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The Effects of Unconventional Monetary Policy on Stock Markets and Household Incomes in Japan

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Abstract

In this study, we investigate the impact of monetary policy on Japanese household incomes using the *Family Income and Expenditure Survey*. Our analysis focuses on the savings and income structure of households, and covers the period from Q1 2007 to Q2 2021. We find that households in the highest income brackets have a higher proportion of their savings invested in stocks, while middle and lower income households hold a greater share of their savings in bank deposits. Our hypothesis is that the Bank of Japan's monetary policies have boosted stock markets in particular, leading to disproportionate benefits for high-income households through capital gains and dividends. Using local projections, we first identify a positive, lasting cumulative effect of both conventional and unconventional monetary expansion on Japanese stock markets. We then examine how stock market performance impacts household incomes, and find that the effect is strongest for high-income households, decreases for middle-income households, and disappears for lower-income households. Our results suggest that monetary policy may have contributed to the persistent growth in income inequality in Japan, as measured by metrics such as the Gini coefficient and top-to-bottom income ratios.

Keywords: monetary policy; inequality; Japan; household income.
JEL-Codes: D31; D63; E52.

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1 Introduction

Income inequality has garnered significant attention in recent years due to its potential impacts on economic and societal outcomes. Research has shown that higher levels of inequality can erode trust in institutions, hinder social mobility, exacerbate economic crises, and even contribute to the rise of populism (Rajan, 2010; Stiglitz, 2012; Perugini et al., 2016; O'Connor, 2017; Rodrik, 2018; Guiso et al., 2019; Schnabl and Müller, 2019). It can also negatively affect economic growth (Cingano, 2014) and stability (Ostry et al., 2014).

One country that has seen a notable shift in income and wealth distribution in recent decades is Japan. In 1980, Japan had the lowest levels of inequality among G7 countries, but has since risen to the second highest among G7 countries and the ninth highest among OECD countries (Komiya and Kihara, 2021). This increase in inequality has led to the erosion of the perception of a largely middle-class society in Japan (Aoyagi et al., 2015).

Our goal in this paper is to contribute to an explanation of this development. We focus on the distributional effects of monetary policy as one potential driver. While the distributional impact of fiscal policies on income inequality is well-established (Niehues, 2010; Bastagli et al., 2012; Muinelo-Gallo and Roca Sagalés, 2013; Woo et al., 2013), the relationship between monetary policy and inequality is less clear. Obtaining a better understanding of how monetary policies affect the distribution of income therefore requires more in-depth empirical research.

Our study makes several contributions to the existing literature on the relationship between monetary policy and income inequality. Firstly, we trace the effect of conventional and unconventional monetary policy measures on household income inequality through the portfolio channel by means of local projections. Secondly, using semi-aggregated household survey data, we provide a more nuanced understanding of the drivers of income inequality by examining the direct effects on different income brackets, rather than relying solely on summary statistics of inequality. This approach is similar to that used in recent studies of Denmark (Andersen et al., 2022) and Sweden (Amberg et al., 2022). Finally, our study covers a longer time period than previous research, including the Bank of Japan's large-scale asset purchases during the COVID-19 pandemic.

The following section provides an overview of previous studies on the link between monetary policy and income inequality with a special focus on Japan. We then present and describe our data in section 3 and our empirical model and estimation results in section 4. Section 5 concludes.

2 Previous research

Empirical studies on the relationship between monetary policy and inequality have yielded conflicting results. Some research suggests that expansionary monetary policy can reduce income inequality among households. For instance, Coibion et al. (2017) provide evidence of this for the US, Mumtaz and Theophilopoulou (2017) for the UK, and Furceri et al. (2018) for various countries. These studies argue that monetary expansion can decrease income inequality through the earnings heterogeneity channel and the job creation chan-

nel, as it helps to keep low-income workers employed or improves their ability to find new employment (Draghi, 2016).[1]

However, the overall effect of monetary expansion on income inequality is uncertain as higher-income households may disproportionately benefit from increased asset prices. This amplifying effect on inequality can occur through either the portfolio channel or the earnings heterogeneity channel, if high-income households hold a higher proportion of financial assets and therefore receive more capital income (Bernanke, 2015; Inui et al., 2017; Yoshino et al., 2020).

There is growing empirical evidence that Japan's income inequality, in particular, has increased in response to unconventional monetary policies. There are several potential explanations for this trend. Firstly, growth in wages and housing prices, which are often linked to lower levels of inequality, has been slower in Japan. Secondly, the interest rate was already close to zero when Japan implemented unconventional monetary policies in 2001, limiting the ability of these policies to stimulate investment and job creation through lower rates. Thirdly, Japan's lifetime employment practices result in generally low unemployment rates, diminishing the impact of the job creation channel of monetary policy. Finally, expansionary monetary policies may be less effective in an aging society with lower credit demand and higher risk aversion (Iman, 2013).

Saiki and Frost (2014) were the first to examine the impact of unconventional monetary policy on income distribution in Japan. Using data from the *Household Savings and Liabilities Survey*, which is part of the *Family Income and Expenditure Survey* (FIES), for the period from Q4 2008 to Q1 2014, the authors found that income inequality as measured by the ratio of the top 20% income share to the bottom 20% income share increased following the implementation of unconventional monetary policy measures by the Bank of Japan. The authors attributed this increase to the portfolio channel, as high-income households in Japan are more likely to hold a higher proportion of their savings in stocks, and therefore benefited more from the resulting increase in capital income.

Inui et al. (2017) investigate the distributional effects of monetary policy shocks on income inequality in Japan using quarterly time series of inequality measures from 1981 to 2008. The study is also based on micro-level household data from the *Family and Income Expenditure Survey* (FIES), specifically the *Household Income and Expenditure Survey*, which is another subset of the FIES. Inui et al. (2017) use the Gini coefficient and the ratio of the top 10% to the bottom 10% income shares as their preferred inequality measures. They find that, overall, monetary policy shocks do not have a stable and statistically significant impact on income inequality across a subset of Japanese households whose head is employed.[2] Only during the period between Q1 1981 and Q4

[1] Coibion et al. (2017), Nakajima (2015) and Inui et al. (2017) give an extensive overview of potential transmission channels through which monetary policy affects inequality. The four major channels are the earnings heterogeneity channel, the job creation channel, the portfolio channel and the savings redistribution channel.

[2] As Saiki and Frost (2014) indicate, the subset of the FIES that Inui et al. (2017) use covers a longer time period and has a higher frequency, but only includes households where the head of the household is employed and therefore excludes self-employed, company owners, property owners, unemployed, most agricultural workers, etc. It thus only represents about 50% of Japanese households. In contrast, the *Savings and Liabilities Survey* of the FIES - the dataset that Saiki and Frost (2014) and we use - covers almost all of the representative households in Japan.

1998 they find that expansionary monetary policy shocks increase income inequality among these households. They suggest that this effect occurs through the earnings heterogeneity channel, as there is a procyclical response of earnings inequality following monetary policy shocks.

El Herradi and Leroy (2020) examine the impact of monetary policy on top income earners in 12 advanced economies, including Japan, over the period from 1920 to 2015. They use local projections to analyze the dynamic responses of the top 1% of income earners' pre-tax national income share to an exogenous shock in the short-term interest rate. Their findings suggest that expansionary monetary policy significantly increases the share of national income held by the top 1%, likely due to the stimulation of returns on real and financial assets through the portfolio channel.

Israel and Latsos (2020) use the *Japan Household Panel Survey* from 2003 to 2014 to examine the impact of unconventional monetary policy on income inequality. They find that expansionary monetary policies had a narrowing effect on the gender pay gap and a widening effect on the education pay gap, possibly through the aggregate demand and labor productivity channels. However, monetary policy had no significant effect on the age pay gap in Japan.

Taghizadeh-Hesary et al. (2020) study the effect of Japan's zero and negative interest rate policy, combined with its tax policy, on income inequality between 2002 and 2017. They find that the increase in the money stock through quantitative and qualitative easing significantly increased income inequality. While tax policies implemented by the Japanese government were able to mitigate this effect, unconventional monetary policies still contributed to a net increase in inequality, as measured by the ratio of the top 10% to the bottom 10% income shares.The authors also observe that the top 20% of income earners in Japan held five times as much securities (stocks and bonds) in their savings portfolios as the second highest quintile (60-80%), suggesting that the earnings heterogeneity and portfolio channels may be particularly relevant in this case, and that an overproportionate stimulation of capital income may be driving the increase in income inequality.

