component. The distributional changes in non-labor income and wealth move slower than aggregate changes. However, labor income still accounts for approximately 75% of the national income, and its distribution can rapidly change. To consider fast-moving distributions due to changes in employment and wage earnings among different industries and counties, we use monthly employment data and quarterly specific wage distributions from the BLS Quarterly Census of Employment and Wages.

For the income inequality measure in this study, we use household factor income, which covers all capital and labor income before taxation and adds up to the national income. We also use data on labor income to better understand the source of inequality. For the wealth inequality measure, we use all marketable wealth (assets – liabilities) held by households. Funded pensions were included and debts were subtracted. Vehicles and unfunded pension promises were excluded from the wealth data. The sample period for these inequality data is January 1976 to December 2021. The data are reported for six groups, which include not only standard groups considered in the literature (i.e., top 1%, top 10%, middle 40%, and bottom 50%), but also the super-rich group often overlooked in the literature due to data limitations (top 0.01% and top 0.1%). The corresponding income or wealth ranking defines these groups.

Figure 1 shows the real wealth share (left) and real income share (right) for each group during the sample period. The top panel plots the share of the top 10%, middle 40%, and bottom 50%, and the bottom panel plots the share of the top 0.01%, 0.1%, and 1%. There has been a strong trend of increasing inequality in wealth and income, as is apparent from the steadily increasing share of the rich (e.g., the top 10% or 1%), especially when the share of the super-rich (top 0.01% or 0.1%) is considered. This is consistent with prior observations that U.S. inequality has accelerated since the 1980s (Piketty et al., 2018). For example, the wealth and income share of the top 0.01% is nearly zero in 1980, but they become nearly 5% and 10% in 2019, respectively.

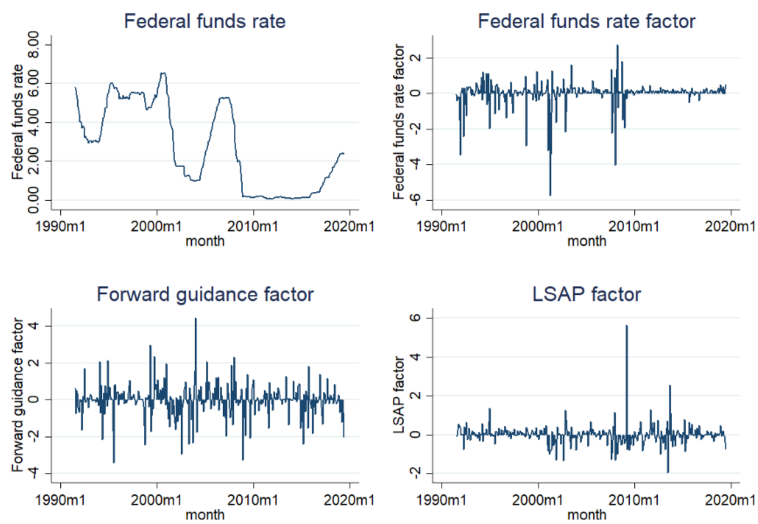
Figure 1. Evolution of wealth and income share of different groups over time

Note: The top panel plots the share of wealth (left) and income (right) across groups. The NBER recessions are marked with shaded areas. The sample period is January 1976 to December 2019.

Measure of monetary policy shocks. One of the main novelties of our work is to consider different aspects of monetary policy in a unified framework by drawing on three monetary policy factors from Swanson (2021). Swanson (2021) recently estimates the effects of FOMC announcements on asset markets in three dimensions. The three factors include the changes in the federal funds rate (FFR factor), forward guidance (FG factor), and large-scale asset purchases (LSAP factor). Building on the dataset from Gürkaynak et al. (2005a), Swanson (2021) extends the dataset, which covers from July 1991 to June 2019. The FOMC announcement dates and the immediate changes in the asset prices after the announcements are used for data extension.

Regarding the optimal numbers of factors, the results from the Cragg-Donald test by Cragg and Donald (1997) suggest that the three components are needed to explain the interest rate changes after the FOMC announcements, which requires three identifying assumptions. Following Gürkaynak et al. (2005a), Swanson (2021) assumes that forward guidance does not affect the current federal funds rate. Additionally, LSAP factors are assumed to not affect the current federal funds rate and also are assumed to be almost zero before the ZLB period. Figure 2 presents the evolution of the three monetary policy factors, together with the effective federal funds rate.

Figure 2. Federal funds rate and the three monetary policy factors by Swanson (2021)



Note: This graph plots the federal funds rate, and the three components of surprise changes after the FOMC announcement estimated by Swanson (2021), which are the estimated federal funds rate, forward guidance, and LSAP (large-scale asset purchase) factors. The sample period is July 1991 to June 2019.

Other macroeconomic and financial variables. We include a standard set of macroeconomic and financial variables in the baseline VAR model. The choice of variables closely follows existing studies on the macroeconomic effects of monetary policy shocks, such as Christiano et al. (1999) and Stock and Watson (2001). The set of variables used in the baseline model closely follows Coibion (2012) and includes, industrial production, unemployment rate, consumer price index (CPI), and monetary policy shock series, which are available at a monthly frequency.

Once we establish a causal link between various kinds of monetary policy shocks and inequality metrics, we extend the baseline model to better understand the empirically relevant channels. In the extended model, we include additional variables capturing potential channels through monetary policy affects inequality, including the stock market index (S&P500), housing prices, inflation expectations from the Michigan consumer survey, hourly earnings, long-term mortgage rate, and excess bond premium constructed by Gilchrist et al. (2021).

B. Vector Autoregression model

In this subsection, we briefly describe the main empirical framework used in this analysis. We employ a standard VAR model to estimate the responses of the variables capturing wealth and income inequality to the monetary policy shock while accounting for their dynamic relationship with other aggregate variables. The baseline VAR model includes (i) three of the estimated monetary policy factor series by Swanson (2021), (ii) standard real and monetary variables characterizing the U.S. economy common to each VAR model explained above, and (iii) each of the various inequality metrics entering the VAR system in turn.

The following general representation summarizes the structural VARs used in this study:

$$Ay_t = c + \sum_{k=1}^{p} F_k y_{t-k} + u_t, \tag{1}$$

where y_t is an $n \times 1$ vector of the aforementioned variables ($n = 7$ in the baseline model). c denotes an $n \times 1$ vector of constants and linear time trends. F_k are $n \times n$ matrices of coefficients, and u_t is an $n \times 1$ vector of structural shocks. The lag p for the baseline analysis is 6, which is the lag Akaike information criteria suggest. Following much of the literature, we identify the simultaneous relations of structural shocks by assuming that A is a lower triangular matrix (i.e., recursive identification):

$$A = \begin{pmatrix} 1 & 0 & \dots & 0 \\ a_{21} & 1 & \dots & 0 \\ \dots & \dots & \dots & 0 \\ a_{n1} & \dots & a_{nn-1} & 1 \end{pmatrix}.$$

A reduced-form model can be obtained from (1):

$$y_t = A^{-1}c + \sum_{k=1}^{p} B_k y_{t-k} + A^{-1}\Sigma\epsilon_t, \qquad \epsilon_t \sim N(0, I_n), \tag{2}$$

where $B_k = A^{-1}F_k$ for $k = 1, 2, \dots, p$, and

$$\Sigma = \begin{pmatrix} \sigma_1 & 0 & \dots & 0 \\ 0 & \sigma_2 & \dots & 0 \\ \dots & \dots & \dots & 0 \\ 0 & \dots & 0 & \sigma_n \end{pmatrix},$$

where σ_i denotes the standard deviation of each structural shock.

