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Reoccurring instability keeps forcing central banks repeatedly to intervene in financial markets, since the 2007-2008 crisis most notably with massive asset purchases, whose popularisation was spearheaded by the Bank of Japan. This paper exploits the world's first implementation of quantitative easing in the vicinity of zero interest rates in Japan from 1999 through 2006 to evaluate their distributional impact by means of the synthetic control method. Comparing the actual and counterfactual development demonstrates that unconventional monetary policy increased the top 10 percent to bottom 50 percent income ratio by more than 28 percent. This exercise also detects a rise of more than 7 percent for the Gini coefficient which is beneath the corresponding value of 12.5 percent for the share of the top income decile. These results, together with evidence from capital and labour income trends as well as data on household ownership of financial assets, suggest that inequality widened via heightening asset prices converting into gains for richer income groups. Conditional upon structural features of an economy a negative distributional side effect of central banking's new tools may turn out to be of severe magnitude.

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Central Banks Fuelling Inequality: A Comparative Case Study of Japan's Unconventional Monetary Policy 1999–2006 *

Moritz Uhl †

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Abstract

Reoccurring instability keeps forcing central banks repeatedly to intervene in financial markets, since the 2007–2008 crisis most notably with massive asset purchases, whose popularisation was spearheaded by the Bank of Japan. This paper exploits the world's first implementation of quantitative easing in the vicinity of zero interest rates in Japan from 1999 through 2006 to evaluate their distributional impact by means of the synthetic control method. Comparing the actual and counterfactual development demonstrates that unconventional monetary policy increased the top 10% to bottom 50% income ratio by more than 28%. This exercise also detects a rise of more than 7% for the Gini coefficient which is beneath the corresponding value of 12.5% for the share of the top income decile. These results, together with evidence from capital and labour income trends as well as data on household ownership of financial assets, suggest that inequality widened via heightening asset prices converting into gains for richer income groups. Conditional upon structural features of an economy a negative distributional side effect of central banking's new tools may turn out to be of severe magnitude.

JEL Codes: D31, E52, E58

Key Words: Japan, income inequality, unconventional monetary policy, quantitative easing, synthetic control method

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Central banking is a strange profession little understood by members of the public whose interests it exists to protect, by governments with which it shares responsibilities, or by financial institutions whose activities it to some degree controls. Those who practice it often feel themselves to be members of an international freemasonry, a kind of 'mystery' in the medieval sense of a group who possess some exclusive knowledge or skill, and indeed there has always been an element of mystery ... about what central bankers do.

H. C. 'Nugget' Coombs (1981, p. 141), Governor of the Australian Central Bank 1949–1968

Abbreviations

BoJ	Bank of Japan
ECB	European Central Bank
FDI	foreign direct investment
Fed	Federal Reserve
GDP	gross domestic product
JGB	Japanese government bond
MSPE	mean squared prediction error
OECD	Organisation for Economic Co-operation and Development
QE	quantitative easing
UMP	unconventional monetary policy
WID	World Inequality Database
ZIRP	zero interest rate policy

1 Introduction

Inflation targeting being the supreme scheme of central banking to support long-term growth became somewhat of a mantra. According to conventional wisdom, central banks influence the costs of borrowing by setting the key interest rate. High rates raise the prices of loans, which cools the economy and reins in inflation. The fact that by the advent of the twenty-first century inflation targeting was about to 'surpass in longevity all the other monetary policy regimes over the last half century or so' (Siklos, 2006, p. 308) tempted some to declare that the Holy Grail of central banking had been found. Ironically, this is the time when the Bank of Japan saw no other option but to turn its back on this prescription. Thereby, it engendered a watershed in the evolution of central banking. Pride of place goes to Japan, yet central banks all over the world followed in its footsteps to navigate through the challenges of the Global Financial Crisis, because with interest rates lingering close to zero, the rehearsed practice of inflation targeting had become a blunt tool.

Although primarily aimed at stabilising the economy, quantitative easing, in particular, might unintentionally worsen economic inequality (Coppola, 2019; Petrou, 2021).[1] Large-scale purchase programmes of government bonds or other (private) financial assets alter their market prices. But not everyone necessarily gains equally from rising prices on financial markets. Isabel Schnabel (2021b), a member of the Executive Board of the ECB, points to this fact: '[C]entral banks purchasing longer-dated assets disproportionally benefit wealthier households whose assets tend to have longer durations than their liabilities'. The unequal distribution of assets (as catalogued in the Distributional Wealth Accounts (European System of Central Banks, 2024) for the euro area or the Fed's (2024) Distributional Financial Accounts) is one aspect of a revived inequality attracting more and more attention (Piketty, 2014). Others like the former chairman of the Fed Ben Bernanke (2015) rather argue that quantitative easing secured poorer households from job losses. From this perspective, with wages as a major source of income for the poor and capital income mostly profiting the rich, whether or not quantitative easing increases income inequality ultimately remains an empirical question.

The peculiar case of Japan being the first to venture away from conventional monetary policy during the period 1999–2006 offers a rare opportunity to appraise the prospective distributional effect of these new instruments. This chance is left untouched so far despite academic interest in the link between unconventional monetary policy and (income) inequality (Bivens, 2015; Bunn et al., 2018; Guerello, 2018; Inui et al., 2017; Lenza & Slacalek, 2018; Montecino & Epstein, 2015; Mumtaz & Theophilopoulou, 2017; Saiki & Frost, 2014). Taking advantage of Japan acting

[1] A side effect which can prove an obstacle to the smooth transmission of macroeconomic policies (Auclert, 2019).

on its own in executing massive asset purchases along with its zero interest rate policy permits gauging this remedy's impact on income inequality by employing the synthetic control method. The evolution of income inequality for a counterfactual Japan constructed as a combination of other countries sticking to conventional monetary policy is compared to Japan's actual encounter.

The rest of this paper is structured as follows: Section 2 summarises the literature on the distributional effects of unconventional monetary policy. Then Section 3 chronicles the Bank of Japan's realisation of unconventional instruments and outlines the channels through which such non-standard measures might feed into income inequality. The dataset and first descriptives are introduced in Section 4, the empirical strategy in Section 5. Section 6 presents the results, whose validity is discussed in Section 7 with respect to the appropriateness of the control group just like the applicability for other countries. Finally, Section 7 also concludes by stressing the magnitude of potential distributional consequences from unconventional monetary policy and the importance of structural characteristics for this effect.

2 State of Research

There is a fair amount of work concerning conventional monetary policy and inequality (e.g., Coibion et al., 2012; Furceri et al., 2018; Mumtaz & Theophilopoulou, 2017) whereas research on the distributional implications of unconventional measures is scarce due to their recent topicality (Colciago et al., 2019). The established solution to separate the genuine effects of monetary policy from what it reacts to is to concentrate on shocks. To model the relationship simulations, local projections or (structural) vector autoregression models are commonly opted for. Further difficulties are encountered when data are available only over a short time period or isolated years. The focal point is central banks buying immense amounts of assets. According to an evaluation from the Bank of International Settlements, the employment impact of large-scale asset purchase programmes by the Fed in the United States and the Bank of England faded to zero over time while the significant positive effect on stock prices endured (Hesse et al., 2018). Nevertheless, recapping the literature on the impact of unconventional monetary policy (UMP) on inequality ascertains mixed results. Even though this paper deals with income inequality, the overall wealth effect, too, is ambiguous (Adam & Tzamourani, 2016; Albert et al., 2020; Bivens, 2015; Bunn et al., 2018; Davtyan, 2023; de Luigi et al., 2019; Domanski et al., 2016; Lenza & Slacalek, 2018; Mumtaz & Theophilopoulou, 2020; O'Farrell et al., 2016) since prices of different asset types have offsetting distributional impacts: boosted house prices tend to reduce inequality while higher bond prices and equity prices in particular widen it.

Rising values of assets involve higher returns, though their purchases intend economic growth. And while the labour income of those at the bottom is more sensitive, the top is more closely tied to the business cycle as a whole through their capital income (Guvenen, 2009). For the United States Montecino and Epstein (2015) observe that quantitative easing accelerated income inequality through asset appreciation based on a recentered influence function regressions in conjunction with the Oaxaca-Blinder decomposition. Davtyan (2023) attains an analogous outcome with UMP pushing capital income more than wages. Lee (2021) exhibits that quantitative easing shrank income inequality within the bottom 90% but augmented the top 10% and the top 1% share of income. Results for the United Kingdom suggest that in times of conventional monetary policy contractionary shocks increase income inequality, while in the post-2008 period on the other hand, the expansionary policy of quantitative easing increased inequality when measured as disposable income or as consumption of non-durables (Mumtaz & Theophilopoulou, 2017). Bunn et al. (2018) conclude that monetary policy in the United Kingdom between 2008 and 2014 has had a negligible impact on the Gini coefficient with gains marginally skewed towards the higher-income households. Other approaches utilising data from the Standardized World Income Inequality Database for the euro area (Tsiaras, 2023) just like from the Household Finance and Consumption Survey for the four largest eurozone countries (Lenza & Slacalek, 2018) or from data on income and wealth by the *Banca d'Italia* (Casiraghi et al., 2018) contend that quantitative easing compresses the income distribution. In contrast, Guerello (2018) exposes that within the euro area, those countries with households tightly connected to financial markets experienced a hike in income dispersion. Likewise, Tsiaras (2023) emphasises that the distributional effect of quantitative easing varies with the level of asset market participation.

Being the first country to arrange itself with UMP Japan serves as an important data source. Admittedly, in the case of Japan studies by and large are looking for an effect on income inequality. Employing data from the Japanese Family Income and Expenditures Survey an analysis discloses a disappearance of a negative distributional effect which accompanied expansionary monetary before quantitative easing (Inui et al., 2017). Yet, the majority of scholars investigating the effect of quantitative easing for Japan signify an increase in income inequality (Feldkircher & Kakamu, 2022; Israel & Latsos, 2020; Leo, 2022; Saiki & Frost, 2014, 2020; Taghizadeh-Hesary et al., 2020; Yoshino et al., 2018; Yuksel, 2021).[2] With inequality itself making future inequality (Taghizadeh-Hesary et al., 2020; Yoshino et al., 2018) there are persistent consequences beyond temporal changes. These studies quantify effects principally as impulse responses, that is as a reaction to a monetary

[2]Methodologically, the only departure from (extensions of) vector autoregression models is a simple linear panel regression analysis (Israel & Latsos, 2020).

policy shock. Calculating the total contribution of asset purchases to a growing income Gini coefficient over two decades encompassing their first utilisation as well as their reinstatement in answer to the 2007–2008 financial crisis Leo (2022) arrives at a value of 15.3%. The presented research views any impact of UMP on income inequality exclusively through the lens of a handful of models. Strangely none exploits Japan's unique experience with UMP before the Global Financial Crisis for the sake of a comparative case study.

3 Unconventional Monetary Policy as an Inequality Engine

3.1 The Bank of Japan Pioneering Unorthodoxy

The Bank of Japan (BoJ), referred to as *Nippon Ginkō* or *Nichigin* for short, started experimenting with unconventional monetary policy as a reaction to a chain of events gaining momentum with the Japanese asset price bubble from 1986 until 1991.[3] Japan's so-called bubble economy (*baburu keiki*) ballooning during the late 1980s was characterised by a rapid acceleration of asset prices, an overheating of economic activity and an expansion in money supply and credit (Okina et al., 2001).

The beginning of the asset price inflation is closely linked to the Plaza Accord of September 1985 (Hamada & Okada, 2009) under which the Group of Five (later Seven) agreed to a devaluation of the dollar against the currencies of the other parties. Yen appreciation threatened to erode Japanese exports. To shield its domestic industry the government launched an aggressive fiscal policy (Okina et al., 2001). Simultaneously, concerns over further yen appreciation motivated the BoJ, which has been criticised for playing a role in starting the bubble, to slash interest rates to levels as low as deemed necessary.

While worrying about the exchange rate, other domestic objectives became subordinate (Cargill et al., 1997, 91–116). Cheap credit attracted demand on stock and real estate markets. Decreasing returns incentivised even more purchases. Meanwhile maintaining interest rates at a minimal level under economic expansion fuelled expectations that low interest rates would continue for a considerable period (Shiratsuka, 2001). This was reflected in an acceleration of monetary growth. Not only bank borrowing but also financing from capital markets swelled (Okina et al., 2001). Interest rate cuts are only one side of the story. Under its policy of window guidance (*madoguchi shidō*) the BoJ determined the volume of credit and ordered loan quotas to individual banks. As too much money was pumped into the economy banks virtually begged companies to borrow (Werner, 2003, 76–77). Already fully

[3]Note that determinations of the dates marking the emergence, expansion, and bursting of the bubble vary.

invested in productive endeavours firms obtained loans from banks for real estate investment purposes, oftentimes recycling real estate as collateral. Since monetary growth under financial liberalisation was also driven by new financial instruments it was hard to assess a central bank's policy stance from monetary aggregates (Cargill et al., 1997, 91–116). Focusing on the consumer price index instead, which stayed below 1% from 1986 to 1988, the BoJ tightened its monetary policy in line with standard central banking practice in 1989 when it became explicit that inflation was picking up speed.

This turned out to be too late. In the meantime, the Tokyo stock price index Nikkei 225 (*Nikkei heikin kabuka*), which moved around the 13,000 benchmark in the first months of 1986, already more than doubled by the end of 1988 without showing any sign of reversal.[4] Initiated by the BoJ's monetary policy, progress of financial deregulation and decreased profitability, diverse additional factors like aggressive behaviour of financial institutions, taxation and regulation on land as well as overconfidence had combined to form 'intensified bullish expectations' bringing about an unparalleled bubble (Okina et al., 2001).

The burst of the Japanese asset price bubble bred what came to be coined the 'lost decade': a prolonged period of stagnation. The 'self-correcting mechanism of speculative process' amplified among other factors by increases of interest rates as well as controls over banks' real estate lending and reformation of taxation concerted by the Ministry of Finance (Cargill et al., 1997, 108–110) triggered the crash of the bubble. The Nikkei 225 tumbled from 1990 onward and, in fact, did not breach its historical peak during the bubble economy until 2024. Other asset prices pursued. In 1992 stock prices hit a preliminary low. The consequences of the financial bubble persisted without any real prospect of resolution as Japan was hamstrung by extremely slow economic recovery with deflating debt crippling consumption.

Initially, the BoJ attempted to escape from the lost decade through standard short-term interest rate reductions[5], which had served their time by 1999. In September 1998 the BoJ lowered the uncollateralised overnight call rate to 0.25% already bringing it very close to the zero bound. With an additional reduction by 0.10 percentage points in February 1999 the BoJ lowered rates to essentially zero and announced that further declines would be induced in view of market developments. This maintenance of interest rates near their boundary level of zero was dubbed zero interest rate policy (ZIRP). Hence, this endorsement of the Bank also marks the beginning of Japan's experimentation with unconventional central banking. All decisions of the Policy Board on monetary policy at the BoJ spanning the period from February 1999 through March 2006 are summarised by Table 2.

[4]The Nikkei 225 is operated by the Nihon Keizai Shimbun newspaper, for historical data see Nikkei (2024).