Israel et al. (2022) examine the impact of Japanese monetary policy on household saving patterns over the period from 1993 to 2017. Using data from the *Japanese Panel of Consumers*, they find that monetary expansion contributed to a widening gap in the ability to save for households with different levels of education. Specifically, the volume of saving for non-academic households decreased, while academic households were able to increase their saving despite the negative effects of monetary expansion. As saving is a key factor in building wealth over time, these developments likely contributed to an increase in wealth inequality, which can in turn have feedback effects on income inequality through the structure of households' savings portfolios.

Feldkircher and Kakamu (2022) present evidence that contradicts the findings of other studies on the impact of monetary policy on income inequality in Japan. Using grouped income data to estimate the Gini coefficient, they found that monetary tightening led to an increase in income inequality among households whose head was employed. This was likely due to the financial channel and job destruction channel, as tighter financing conditions and increased unemployment disproportionately impacted poorer households. However, it is worth noting that this study relied on highly aggregated data, estimating the Gini coefficient from income deciles provided in the same unrepresentative sub-

set of the FIES that Inui et al. (2017) use. More recent studies of Denmark and Sweden have demonstrated the benefits of using micro-level data to provide a more detailed analysis of the effects of monetary policy on household income.

Andersen et al. (2022) conduct a study on the impact of monetary policy on income inequality in Denmark using individual-level tax records from 1987 to 2014. They find that higher income households disproportionately benefited from expansionary monetary policy, likely due to their greater exposure to non-labor income channels such as the portfolio channel and the debt channel. They conclude that the different drivers of income had a negative overall effect on the income distribution and that extensive monetary easing increased income inequality in Denmark.

Amberg et al. (2022) use administrative micro-data for every legal resident in Sweden from 1999 to 2018 to examine the impact of monetary policy on the income distribution. They find that expansionary monetary policy has a U-shaped effect on income shares along the distribution, with low-income and high-income households experiencing rising incomes in response to a monetary policy shock, while middle-class incomes remain stagnant. The authors attribute this to the job creation channel benefiting low-income households and the portfolio channel benefiting high-income earners. They also note that the trend in income inequality is similar among advanced industrial countries, suggesting external validity for their findings. The fact that expansionary monetary policy tends to benefit both low- and high-income households while harming middle-class incomes (at least in relative terms) may have significant implications for the stability of democratic societies and the continuation of market economies, as highlighted by Schnabl and Müller (2019), especially in a traditionally middle-class driven economy like Japan.

Continuing in the vein of Andersen et al. (2022) and Amberg et al. (2022), we aim to further contribute to the ongoing debate on the relationship between monetary policy and income inequality in Japan.

3 Data Description

To examine the impact of monetary policy on income inequality in Japan, two sets of empirical data are used. The first set includes indicators of the monetary policy stance of the Bank of Japan (BoJ) and various macroeconomic aggregates, which are obtained from multiple data sources. The second set consists of data from the *Family Income and Expenditure Survey* (FIES), which covers various aspects of household finances. Both sets of variables will be discussed in the following sections.

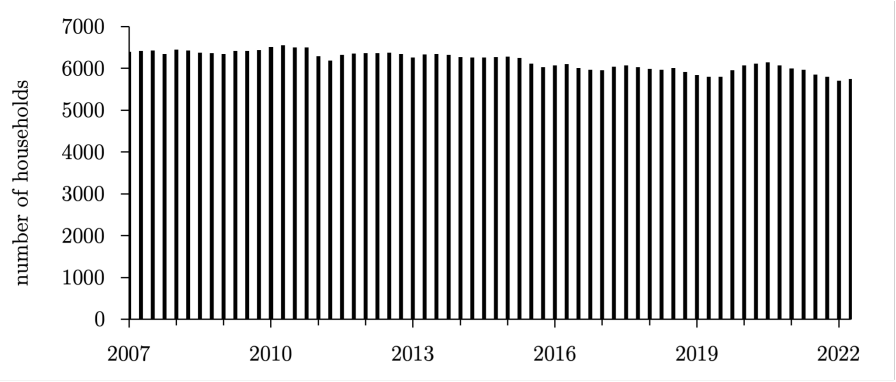
3.1 Household income and savings portfolios

The *Family Income and Expenditure Survey* (FIES)[3] provides comprehensive information about the income distribution and savings portfolios of Japanese households. The survey has been conducted annually by the Statistical Bureau of the Ministry of Internal Affairs and Communication of Japan since 1958,

[3]For information on the FIES see `https://www.stat.go.jp/english/data/kakei/index.html`.

and quarterly data on the income distribution and savings portfolios has been published online since 2007.

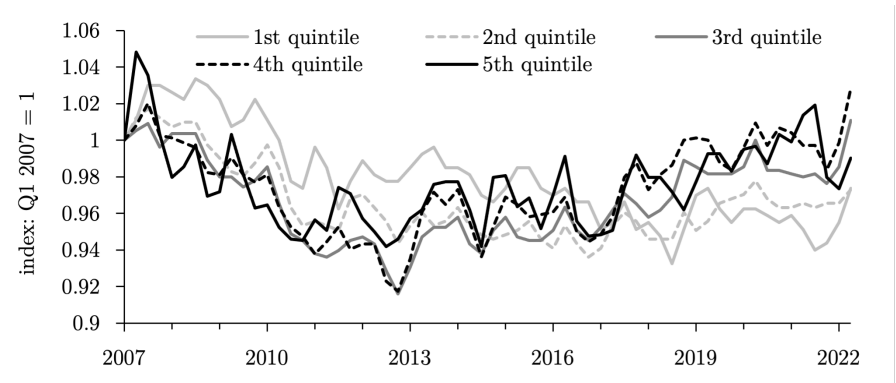
Figure 1
Number of households in the survey



Source: *Family Income and Expenditure Survey* (FIES).

The statistical units surveyed are households with two or more persons. The average sample size is 6,186 households, selected using a three-stage stratified sampling method across the entire area of Japan. The sample is refreshed monthly, with 1/6 of the households replaced each month. The survey has a maximum sample size of 6,517 households (in 2010) and a minimum of 5,724 (in 2022). The evolution of the number of households in the survey is illustrated in Figure 1.

Figure 2
Evolution of income shares by quintiles



Source: *Family Income and Expenditure Survey* (FIES).

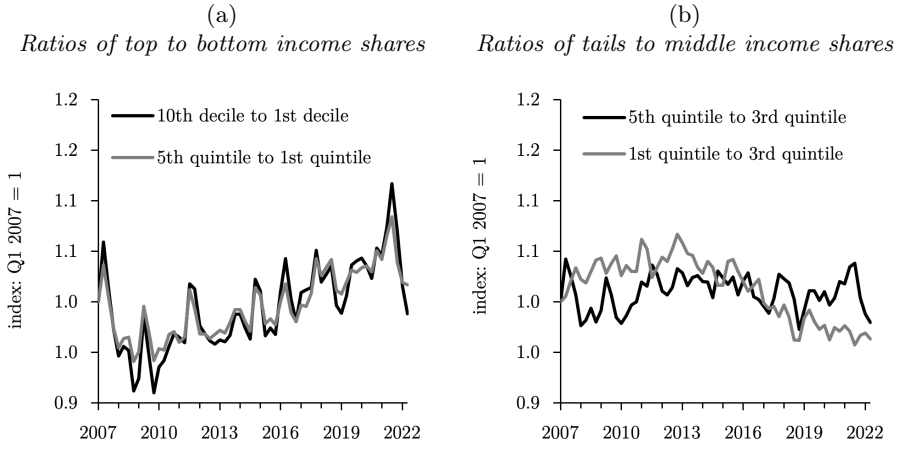
The income variable represents gross average annual household income.[4] Figure 2 shows the development of income shares by quintiles. In Q2 2022, households belonging to the lower half of the income distribution are worse

[4]Income sources included are regular income from employment and bonuses, pensions, other annual income.

off than in the beginning of the sample (see also Figure 11 in the appendix for the income shares by deciles). The upper half of the income distribution also suffered losses in the aftermath of the Great Financial Crisis. However, their incomes increased again since 2010. This rise coincides with the BoJ's re-implementation of large-scale purchases of Japanese government bonds (JGBs) (Taghizadeh-Hesary et al. (2020)).