Recursive identification in our seven-variable baseline VAR model is achieved by the following Cholesky ordering in line with the standard monetary VAR model by Christiano et al. (1999): industrial production, unemployment rate, log of CPI, three estimated monetary policy factors (FFR factor, FG factor, LSAP factor) by Swanson (2021), and inequality metrics. Since the three monetary policy factors are orthogonal to one another, the ordering among them should be irrelevant.[2]

The ordering indicates that monetary policy shocks do not have a contemporaneous effect on (slow-moving) macroeconomic variables and reflects the timing underlying the Taylor rule. A disaggregate nature of inequality metrics justifies their last ordering in the VAR system. A large body of literature on this issue suggests that estimating a VAR model in levels is still desirable to preserve the co-integrating relationships among variables (Sims et al., 1990).

III. Empirical Findings

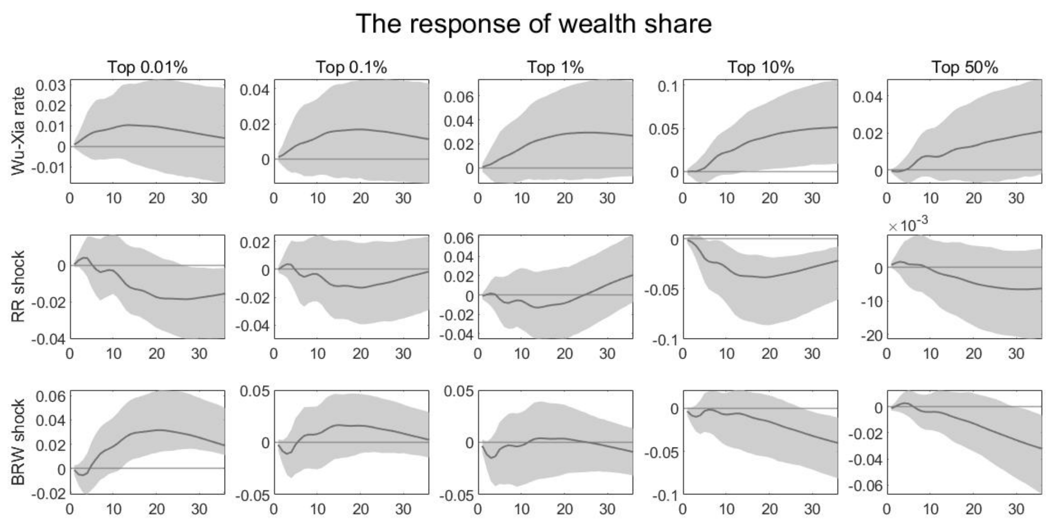
A. Main results

Response to standard single-factor monetary policy shocks. Before presenting the main findings, we revisit the macroeconomic and distributional effects of monetary policy shocks that are identified by a standard approach without considering the different dimensions of monetary policy considered in Swanson (2021). First, monetary policy shocks are identified by innovation to the federal funds rate, after accounting for contemporaneous developments in output, unemployment, and prices. Thus, this VAR model is the same as the baseline model except that it does not include any identified monetary policy factor in Swanson (2021). Given that our sample includes a non-trivial share of the period under the ZLB, we use the shadow rate estimated by Wu and Xia (2016) instead

[2] We still test whether our findings are robust to the ordering among the three factors in Section III.B.

during the ZLB period.[3] The estimation sample runs from 1976M1 to 2019M12. The starting sample is dictated by the availability of high-frequency wealth inequality metrics from Blanchet et al. (2022) and the ending period is determined considering the erratic nature of the COVID-19 crisis.[4]

Figure 3. Response of wealth shares to single-factor monetary policy shocks



Note: This graph plots the 36-month-horizon impulse response functions of various wealth shares to one standard deviation federal funds rate (with Wu-Xia rate) shock (top), RR shock (middle), and BRW shock (bottom). The x-axis denotes months and the y-axis represents a percentage scale. Each column represents the responses of each group. The shaded area represents the bootstrap 90% confidence interval. The sample period is January 1976 to December 2019 (top), January 1976 to December 2007 (middle), and January 1994 to December 2019 (bottom), respectively.

The first row in Figure 3 presents the responses wealth share of each group to the same shock. For wealth share metrics, the response of the rich in a broad sense (i.e., the top 10% or 50%) is positive, indicating an increase in wealth inequality following expansionary monetary policy shocks. However, once we look at the right tail of the distribution (i.e., the top 1% or above), the responses become much weaker and statistically insignificant. To the extent that the rapid increase in wealth

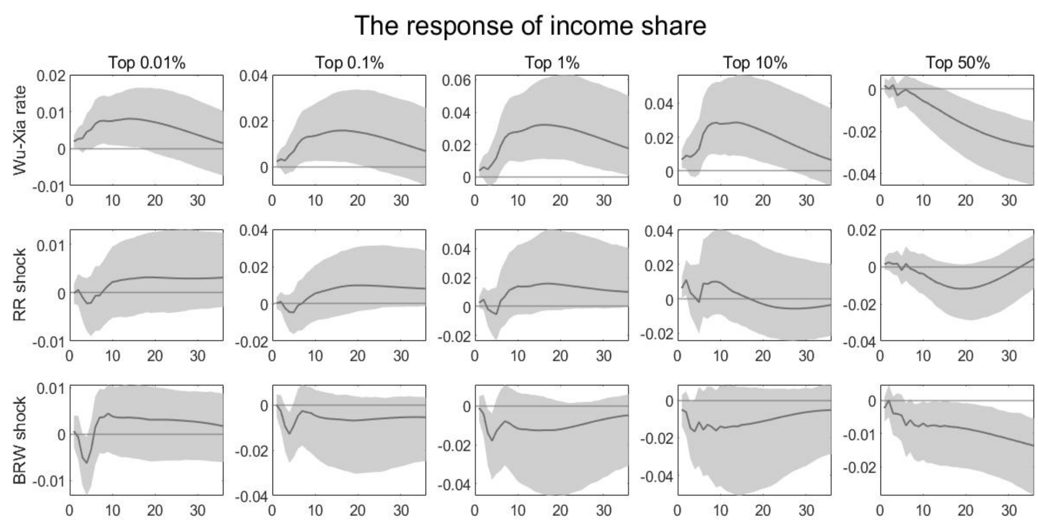
[3] Using the effective federal funds rate for the entire period yields qualitatively similar results.

[4] The first row in Figure A.1 in the appendix shows the response of aggregate variables to the monetary policy shock under the standard identification scheme in which the top 10 percent wealth share is used as a measure of inequality. Despite the presence of price puzzle, exogenous monetary policy easing leads an increase in output and a decrease in unemployment.

inequality since the 1980s is largely driven by those at the top of the distribution, this finding appears to limit the role of monetary policy in understanding the evolution of wealth inequality.