[5]With liberalisation begetting various non-bank financial actors window guidance had foiled its effectiveness (Fukumoto et al., 2010).

Table 2: BoJ's policy decisions under ZIRP and QE (12/02/99–09/03/06)

Date	Current account balances	Monthly purchase targets	Overnight call rate	Other changes
12/02/99			Reduced to 0.15%	Adopted ZIRP; Announced to provide liquidity through existing short-term operational instruments
11/08/00			Increased to 0.25%	Lifted ZIRP
09/02/01				Reduced official discount rate to 0.35% (from 13/02/01); Introduced a standby (Lombard-type) lending facility against collateral (from 03/01); Increased outright operations of short-term government securities; Announced preparation of bill purchases at all offices
28/02/01			Reduced to 0.15%	Reintroduced ZIRP; Reduced official discount rate to 0.25% (from 01/03/01)
19/03/01	Increased by ¥ 1 trillion to ¥ 5 trillion	Authorised to exceed ¥ 400 billion limit		Changed main operating target to current accounts (beginning of QE)
14/08/01	Increased by ¥ 1 trillion to ¥ 6 trillion	Increased by ¥ 200 billion to ¥ 600 billion		
18/09/01	Authorised to exceed ¥ 6 trillion			Reduced official discount rate to 0.10%; Extended maximum discount term to 10 business days for Lombard-type lending facility (from 16/09/01 till 15/10/01)
19/12/01	Increased to ¥ 10–15 trillion	Increased by ¥ 200 billion to ¥ 800 billion		Announced to strengthen money market operations by more actively purchasing commercial paper under repurchase agreements, by broadening the range of eligible collateral and by increasing the frequency of bill purchasing operations with all eligible counterparties
28/02/02	Authorised to exceed ¥ 10–15 trillion	Increased by ¥ 200 billion to ¥ 1 trillion		Suspended limit on number of business days for Lombard-type lending facility (from 01/03/02 till 15/04/02); Announced to examine operational issues to broaden the range of eligible collateral

30/10/02	Increased to ¥ 15–20 trillion	Increased by ¥ 200 billion to ¥ 1.2 trillion	Extended maturity limit for bills purchased by 6 months to 1 year
25/03/03	Increased to ¥ 17–22 trillion (from 01/04/03)		Suspended limit on number of business days for Lombard-type lending facility
30/04/03	Increased to ¥ 22–27 trillion		Included loans on deeds to the Industrial Revitalization Corporation of Japan with government guarantee as eligible collateral
20/05/03	Increased to ¥ 27–30 trillion		
10/10/03	Increased to ¥ 30–32 trillion		Extended maturity limit for JGBs purchased with repurchase agreements by 6 months to 1 year; Committed to maintain QE
20/01/04	Increased to ¥ 30–35 trillion		
09/03/06	Announced reduction to required reserves		Changed main operating target to uncollateralised overnight call rate

Notes: Table lists statements on meetings of the Policy Board on monetary policy at the BoJ (1999, 2000a, 2001a, 2001b, 2001c, 2001d, 2001e, 2001f, 2002a, 2002b, 2003a, 2003b, 2003c, 2003d, 2004, 2006a). Unlisted meetings included no changes. Table excludes changes in communication strategies on 30 April 2003 and 10 October 2003, the decision to inject capital into Resona Bank on 20 May 2003 and the introduction of a new framework for the conduct of monetary policy on 9 March 2006. Decisions on 18 September 2001 were reached in the context of the terrorist attacks in the United States. Decisions on 25 March 2003 were reached both in the context of a new regulation requiring the Japan Post to hold about 2 trillion yen in its current deposits and of military action against Iraq.

The BoJ (2000a) hoped to exit from ZIRP as early as after one and a half years, in retrospect incorrectly assuming 'that Japan's economy has reached the stage where deflationary concern has been dispelled'. In doing so the BoJ (2000b) rejected the request of delegates from the Ministry of Finance and the Economic Planning Agency to postpone the vote on the proposed change in monetary policy. The uncollateralised overnight call rate was reinstalled at a level of 0.25%. The economic environment worsened as soon as the BoJ terminated ZIRP. After six months of continued weakness the BoJ (2001b) returned to ZIRP by revoking its prior increase and fixating the call rate at a level of 0.15%. With ZIRP Japan had already taken the first step in designing a new way of central banking, whereupon

the BoJ decided to move away from conventional monetary policy for good in favour of a more resolute monetary easing.

Reenacting ZIRP was quickly followed by more far-reaching interventions, self-described as 'monetary easing measures unprecedented in the history of central banking' (BoJ, 2001e). In March 2001 the main operating target was changed to the current account balances held by commercial banks with the BoJ. With the aim of banks building up reserves far exceeding the required amount the BoJ provided additional funds through its open market operations focused mainly on purchases of long-term Japanese government bonds (JGBs) (Maeda et al., 2005). In addition, the BoJ (2001c) vowed that these 'new procedures for money market operations continue to be in place until the consumer price index (excluding perishables, on a nationwide statistics) registers stably a zero percent or an increase year on year'. In sum, the BoJ's policy of quantitative easing (QE) consisted of three pillars (Ugai, 2006): first, in shifting the main operating target from the uncollateralised overnight call rate to the current account balances held at the Bank through which ample liquidity was supplied; second, in expanding the purchase of long-term JGBs if deemed necessary to facilitate meeting the targeted current account balances; third, in signalling a clear commitment to keeping the policy in effect until the consumer price index registers stably zero percent or an increase year-on-year.

Under QE the BoJ injected ample liquidity into the economy. In January 2004 the current account balance target reached its final designated upper level of 35 trillion yen when the BoJ lifted it for the ninth time since March 2001. The Bank achieved its current account balance targets primarily by buying long-term JGBs. Monthly purchases of long-term JGBs grew from 0.4 trillion yen to 1.2 trillion yen. The BoJ also established a standby lending facility through which the Bank, in exchange for collateral, extended loans at the requests of counterparties (including securities companies, tanshi money market dealers and securities finance companies in addition to banks). In February 2002 the BoJ reported that 'the year-on-year growth rate of monetary base ... reached nearly 30 percent'. By the end of 2006, the monetary base exceeded 90 trillion meaning that it had expanded by 50% as compared to the end of 1998 (BoJ, 2024).

After six years of QE with 'year-on-year changes in the consumer price index ... expected to remain positive' the BoJ (2006a) 'judged that the conditions laid out in the commitment are fulfilled'. Consequently, in March 2006 the BoJ opted to let its QE policy phase out. By raising the call rate to 0.25% (BoJ, 2006b) Japan seemed to confirm its return to conventional monetary policy once and for all. Little did its Policy Board members know that they were already on the brink of a new crisis which would propel the BoJ to reenact its use of unconventional tools.

3.2 The Impact of Quantitative Easing under Zero Interest Rates on Income Inequality

Right after leaving office Ben Bernanke famously quipped that QE works in practice but not in theory.[6] Under the hypothesis of efficient markets outright purchases or sales should leave yields untouched (Eggertsson & Woodford, 2003). However, QE is not a toothless act of desperation in the vicinity of nominal interest rates at the zero bound. By now there is broad consensus that asset purchases theoretically support economic growth and spur inflation in three main ways (Bailey et al., 2020; Busetto et al., 2022; Gern et al., 2015; Schnabel, 2021a): through the *market stabilisation channel*, the *portfolio rebalancing channel* and *the signalling channel*.

First, asset purchases can stabilise markets under acute financial stress. Under active liability management financial actors administer their risk chiefly by matching assets to the liability structure on their balance sheets (Konings, 2011, p. 114). One downside of this technique is its vulnerability to weakening markets. Falling asset values (or rising credit and counterparty risk) typically put financial intermediaries under severe pressure. An unmet need for short-term liquidity may force sales of assets, which further depreciates the market value of these commodities. In the worst case, this vicious circle may freeze financial markets under the weight of uncertainty. When market liquidity dries up, asset purchase programmes can fill the void and eliminate some market risk which relaxes the constraints on risk-bearing capacities.

Second, QE withdraws a vital share of safe assets from the market nudging participants to turn to other asset classes (Albertazzi et al., 2018; Andrade et al., 2016). By acquiring a large share of sovereign bonds central banks depress the yields of these assets. Risk aversion is rendered less appealing. When riskier assets are bought, the easing is more pronounced. Long-term or riskier assets are exchanged for short-term and safe central bank reserves. This mitigates the riskiness of portfolios allowing banks to buy risky loans and reduce lending rates. Asset purchase programmes crank up the trade of assets that require some degree of risk-taking.

Third, a policy of asset purchases anchors expectations on future interest rate levels staying low. This reassures financial actors about the intentions of central banks and serves to brighten their outlook on inflation. The *signalling channel* is closely related to the communication strategy of forward guidance, meaning an announcement or foreshadowing of the likely future course of monetary policy. QE underpins a central bank's credibility to keep interest rates low.[7] This is because asset purchases may function as a commitment device altering the incentive structure of a central bank itself (Bhattarai et al., 2015). By voluntarily exposing their balance sheets to the risk of losses (if short-term rates are abruptly increased) central banks

[6] As quoted in an article of the Financial Times (Harding, 2014, October 13).

[7] Thereby, QE is unmistakably connected to another milestone in central banking, that is to what has been labelled ZIRP.

confine themselves to raise interest rates at most gradually on the exit from a crisis – similar to Odysseus who tied himself to the mast of his ship.

Until recently monetary authorities habitually turned a blind eye to inequality and continued to show underdeveloped concerns for this topic even while bidding farewell to conventional monetary policy: they incline towards caring for inequality out of instrumental reasons only, play down any causal impact of monetary policy and reject proposals to inscribe the containment of inequality into official mandates (Fontan et al., 2016). Either way, central bankers have to take off the blinders to fully understand what they are doing, because redistribution is changing the aggregate consumption response to their policies (Pekanov, 2024). They are no innocent bystanders when it comes to the distribution of income (Coibion et al., 2012). This is even more obvious in the age of unconventional monetary policy because as some observers noticed with governments rolling back fiscal policy central banks were left as the 'only game in town' (El-Erian, 2016). The monetary policy of QE, whose *raison d'être* is the zero bound of interest rates, affects income inequality through five transmission channels fleshed out by Coibion et al. (2012), Nakajima (2015) and Inui et al. (2017): the *earnings heterogeneity channel*, the *job creation channel*, the *income composition channel*, the *portfolio channel* and the *savings redistribution channel*.

First, responses to monetary policy shocks differ along the wage distribution. Candidate explanations for the earnings heterogeneity channel are distinct wage rigidities or degrees of labour market flexibility at different wage levels. This channel can impact income inequality either positively or negatively.

Second, the job creation channel is a variant of the earnings heterogeneity channel (Nakajima, 2015) operating through job creation or destruction. This channel is expected to generate some countercyclical feedback of labour income inequality (Bernanke, 2015). An accommodative monetary policy shock lifts the number of households with earnings more than zero. The stimulation of the economy through QE is able to secure jobs, which is conducive to narrowing income inequality.

Third, labour and capital income are of varying importance for income mixes and react contrarily to monetary policy shocks. Low-income households disproportionately depend on labour income whereas high-income households hold a respectable amount and share in assets. Indeed, ownership of assets, from stocks and bonds to real estate, is distributed exceptionally unequally. Under QE higher yields from assets as a result of central banks' interventions on financial markets might combine with sticky nominal wages. While wages stagnate returns from capital increase – a source of income mostly for the rich. Under the premise of households differing in their composition of income types, the income composition channel contributes to a widening of inequality.

Fourth, an expansionary monetary policy induces a rise in nominal prices, which depreciates the purchasing power of money unchecked while other asset classes are backed up by the purchases of central banks. The real value of cash typically falls amidst such an inflationary shock whereas that of tangible assets is boosted. Under the assumption of low-income households holding most of their assets in cash and high-income households in more marketable ones, the portfolio channel tends to exacerbate inequality as the capital income of the poor is dampened.

Fifth, a decline in the policy rate set by the central bank might imply transfers from lenders to borrowers. Overall, inflation still hurts households with positive (not altogether adjustable) nominal balance sheet positions in real terms, but households with negative nominal balance sheet positions become less indebted. Interest payments charged on loans are reduced (Doepke & Schneider, 2006). If rich households are disproportionately creditors and poor households mostly debtors the savings redistribution channel works countercyclically.

4 Data and Descriptives

The analysis must be sound on income inequality data comparable across countries over a considerable time horizon, for which it draws on the World Inequality Database (WID). Many papers on wealth or income effects of monetary policy rely on pure survey data, in which distributional tails are poorly represented. The WID circumvents this limitation by integrating multiple sources to measure wealth or income levels more precisely: national accounts, surveys, fiscal data and wealth rankings. Annual indicators can be downloaded directly via a Stata module (Blanchet, 2017).[8] Among all these, the top 10% to bottom 50% ratio of pre-tax national income is chosen as the preferred measure. Pre-tax income is the benchmark distributional income concept of the WID and includes social insurance benefits (removing corresponding contributions), but excludes other forms of redistribution such as income taxes or social assistance benefits. In general, income ratios are strongly and significantly correlated with alternative measures of income inequality such as shares held by top income groups (Leigh, 2007). To avert a one-sided portrayal the Gini coefficient and the top 10% share of national income are used to check the sensitivity of the results while information on net capital income and compensation to employees is consulted to explore what channels are at work.

To control for covariates additional data is obtained from the World Bank (2019, 2023). The literature recognises several important drivers of income inequality: economic growth, trade as well as financial openness, financial development, the outbreak of banking crises, government spending, tax progressivity, the level of devel-

[8]Statistics from the WID were retrieved most recently on 10 January 2024.

opment and demographics, unemployment, technological change (Furceri & Ostry, 2019; Roine et al., 2009). The database on World Development Indicators (2023) contains international statistics on global development and is appended by variables from the database on Global Financial Development (2019) capturing aspects of financial markets. Growth is taken into account by adding GDP per capita. Trade openness is measured as the sum of exports and imports over GDP, financial openness in the form of net FDI inflows as a percentage of GDP. Financial development is proxied by the amount of private credit from financial institutions over GDP. The model also includes a dummy for the presence of a banking crisis, which is defined as systematic when two conditions are met: signs of financial distress and banking policy interventions in response to losses. General government final consumption expenditure is relativised to GDP. Lastly, total population and employment as a share of the population older than 14 are incorporated. In short, based on information retrieved from the data collection on World Development Indicators (2023) and Global Financial Development (2019) a set of inequality predictors is mimicked to guarantee a reliable counterfactual for comparison.

The synthetic control method is applied to strongly balanced panel data for the period from 1980 through 2007. With the introduction of its zero interest rate policy, Japan's first era of unconventional monetary policy dates from the year 1999. This leaves 19 years of pre-intervention data. For Japan, outcome data are available from 1980 onward, which is why this year is selected as the beginning of the sample period. It ends with the year 2007 since most major economies commenced quantitative easing policies in the aftermath of the Global Financial Crisis following the decision of the United States in 2008.