The income development of different brackets of the income distribution has been heterogeneous over time. While the upper end of the distribution has experienced income gains, the middle class and lower end have either stagnated or experienced declines. To further understand these developments, we will present various measures of income inequality.

Figure 3
Indicators of household income inequality



Source: *Family Income and Expenditure Survey* (FIES).

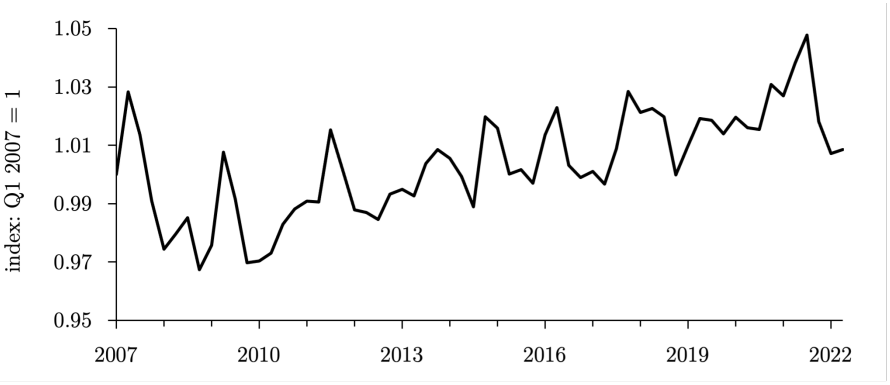
We first compare the development of the tails of the distribution relative to one another (top and bottom) and then look at the development of the tails relative to the center of the distribution. The highest income brackets (top 10% and top 20%) have diverged from the lowest income brackets (bottom 10% and bottom 20%) over the sample period (Figure 3a). The ratio of the top 10% (20%) to the bottom 10% (20%) of the income distribution has increased by 11.6% (8.4%) until Q3 2021, but decreased by 12.8% (6.7%) between Q3 2021 and Q2 2022.[5] However, the BoJ's purchases of exchange-traded funds (ETFs) and Japan Real Estate Investment Trusts (J-REITs) as part of their unconventional monetary policy (Harada and Okimoto 2021) from Q1 2010 until Q3 2021 coincides with a rise in the ratios of 18% (top 10% to bottom 10%) and 13% (top 20% to bottom 20%), respectively. As of Q2 2022, the two inequality indicators are 5.2% (top 10% to bottom 10%) and 6.3% (top 20% to bottom 20%) higher than in Q1 2010.

The opposite trend can be seen when examining the bottom of the income distribution in relation to the center of the distribution (Figure 3b). Over the

[5]This coincides with a sharp fall in GDP starting in Q2 2021. Between Q2 2021 and Q1 2022 nominal (real) GDP fell by 5.9 (6.3) percentage points. Since Q1 2022 nominal (real) GDP has risen by 1 (0.6) percentage points. See Figure 5.

entire sample period, the income share of the bottom quintile relative to the middle quintile decreased by 3.7%, and has decreased by 6.3% since 2010. In contrast, the top 20% of the income distribution has seen a slightly increasing trend in relation to the center (Figure 3b). From Q1 2007 to Q2 2022, the ratio between the top quintile and the middle quintile rose by 1.6%.

Figure 4
Gini coefficient of household incomes



Source: *Family Income and Expenditure Survey* (FIES).

The Gini coefficient is another measure of income inequality that provides a summary statistic over the entire income distribution, rather than just a comparison of the top and bottom.[6] Figure 4 shows the Gini coefficient for annual household income. The trend is similar to the ratio of the top and bottom of the distribution shown in Figure 3. The Gini coefficient decreased from 2007 to 2010, and then steadily increased for the rest of the sample period. Like the other inequality indicators, the Gini coefficient decreased by 3.9% between Q3 2021 and Q2 2022. It is interesting to note that this trend is similar to the trajectory of balance sheet positions reflecting the Bank of Japan's monetary stimulus programs (shown in Table 1 and Figure 12 in the appendix).

Examining the savings portfolios of Japanese households based on their income levels reveals a high degree of heterogeneity. Our data suggest three key characteristics of these portfolios across the income distribution.

First, the percentage of savings invested in securities tends to increase with household income. For example, the highest income group holds 16.9% of their savings in securities (median over time), while the lowest income decile holds only 8.7% (see Figure 13 in the appendix).[7]

Second, higher-income households are more likely to invest a larger proportion of their savings in stocks and shares. The the highest-income decile allocates 12.5% of their savings to stocks and shares, while the lowest-income households invest only 5.4% (see Figure 14 in the appendix).

Third, the percentage of savings held in deposits tends to decrease with rising income. Demand deposits are the most common type of deposit in households' savings portfolios, followed by time deposits. The lowest income group holds

[6] We have calculated the Gini coefficient from income deciles provided in the survey.

[7] T-tests show that the securities-savings ratio is statistically different for the highest and lowest two income deciles compared to all other income deciles.

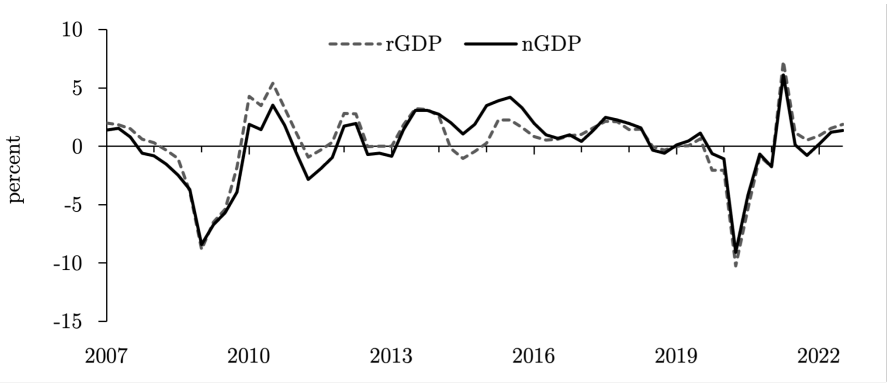
71.9% of their savings in deposits, while the highest income group holds only 58% (see Figure 15 in the appendix). Overall, as income increases, households are less likely to allocate a large proportion of their savings to deposits.

Based on these findings, we can conclude that a monetary policy that boosts stock prices through large-scale asset purchases is likely to generate capital gains, particularly for higher-income households. This is because these households tend to have a larger share of their savings invested in stocks, while lower-income households are less invested in stocks and hold a greater proportion of their savings in non-interest-bearing deposits.

3.2 Macroeconomic and monetary environment

Since the burst of the Japanese asset price bubble in 1991, the Japanese economy has faced numerous challenges and recessions. In response to the Asian financial crisis in 1998, the Bank of Japan (BoJ) gradually lowered the deposit facility rate towards zero (Q4 1999) and as the first central bank in the world implemented unconventional monetary policies in 2001. After the Great Financial Crisis, the Japanese economy contracted by 8.3% year-on-year in real terms in early 2009 (see Figure 5). To address this, the BoJ launched its second unconventional monetary policy program, which involved outright purchases of corporate bonds and commercial papers (Saiki and Frost 2014). From Q1 2009 to Q4 2012, the BoJ's holdings of commercial papers and corporate bonds increased from 1.6 trillion yen to 4.9 trillion yen, with an average quarterly increase of 331 billion yen. In Q4 2010, the BoJ also began buying exchange-traded funds (ETFs) and Japan Real Estate Investment Trusts (J-REITs). The corresponding balance sheet position increased from 16.4 billion yen to 1.6 trillion yen in Q4 2012. Japanese Government Bond holdings more than doubled from 4.3 trillion yen in Q1 2009 to 8.9 trillion yen in Q4 2012 (see Figure 12 in the appendix).

Figure 5
Economic growth in Japan



Source: OECD.

In 2013, the BoJ announced its goal to achieve a 2% price inflation target. However, inflation remained subdued, averaging about 0.6% per year for both the GDP deflator and the consumer price index from Q1 2013 to Q4 2021 (see Figure 16 in the appendix). To reach its target, the BoJ implemented

expansionary monetary policy measures such as Quantitative and Qualitative Easing,[8] and introduced negative interest rates[9] and yield curve control[10] in 2016. From 2013 to Q2 2022, the BoJ's total assets increased significantly, rising from 164.8 trillion yen to 732 trillion yen, an increase of almost 5.5 times (see Figure 12 in the appendix).