When we repeat the same exercise for income inequality, we obtain a similar conclusion except that the top 50% income share declines persistently and statistically significantly, which is shown in the first row in Figure 4. One possible explanation for the difference in the top 50% shares is a much larger concentration of wealth compared with income across the distribution. If we focus on the top 10% or above, this finding is consistent with El Herradia and Leroy (2021) and Amberg et al. (forthcoming) who documented an increase in income inequality following expansionary monetary policy shocks.

Figure 4. Response of income shares to single-factor monetary policy shocks



Note: This graph plots the 36-month-horizon impulse response functions of various income shares to one standard deviation federal funds rate (with Wu-Xia rate) shock (top), RR shock (middle), and BRW shock (bottom). The x-axis denotes months and the y-axis represents a percentage scale. Each column represents the responses of each group. The shaded area represents the bootstrap 90% confidence interval. The sample period is January 1976 to December 2019 (top), January 1976 to December 2007 (middle), and January 1994 to December 2019 (bottom), respectively.

However, weak and insignificant results regarding the role of monetary policy in wealth inequality might have been driven by the failure of identifying monetary policy shocks. In particular, there have been many critiques about the recursive identification of monetary policy shocks. To guard against this critique, we use two alternative monetary policy shock series obtained from different approaches. The first one is well-known narrative shocks (RR shocks, hereafter) constructed by Romer and Romer (2004), which is extended by Coibion et al. (2017) until December 2008. Romer and Romer (2004) identify monetary policy innovations by first constructing a historical series of interest rate changes decided upon at meetings of the FOMC and then isolating the innovations to these policy changes that are orthogonal to the Fed's information set.

The second one is a unified measure of monetary policy shocks (BRW shocks, hereafter) spanning both conventional and unconventional policies free of the central bank information effect, recently constructed by Bu et al. (2021). This series captures an average impact of changes to the Federal funds rate, forward guidance, and LSAPs after the FOMC meeting, and thus connects the conventional and unconventional monetary policy era well similar to the shadow rate by Wu and Xia (2016). Thus, we call these three (Wu-Xia, RR, and BRW) shocks a single-factor monetary policy shock. It is different from other alternative series because it is mostly unpredictable, and does not include significant central bank information effect.[5]

These two series replace the effective federal funds rate (and the Wu-Xia rate for the ZLB period) in the previous model in turn, and the responses of wealth share to each of these two additional monetary policy shocks are shown in the second and third rows of Figure 3, respectively. The sample period is January 1976 to December 2008 for the RR shock and January 1994 to December 2019 for the BRW shock, respectively. Figure A.1 in the appendix presents the responses of macroeconomic variables to these single-factor monetary policy shocks, which are normalized to denote monetary easing.

Interestingly, the implication of monetary policy shocks identified by a narrative approach on wealth inequality is quite different from that of a standard recursive identification approach. Although the responses tend to be statistically insignificant, they are certainly negative. The top

[5] It is estimated through two-step regressions from Fama and MacBeth (1973), and a partial least squares (PLS) method was used. The PLS approach excludes the information effect if the short-term interest rate and long rates are influenced by the information effect differently, or if long rates are unaffected by the information impact. Adding to that, this series uses the whole yield curve to eliminate the Fed information effect.

10% share—perhaps the most widely-used metric among share-based metrics—declines significantly, suggesting that expansionary monetary policy reduces wealth inequality. Whereas this finding is in line with Coibion et al. (2017), who found that contractionary monetary policy increases inequality in income, consumption, and expenditures using the same RR shock series,[6] it poses a possible critique that the implication on inequality depends on how monetary policy shocks are identified.

Next, the effects of BRW shock on wealth inequality are far from homogeneous across different inequality metrics. For example, the wealth share of the super-rich (top 0.01%) increases significantly, while that of the top 10% or 50% declines, borderline statistically significant though. Those in between (i.e., the top 0.1% or 1%) do not respond much to the BRW shock. Through the lens of our main analysis (i.e., considering FFR, FG, and LSAP factors separately), this finding is especially intriguing, as the BRW shock is a combination of the three factors with potentially different consequences on inequality. In other words, our findings indicate that different factors of monetary policy can have effects on inequality offsetting each other, which necessitates a separate analysis for comprehensive understanding. We provide a systematic analysis of this account in Section IV.

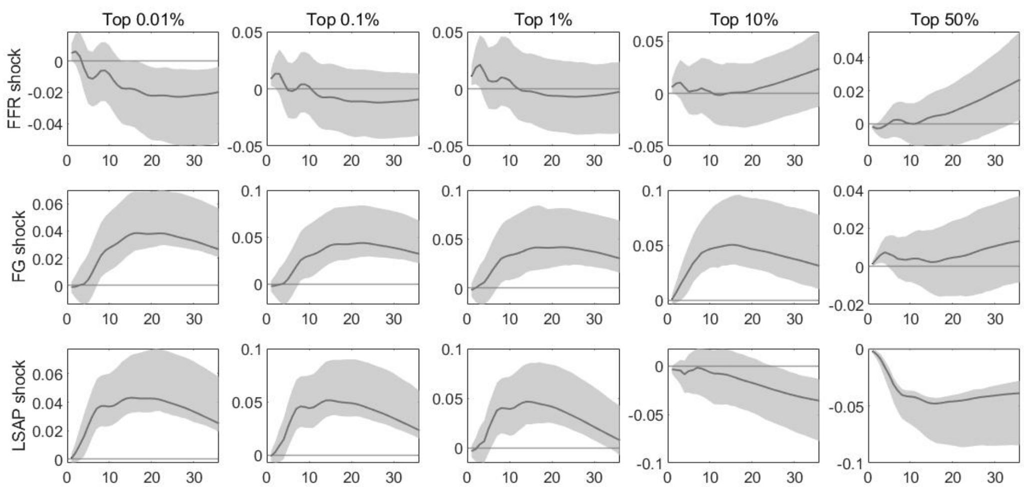
The responses of income inequality to alternative monetary policy shocks shown in Figure 4 paint a similar picture. Although the responses are, in general, not precisely estimated, there is mixed evidence regarding the distributional consequence of monetary policy, both across different income percentiles and different measures of monetary policy shocks. For example, the income distributional effects of the BRW shock are the opposite of the Wu-Xia shock for the top 10% and above, but they are similar for the top 50%. In sum, our findings explain why the existing literature (those using different measures of inequality and monetary policies) often found contrasting results.

Response of wealth inequality to each of identified monetary policy factors. After confirming that single-factor monetary policy surprises studied in the literature fail to deliver a robust effect on

[6] Coibion et al. (2017) did not study wealth inequality.

wealth and income inequality, we provide the main finding of the paper. We plot the response of the wealth share of the top 0.01%, 0.1%, 1%, 10%, and 50% to a surprise in each of the three identified monetary policy factors in Figure 5. Three rows represent the response to the FFR shock, FG shock, and LSAP shock, respectively. To keep consistency among the three shock measures, the impact response is normalized to imply monetary easing. By summarizing the response of different inequality metrics and different dimensions of monetary policy shocks in one figure, we obtain a comprehensive understanding of the relationship between monetary policy and inequality compared with most existing studies focused on a single statistic as a measure of inequality or a single monetary policy shock.