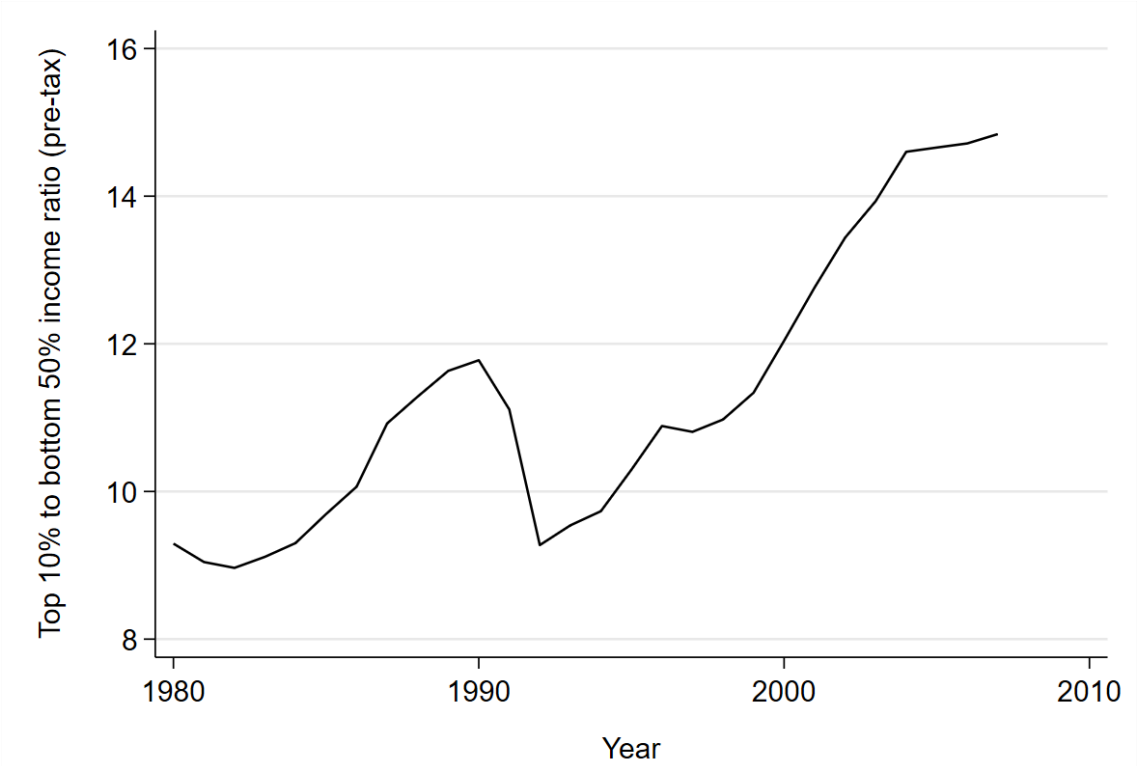
Synthetic Japan is constructed as a weighted average of countries that joined the OECD before the Global Financial Crisis. Despite all variations in their conduct of monetary policy, the Bank of Japan was the only central bank to resort to quantitative easing until 2008. A wide donor pool is given by 29 OECD members: Australia, Austria, Belgium, Canada, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Türkiye, the United Kingdom and the United States.

4.1 Descriptives

With the turn of the millennium income inequality in Japan steered towards unusually high levels. As Figure 1 illustrates, the top 10% to bottom 50% income ratio soared to a level of 14.60 by 2004. Thereafter, inequality stabilised at a distinctive plane well above its level of 10.97 in 1998. Still, the income ratio continued creeping up to 14.84 in 2007. It took less than a decade for this discrepancy to advance by a

value of 3.87. The top 10% to bottom 50% income ratio compares how much more the top decile of a population acquires in relation to the lower half. Hence, a ratio of 14.84 means that the share of the top 10% incomes is nearly 15 times that of the bottom 50%. Ratios of top and bottom percentiles can be more divulging of inequality levels since they prevent the middle percentiles from statistically obscuring the measurement of inequality. Side by side with Japan's unconventional monetary policy experimentation the share of the top income decile progressively distended from the income share of the lowest 50%.

Figure 1: Income Inequality in Japan



Notes: Graph depicts the time series of the top 10% to bottom 50% (pre-tax) income ratio in Japan during the period 1980–2007.

The starting point of roaring income inequality coincided with the birth of unconventional monetary policy in 1999. As outlined in Subsection 3.1 Japan's zero interest rate policy was introduced in February 1999, accompanied by quantitative easing from March 2001 onward. The descriptives of income inequality in Japan are a first clue for a growing divide due these new tools.

From 1980 through 1998 inequality in Japan evolved everything but stable. The oscillation of the income ratio is most likely associated with country-specific circumstances mentioned in Subsection 3.1. The asset price bubble 1986–1991 saw raging inflation of real estate and market prices. Its collapse caused secular stagnation forcing the Bank of Japan to adopt non-standard measures in the first place. Japan's

economic history articulated itself in strong fluctuations of the income ratio during the pre-treatment period.

5 The Synthetic Control Method

Japan's experience is naturally suited to evaluate the impact of unconventional monetary policy on income inequality by exploiting its pioneering role for a comparative case study. Bridging quantitative and qualitative research the synthetic control method concedes the possibility of quantitative inference within small samples, without precluding qualitative approaches. Borrowing an expression from Tarrow (1995) the synthetic control method enables 'putting qualitative flesh on quantitative bones'. To test whether or not a zero interest rate policy upgraded by quantitative easing alters income inequality, Japan is compared to a weighted control group of several other countries that refrained from monetary policy experimentation.

Formulating the dilemma of causal inference in the framework of Rubin's (1974) potential outcome model, assessing a causal effect in observational and experimental settings requires the comparison of two alternative futures: one in which the treatment arose and one in which it remained absent. An identification problem emerges since the treatment effect depends on the potential outcome in both states, while for a single country only one state is observed in any year. The synthetic control method introduced by Abadie and Gardeazabal (2003) approaches this problem by comparing the trend of an outcome Y – whose realisation during year t is equal to y_t^1 if the entity underwent an intervention and y_t^0 otherwise – during the post-treatment period with that of a weighted combination of other countries. The effect is then diagnosed using the difference between the actual outcome of the treated unit and the counterfactual outcome of the weighted control group. Suppose $J+1$ is the number of countries, where the first was exposed to an intervention, while the remaining J constitute the so-called donor pool of potential control units. The scalar w_j denotes the weight of entity j in the synthetic control. Information is necessary for T time periods, whereas T_0 is the number of pre-treatment periods, with $1 \leq T_0 < T$. Typically a sizeable time series of the outcome prior to the intervention is required. The reason is that the synthetic control method instils confidence when mirroring the characteristics and outcome levels of the treated unit during an extended period before an intervention. $W = (w_1, ..., w_j)$ represents a $(J \times 1)$ vector of non-negative weights which sum to one. Subsequent to the intervention after T_0 the treated entity and its controls are observed in different states. The estimator $\hat{\beta}_t$

thus takes the following form:

$$\hat{\beta}_t = y_{1t}^1 - \sum_{j=2}^{J+1} w_j y_{jt}^0, \quad \forall t > T_0. \tag{1}$$

The synthetic control method provides a systematic way for selecting a suitable control, more precisely: it synthetically constructs a desired unit with respect to relevant predictors. Let X_1 be a $(K \times 1)$ vector containing pre-treatment values of k variables functioning as predictors of the outcome. Most commonly pre-intervention values of Y act as predictors, too. Now suppose $\boldsymbol{X}_J$ is a $(K \times J)$ matrix of the values of the same variables for all potential controls from the donor pool. Further, $\boldsymbol{V}$ is a diagonal matrix with non-negative components. The values of the diagonal elements in $\boldsymbol{V}$ denominate the relative importance of different predictors. The discrepancy in pre-treatment characteristics between the affected country and its synthetic counterpart is expressed by the vector $X_1 - \boldsymbol{X}_J W$. Conditional on $\boldsymbol{V}$, the optimal vector of weights W^* for the units in the donor pool is meant to minimise

$$(X_1 - \boldsymbol{X}_J W)^{\mathsf{T}} \boldsymbol{V} (X_1 - \boldsymbol{X}_J W) \tag{2}$$

subject to $w_j \geq 0$ $(j = 1, 2, ..., J)$ and $w_1 + ... + w_J = 1$. Put differently, W^* is the vector of weights minimising

$$\sum_{m=1}^{k} v_m (X_{1m} - (\boldsymbol{X}_J W)_m)^2, \tag{3}$$

where v_m stands for the relative importance of the m-th variable. The designed synthetic cohort is defined by the set of weights W^* that resembles the treated unit in determinants of the outcome variable as closely as possible.

Because W^* builds on the importance of a set of predictors expressed in $\boldsymbol{V}$ clarifying a procedure to detect favourable values for them is indispensible. To evade cherry picking Abadie and Gardeazabal (2003) propose setting $\boldsymbol{V}$ such that the evolution of the outcome is best reproduced by the synthetic control. Formally, $\boldsymbol{V}^*$ should minimise the sum of the squared differences between predicted and true values before the treatment: the mean squared prediction error (MSPE) defined as

$$\text{MSPE} = \frac{1}{T_0} \sum_{t=1}^{T_0} \left(y_{1t}^0 - \sum_{j=2}^{J+1} w_j y_{jt}^0 \right)^2. \tag{4}$$

Alternatively, the MSPE might also be minimised for some matching period shorter than T_0. The pre-treatment MSPE hints at how accurately the synthetic cohort tracks the actual levels of the outcome and demonstrates whether or not the method

is able to model the outcome path based on predictors. The decision on $\boldsymbol{V}$ in this data-driven technique aims to tweak the simulated outcome trend in comparison with its real course.

The goal is to calculate unconventional monetary policy's effect as the difference between Japan's true inequality path and its unobserved counterfactual. Unless there is a strong prior belief that the synthetic control method needs to balance specific covariates Ferman et al. (2020) recommend a model simply using all pre-treatment values of the outcome variable as predictors.[9] In defiance of this rule of thumb, the model considers additional predictors since it is hardly possible to replicate ups and downs by averaging the variable of interest alone. Although, the selection of covariates is always subject to somewhat arbitrary decisions, the erratic history of Japan's economy advises to do so. $\boldsymbol{Y}_J$ is a $(T \times J)$ matrix whose elements are values of income inequality for the controls. The outcome levels that Japan would have experienced in the absence of an intervention are approximated by the synthetic cohort: $\boldsymbol{Y}_J W^*$.[10]

6 Results

6.1 Main Model

Table 3 confirms that the synthetic cohort succeeds in matching Japan in terms of the selected predictors. To reproduce the trend of income inequality in Japan the data-driven procedure assigns Germany a weight of 0.661, Türkiye a weight of 0.106 and the United States a weight of 0.233. All other countries in the donor pool end up with zero W-weights. Table 3 contrasts the pre-treatment characteristics of Japan with that of its synthetic version and the average of the 27 countries in the donor pool (after excluding Canada and Luxembourg). All in all, this demonstrates the affinity between Japan and its synthetic counterpart. The inclusion of covariates safeguards against comparing 'extreme counterfactuals' too far away from the original data (King & Zeng, 2006). The weighted synthetic control enables an approximation of the values observed for drivers of income inequality in Japan.

[9] Such a conduct of the synthetic control method is presented in Subsection A.2 of the Appendix.

[10] Considerations on requirements of the method as well as its explanatory power are moved to Subsection A.1 in the Appendix.

Table 3: Income Inequality Predictor Balance

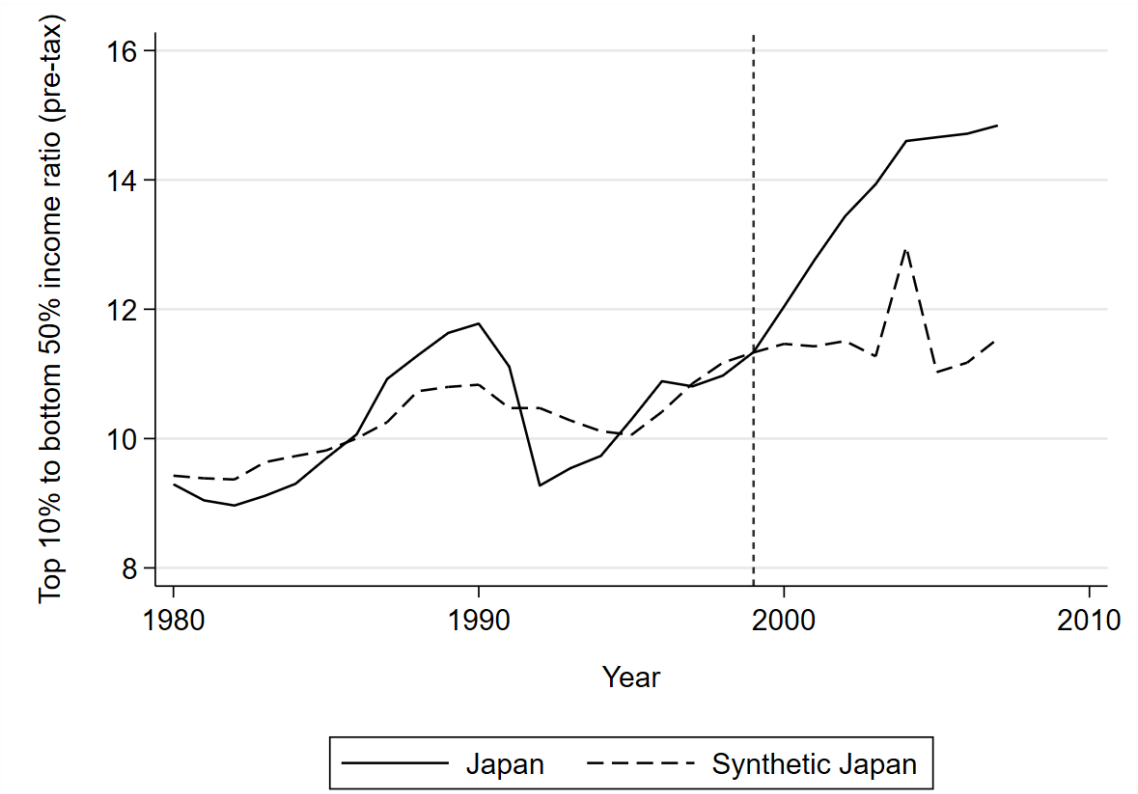
Variables	Japan	Synthetic	Donor Pool (⌀)
Top 10% to bottom 50% income ratio	10.27	10.03	8.79
GDP per capita	24,630.06	18,256.70	15,178.97
Trade-to-GDP	20.21	37.85	60.80
FDI inflows (% of GDP)	0.02	0.41	1.39
Private credit (% of GDP)	155.52	90.05	61.68
Banking crisis	0.11	0.03	0.08
Government consumption (% of GDP)	14.28	17.94	18.28
Population	123,000,000	116,000,000	32,800,000
Employment-to-population	61.75	54.93	54.57

Notes: All variables except the pre-treatment observations of the top 10% to bottom 50% (pre-tax) income ratio are averaged for the period 1980–1998. The top 10% to bottom 50% income ratio is averaged for the years 1980, 1985, 1990 and 1995. GDP per capita is measured in constant 2015 US dollars.