Table 1
Assets held by the Bank of Japan

Assets (in billion yen)	**2007 Q1**	**% of GDP**	**2022 Q2**	**% of GDP**
Gold	441.20	0.08	441.20	0.08
Cash	199.80	0.04	342.60	0.06
Japanese Government Securities	76,445.70	14.11	542,452.70	98.87
Financing Bills, Treasury Bills and Treasury Discount Bills	27,206.50	5.02	14,226.00	2.59
Japanese Government Bonds	49,239.20	9.09	528,226.60	96.28
Corporate Bonds			8,482.50	1.55
Commercial paper			2,704.10	0.49
ETFs			36,811.10	6.71
J-REITs			657.60	0.12
Loans and Discounts	23,187.70	4.28	131,238.50	23.92
Foreign currency assets	5,419.40	1.00	8,425.80	1.54
Others	716.30	0.13	729.50	0.13
Total	112,740.90	20.81	732,730.60	133.56

Source: Bank of Japan.

The expansion of the Bank of Japan's (BoJ) balance sheet is most evident in its holdings of Japanese Government Bonds (JGBs), loans and discounts, and exchange-traded funds (ETFs) (Table 1). The BoJ's JGB holdings have increased to 96.3% of GDP, or 528.2 trillion yen, while its loans and discounts now account for 23.9% of GDP. The BoJ's ETF position is valued at 36.8 tril-

[8]The quantitative dimension refers to the expansion of the monetary base. The qualitative dimension refers mainly to the guidelines for asset purchases such as JGBs, ETFs and J-REITs. In September 2016, the BoJ announced to purchase ETFs and J-REITs "so that their amount outstanding will increase at annual paces of about 6 trillion yen and about 90 billion yen, respectively" (BoJ 2016).

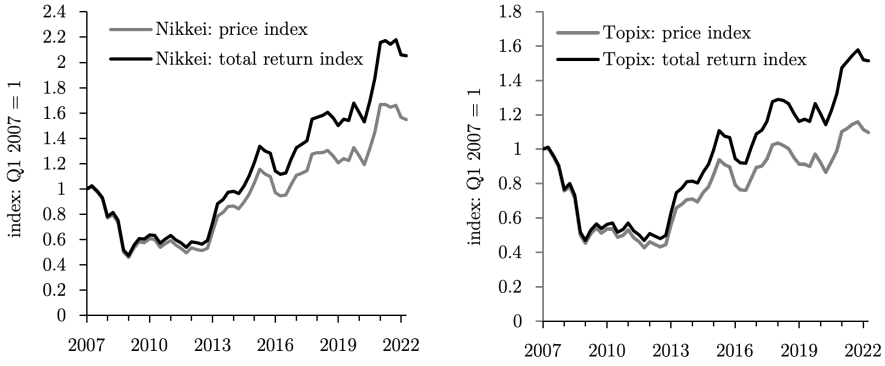
[9]The negative interest rate policy was implemented through a three-tier system. Tier 1: The Basic Balance (interest rate: 0.1%) corresponds to the average of all commercial banks' deposits at the Bank of Japan in 2015 minus the minimum reserves. Tier 2: The Macro Add-on Balance (interest rate: 0.0%) corresponds to the minimum reserves plus deposits at the Bank of Japan associated with Bank of Japan lending programs. Tier 3: The Policy Rate Balance (interest rate: -0.1%) corresponds to all commercial bank deposits in excess of the other two items. In the case of increasing deposits beyond levels 1 and 2, the Bank of Japan may apply a multiplier to avoid too large an increase. The share of negative-rate deposits in total commercial bank deposits at the Bank of Japan is currently only about 5% (Schnabl and Sepp 2022).

[10]To control the yield curve, the BoJ announced to purchase JGBs at "an annual pace of increase in the amount outstanding of its JGB holdings at about 80 trillion yen" so that the 10-year JGB yields remain around 0% (BoJ 2016).

lion yen, making it the single largest shareholder of the Japanese stock market (Komiya and Kihara 2021). In fact, the BoJ's ETF holdings make up a significant portion of the Japanese ETF market, at around 80%, and around 8% of the entire Japanese stock market (Harada 2021). The BoJ's share of JGBs has even surpassed 50% of the total JGBs (Nikkei Asia 2022). In July 2022, the BoJ announced that it would intensify its approach to yield curve control by "purchasing 10-year JGBs at 0.25% every business day through fixed-rate purchase operations" in order to implement the third tier of its negative interest rate policy (a policy rate balance of -0.1%) and to keep 10-year JGB yields around 0% (BoJ 2022). This policy has resulted in a drying up of the 10-year JGB market as the BoJ is offering higher prices than any market participant is willing to pay. In October 2022, there were four consecutive days where no JGBs were traded (Fujikawa 2022).

The most important stock market indices in Japan are the Topix and the Nikkei (Figure 6). These indices do not fully reflect the economic conditions described above. During the Great Financial Crisis, the indices fell, then stagnated until 2013, when the BoJ ramped up its asset purchase programs. During the COVID-19 pandemic, the indices fell from Q4 2019 to Q2 2020, but then rose sharply again as the BoJ increased its asset purchases to counter the impact of the crisis. In Q2 2022, the Nikkei total return index stood 110% above its value in Q1 2007. In contrast, the Topix only increased by 51%.[11] While the real economy and aggregate incomes have remained stagnant, the stock market has seen significant growth in comparison. Harada and Okimoto (2021) studied the effect of the BoJ's ETF purchases on the stock market and found that the cumulative effect of large-scale ETF purchases on the Nikkei 225 was around 20% of the index value as of October 2017.

Figure 6
Japanese stock price indices



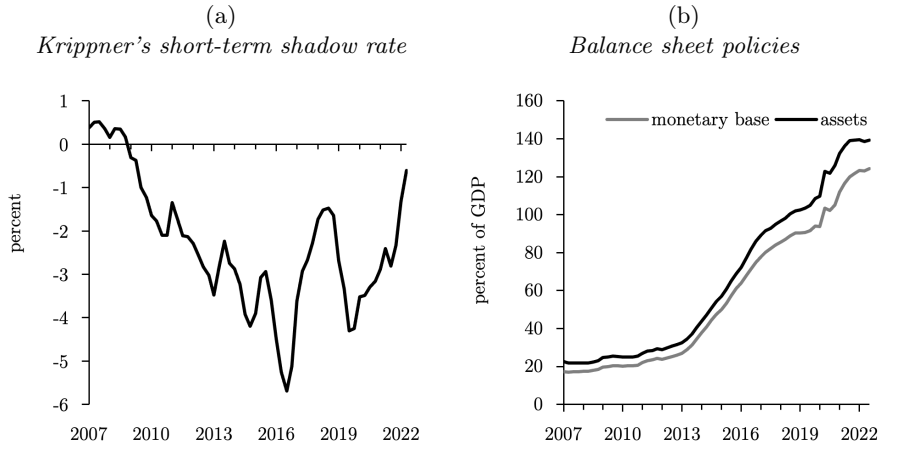
Source: Refinitiv, Nikkei, Tokyo Stock Exchange.

The Krippner short-term shadow rate of interest is a useful summary statistic that incorporates both conventional and unconventional monetary policy measures of the BoJ (Figure 7). Krippner (2020) translates the influence of asset purchases on the yield curve into changes in the short-term interest rate.

[11]The Nikkei includes the biggest 225 Japanese companies, while the Topix measures the performance of more than 2000 Japanese companies.

This is particularly useful because the overnight rate is often constrained by the zero lower bound, making it difficult to compare the effects of unconventional monetary policy measures with those of classical interest rate cuts. In 2016, the BoJ used its balance sheet expansion to lower the short-term shadow rate to almost -6%.

Figure 7
Monetary policy indicators



Source: Bank of Japan, Krippner.

The monetary policy measures implemented by the BoJ in recent years may have contributed to the disconnect between the stock market and the real economy. These measures may also have had negative impacts on income inequality due to the heterogeneous nature of savings portfolios among different income groups. In the following section, we will examine the extent to which BoJ monetary policy has affected both the stock market and various income brackets within the income distribution.