Figure 5. Response of wealth share to three monetary policy factors



Note: This graph plots the 36-month-horizon impulse response functions of wealth inequality metrics to a one-unit shock to FFR factor (top), FG factor (middle), and LSAP factor (bottom). The shaded areas represent the bootstrap 90% confidence interval. The sample period is July 1991 to June 2019.

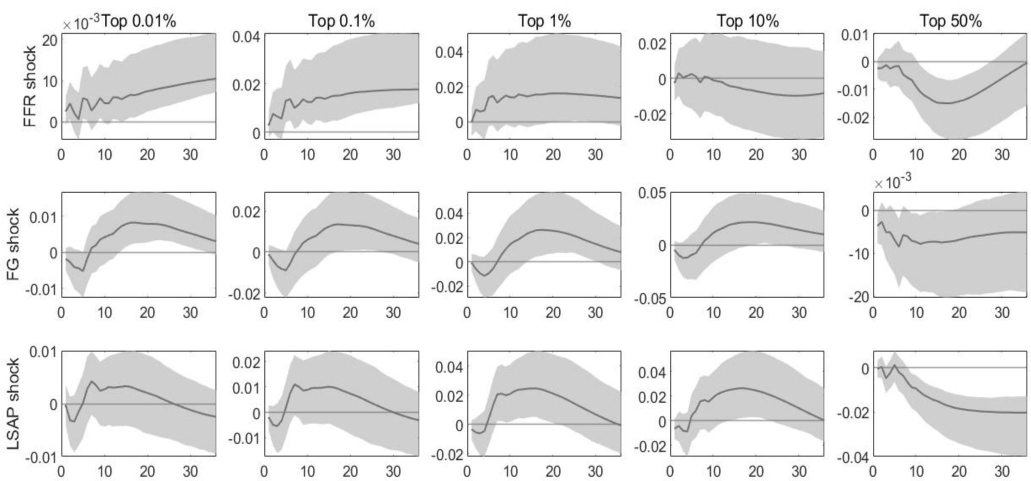
Figure 5 shows that the responses of wealth inequality metrics to the three kinds of monetary policy factors are quite different, providing a hint at why the existing studies failed to reach a consensus. The wealth shares of different groups do not respond much to the FFR shock, except for the super-rich (top 0.01%), who experience a decline in their wealth share. In contrast to the common wisdom, we do not find any clear evidence that expansionary monetary policy increases wealth inequality. Although one might jump to the conclusion that monetary policy is unlikely to explain the increase in wealth inequality presented in Figure 1, the wealth share responses to a shock to the other dimensions of monetary policy tell us a very different story.

As shown in the second and third rows in Figure 5, wealth inequality increases in response to unconventional monetary policy shocks. First, in response to the FG shock, every metric of wealth inequality increases statistically significantly. These responses are in sharp contrast to those related to the FFR shock and highlight different distributional consequences of unconventional monetary policies compared with conventional monetary policies. Our findings can explain why prior studies focusing on conventional monetary policy tend to find that expansionary monetary policy reduces wealth inequality (e.g., Doepke and Schneider, 2006; Meh et al., 2010; Hohberger et al., 2020), whereas recent studies including both conventional and unconventional monetary policy often found insignificant results (e.g., Bunn et al., 2018; Casiraghi et al., 2018; Lenza and Slacalek, 2018) or the opposite results (e.g., Domanski et al., 2016; Mumtaz and Theophilopoulou, 2020).

Second, the wealth shares of those at the far-right of wealth distribution increase significantly, suggesting quantitative easing indeed benefitted the super-rich, which is consistent with the claim by many commentators (e.g., Cohan, 2014; Wolf, 2014). However, the benefit of the QE is quite limited to a small group of households, as the top 10% and 50% wealth shares decrease persistently, suggesting that a single statistic like the Gini index often used in the literature can miss the entire distributional consequence of unconventional monetary policy. Such a divergence across different wealth percentiles is perhaps explained by different wealth compositions (e.g., holding of financial assets is disproportionately concentrated on the right tail of the distribution, while that of housing assets is relatively more evenly distributed). In Section IV, we review potential theoretical channels through which both conventional and unconventional monetary policies affect inequality and test their empirical relevance by employing a larger-scale VAR model with various empirical proxies.

Response of income inequality to each of identified monetary policy factors. To better understand the consequences of different dimensions of monetary policy factors on wealth distribution, we also plot the responses of income shares to the same kinds of shocks in Figure 6. A few interesting results stand out. Most importantly, the responses of income inequality metrics are not necessarily in the same sign as those of wealth inequality metrics. To the extent that the evolution of wealth can be proxied by the sum of current income and the valuation effect occurring on the existing wealth, our findings suggest that the valuation effect can move in a different direction from income accumulation, which requires an independent analysis.

Figure 6. The response of income share to each of the monetary policy factors



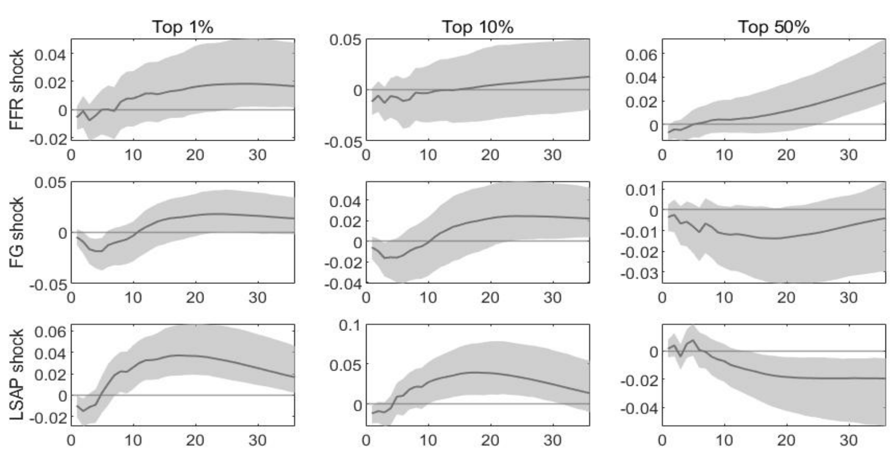
Note: This graph plots the 36-month-horizon impulse response functions of income inequality metrics to a one-unit shock to FFR factor (top), FG factor (middle), and LSAP factor (bottom). The shaded areas represent the bootstrap 90% confidence interval. The sample period is July 1991 to June 2019.

For example, the responses of income shares of the super-rich are quite opposite from their wealth share responses for the FFR shock. A possible explanation is that the interest rate-based monetary easing stimulates the real economy, which increases the business income of the super-rich. However, the same type of monetary easing does not have much of boosting effect on asset prices compared with unconventional monetary policy. Our empirical model in the next section aims to test this kind of hypothesis. While the income share responses to the FG shock are quite similar to the wealth share responses, the LSAP shock is followed by distinct income share responses compared with wealth share responses in Figure 5. This finding can be reconciled if quantitative easing has a negative effect on the interest income of the super-rich but has a positive effect on financial asset prices. For the top 50%, the responses of wealth and income shares are remarkably similar, consistent with the limited financial asset holdings of the middle class (Bach et al., 2020; Hubmer et al., 2021).