The levels of the top 10% to bottom 50% income ratio in Japan progressively outpaced the corresponding levels for the synthetic cohort after the intervention occurred as illuminated by Figure 2. Despite struggling to portray the real outcome path perfectly, the synthetic control method respects the fluctuations during the period 1980–1998. The pre-intervention MSPE for Japan (the average of the squared discrepancies between the income ratio in Japan and its synthetic counterpart during the period 1980–1998) is fairly small taking a value of circa 0.31. This suggests that balancing a set of important covariates provides a sensible approximation of what the income ratio would have been after 1998 in the absence of the Bank of Japan's unconventional monetary policy. The synthetic control method estimates no immediate effect in the year 1999 itself. This changes dramatically thereupon: the actual level of inequality dwarfs the counterfactual scenario. Peaking in 2005 this gap reached a value of 3.63. Overall, the observed divergence corresponds to a rise in income inequality of 28.57% by 2007.

The impact of Japan's unconventional monetary policy on income inequality is substantial in its magnitude. The evolution of the calculated gap is plotted in Figure 3, along with data on the monetary base and the uncollateralised overnight call rate in Japan. Subsequent to the initiation of Japan's zero interest rate policy in February 1999, the gap between the actual and counterfactual income ratio began to spread noticeably. Due to the introduction of quantitative easing in March 2001 the monetary base experienced a sharp upswing preluding a spike in an already pronounced income inequality gap. Prior to unconventional monetary policy central banking basically consisted in setting interest rates. Interestingly, the call rate lagged behind changes in the income ratio during the pre-treatment period. Starting with the intervention, however, the relation between monetary policy and inequality was reversed. Under zero interest rates, income inequality seems to respond to an

Figure 2: Income Inequality in Japan and the Synthetic Control Based on Matching Predictors for the Years 1980–1998



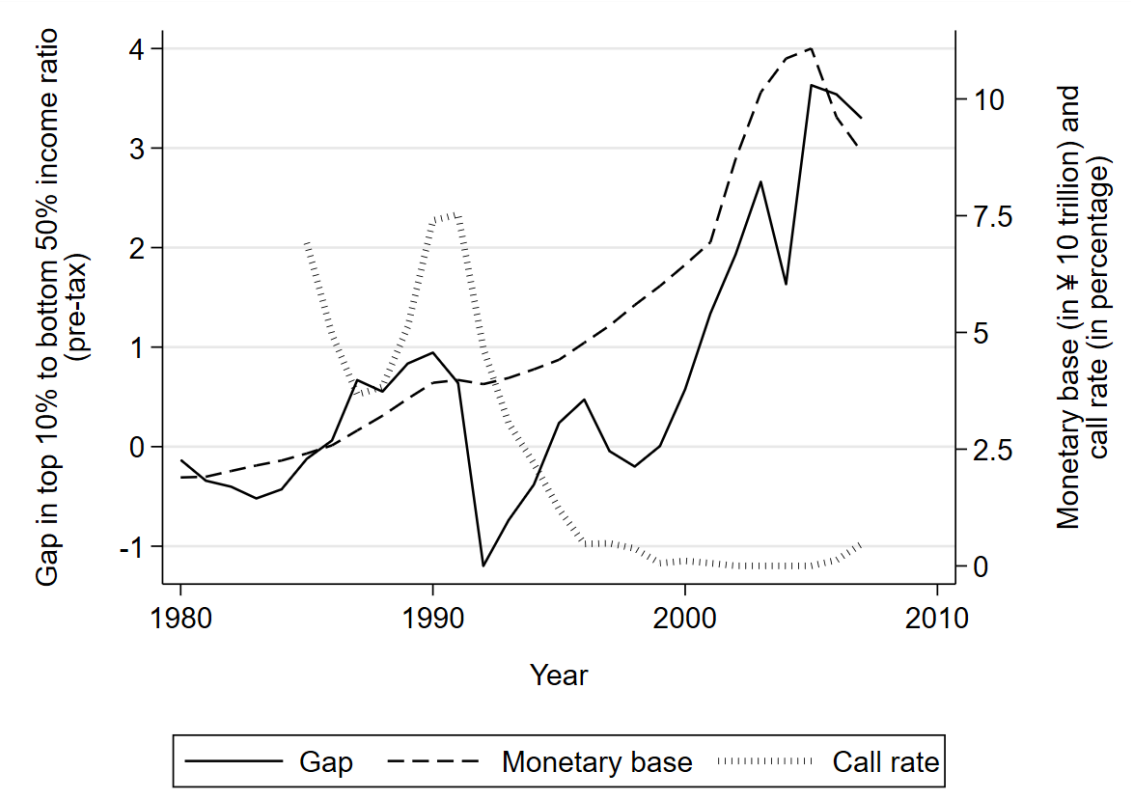
Notes: Graph compares the top 10% to bottom 50% (pre-tax) income ratio in Japan and in a synthetic control constructed as a weighted average of other OECD members. The weights used to construct the synthetic control are chosen to minimise the distance in terms of the average top 10% to bottom 50% income ratio for the years 1980, 1985, 1990 and 1995 as well as other predictors of income inequality (GDP per capita, trade-to-GDP, net FDI inflows (% of GDP), private credit by financial institutions (% of GDP), the presence of banking crises, government consumption (% of GDP), population and employment-to-population) during the period 1980–1998; see Section 5 for more details.

expansion of the monetary base through quantitative easing. With Japan returning to conventional monetary policy in 2006 its experimentation with new policy tools accounted for a rise in income inequality of more than 31%, showing no signs of a considerable decline in 2007.

6.2 Robustness and Sensitivity

Numerous robustness and sensitivity checks do not raise any doubts about the effect of unconventional monetary policy as illustrated by Figure 4. To validate the results reported in Subsection 6.1 alternative applications of the synthetic control method are examined, both varying the outcome variable as well as the compounding of a control group (Subsection A.3 of the Appendix covers more details on these implementations). Altogether, different specifications confirm the credibility of the prior results.

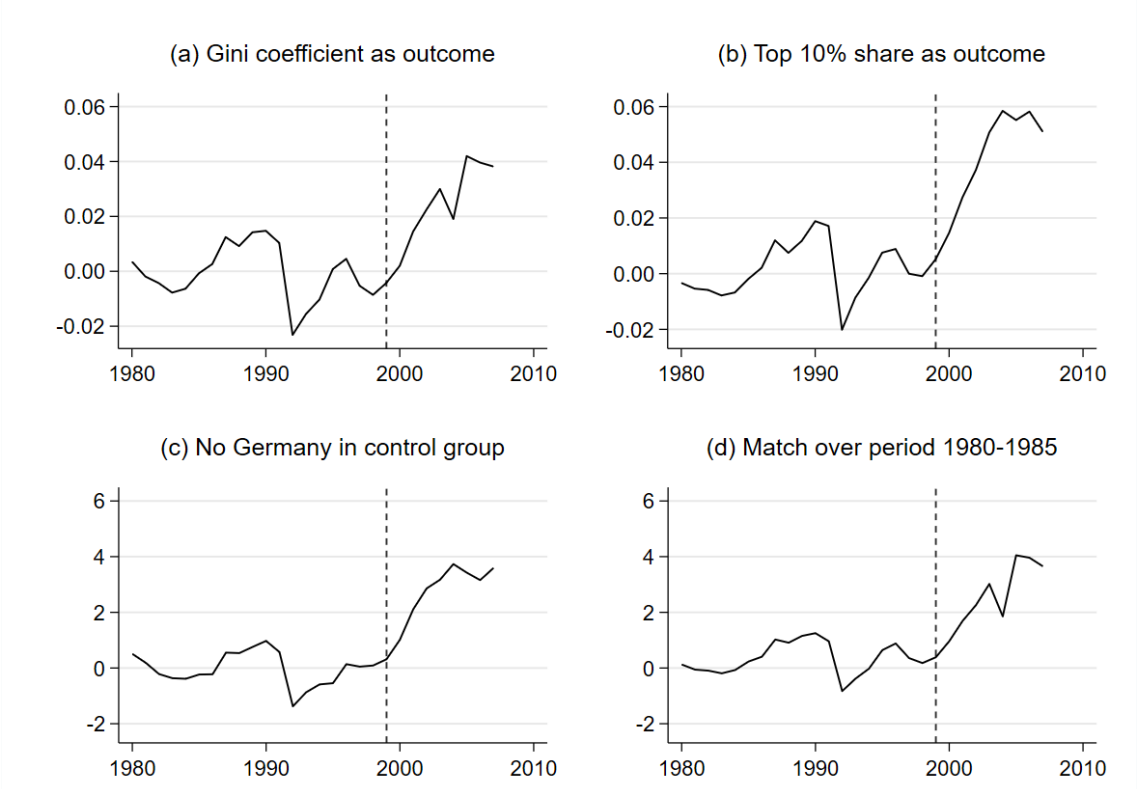
Figure 3: Income Inequality Gap in Japan Based on Matching Predictors for the Years 1980–1998, Monetary Base and Uncollateralised Overnight Call Rate



Notes: Graph depicts the difference between Japan and its synthetic control in terms of the top 10% to bottom 50% (pre-tax) income ratio. The synthetic control is constructed as a weighted average of other OECD members. The weights used to construct the synthetic control are chosen to minimise the distance in terms of the average top 10% to bottom 50% income ratio for the years 1980, 1985, 1990 and 1995 as well as other predictors of income inequality (GDP per capita, trade-to-GDP, net FDI inflows (% of GDP), private credit by financial institutions (% of GDP), the presence of banking crises, government consumption (% of GDP), population and employment-to-population) during the period 1980–1998; see Section 5 for more details. Additionally, the yearly average of the monetary base and the uncollateralised overnight call rate are included in the graph based on information retrieved from the Bank of Japan (2024).

The first two graphs of Figure 4 evince the robustness of the findings to alternative measurements of income inequality. Firstly, the effect on the income Gini coefficient is estimated in (a). Secondly, in (b) the top 10% share of national income is used to assess the impact on inequality. Note that in these cases, changing the outcome variable involves switching to another scale. Both the Gini coefficient and the top 10% share can theoretically range from 0 to 1. The baseline values against which the impact on income inequality is evaluated are already relatively large as they are located between 0.40 and 0.55 towards the end of the sample period. This is important when interpreting the estimated gap. The income inequality gap takes a value of approximately 7.46% or 12.50% when scrutinising the Gini coefficient and the top 10% share, respectively. The effect being more prominent for the top

Figure 4: Robustness and Sensitivity Checks for the Estimation of the Income Inequality Gap in Japan Based on Matching Predictors



Notes: Graph depicts the difference between Japan and its synthetic control in terms of income inequality under different applications of the synthetic control method. The weights used to construct the synthetic control are chosen to minimise the distance in terms of the outcome measuring income inequality (namely the top 10% to bottom 50% (pre-tax) income ratio if not specified differently) and other predictors of income inequality (GDP per capita, trade-to-GDP, net FDI inflows (% of GDP), private credit by financial institutions (% of GDP), the presence of banking crises, government consumption (% of GDP), population and employment-to-population). The distance between Japan and its synthetic control is minimised over the period 1980–1998 (if not specified differently) while the observation of the outcome is included only for every fifth year of the matching period; see Section 5 for more details.

10% share propounds that the rise in inequality is driven by top incomes elevating. What is essential is that the synthetic control method yields highly similar patterns in terms of the evolution of income inequality.

The last two graphs of Figure 4 document the sensitivity to variations alternating the construction process of the synthetic cohort. Since the synthetic control method usually delivers weights for a small number of units in the donor pool (Abadie et al., 2010), one concern may be a sensitivity to the particular performance of single control units. In the main model, Germany dominates the composition of the control group with a weight of 0.661. Therefore, in a third step, Germany is discarded from the donor pool. Notwithstanding, the estimation in (c) changes little in terms of the results. Finally, a fourth step in (d) is to minimise the distance between Japan and its

synthetic counterpart over a different time window: 1980–1985. This divides the pre-treatment years into a training period from 1980 to 1985 and a validation period from 1986 to 1998. For the purpose of narrowing the matching period to 6 years further countries (besides Canada and Luxembourg) need to be excluded from the donor pool due to data limitations: Czechia, Hungary, Poland and Slovakia. Information on employment before 1991 is not obtainable, which is why the variable employment-to-population must be dropped as a predictor. Still, the synthetic control method based on a shorter matching period is obtaining results largely similar. If anything, the adjustments in designing the control group encourage a clear-cut result: an income inequality gap of nearly 26% in (c) and more than 32% in (d).

6.3 Placebo Study

In practice the application in (c) of Figure 4 entails an in-time placebo test, albeit extending the scope beyond the true year of intervention. Subsection A.4 from the Appendix adds another in-time placebo test, for which the year 1993 is elected as a hypothetical kickoff of unconventional monetary policy in Japan. Synthetic Japan carefully reproduces the real trend of income inequality for the matching period and, what is even more crucial, for the subsequent years through 1999 in either of these models.

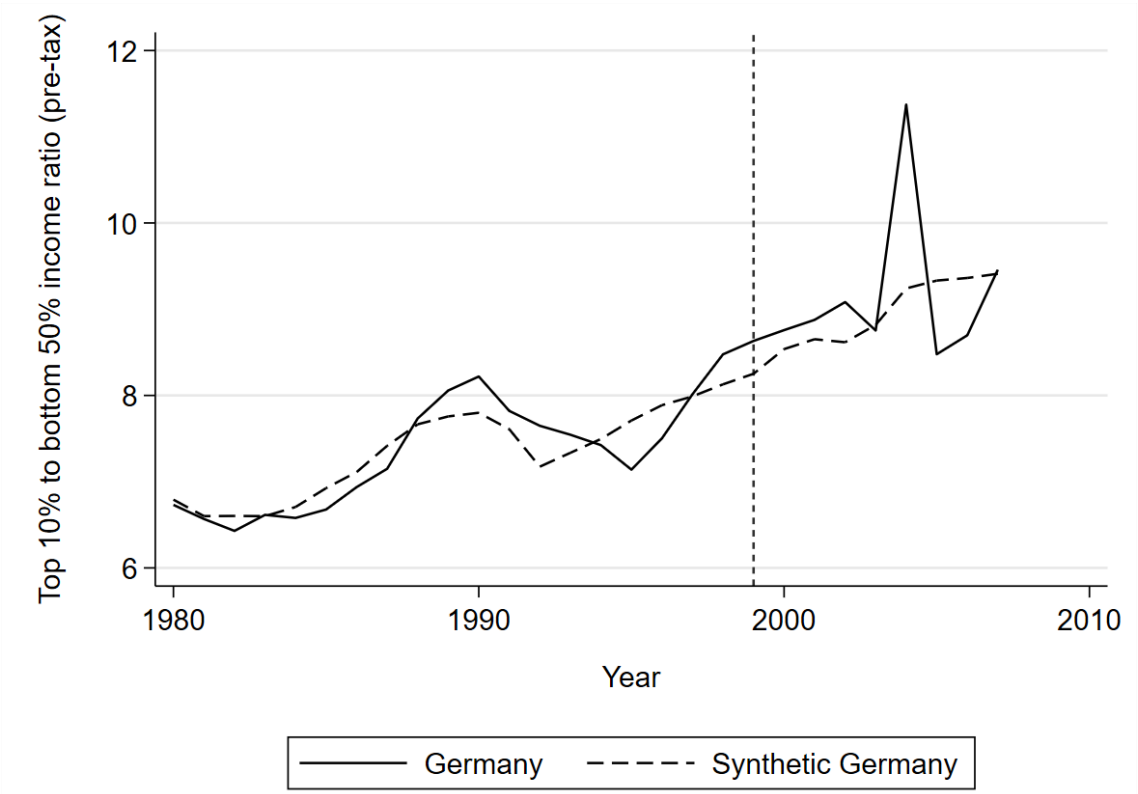
To carry out an in-space placebo study Germany as the largest weight for synthetic Japan is selected. Beyond being akin in features grasped directly by inequality determinants before Japan's departure from conventional monetary policy a closer inspection of central banking in Japan and Germany exhibits striking similarities. The *Bundesbank* is widely credited as the independent central bank *par excellence*. Its predecessor, the *Bank deutscher Länder*, was able to consolidate its autonomy thanks to missing political consensus on the question of central bank independence after the Allies relinquished their command (Singleton, 2011, pp. 122–125). The Bundesbank engaged in 'monetarist corporatism' (Johnson, 1998, p. 109) moderating a collective effort of institutional actors to stabilise inflation. *De jure* the situation was vastly different for the Bank of Japan. Until 1998 the Bank of Japan Law promulgated in 1942 stipulated that the 'Bank of Japan shall be operated exclusively with a view to accomplishing the purposes of the state' (as cited in Sakakibara & Noguchi, 1999, p. 409). Below the radar, however, the Bank of Japan independently allocated strict loan quotas to individual banks to fit a desired growth rate of credit (Werner, 2003, pp. 62–63). Therefore, just as in Germany monetary targets served as plausible abstractions from underlying financial operations (Wansleben, 2022, p. 103). Bank officials learned about how large their loan quota was going to be practically over the counter of the Banking Department, which is why this policy instrument came to be called window guidance (Werner, 2003, pp. 68–69).