4 Empirical Model

In this study, we use local projections (Jordá, 2005) to estimate three pass-through equations. The first equation examines the cumulative effect of changes in the short-term shadow rate on the Nikkei and Topix stock market indices. The second equation investigates the impact of an increase in these stock indices on household incomes. The third equation estimates the direct effect of changes in the short-term shadow rate on household incomes. To assess the distributional impact on household incomes, these pass-through equations are applied to all income quintiles.

We expect unconventional monetary policy measures, such as large-scale asset purchases of Japanese government bonds and exchange-traded funds, to increase household capital income through the portfolio channel. However, drawing on the findings from Section 3.1, which highlights the significant differences in the portfolio structures of Japanese households across different income groups, we anticipate that the impact will vary based on the amount of stocks held in

household savings portfolios and their corresponding position in the income distribution.

Unlike other studies (e.g., Inui et al., 2017; Andersen et al., 2022; Amberg et al., 2022), we do not explicitly identify exogenous monetary policy shocks in our pass-through estimates. Therefore, our results should be interpreted as dynamic correlations between the variables studied and cannot be considered as cause-and-effect relationships in isolation. We suspect that persistent monetary expansion, whether expected or unexpected, may lead to changes in households' saving habits and portfolio structures over time. Some households may be better able to make the necessary adjustments than others (Israel and Latsos, 2020; Israel et al., 2022). In this way, monetary expansion may have structural effects on the distribution of income and wealth, even when correctly anticipated, that is, even without any monetary policy shocks.[12]

Moreover, identifying monetary policy shocks in Japan is particularly challenging. For example, Andersen et al. (2022) rely on an identification strategy based on Denmark's fixed exchange rate system, arguing that the monetary policy conducted by the European Central Bank (ECB) is exogenous to Denmark's inflationary dynamics and economic activity. However, this exogeneity depends on the divergence of business cycles and inflationary dynamics in the euro area and Denmark.

Amberg et al. (2022) use high-frequency data and a "poor man's sign restriction" approach (Jarocisnki and Karadi, 2020) to identify monetary policy shocks. This approach is based on a surprise series and an inverse relationship between stock market movements and interest rate shocks. If the movement is inverse, it is assumed to be related to a change in monetary policy that differs from previous expectations. The monetary surprise is then regressed on the actual change in the repurchase rate, and the resulting monetary shock series is equal to the fitted values of this regression. However, Amberg et al.'s (2022) income data is only available at an annual frequency, requiring them to transform the identified monetary policy shocks to the same frequency. While similar aggregation methods have been used in the literature (e.g., Gertler and Karadi, 2015; Hanson and Stein, 2015), the underlying process is complex and the weighting scheme can be somewhat arbitrary.[13]

Since the yen has a floating exchange rate and the Bank of Japan's monetary policy is primarily focused on responding to domestic inflationary dynamics and economic activity, we cannot assume exogeneity and replicate the approach used by Andersen et al. (2022). Furthermore, our data on household income is only available at a quarterly frequency, so aggregating high-frequency monetary shocks would introduce the aforementioned issues present in Amberg et al. (2022). Therefore, we adopt a different approach and estimate the pass-through equations via local projections without identification of monetary policy shocks.

[12] This is connected to the idea of asymmetric monetary policies, where monetary policy is eased over-proportionately during downturns and only hesitantly tightened during upswings (Schnabl 2011).

[13] It is unclear whether shocks that occur at the beginning of the year have a different impact on annual income than shocks that occur later in the year. Amberg et al. (2022) simply sum the high-frequency shocks, implying that they believe the effect of shocks on annual household income is the same regardless of when they occur within the year.

4.1 Pass-through estimates via local projections

The first equation examines the relationship between our measure of monetary expansion, the short-term shadow rate (ssr_t), and the Japanese stock market (s_t). The ssr_t is reported at a daily frequency and converted to a quarterly frequency by taking the unweighted average over the period of the corresponding quarter. The equation is controlled for gross domestic product (GDP_t) to account for overall economic activity. The stock market and GDP variables are transformed using the natural logarithm, so the first differences approximate quarterly growth rates. The ssr_t is used in its raw level, so the associated coefficient can be interpreted as a semi-elasticity.[14] Local projections are estimated for nine forecasting horizons ($h \in [|0, 8|]$), allowing us to estimate the cumulative dynamic effect up to two years after the initial direct effect.

$$(s_{t+h} - s_{t-1}) = \alpha + \beta_1 ssr_t + \beta_2 (GDP_t - GDP_{t-1}) + \epsilon_{t+h} \quad \text{for} \quad h = 0, \ldots, 8 \quad (1)$$

The Nikkei index is initially used to measure the stock market, but the analysis is replicated using the Topix index as an alternative measure of the overall performance of the Japanese stock market.

In the second step, we estimate the cumulative impact of a change in the stock market index on Japanese households' income. Unlike in the first equation, we use annual growth rates rather than quarterly growth rates to account for the fact that it takes time for changes in the stock market to affect household income.[15] A model based on quarterly growth rates is presented in the appendix (Table 6). It becomes apparent that significant effects only arise after one year, highlighting the importance of the time lag in the manifestation of capital gains in actual household income.

$$\begin{aligned}(y_{i,t+h} - y_{i,t-4}) = \alpha_i + \sum_{j=0}^{3} [\beta_{j+1,i}(s_{t-j} - s_{t-4-j}) + \beta_{j+5,i}(GDP_{t-j} - GDP_{t-4-j})] \\ + \epsilon_{t+h} \quad \text{for } i = 1, \ldots, 5 \text{ and } h = 0, \ldots, 4\end{aligned} \quad (2)$$

Household incomes are denoted as ($y_{i,t}$), where i corresponds to the position in the income distribution. In this case where we consider the quintiles of the distribution, i runs from 1 to 5. The stock market is denoted by (s_t). Equation 2 also includes the gross domestic product (GDP_t) to control for the general level of economic activity. We use local projections to estimate the cumulative effect for up to 2 years after the initial state of the stock market ($h \in [|0 : 4|]$) for all income quintiles. The left-hand side of the equation is given in absolute income levels, hence it corresponds to the absolute income gain from the base period to the forecast horizon. The variables on the right-hand side are transformed by applying the natural logarithm and then differences to the previous year's quarter are calculated to approximate annual growth rates.

[14] Effect on the dependent variable of a one-percentage point decrease of the independent variable.

[15] Although dividends are typically realized on a regular basis, the realization of capital gains depends on household transactions and can take more time. Additionally, a company's dividend policy may change over time.

These two-step pass-through estimations reflect our rationale for a transmission mechanism from monetary expansion over the stock market to the incomes of households.

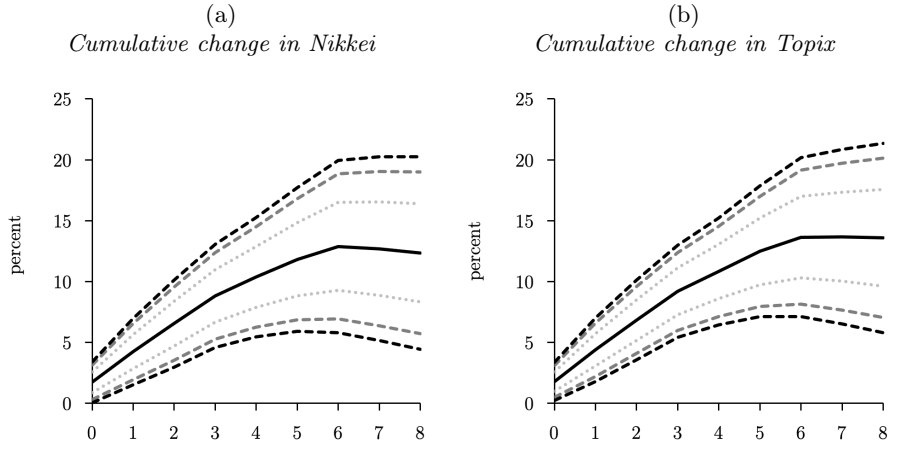
$$(y_{i,t+h} - y_{i,t-1}) = \alpha_i + \beta_{1,i} ssr_t + \beta_{2,i}(GDP_t - GDP_{t-1}) + \epsilon_{t+h} \quad \text{for } i = 1, \ldots, 5 \text{ and } h = 0, \ldots, 8 \tag{3}$$

Equation 3 directly estimates the cumulative effect of a change in the short-term shadow rate ($ssrt$) on household income ($y_{i,t}$). Again, the equation includes the gross domestic product (GDP_t) to control for the aggregate level of economic activity. The left-hand side is equal to the absolute income gain between the base period and the forecast horizon. GDP is transformed to quarterly growth rates by applying the natural logarithm and calculating the difference to the first lagged value (one quarter back in time). The ssr_t is added in levels, thus the related coefficient can be interpreted as a semi-elasticity. As in the first step, the local projections are estimated for nine periods ($h \in [|0 : 8|]$) hence the cumulative effect is estimated for up to two years.