Response of labor income inequality to each of identified monetary policy factors. In a similar vein, we further investigate the response of labor income inequality metrics to the three kinds of monetary policy shocks. This exercise is particularly informative because one can learn the relative contribution of labor income vs. non-labor income in driving income and wealth inequality. One limitation of this exercise is that labor income shares are not available for the super-rich (beyond the top 0.1%) as in wealth or (total) income shares. However, to the extent that non-labor income contributes to the super-rich's income more than labor income, this limitation does not seem critical for our analysis.

As shown in Figure 7, the responses are, in general, consistent with those in Figure 6. The most notable exception is the top 50% share response to the FFR shock, which shows the opposite pattern. One way of interpreting this result is the role of transfer income, which is important only for the bottom 50%. We will investigate whether transfer income responds differently to the three monetary policy factors in the next section.

Figure 7. Response of labor income share to each of the monetary policy factors



Note: This graph plots the 36-month-horizon impulse response functions of labor income inequality metrics to a one-unit shock to FFR factor (top), FG factor (middle), and LSAP factor (bottom). The shaded areas represent the bootstrap 90% confidence interval. The sample period is July 1991 to June 2019.

Forecast error variance decomposition. In this section, we evaluate the contribution of different kinds of monetary policy shocks to the dynamics of inequality metrics by conducting a forecast error variance decomposition. Table 1 reports the share of error variance in the wealth and income shares explained by each type of monetary policy shock at the two forecasting horizons (12 and 36 months after the shock). Importantly, the share of the variation in both wealth and income shares explained by each of the three monetary policy factors is sharply different, further corroborating heterogeneity in the impulse response functions presented in Figures 5, 6, and 7. Several findings are worth attention

Table 1. Role of different monetary policy factors in inequality dynamics

		FFR		FG		LSAP	
		H=12	H=36	H=12	H=36	H=12	H=36
Wealth share	Top 0.01%	0.96%	5.35%	4.10%	15.30%	10.21%	20.39%
	Top 0.1%	0.32%	0.98%	3.04%	13.50%	8.83%	17.76%
	Top 1%	0.68%	0.55%	3.01%	10.68%	4.99%	9.60%
	Top 10%	0.19%	0.77%	8.58%	11.85%	0.21%	3.02%
	Top 50%	0.09%	2.65%	0.65%	0.91%	29.19%	28.23%
Income share	Top 0.01%	1.92%	8.76%	1.36%	5.49%	0.79%	0.88%
	Top 0.1%	3.34%	9.17%	0.97%	3.53%	1.59%	1.75%
	Top 1%	1.47%	3.20%	1.20%	5.02%	2.70%	4.24%
	Top 10%	0.03%	0.64%	0.86%	3.38%	1.74%	4.37%
	Top 50%	2.48%	5.73%	2.57%	2.44%	2.77%	15.30%
Labor income share	Top 1%	0.51%	3.12%	1.52%	3.24%	4.77%	12.20%
	Top 10%	0.36%	0.45%	0.69%	2.83%	2.39%	6.13%
	Top 50%	0.32%	4.81%	1.62%	1.73%	0.78%	3.96%

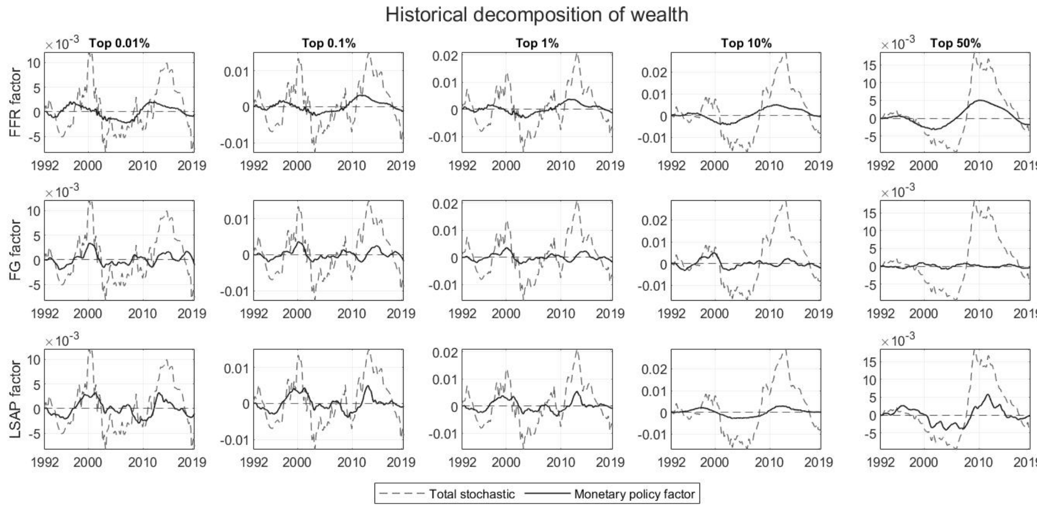
Note: The top, middle, and bottom panels of the table show the forecast error variance decomposition of the wealth, income, and labor income shares explained by three kinds of monetary policy factors over the two forecasting horizons. (H=12, and 36 months). The sample period is July 1991 to June 2019.

First, the importance of monetary policy in driving inequality dynamics is far from trivial and sometimes it can be a dominant driver. For example, the sum of the contribution by the three factors can be as large as 40% for the top 0.01% wealth share three years after the shock. Given the conservative ordering of monetary policy factors in the baseline VAR model (i.e., after accounting for output, unemployment, and prices), the quantitative importance of monetary policy shocks in inequality should not be neglected. Across different percentiles, the three monetary policy shocks together explain, on average, 28%, 15%, and 13% of inequality metrics in wealth, income, and labor income, respectively at the three-year horizon. Second, the contribution of unconventional monetary policy shocks (FG and LSAP) tends to be much larger than that of conventional monetary policy shocks (FFR) and this tendency is especially pronounced for wealth inequality. This pattern can be understood by the stronger asset price effect of unconventional monetary policy than conventional monetary policy (Swanson, 2021).

Third, medium-term contribution (three years after the shock) tends to be much bigger than short-term contribution (one year after the shock), which indicates a persistent effect of monetary policy on inequality. This pattern is the most visible for wealth inequality metrics and the distinct nature of wealth (i.e., stock variable) compared with income (i.e., flow variable) can explain it. Fourth, the importance of monetary policy shocks varies vastly across different percentiles. For example, while FG shocks explain 12% (less than 1%) of the variation in the top 10% (top 50%) wealth share, LSAP shocks explain only 3% for the top 10% and 28% for the top 50% wealth share, respectively.

Historical decomposition. We perform a historical decomposition of wealth inequality to determine how the role of different kinds of monetary policy shocks in explaining inequality dynamics evolves over time. The top panel in Figure 8 presents the historical decomposition of wealth share for each group. First of all, there are two distinct peaks of top wealth shares (the peak of the dot com bubble and the middle of the ZLB) during our sample period. For the super-rich, both types of unconventional monetary policy explain their dynamics very well, while the conventional monetary policy does not. Instead, the conventional monetary policy appears to explain the low-frequency dynamics of wealth inequality. Although the FG factor and LSAP factor share a similar historical role for the top 10% or above, this is not the case for the top 50% share, which requires further analysis. For completeness, we also plot the historical decomposition of income and labor income inequality in Figures A.2 and A.3 in the appendix.