The Bank of Japan resorted to window guidance as it was extricated from inference by the Ministry of Finance. Moreover, while the Ministry of Finance and the Bank of Japan rotated in appointing a candidate for central bank governorship in fact offspring from the Bank of Japan – the 'princes of the yen' – remained in charge all the time, first as deputy governor for an official figurehead from the Ministry and then as governor (Werner, 2003, pp. 145–148). The dominant position of the Bank of Japan and the Bundesbank empowered both central banks to impose a fixation on price stability at social and economic costs (Wansleben, 2022, p. 105). Akin to Japan Germany went through a period of low growth in the 1990s due to its approach to macroeconomic policymaking (Bibow, 2012). Packages of financial system reforms both in Germany and Japan started to dismantle their more co-ordinated models during the 1990s by leveraging markets at the expense of banks (Vitols, 2003). During the persistent stagnation in the 1990s, the Bank of Japan dropped its ties to the quantitative control regime and gained formal independence in 1999 (Rhodes & Yoshino, 2007). Meanwhile, policymakers on the other side of the globe envisaged the installation of the European System of Central Banks. The Bundesbank triumphed in insisting on a strong commitment to price stability and independence from any political control (Singleton, 2011, pp. 263–264). In 1999 the baton was passed to the ECB.[11] An inquiry into an international comparison of central banking by three ECB economists maps out that despite institutional differences the ECB, the Fed and the Bank of Japan (if experimentation with unconventional measures is overlooked) administer monetary policy in a fundamentally similar fashion (Gerdesmeier et al., 2007). Unlike the other two, the Bank of Japan has very limited influence on the foreign monetary policy of major economies in the immediate term (Antonakakis et al., 2019), which should dispel concerns over potential spillovers. Inflation – which was not included as a predictor since the beginning of Japan's pre-treatment period would draw a picture contradicting the chronic deflationary pressure holding the country firmly in its grip towards the end – was nothing out of the ordinary in Germany (a closer inspection is part of Subsection A.7 in the Appendix). Right from the start the ECB was required to cope with economic challenges: the breakdown of the dot-com bubble in 2000 demanded harsh cuts in interest rates (even more so in the United States) (Hartmann & Smets, 2018). While the ECB (and the Fed) were dedicated to a textbook example of central banking during the post-treatment period Japan implemented unfamiliar monetary policy tools – a fact that may indeed help in disentangling the effect of non-standard instruments relative to those measures central banks are more conversant with.

The placebo study assigns a pseudo-intervention to untreated Germany with the aim of proving that the employed techniques are able to replicate the outcome

[11] A detailed record of the ECB's conduct of monetary policy until its twentieth anniversary is provided by Rostagno et al. (2019).

Figure 5: Income Inequality in Germany and the Synthetic Control Based on Matching Predictors for the Years 1980–1998 (Placebo Test)



Notes: Graph compares the top 10% to bottom 50% (pre-tax) income ratio in Germany and in a synthetic control constructed as a weighted average of other OECD members. The weights used to construct the synthetic control are chosen to minimise the distance in terms of the average top 10% to bottom 50% income ratio for the years 1980, 1985, 1990 and 1995 as well as other predictors of income inequality (GDP per capita, trade-to-GDP, net FDI inflows (% of GDP), private credit by financial institutions (% of GDP), the presence of banking crises, government consumption (% of GDP), population and employment-to-population) during the period 1980–1998; see Section 5 for more details.

path in the absence of any experimentation with unconventional monetary policy. Figure 5 shows the actual evolution of the top 10% to bottom 50% income ratio for Germany and the one implied by the synthetically constructed Germany. The weighted combination of OECD members virtually clones income inequality for Germany. The MSPE for the pre-treatment and the post-treatment period is 0.07 and 0.61, respectively. The slightly higher MSPE for the post-treatment period is chiefly driven by an unexpected momentary amplitude of income inequality in Germany. A corresponding calculation of the pre-treatment MSPE for Japan is 0.31, that of the post-treatment MSPE 5.8. Since Germany is the primary contributor to the synthetic control for Japan, its spike in income inequality in 2004 provokes an artificial apogee of the simulated outcome path of synthetic Japan in the same year (see Figure 2). At the end of the sample period, however, the income inequality gap for Germany is nearly zero. The placebo test indicates that, while reproducing

fluctuations in the income ratio for Germany leaves room for improvements, the long-term trend can be reasonably well imitated by the synthetic control method. The ample weight of Germany in the synthetic cohort against which the final effect of quantitative easing in the vicinity of zero interest rates in Japan is calculated promotes an accurate estimation.

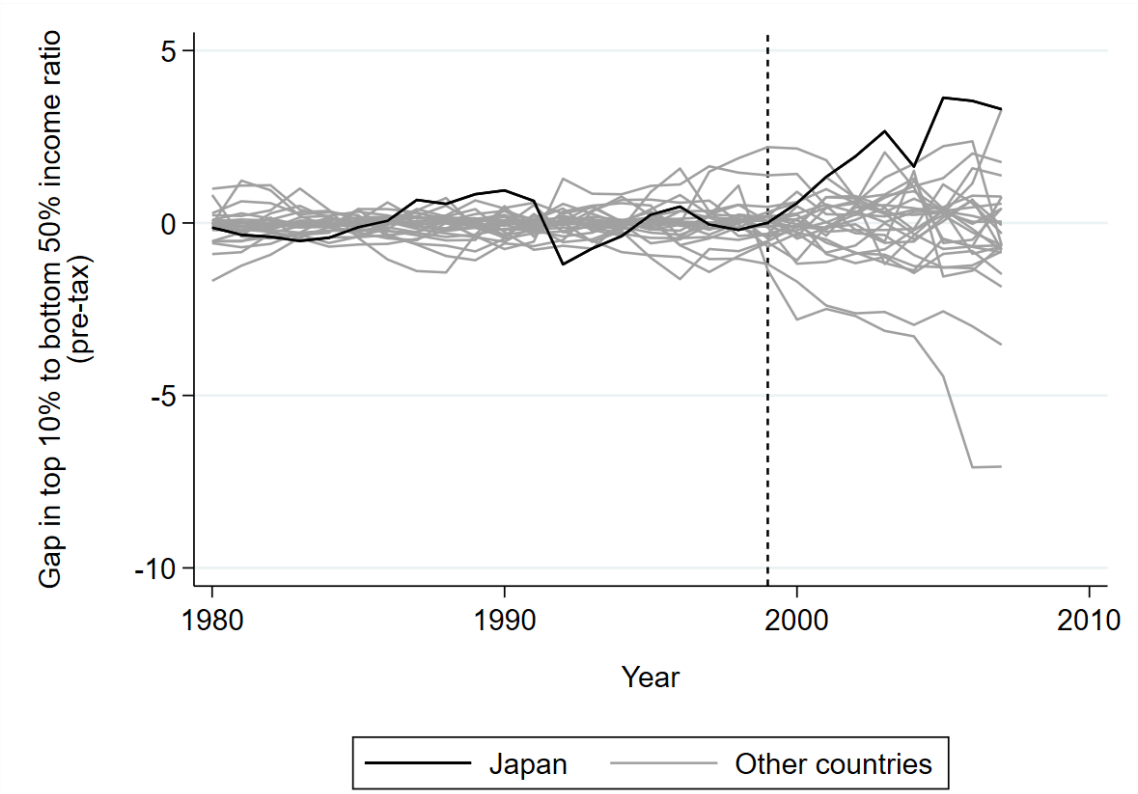
6.4 Inference

To assess the significance of the estimates derived from the synthetic control method, Abadie et al. (2010) propose to conduct a series of in-space placebo studies by iteratively applying the synthetic control method to all other entities in the donor pool. In each iteration, the intervention is reassigned to one control unit shifting the 'truly' treated one to the donor pool. Analogously, the effect of unconventional monetary policy reported in Figure 2 is computed for each of the other OECD members pretending that every single country experienced the treatment in 1999. In doing so 26 pseudo-treatment effects are calculated omitting Canada and Luxembourg for which data are missing as well as Mexico for which the synthetic control method can not be executed. The permutation provides a distribution of estimates for the treated unit along its placebos.

The synthetic control method offers a good fit for the top 10% to bottom 50% income ratio in most countries prior to Japan's overhaul of central banking. The median pre-intervention MSPE among all remaining countries is about 0.10. Their estimates are displayed in Figure 6. Excluded from the graph is – besides Canada, Luxembourg and Mexico – Türkiye, for which the pre-intervention MSPE is more than 16 times higher than that of Japan. Concerning the data, the large MSPE for Türkiye is no surprise, for it is associated with extreme values of the income ratio. Among all countries in the sample, the income ratio of Türkiye is the second highest during the whole period prior to the treatment. Mexico exhibits the highest income ratio for every year before 1999. Thus, there exists no convex combination of countries that can copy the time series of the income ratio in Mexico. The outcome path of Türkiye posits comparable problems. For these countries, the synthetic control method seems ill-advised. The exclusion of Türkiye corresponds to a very lenient cutoff of more than 16 times the MSPE of Japan (see Subsection A.5 of the Appendix for the graph of permutations dropping this cutoff). Putting outliners aside the synthetic control method provides decisive approximations.

According to the results from the iterations of the synthetic control method in Figure 6 no placebo suffered a rise in inequality fully comparable to that of Japan. The grey lines represent the gaps associated with the runs of the placebo tests. That is, the lines show the differences in the income ratio between each country and its respective synthetic cohort. The superimposed black line denotes the

Figure 6: Estimated Income Inequality Gap for Each Unit of the Donor Pool Based on Matching Predictors for the Years 1980–1998 (Placebo Tests)



Notes: Graph depicts the difference between Japan ('treated') and its synthetic control in terms of the top 10% to bottom 50% (pre-tax) income ratio along the same differences for all other countries ('placebos') in the donor pool. Countries with a pre-treatment MSPE 16 times higher than Japan or constant outcome levels during the pre-treatment period are discarded. Each synthetic control is constructed as a weighted average of other OECD members, where the weights are chosen to minimise the distance in terms of the average top 10% to bottom 50% income ratio for the years 1980, 1985, 1990 and 1995 as well as other predictors of income inequality (GDP per capita, trade-to-GDP, net FDI inflows (% of GDP), private credit by financial institutions (% of GDP), the presence of banking crises, government consumption (% of GDP), population and employment-to-population) during the period 1980–1998; see Section 5 for more details.

corresponding gap estimated for Japan. During the era of unconventional monetary policy beginning in 1999, the gap in the income ratio between Japan and its synthetic cohort surged from the middle to the top end of the distribution. By 2007 the only other country with a comparable income inequality gap is Hungary. Nonetheless, the gap for Hungary is inconspicuous until it suddenly jumps upward at the very end of the sample period. By contrast, the rise of income inequality in Japan unfolds in tandem with the post-treatment period. Ergo it can be attributed to the intervention. In the context of this paper's research interest the estimated effect for Hungary, whose placebo study is confined to the Appendix (Subsection A.6), appears to be a mere coincidence. Either way, the estimated effect for Japan is

unusually high relative to the distribution of gaps for the countries in the donor pool.

In absolute value, two other countries experienced a divergence of their actual and counterfactual inequality trend as large as that of Japan: Spain and New Zealand. Spain's synthetic counterpart soared to exceptionally high levels from 1995 onward. A reason for this is given by researchers from the *Banco de España* (Izquierdo & Lacuesta, 2007). Technically alterations in the labour force would have increased inequality had the wage structure not changed. New Zealand enjoyed a steep decline in income inequality after 1998 subsequent to a wide range of reforms superseding a highly regulated economy under weak performance (Hyslop & Yahanpath, 2006). Although one might typically associate liberalisation with rising inequality, it has seemingly resulted in broadly inclusive growth for New Zealand. With explanations at hand, that are not factored in by the model for the evaluation of the Japanese case, the estimations for Spain and New Zealand are not puzzling.

Overall, Japan's rise of income inequality appears to be extremely unlikely (based on the distribution of placebo estimates) under the null hypothesis of unconventional monetary policy having no effect. Two approaches to quantify the significance of the results are worth considering (Abadie et al., 2010). One way of evaluating the true treatment effect centres on the ratios of the post-treatment (root) MSPE to the pre-treatment (root) MSPE. In plain words, this means contrasting how strongly the countries differ from their synthetic counterpart in the post-treatment period as compared to the pre-treatment period. In light of Japan's unsettled economic course, which is difficult to imitate in its fluctuations by a combination of other countries, this exercise is not as desirable as it seems at first glance. Another more straightforward strategy fits better for the present issue: because Figure 6 includes 26 countries, the probability of receiving an income inequality gap as high as that for Japan under a random permutation of the intervention in the given data is $\frac{1}{23} \approx 0.04$ when putting outliners aside. A value of 4% is below test levels commonly used in conventional tests of statistical significance. Endowed with credibility by a series of placebo tests, the synthetic control method apprises us of Japan's trial of non-standard measures fuelling income inequality.

6.5 Channels

The results presented so far reflect a strong negative effect of unconventional monetary policy for income equality, yet they are unable to unravel the mechanisms behind such an outturn. To explain how quantitative easing under zero interest rates may affect income inequality Subsection 3.2 introduced five transmission channels: the earnings heterogeneity, the job creation, the income composition, the portfo-

lio and the savings redistribution channel. These transmission channels serve as guidance when dissecting the revealed effect.