4.2 Results

Figure 8 shows the cumulative effect of a one-percentage point decrease in the ssr on the Nikkei and Topix total return indices estimated on the basis of Equation 1. The results using the performance indices of the Nikkei and Topix are very similar (see Figure 18 in the appendix).

Figure 8
The effect of a one-percentage-point decrease in the short-term shadow rate on Japanese stock market total return indices



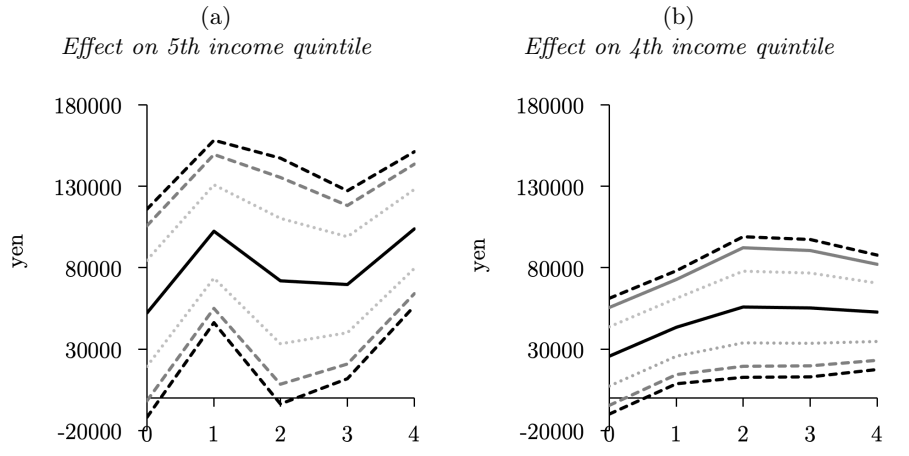
Source: Authors' calculations.

A one-percentage-point decrease in the short-term shadow rate is associated with a direct effect of 1.7% on the total return Nikkei index (Figure 8a). The value is significantly different from zero. The 95%-confidence interval ranges from 0.05% to 3.4%. Over the next quarters the effect steadily increases. After four quarters, the effect reaches 10.4%, with the 95%-confidence interval ranging

from 5.5% to 15.3%. From the fourth quarter onward, the effect does only increase slightly. After eight quarters the estimated effect is equal to 12.4%, with a 95%-confidence interval between 4.4% and 20.3%. The effect for the broader stock market index Topix has a similar trajectory (Figure 8b). After 4 quarters the effect equals 10.8%, with the 95%-confidence interval ranging from 5.7% to 21.4%. Again, the effect in the subsequent quarters increases only slightly to 13.6% with a 95%-confidence interval of 5.8% to 21.4%.

The estimation of the second equation complements the first equation to trace the transmission mechanism further (portfolio channel of monetary policy) through which monetary expansion affects household incomes. We estimate the effect of a 10% increase in the stock market on the annual income for each quintile up to two years into the future. The magnitude of the increase in the stock market is in line with the findings of the first pass-through estimation, where the impact of a one percentage point decrease in the ssr_t is roughly associated with a 10% increase in the stock market after 4 quarters (Figure 8).

Figure 9
The effect of a 10 percent annual increase in the stock market (Nikkei) on top income brackets (coefficient β_1 in Equation 2)



Source: Authors' calculations.

The direct effect of a 10% increase in the stock market over one year on the income of the top 20% income earners (5th quintile) is equal to 52,028 yen (Figure 9), but the coefficient is only significant for the 65%-confidence interval. Though after one quarter the effect doubles to 102,280 yen with the 95%-confidence interval ranging from 46,178 yen to 158,381 yen. After four quarters (two years), the effect reaches 103,784 yen with the 95%-confidence interval ranging from 56,437 yen to 151,132 yen. The average income level of the 5th quintile over the period Q1 2007 to Q2 2022 is 12 million yen hence the relative effect ranges from 0.5% to 1.2%.

The effects for the other quintiles are summarized in Table 2. For the lowest income brackets (1st and 2nd quintile), the effect is insignificant for all periods. For the second highest income bracket (4th quintile), we obtain a significant positive effect on income development. The effect equals 52,637 yen after two years and the 95%-confidence interval spans from 17,557 yen to 87,716 yen.

Hence, the effect in absolute terms is half as big as for the top 20% income bracket. The average income for the 4th quintile over the period Q1 2007 to Q2 2022 is around 7 million yen hence the relative effect ranges from 0.2% to 1.2%.

For the middle income bracket (3rd quintile), we also find a positive effect of 23,735 yen after two years. The 95%-confidence level ranges from 1,529 yen to 45,941 yen. The average income for the 3rd quintile over the period Q1 2007 to Q2 2022 is equal to roughly 5 million yen hence the relative effect ranges between 0.03% and 0.9%. The results are in line with the descriptive statistics from section 3. The higher the share of stocks and shares in the savings portfolio (which is correlated with the position in the income distribution), the higher the effect of an increase in the stock market index on income.

Table 2
The effect of a 10% annual increase in the stock market (Nikkei) on all income quintiles

	After 1 quarter			After 4 quarters		
Quintile	Coefficient	95%-Confidence Interval		Coefficient	95%-Confidence Interval	
1	878	11,330	-9,574	-2,409	4,867	-9,685
2	6,750	20,813	-7,313	8,012	16,853	-829
3	15,865	36,763	-5,033	23,736	45,942	1,530
4	43,414	78,101	8,726	52,637	87,716	17,558
5	102,280	158,382	46,178	103,785	151,133	56,437

Source: Authors' calculations.

A specification based on quarterly growth rates as opposed to annual growth rates is also estimated as a robustness check. The corresponding adaptation of Equation 2 and the estimated effects are given in the appendix (Figure 17). It can be seen that there is again a time lag at work between a stock market increase and its impact on household income. The effects of a 10% quarter-to-quarter increase in the stock market after 4 quarters (one year) and after 8 quarters (two years) are summarized in Table 3. The size of the effect is broadly in line with the model based on annual growth rates. On a 5%-confidence level we find significant positive effects for the 5th, 4th and 3th quintile, while the effects for the 2nd and 1st quintiles are insignificant.

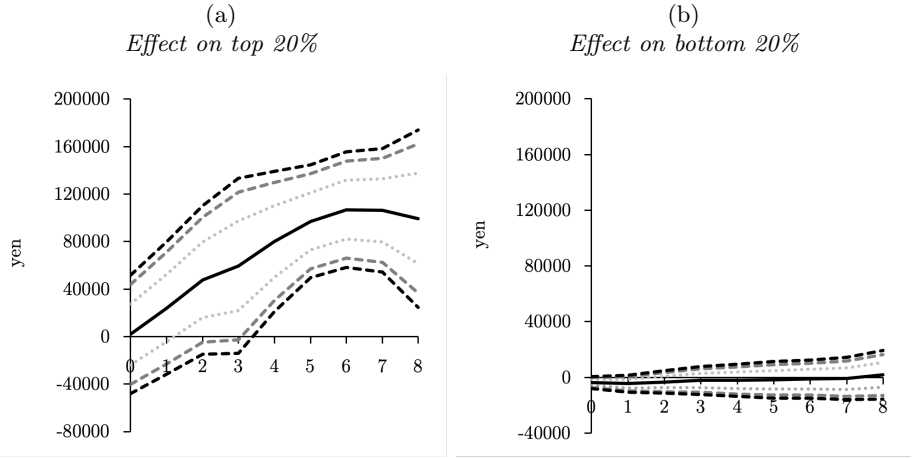
Table 3
The effect of a 10% quarterly increase in the stock market (Nikkei) on all income quintiles (Equation 4 in the appendix, note to Figure 17)

	After 4 quarters			After 8 quarters		
Quintile	Coefficient	95%-Confidence Interval		Coefficient	95%-Confidence Interval	
1	-3,641	10,594	-17,875	3,182	23,789	-17,424
2	10,759	24,270	-2,752	14,003	47,788	-19,783
3	30,373	55,708	5,038	39,946	76,883	3,009
4	71,719	109,890	33,549	69,311	128,151	10,471
5	125,017	176,128	73,906	105,991	208,101	3,880

Source: Authors' calculations.