Figure 8. Historical decomposition of wealth inequality



Note: This graph plots the historical decomposition of the wealth shares of different groups. Each column represents different wealth groups and each row represents the three different monetary policy factors.

B. Robustness checks

Alternative VAR specifications. We further checked the robustness of our findings by employing (i) the alternative ordering of the three monetary policy factors (ii) the generalized impulse response functions (IRFs) developed by Koop et al. (1996) that the responses are invariant to any reordering of the variables in the VAR system. For the former, we reverse the ordering among the three monetary policy factors (i.e., LSAP, FG, and FFR).[7] For the latter, the generalized IRFs do not impose orthogonality, allowing for meaningful interpretation of the initial impact response of each variable to shocks to any other variable

Figures A.3 and A.4 in the Appendix report the results that confirm that the ordering of the uncertainty variable is largely irrelevant to its distributional consequences. This is not surprising because our main focus is not the response of an aggregate variable, but rather the response of a disaggregated variable (i.e., inequality metric), which is less likely subject to the concern of reverse

[7] The literature has debated whether rising uncertainty is an exogenous driver of business cycles or an endogenous response to business cycles. Our benchmark identifying assumption corresponds to the latter, while the identifying assumption here corresponds to the former.

causality. Table A.1 in the appendix also confirms that the ordering among the three monetary policy factors is irrelevant in determining their importance in explaining inequality dynamics.

TBA

IV. Monetary Policy and Inequality: Exploring Channels

A. Theoretical channels

In this section, we lay out competing but not necessarily mutually exclusive channels through which monetary policy affects inequality. TBA

B. Test of competing theoretical channels

TBA

V. Conclusion

TBA

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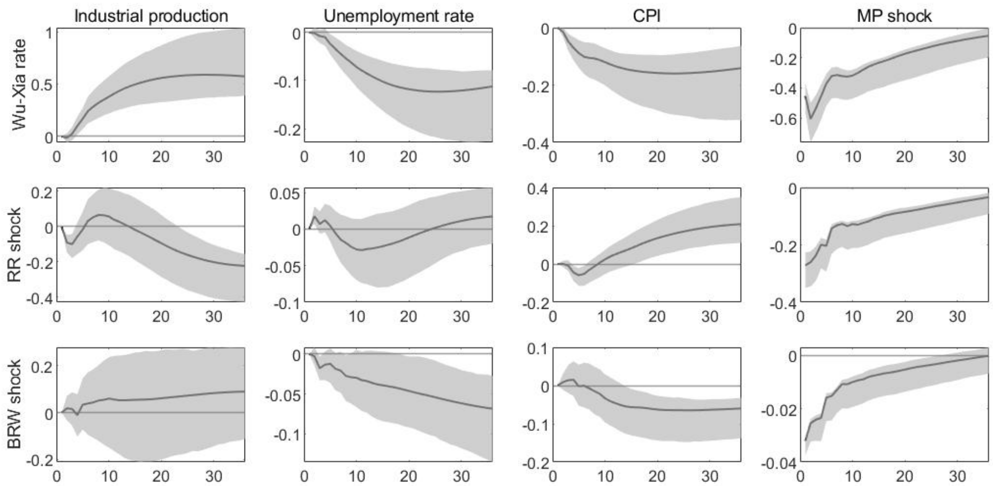
Online Appendix for "Impact of Uncertainty Shocks on Income and Wealth Inequality"

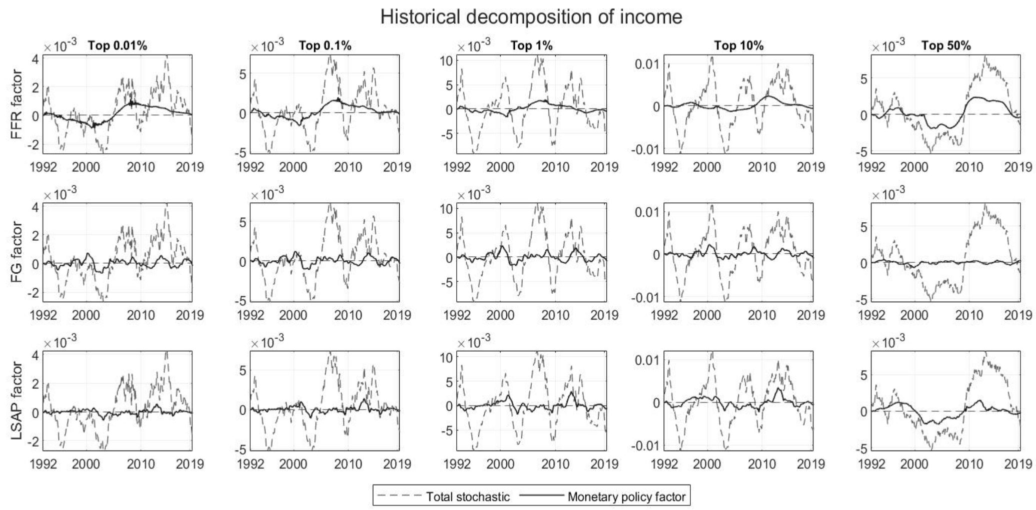
A. Additional results

Figure A.1. Response of aggregate variables to single-factor monetary policy shocks



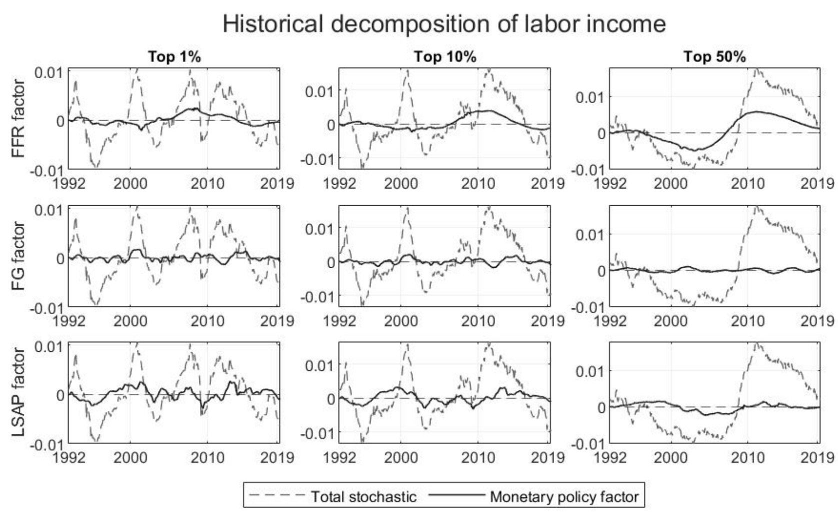
Note: This graph plots the 36-month-horizon impulse response functions of the aggregate variables to one standard deviation negative federal funds rate (with Wu-Xia rate) shock (top), cumulative RR shock (middle), and cumulative BRW shock (bottom). It is represented as a percentage scale. The wealth share of the top 10% is used as a measure of inequality, but the result is not presented in the figure. Each column represents the responses of different macroeconomic variables. The shaded area represents the bootstrap 90% confidence interval. The sample period is January 1976 to December 2019 (top), January 1976 to December 2007 (middle), and January 1994 to December 2019 (bottom) respectively.