For their explanatory power, two of the channels mentioned above rely on the occurrence of inflation, namely the savings redistribution and the portfolio channel. Yet, inflation did not loom during the post-treatment period. In fact, part of the Bank of Japan's policy was a dedication to maintain non-standard measures until deflationary pressure was tamed (Bank of Japan, 2006a). The conditions laid out in its commitment were not fulfilled until March 2006. In 2007 the uncollateralised call rate persisted at a level below 0.5% as reported in Figure 3. Withstanding a substantial monetary expansion inflation remained far from ascending. A record of changes in the consumer price index for Japan from 1980 through 2007 is attached to Subsection A.7 of the Appendix. Against the backdrop of Japan's monetary policy failing to notch up inflation, the savings redistribution channel and the portfolio channel can be ruled out as mechanisms behind the rise of income inequality.

Two other channels – the income composition and the job creation channel – expound the effect of unconventional monetary policy by its impact on the ratio of capital to labour income. The job creation channel argues that unconventional monetary policy dampens income inequality by securing or creating jobs through economic stimulation. This means, that labour income may be lifted. In contrast, the income composition channel posits that income inequality widens since high-income households can capitalise on flourishing financial markets while low-income households depend on stagnating nominal wages. Subsequently, whatever channel prevails decides on the direction of the effect – leaving aside any impact of the earnings heterogeneity channel independent from the job creation channel. Analysing the trend of capital and labour income offers an opportunity to study the underlying mechanisms. If unconventional monetary policy broadened income inequality due to the income composition channel prevailing over the job creation channel one should observe higher growth rates of capital income during the period 1999–2007.

The earnings heterogeneity channel, through whom the job creation channel operates, anticipates a modification within the labour income distribution. The fact that changes in hours worked and the unemployment rate mainly affect wages at the bottom (Amaral, 2017) alludes to a supremacy of the job creation channel within the mechanism of the earnings heterogeneity channel. An autonomous effect of the earnings heterogeneity channel might abide as Groiss (2023) points out for the impact of quantitative easing in Germany. As long as creating or securing jobs overrules other causes of change, a more even distribution of labour income averts something worse even if quantitative easing increases inequality overall.

Dictated by a lack of sufficient data the investigation must continue descriptively since moving to capital or labour income as an outcome variable is not feasible. Unfortunately, the dataset does not allow running the synthetic control method in

a reliable manner for a model estimating an effect on these concepts. Sufficient information is lacking for a major share of countries. Luckily, for Japan data on net capital income and compensation of employees during the period 1980–2007 is given. Therefore, it is possible to check the plausibility of the explication mapped out in Subsection 3.2 descriptively. Figure 7 charts the growth rates year-on-year for capital and labour income in Japan.

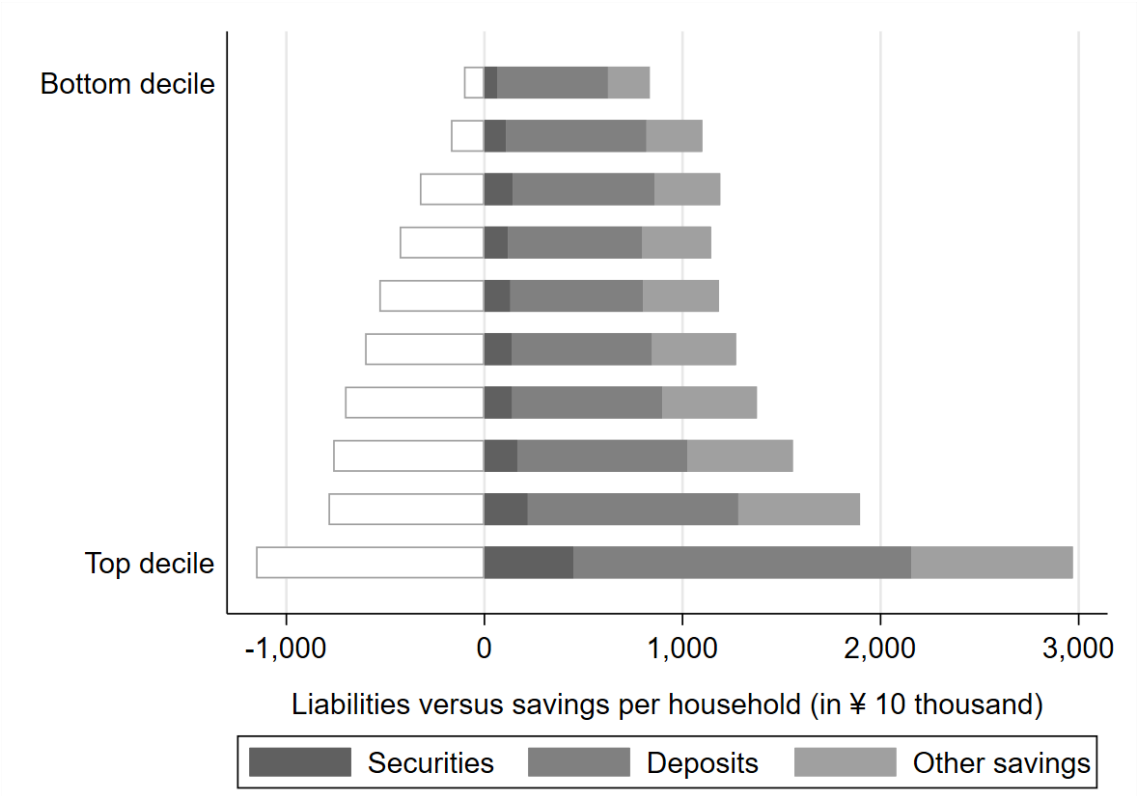
Figure 7: Year-on-year Growth Rates for Capital and Labour Income in Japan

Notes: Graph depicts the growth rates year on year for net capital income and labour income (compensation to employees) in Japan during the pre-treatment period 1980–1998 and the post-treatment period 1999–2007.

Comparing the year-on-year growth rates for capital and labour income plotted in Figure 7 bespeaks a predominance of the income composition channel. In general, the growth rates of capital income are subject to larger fluctuations. Besides that, growth rates in the pre-treatment period follow no clear pattern in terms of either those of capital or labour income outweighing the other. The treatment year 1999 seems to mark a switching point. While being more than 5 percentage points lower than the growth rate of labour income in 1998 the growth of capital income caught up in 1999 and reached a value of 10.53% the following year being 9.44 percentage points higher than that of labour income. Note that year-on-year growth was higher for capital than labour income during the whole post-treatment period. Labour income was effectively stagnating during the period 1999–2004 with growth rates near zero. This is in line with what the income composition channel predicts. After

the intervention, capital income growth exhibits two peaks, the first one just a year after the announcement to keep interest rates at the zero bound, the second one in the course of quantitative easing. A tentative interpretation of this is that the Bank of Japan's zero interest rate policy on its own was a strong signal reviving market expectations. Expectations plumped when the Bank of Japan retracted its commitment temporarily. The observed trend of capital and labour income growth implies progressing inequality – provided that top earners disproportionately receive returns from capital not nullified by changes in the labour income distribution.

Figure 8: Financial Assets per Household by Yearly Income Decile Group in Japan for the Year 1999

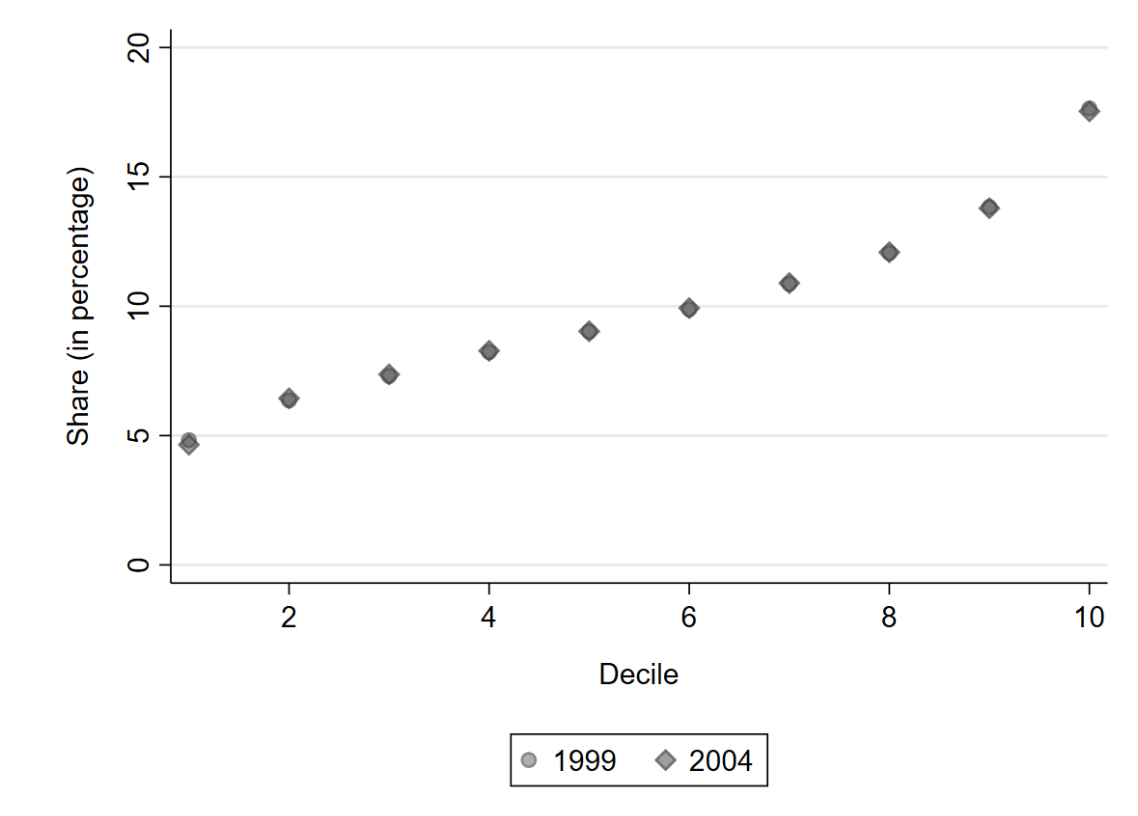


Notes: Graph compares the estimated value of financial family assets of two or more person households by yearly income decile groups in Japan as of the end of November 1999 based on information supplied by the Statistics Bureau of Japan (2001) from the National Survey of Family Income and Expenditure.

As a matter of fact, high incomes possessed way more fortunes in the form of financial assets as of the end of November 1999. Asset holdings were distributed unequally among households which is what Figure 8 delineates. Less liabilities savings of two or more person households came to 89.53 million yen in total. On average 8.95 million yen were held per household decile. Net assets amounted to 18.17 million yen for the top income decile alone while the whole bottom half owned 38.95 million yen. Put into perspective, the share of the top 10% income households exceeded 20% (and is more immense when looking at securities only). These richer

income groups invest a larger proportion in riskier assets like stocks (Nakagawa & Shimizu, 2000, p. 5), whose prices increased due to quantitative easing (Tsuji, 2016). Wages and salaries of households[12] remained constant in their distribution (see Figure 9), leastways until 2004, the last year before the Global Financial Crisis covered by national statistics.

Figure 9: Share of Overall Wages and Salaries per Worker Household by Yearly Income Decile Group in Japan for the Years 1999 and 2004



Notes: Graph compares the distribution of overall wages and salaries of two or more person households whose heads are employed by yearly income decile groups in Japan between the years 1999 and 2004 based on information supplied by the Statistics Bureau of Japan (2001, 2004) from the National Survey of Family Income and Expenditure.

The leap in Japan's income inequality corresponds to the pattern sketched out by the income composition channel: capital income underwent excessive growth while labour income was more or less stagnating, a development favouring higher incomes which park more money in financial assets. Recall, that the estimation for the top 10% share as the outcome in (b) of Figure 4 urged the interpretation that inequality intensified chiefly on the grounds of uplifting top incomes. With its zero interest rate policy Japan made the first move for this. All this is not to rule out the job creation channel and/or the residue of the earnings heterogeneity channel anyhow cushioning the negative impact on equality. Yet, they surely did not cancel out the income

[12]Be aware that the raw data excludes households whose heads are unemployed or executives of companies or corporations.

composition channel. Both the portfolio and the savings redistribution channel did not play out with inflation failing to materialise. Altogether quantitative easing in the vicinity of zero interest rates accounts for a rise of roughly 28% in inequality measured as the top 10% to bottom 50% (pre-tax) income ratio for Japan.

7 Discussion and Concluding Remarks

In unveiling a negative impact of the Bank of Japan's unconventional monetary policy on income equality the present comparative case study joins the ranks of plentiful model-based studies (Feldkircher & Kakamu, 2022; Leo, 2022; Saiki & Frost, 2014, 2020; Taghizadeh-Hesary et al., 2020; Yoshino et al., 2018; Yuksel, 2021). Pinned down to almost a 29% increase of the top 10% to bottom 50% income ratio (in contrast to a counterfactual outcome path synthetically constructed from countries that stuck to conventional monetary policy) the estimated effect appears drastic in its magnitude. Looking at other inequality measures the impact is more pronounced when deploying the synthetic control method for the top 10% income share than the Gini coefficient. These results hint at the distributional effect mainly running via the income composition channel. The underlying mechanism is that in a period of serious economic stress guaranteeing minimal interest rates and staging massive demand on financial markets boosts asset prices (and the income they generate) more than wages and employment. Preceding quantitative easing by two years it was indeed the Bank of Japan's zero interest rate policy firing the starting gun for galloping inequality, presumably, because the Bank of Japan's promise augured well for financial market prospects. Income inequality swelling enormously during Japan's first experimentation with unconventional monetary policy 1999–2006 presents a cautionary tale – although it is easy to imagine Japan being worse off without this therapy.

This finding fortifies the empirical literature warning of unconventional monetary policy's distributional consequences. The calculation for the income Gini coefficient tops that of Leo (2022), who claims that quantitative easing accounts for 15.3% of a 9.3% rise from 2000 to 2021. The present study finds that the Gini coefficient rose from 0.50 in 1998 to 0.56 in 2007 while spotting a gap of 0.04 between the actual and counterfactual trend. Hence, unconventional monetary policy is responsible for two-thirds of the observed growth in inequality. A large part of this disaccord is probably owed to differences in data.[13] Despite being only suggestive without giving a quantification of the relevance of different channels their exploration indicates that income inequality increased mainly through rising asset prices which convert into capital income gains for the rich (income composition channel). Employment effects

[13] After grossing up averages of income brackets Leo (2022) notices a rise in inequality only from 2013 onward, to begin with.

(job creation channel) were not sufficient in turning around the overall impact. Inflation (portfolio and savings redistribution channel) slumbered and the descriptives contain no clue for changes within the distribution of labour income (earnings heterogeneity channel). A prior examination puts forth that the prolonged monetary easing in Japan widened labour income inequality – at least between high-skilled and low-skilled workers (Israel & Latsos, 2020). This still leaves an avenue for further research. Similarly, distinguishing between purchases of different asset types is beyond the scope of the presented analysis. To ensure comparability the sample period ends with the year 2007 soon after the Bank of Japan resigned from quantitative easing. Thus, the observed increase in income inequality may be more informative for short-term effects. Nothing of the sort should blind policymakers to the fact that these side effects entail long-run consequences with inequality itself making future inequality (Taghizadeh-Hesary et al., 2020; Yoshino et al., 2018). What should be stressed is that with various channels pulling in opposing directions, the overall effect of unconventional monetary policy is theoretically indefinite. Accordingly, it would be valuable to devote further efforts to inquiries into (country-specific) structural characteristics amplifying or diminishing particular channels.