Both models (based on quarterly and annual growth rates) are re-estimated by using the broader stock market index Topix. The results are very similar and can be found in the appendix (Table 5 and Table 6).

Figure 10
The effect of a one-percentage-point decrease in the short-term shadow rate on top and bottom income quintiles



Source: Authors' calculations.

In the third step, we directly estimate the impact of a change in the short-term shadow rate on different income brackets. Figure 10a shows the cumulative pass-through of a one-percentage-point decrease in the *ssr* on the top 20% of the income distribution. After four quarters (one year), the effect is equal to an increase of 80,100 yen with a 95%-confidence interval ranging from 21,150 yen to 139,050 yen. After eight quarters (two years) the effect is equal to 99,382 yen with a 95%-confidence interval spanning from 24,790 yen to 173,973 yen.

With respect to the average income, the effect size ranges from 0.2% to 1.4%. In contrast, the effect on the 1st quintile of the income distribution is insignificant for all periods even when a 65%-confidence interval is considered. For the 2nd, 3rd and 4th quintile there are lower effects in magnitude than for the 5th quintile, but the effects are statistically significant and positive at a confidence level of 5%. The effect increases for subsequent quarters and is highest after 8 quarters (two years). Table 4 summarizes the estimated effects for all quintiles.

These results show that expansionary monetary policy can have a systematic effect on income inequality. When asset purchases increase bond prices, decrease bond yields, and lead to stock price increases, households who hold these assets in their savings portfolios receive relative income gains. In Japan, the impact is greater for higher-income households who invest more in stock market. Lower-income households, who have less invested in these assets, do not see significant income gains. Our results confirm earlier studies, such as Saiki and Frost (2014) or Israel and Latsos (2020).

Table 4
The effect of a one-percentage-point decrease in the short-term shadow rate on all income quintiles

	After 4 quarters			After 8 quarters		
Quintile	Coefficient	95%-Confidence Interval		Coefficient	95%-Confidence Interval	
1	-2135	9439	-13709	1813	19321	-15695
2	15397	25236	5558	25210	41416	9004
3	28523	48128	8918	56703	84441	28966
4	50340	75375	25305	82798	120257	45339
5	80100	139050	21150	99382	173973	24790

Source: Authors' calculations.

5 Conclusion

The expansionary monetary policies implemented by the Bank of Japan over the past decades have likely contributed to rising income inequality in the country. These policies, particularly unconventional asset purchase programs, have led to increased stock market performance, which has disproportionately benefited high-income households that tend to hold a larger share of their savings in stocks. Low-income households, on the other hand, have largely held their savings in demand and time deposits, and therefore have not benefited as much from these policy measures.

Our findings suggest that, to the extent that rising inequality is a concern, monetary policy as conducted in Japan and many other countries may need to be reevaluated in terms of its cost-benefit performance. While expansionary monetary policy can have positive short-term effects on employment, it is important to consider its potential impacts on income distribution and address any negative consequences.

Overall, our study adds to the growing body of research on the distributional effects of monetary policy and highlights the need for a more nuanced understanding of the mechanisms through which these policies affect income inequality. Further research could explore the distributional impacts of other policy measures, such as fiscal policies, and their potential interactions with monetary policy. For example, if expansionary monetary policy leads to increased asset market performance and boosts capital income disproportionately, lower taxes on capital income as compared to labor income can amplify the adverse distributional effects of monetary expansion.

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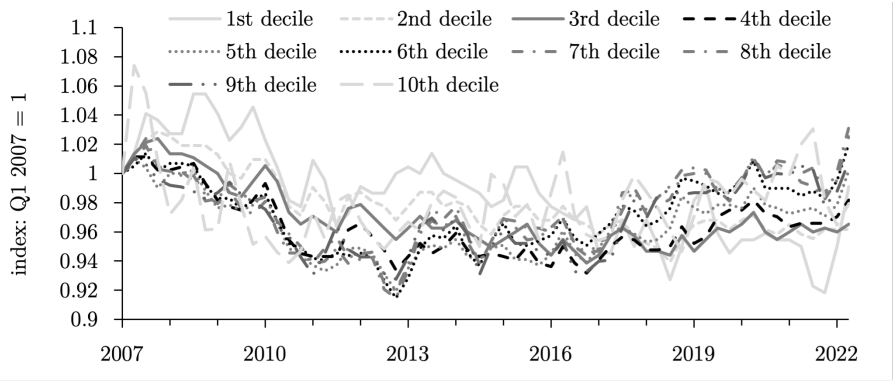
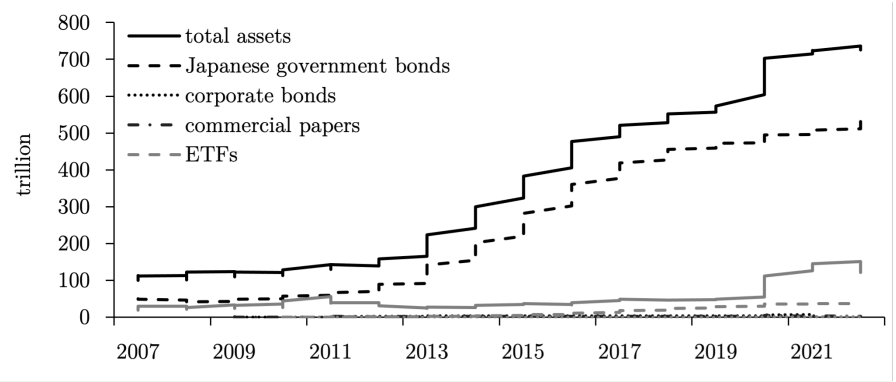
Appendix

Figure 11
Evolution of income shares by deciles



Source: *Family Income and Expenditure Survey* (FIES).

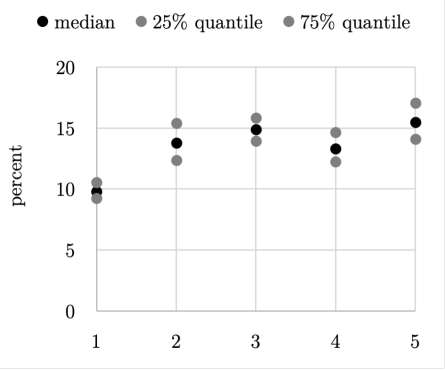
Figure 12
Selected balance sheet positions of the Bank of Japan



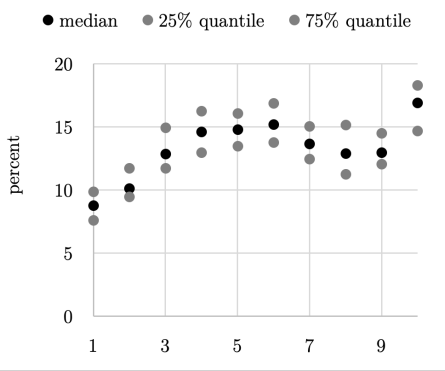
Source: Bank of Japan.

Figure 13
Proportion of security in overall savings by income level

(a) *Quintiles*



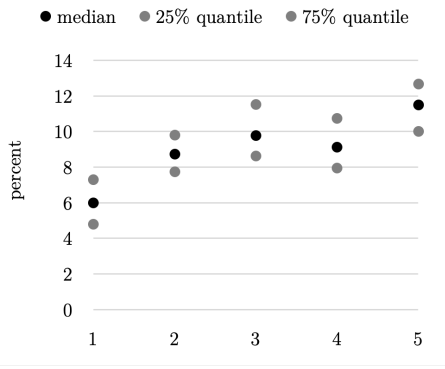
(b) *Deciles*



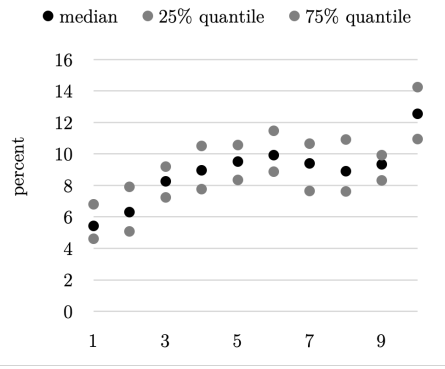
Source: *Family Income and Expenditure Survey* (FIES).