Figure A.2. Historical decomposition of income inequality



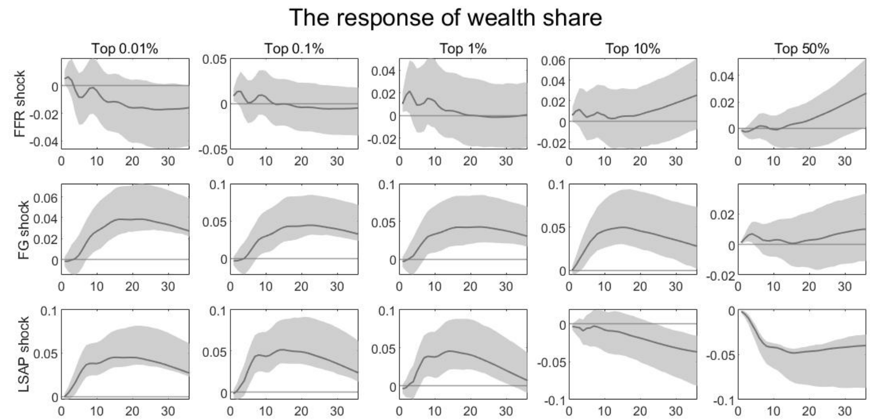
Note: This graph plots the historical decomposition of the income shares of different groups. Each column represents different income groups and each row represents the three different monetary policy factors.

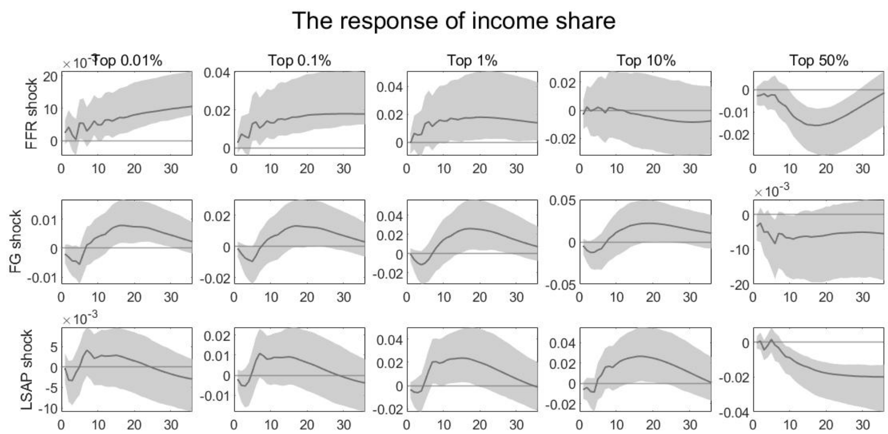
Figure A.3. Historical decomposition of labor income inequality

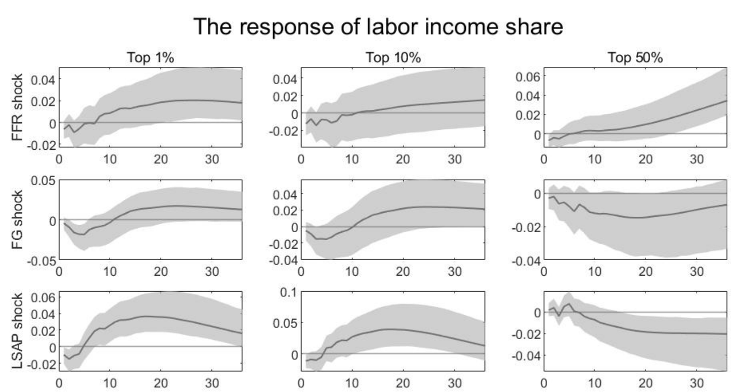


Note: This graph plots the historical decomposition of the labor income shares of different groups. Each column represents different labor income groups and each row represents the three different monetary policy factors.