Unease over unconventional monetary policy cementing a tide of inequality is everything but misplaced. Monetary authorities tend to miss this because their models routinely capture aggregates rather than distributions, thus falling for the fallacy of an aggregate-data error (Petrou, 2021, pp. 98–102). Although for unconventional monetary policy necessity can be said to be the mother of invention central banks will probably keep non-standard instruments in their toolkit (Blinder et al., 2017). After all, this is exactly what the experience of Japan tells us, whose second round of unconventional monetary policy was way more aggressive. With finance enjoying infrastructural power for the transmission of monetary policy (Braun, 2020) non-standard instruments are likely to be used more regularly.[14] The exploration of relevant channels affirms that structural issues specify how inequality reacts to quantitative easing under zero interest rates. In the Japanese case labour market rigidity and the large share of the population older than 65 years or retired may have muted channels operating through the labour market (Saiki & Frost, 2020). While wages did not grow due to labour market frictions the older cohort's capital gains were re-saved in assets instead of being consumed or invested to start businesses. Therefore, an international comparison of structural characteristics determining the distributional effects of unconventional monetary policy offers a promising path for

[14]The persistence with which instruments other than interest rate changes are used has already prompted the former chairman of the Fed Ben Bernanke (2020) to try revising terminology on behalf of 'new tools of monetary policy' and some scholars go so far as to diagnose an era of central bank capitalism, in which economies hang by the silken thread of these operations (Wullweber, 2021). Whether central banks will be able to use their new tools more cautiously (Schnabel, 2024) depends on the volatility of the macroeconomic landscape and the financial system.

future research. This all is not to neglect that asset purchases are a vigorous measure to stabilise financial markets and the economy as a whole when push comes to shove. Nevertheless, their inadvertent side effects underscore doubts about new monetary policy tools being genuinely beneficial for broader societal concerns. Critics lament that unconventional monetary policy has been twisted to become a life support for fragile financial systems (Wullweber, 2021, pp. 229–234) that is manoeuvring economies deep into a financialisation trap (Wansleben, 2022, pp. 206–227). One side of this problem is the retreat of fiscal policy (El-Erian, 2016) in consolidated states tying up their own hands (Streeck, 2013). This is why some scholars call for revised fiscal policies to compensate for negative distributional effects (Coppola, 2019).

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A Appendix

A.1 Requisites of and Inference with Synthetic Controls

In comparative case studies at least one unit exposed to an intervention is contrasted with one or more untreated entities. The synthetic control method facilitates comparative case studies in instances when no single unit proves to be a satisfactory reference for comparison, a problem which is often encountered when large aggregates such as countries are focused (Abadie et al., 2015). Other central banks besides the Bank of Japan stuck to conventional monetary policy until 2008, so that Section 5 could proceed with a nomenclature for one treated unit. Presuming one exposed unit simplifies the exposition. Otherwise, data from the affected countries could first be aggregated.

Note, that some issues can still lead to a bias since the synthetic control method hinges on the assumption that a combination of control units can mimic the evolution of the outcome which one would observe for the treated unit in the absence of the intervention. Therefore, constituents of the control group should neither be influenced by events of a similar nature nor by spillovers from the treated unit. An entity having suffered vast idiosyncratic shocks to the outcome of interest should also motivate its exclusion if such shocks would not have disturbed the treated unit in the absence of the intervention. To avoid an interpolation bias the donor pool should not include controls with characteristics far from those of the treated unit. Restricting the size of the donor pool by strictly picking up controls similar to the treated unit also limits the risk of overfitting. This is why Abadie et al. (2015) use only members of the OECD when analysing the impact of German reunification. If a control unit violates the prerequisites for inclusion, it will ensure biased results, yet only if it obtained a non-zero weight w_j.

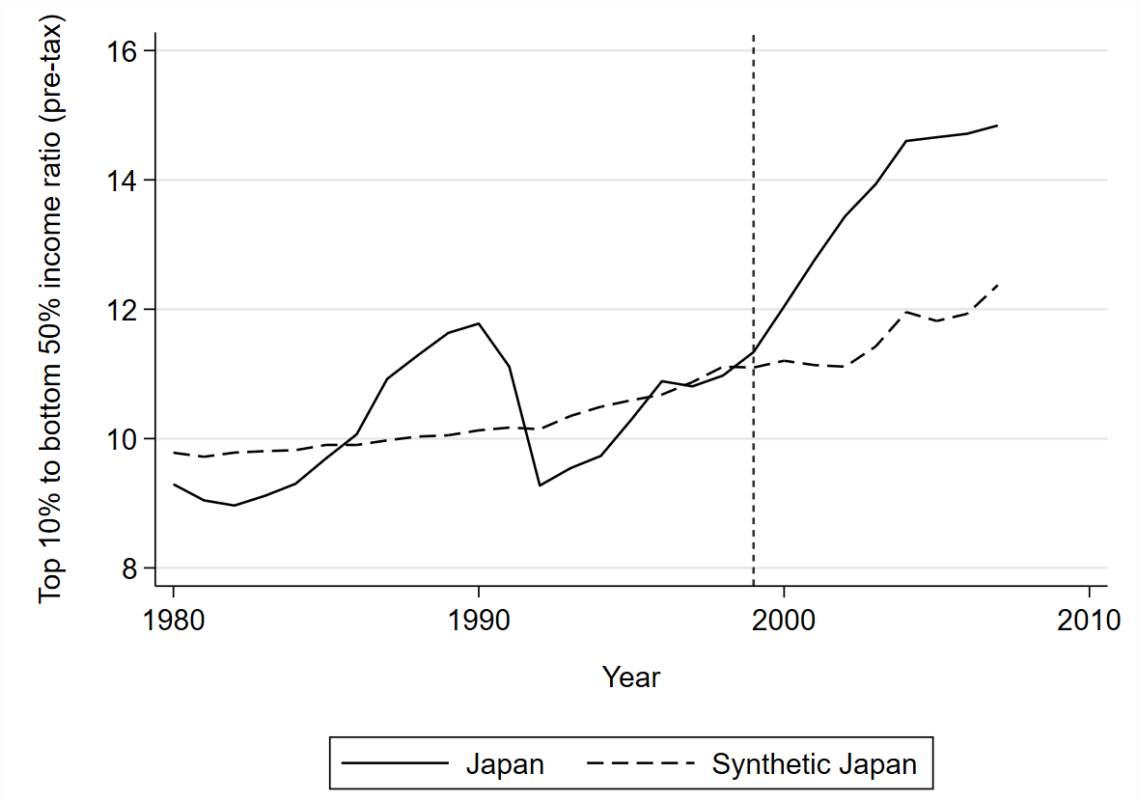
The synthetic control method alone says little about the credibility of its results and should be complemented by analyses to corroborate the credibility of the estimation: robustness and sensitivity checks as well as placebo studies. While robustness and sensitivity checks are regularly performed for all sorts of statistical analyses, in the context of the synthetic control method placebo studies are specifically designed to enable statistical inference. Classical significance tests building on standard errors and confidence intervals do not lend themselves to judgments in the context of the synthetic control method. Instead, statistical inference can be carried out by falsification exercises. Placebo studies apply the identification method to scenarios, in which no effect comparable in magnitude should be discovered, in order to validate that the effect is not merely accountable to an inability of the model to duplicate the counterfactual outcome path. In-time placebos as executed by Abadie et al. (2015) keep the treated unit constant and change the treatment

date to a point of time before the intervention. This is only feasible with sufficient pre-treatment data. Alternatively, in-space placebos performed by Abadie and Gardeazabal (2003) or Abadie et al. (2010) reassign the treatment not in time, but to an unaffected member of the donor pool. This creates a pseudo-treatment effect. Ideally, the synthetic cohort traces the outcome path of the placebo rigorously, not identifying any effect. Repeating the calculation for the whole donor pool delivers a distribution of placebo effects, which can be compared with the effect estimated for the actual intervention. The null hypothesis that the effect is equal to zero can be rejected if the real treatment effect is abnormal relative to the distribution of placebo estimates.

A.2 Model Specification Excluding Drivers of Inequality

Assembling a control group simply from the pre-treatment observations of the outcome substantiates that the results are not bound to a single specification relying on certain predictors. All values of the outcome variable before the intervention are used to obtain the weights contained in the $\boldsymbol{V}$-matrix under the default data-driven regression-based method. The weights for the construction of the synthetic cohort are distributed more or less equally among all countries of the donor pool (including Canada and Luxembourg) ranging from a weight of 0.032 to 0.067. Averaged over the period 1980–1998 the top 10% to bottom 50% income ratio is 10.20 in Japan and 10.17 in its synthetic counterpart. In simulating a smooth progression the synthetic control is abstracting the fluctuating trend of income inequality in Japan. This is reflected by the pre-intervention MSPE. With a value of 0.68, the pre-intervention MSPE more than doubles when ignoring drivers of income inequality. Despite this,

Figure 10: Income Inequality in Japan and the Synthetic Control Based on Matching the Outcome Variable for the Years 1980–1998



Notes: Graph compares the top 10% to bottom 50% (pre-tax) income ratio in Japan and in a synthetic control constructed as a weighted average of other OECD members. The weights used to construct the synthetic control are chosen to minimise the distance in terms of the average top 10% to bottom 50% income ratio during the period 1980–1998; see Section 5 for more details.

the results are similar to the main model from Subsection 6.1. As Figure 10 illustrates, the gap between the actual and counterfactual income ratio widened from

around zero at the end of the pre-treatment period to 2.47 in the last year of the sample period. Overall, the observed divergence corresponds to a rise in income inequality of nearly 20% by 2007. This affirms the strong negative impact of unconventional monetary policy, yet not without underlying the need to balance economic predictors.

A.3 Details on Robustness and Sensitivity Checks

The four models in Subsection 6.2 demonstrate the robustness and sensitivity of the results from Subsection 6.1 under the fully nested optimisation procedure. When running the synthetic control method for the income Gini coefficient as the outcome Switzerland ends up with a weight of 0.11, Germany with circa 0.4, Türkiye with 0.16 and the United States with roughly 0.33. The MSPE for the post-treatment is about eight times that of the pre-treatment period. In the case of the top 10% income share, the composition of the synthetic cohort is more similar to that of the main model: 0.64 for Germany, 0.19 for Türkiye and 0.17 for the United States. As compared to the pre-treatment period the MSPE increases by a factor of 20 for the post-treatment period. After excluding Germany from the donor pool Switzerland is assigned a weight of 0.31, France one of 0.15, Türkiye 0.08 and the United States 0.46. Switzerland being brought on to substitute for Germany is compelling because with Japan these countries form a trio in which central banking sovereignty was institutionalised early on under types of coordinated monetary targeting (Wansleben, 2022, pp. 68–106). The post-treatment is more than 12 times higher than the pre-treatment MSPE. When the distance between Japan and its synthetic counterpart is minimised over the period 1980–1985 Germany's contribution to the control group amounts to a weight of 0.72, that of Türkiye to 0.1 and that of the United States to 0.18. The MSPE increases by a factor of 17 from the pre- to the post-treatment period. Again, the selection of weights is coherent with the main model. The fact that the synthetic control method always assigns Germany the strongest weight (as long as it is left in the donor pool) indicates that a comparison of the Japanese case with Germany should be exceptionally insightful. Table 4–7 confirm that the respective synthetic cohort resembles Japan in each of the applications tested.

Table 4: Income Inequality Predictor Balance (Gini Coefficient as Outcome)

Variables	Japan	Synthetic
Income Gini coefficient	0.49	0.49
GDP per capita	24,630.06	19,027.82
Trade-to-GDP	20.21	39.13
FDI inflows (% of GDP)	0.02	0.59
Private credit (% of GDP)	155.52	92.51
Banking crisis	0.11	0.04
Government consumption (% of GDP)	14.28	15.94
Population	123,000,000	124,000,000
Employment-to-population	61.75	56.81

Notes: All variables except the pre-treatment observations of the (pre-tax) income Gini coefficient are averaged for the period 1980–1998. The income Gini coefficient is averaged for the years 1980, 1985, 1990 and 1995. GDP per capita is measured in constant 2015 US dollars.

Table 5: Income Inequality Predictor Balance (Top 10% Share as Outcome)

Variables	Japan	Synthetic
Top 10% income share	0.38	0.37
GDP per capita	24,630.06	16,657.00
Trade-to-GDP	20.21	38.61
FDI inflows (% of GDP)	0.02	0.37
Private credit (% of GDP)	155.52	82.51
Banking crisis	0.11	0.04
Government consumption (% of GDP)	14.28	17.42
Population	123,000,000	103,000,000
Employment-to-population	61.75	54.13

Notes: All variables except the pre-treatment observations of the top 10% (pre-tax) income share are averaged for the period 1980–1998. The top 10% income share is averaged for the years 1980, 1985, 1990 and 1995. GDP per capita is measured in constant 2015 US dollars.

Table 6: Income Inequality Predictor Balance (No Germany in Control Group)

Variables	Japan	Synthetic
Top 10% to bottom 50% income ratio	10.27	10.13
GDP per capita	24,630.06	23,287.95
Trade-to-GDP	20.21	44.78
FDI inflows (% of GDP)	0.02	0.99
Private credit (% of GDP)	155.52	107.92
Banking crisis	0.11	0.04
Government consumption (% of GDP)	14.28	14.69
Population	123,000,000	130,000,000
Employment-to-population	61.75	60.00

Notes: All variables except the pre-treatment observations of the top 10% to bottom 50% (pre-tax) income ratio are averaged for the period 1980–1998. The top 10% to bottom 50% income ratio is averaged for the years 1980, 1985, 1990 and 1995. GDP per capita is measured in constant 2015 US dollars.