Figure 14
Proportion of stocks and shares in overall savings by income level

(a) *Quintiles*

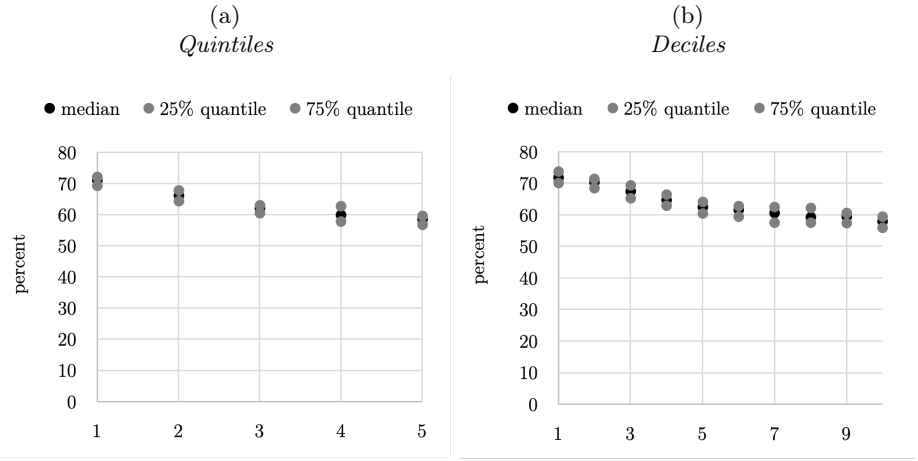


(b) *Deciles*



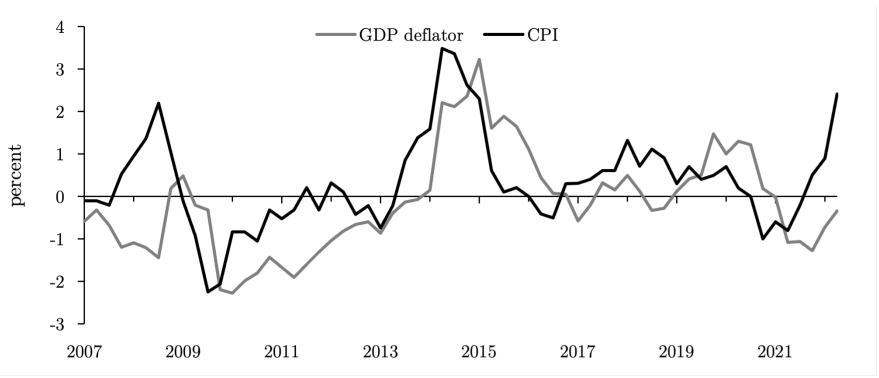
Source: *Family Income and Expenditure Survey* (FIES).

Figure 15
Proportion of deposits in overall savings by income level



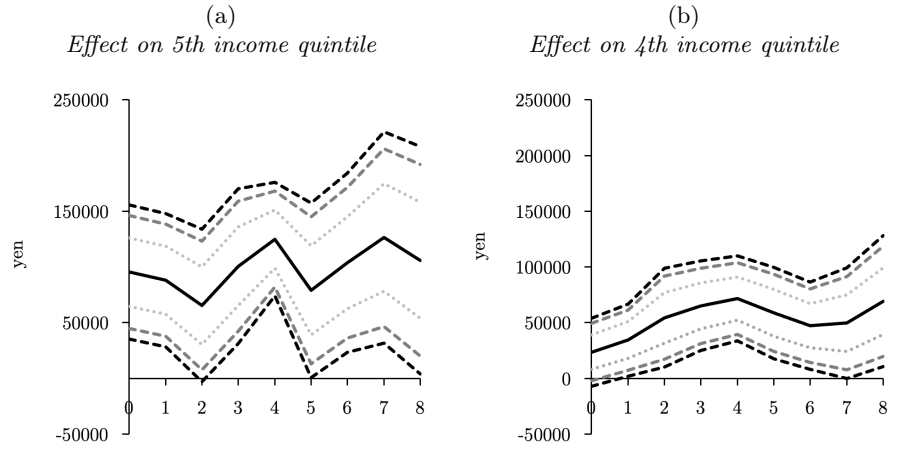
Source: *Family Income and Expenditure Survey* (FIES).

Figure 16
Price inflation in Japan



Source: OECD, Statistics Bureau, Ministry of Internal Affairs and Communication, Japan.

Figure 17
The effect of a 10 percent quarter-to-quarter increase in the stock market on top income brackets

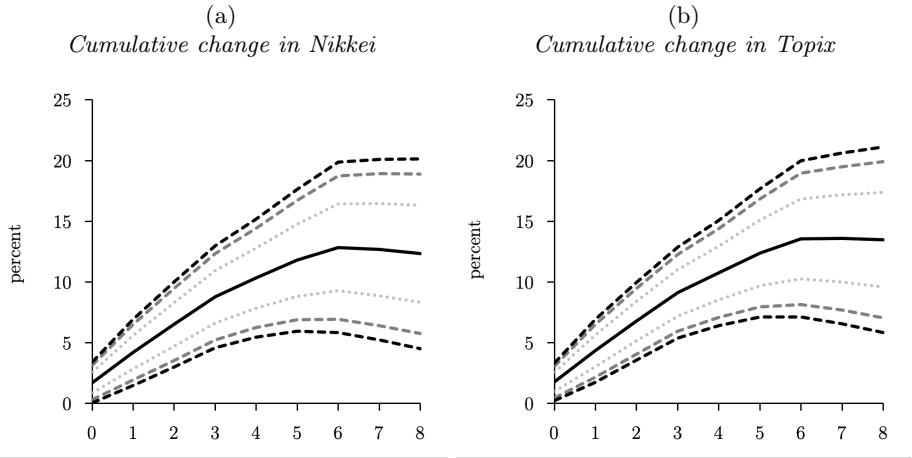


Source: Authors' calculations.

Note: The above estimations are based on the following equation, which is an adaptation of Equation 2, where annual growth rate have been replaced by quarterly growth rates:

$$
\begin{aligned}
(y_{i,t+h} - y_{i,t-1}) = \alpha_i &+ \beta_{1,i}(s_t - s_{t-1}) + \beta_{2,i}(GDP_t - GDP_{t-1}) \\
&+ \sum_{j=2}^{3} [\beta_{j+1,i}(s_{t-j} - s_{t-1-j}) + \beta_{j+3,i}(GDP_{t-j} - GDP_{t-1-j})] \\
&+ \epsilon_{t+h} \quad \text{for } i = 1, \ldots, 5 \text{ and } h = 0, \ldots, 8
\end{aligned}
\tag{4}
$$

Figure 18
The effect of a one-percentage-point decrease in the short-term shadow rate on Japanese stock market performance indices



Source: Authors' calculations.

Table 5
The effect of a 10% annual increase in the stock market (Topix) on all income quintiles

	After 1 quarter			After 4 quarters		
Quintile	Coefficient	95%-Confidence Interval		Coefficient	95%-Confidence Interval	
1	1,509	12,467	-9,448	-1,748	7,402	-10,899
2	6,498	21,016	-8,021	7,780	17,772	-2,212
3	13,057	33,952	-7,838	21,557	44,807	-1,693
4	37,307	71,105	3,510	51,262	89,969	12,555
5	99,280	160,666	37,894	106,428	160,358	52,498

Source: Authors' calculations.

Table 6
The effect of a 10% quarterly increase in the stock market (Topix) on all income quintiles

	After 1 quarter			After 4 quarters		
Quintile	Coefficient	95%-Confidence Interval		Coefficient	95%-Confidence Interval	
1	-3,226	11,523	-17,975	3,668	25,055	-17,719
2	10,150	24,572	-4,273	14,199	49,308	-20,911
3	28,694	53,847	3,542	42,120	82,175	2,065
4	71,939	109,887	33,990	70,830	133,989	7,670
5	123,522	176,866	70,179	98,637	205,822	-8,548

Source: Authors' calculations.