Figure A.4. Robustness check: alternative ordering

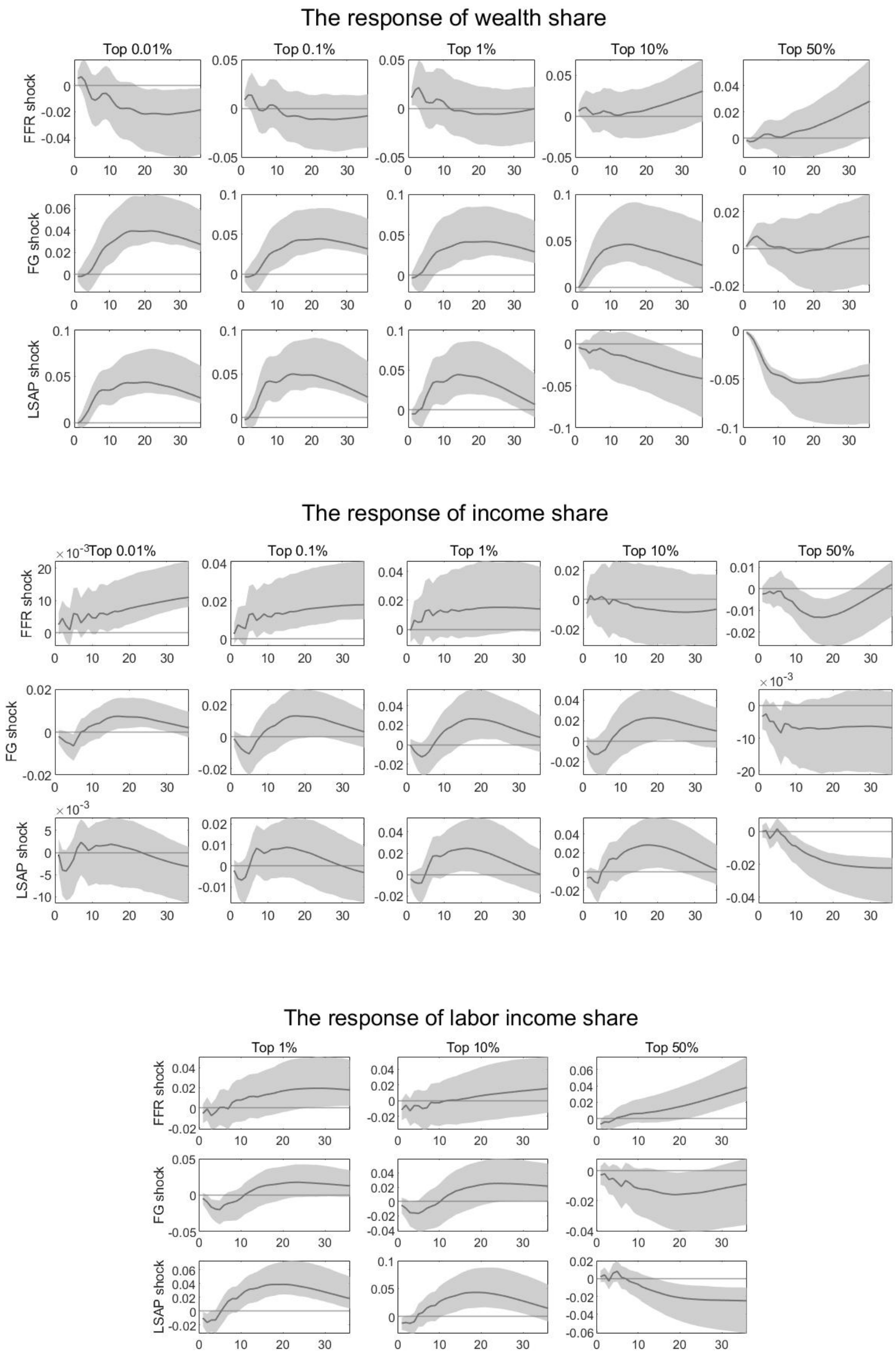






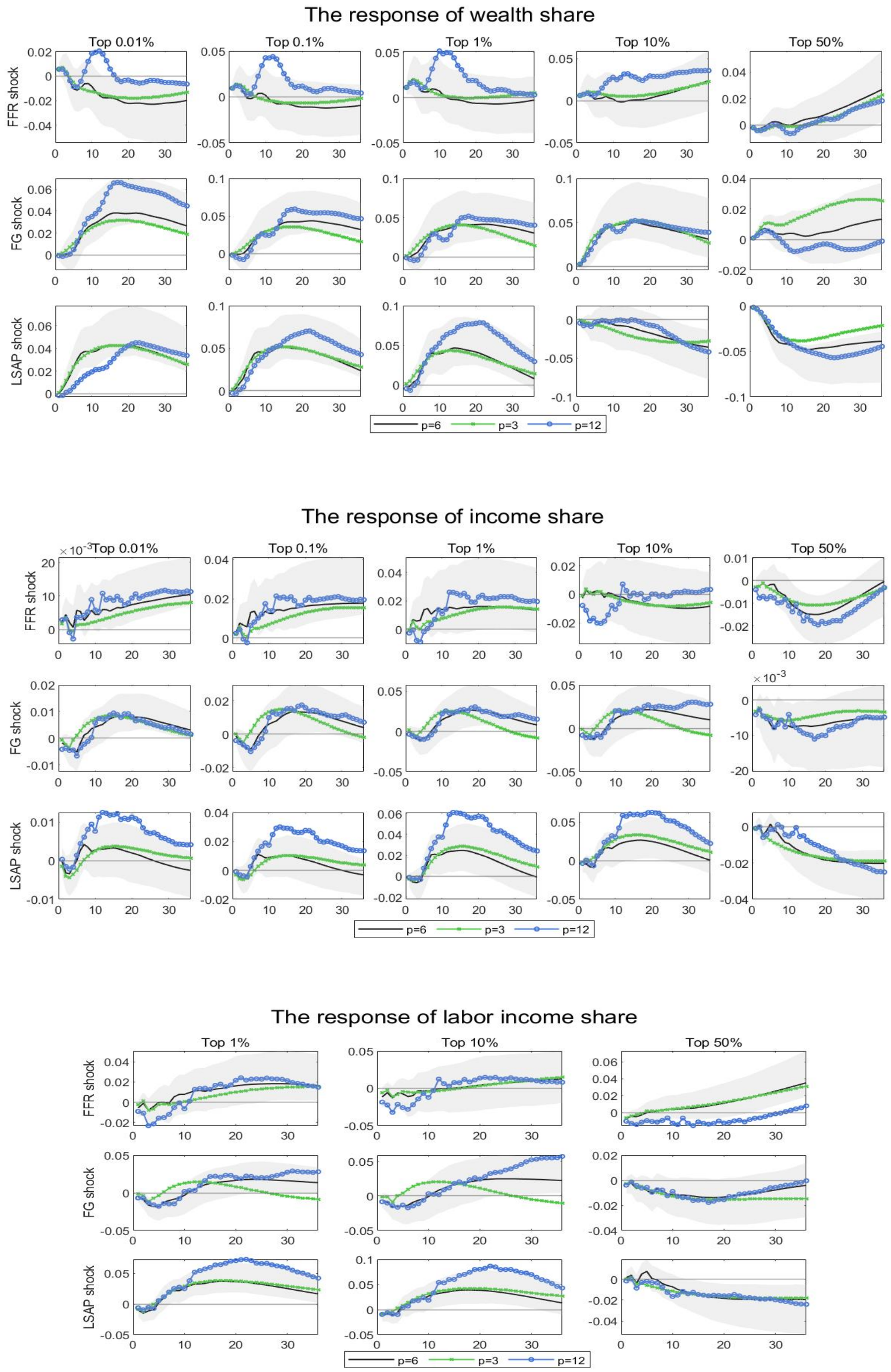
Note: This graph plots the 36-month-horizon impulse response functions of wealth inequality, income inequality, and labor income inequality to a one-unit shock to the FFR factor (top), FG factor (middle), and LSAP factor (bottom). The ordering among monetary policy factors is (i) LSAP factor, (ii) FG factor, and (iii) FFR factor. The shaded areas represent the bootstrap 90% confidence interval. The sample period is July 1991 to June 2019.

Figure A.5. Robustness check: generalized IRF



Note: This graph plots the 36-month-horizon impulse response functions of wealth inequality, income inequality, and labor income inequality to a one-unit shock to the FFR factor (top), FG factor (middle), and LSAP factor (bottom). The generalized IRFs are employed. The shaded areas represent the bootstrap 90% confidence interval. The sample period is July 1991 to June 2019.

Figure A.6. Robustness check: alternative lag length



Note: This graph plots the 36-month-horizon impulse response functions of wealth inequality, income inequality, and labor income inequality to a one-unit shock to the FFR factor (top), FG factor (middle), and LSAP factor (bottom). The graph plots the impulse response functions with 3, 6, and 12 lags. The shaded areas represent the bootstrap 90% confidence interval. The sample period is July 1991 to June 2019.

Table A.1. Role of different monetary policy factors in inequality dynamics: alternative ordering

		FFR		FG		LSAP	
		H=12	H=36	H=12	H=36	H=12	H=36
Wealth share	Top 0.01%	0.44%	2.88%	3.98%	15.57%	10.85%	22.59%
	Top 0.1%	0.44%	0.38%	3.08%	14.08%	8.68%	17.78%
	Top 1%	0.98%	0.56%	3.02%	11.14%	4.68%	9.11%
	Top 10%	0.35%	1.13%	8.33%	11.10%	0.30%	3.40%
	Top 50%	0.06%	2.49%	0.49%	0.53%	29.37%	28.78%
Income share	Top 0.01%	1.99%	9.45%	1.37%	4.88%	0.70%	0.80%
	Top 0.1%	3.46%	9.82%	1.01%	3.15%	1.44%	1.48%
	Top 1%	1.61%	3.74%	1.21%	4.86%	2.55%	3.86%
	Top 10%	0.02%	0.43%	0.87%	3.56%	1.73%	4.39%
	Top 50%	3.03%	6.82%	2.25%	2.04%	2.54%	14.61%
Labor income share	Top 1%	0.64%	3.93%	1.49%	2.97%	4.67%	11.66%
	Top 10%	0.41%	0.70%	0.63%	2.63%	2.40%	6.07%
	Top 50%	0.26%	4.28%	1.68%	2.10%	0.77%	4.11%

Note: The top, middle, and bottom panels of the table show the forecast error variance decomposition of the wealth, income, and labor income shares explained by three kinds of monetary policy factors over the two forecasting horizons. (H=12, and 36 months). The sample period is July 1991 to June 2019.

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