Table 7: Income Inequality Predictor Balance (Match Over Period 1980–1985)

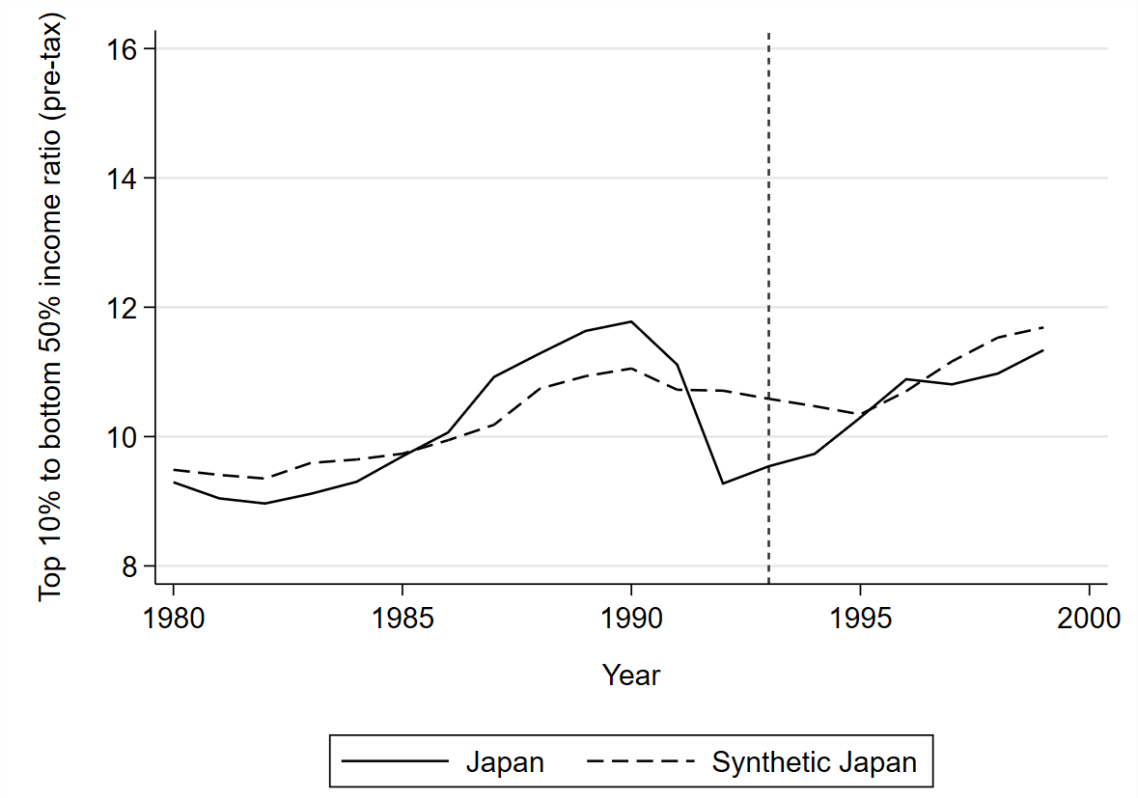
Variables	Japan	Synthetic
Top 10% to bottom 50% income ratio	9.49	9.31
GDP per capita	10,616.80	10,229.78
Trade-to-GDP	25.81	38.13
FDI inflows (% of GDP)	0.03	0.14
Private credit (% of GDP)	126.34	81.39
Banking crisis	0	0.05
Government consumption (% of GDP)	14.34	18.91
Population	119,000,000	103,000,000

Notes: All variables except the pre-treatment observations of the top 10% to bottom 50% (pre-tax) income ratio are averaged for the period 1980–1985. The top 10% to bottom 50% income ratio is averaged for the years 1980 and 1985. GDP per capita is measured in constant 2015 US dollars.

A.4 In-time Placebo Study for the Period 1980–1999

While Subsection 6.3 focuses on an in-space placebo Figure 11 displays the synthetic cohort for the in-time placebo tracking the real path of income inequality in Japan very closely. The model depicted by Figure 2 is rerun for a sample period shortened to the length of the initial pre-treatment period with a pseudo-intervention assigned to the year 1993, one year after the Japanese asset price bubble had visibly plummeted in its entirety. The 1993 placebo introduction of unconventional monetary policy has no perceivable effect, which is expressed by the MSPE. The MSPE both for the pre-intervention and the post-intervention period is 0.37. This suggests that the effect estimated in Subsection 6.1 reflects the impact of unconventional monetary policy rather than a potential lack of predictive power by the synthetic control method.

Figure 11: Income Inequality in Japan and the Synthetic Control Based on Matching Predictors for the Years 1980–1992 (Placebo Test)

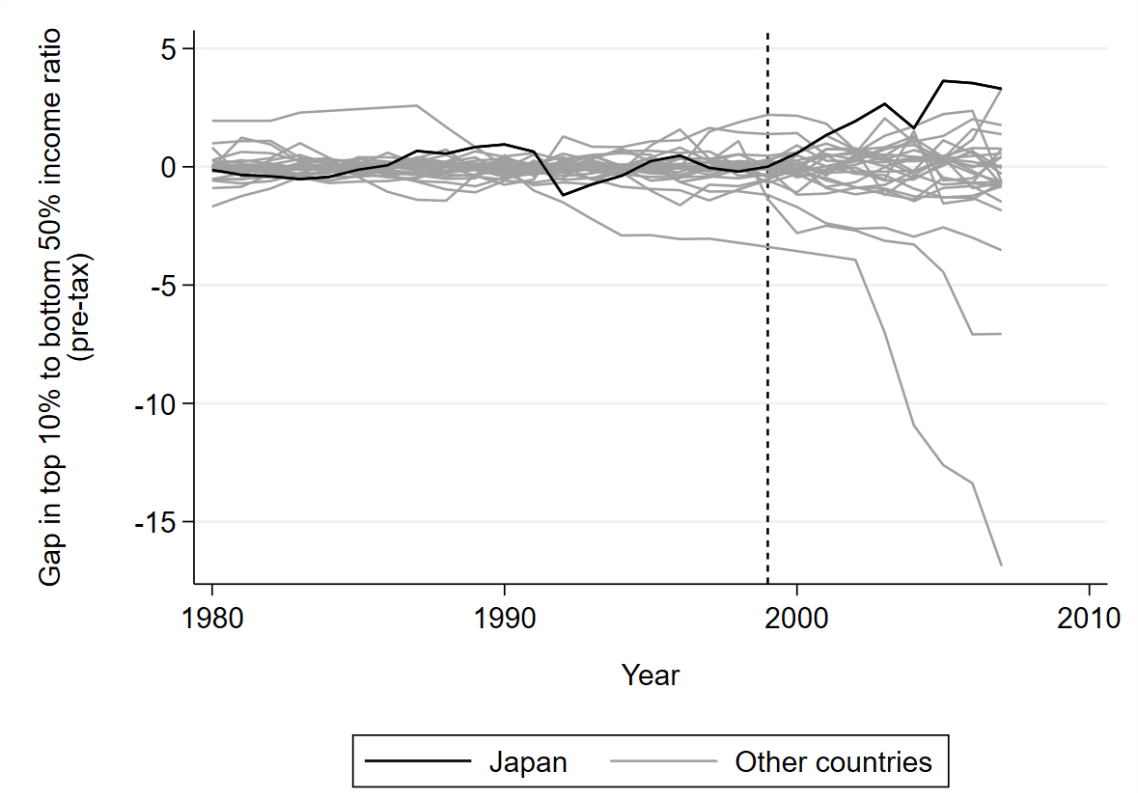


Notes: Graph compares the top 10% to bottom 50% (pre-tax) income ratio in Japan and in a synthetic control constructed as a weighted average of other OECD members. The weights used to construct the synthetic control are chosen to minimise the distance in terms of the average top 10% to bottom 50% income ratio for the years 1980, 1985 and 1990 as well as other predictors of income inequality (GDP per capita, trade-to-GDP, net FDI inflows (% of GDP), private credit by financial institutions (% of GDP), the presence of banking crises, government consumption (% of GDP), population and employment-to-population) during the period 1980–1992; see Section 5 for more details.

A.5 All Permutations of the Synthetic Control Method

The pre-treatment MSPE for Türkiye is more than 16 times that of Japan, which is why Figure 6 excludes the iteration for Türkiye. Figure 12 withdraws the corresponding cutoff. The synthetic control method is definitely ill-advised for Türkiye as it fails to reproduce its outcome path during the pre-treatment period.

Figure 12: Estimated Income Inequality Gap for Each Unit of the Donor Pool Based on Matching Predictors for the Years 1980–1998 (Placebo Tests without Cutoff)

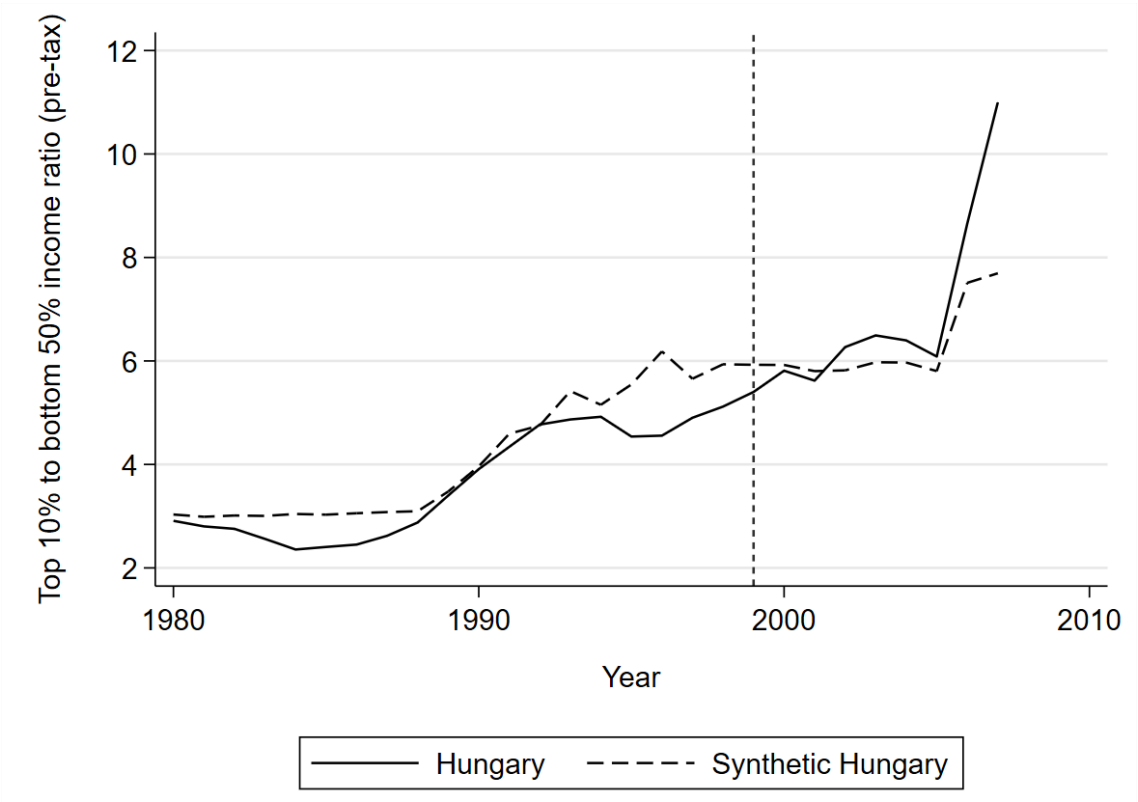


Notes: Graph depicts the difference between Japan ('treated') and its synthetic control in terms of the top 10% to bottom 50% (pre-tax) income ratio along the same differences for all other countries ('placebos') in the donor pool. Countries with constant outcome levels during the pre-treatment period are discarded. Each synthetic control is constructed as a weighted average of other OECD members, where the weights are chosen to minimise the distance in terms of the average top 10% to bottom 50% income ratio for the years 1980, 1985, 1990 and 1995 as well as other predictors of income inequality (GDP per capita, trade-to-GDP, net FDI inflows (% of GDP), private credit by financial institutions (% of GDP), the presence of banking crises, government consumption (% of GDP), population and employment-to-population) during the period 1980–1998; see Section 5 for more details.

A.6 Iteration of the Synthetic Control Method for Hungary

Hungary is the only country for which the synthetic control method yields an estimation somewhat comparable to that of Japan (see Subsection 6.4). Yet, after inspecting Figure 13 this turns out to be true only at first glance. The sole contributor to synthetic Hungary is Czechia with a weight of 1. Income inequality in both countries generally evolved in parallel. A noticeable deviation occurred within the last two years of the sample period when Hungary experienced an abnormal hike. Accordingly, while the MSPE of Hungary and Japan is more or less the same before the intervention (with a value of 0.37 for Hungary and 0.31 for Japan), the post-treatment MSPE of Japan is nearly four times that of Hungary. Given that the gap for Hungary represents a divergence from a single control country at the very end of the sample period, it seems plausible to attribute this effect to a shortcoming of the synthetic control method.

Figure 13: Income Inequality in Hungary and the Synthetic Control Based on Matching Predictors for the Years 1980–1998 (Placebo Test)

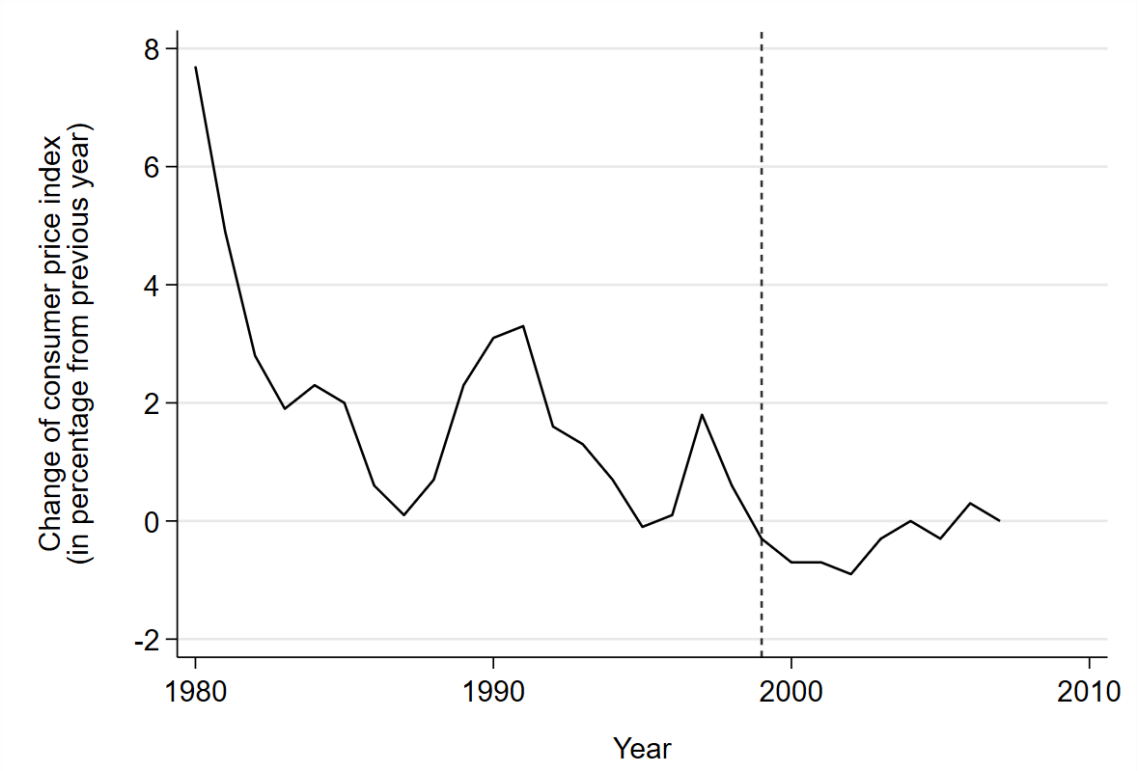


Notes: Graph compares the top 10% to bottom 50% (pre-tax) income ratio in Hungary and in a synthetic control constructed as a weighted average of other OECD members. The weights used to construct the synthetic control are chosen to minimise the distance in terms of the average top 10% to bottom 50% income ratio for the years 1980, 1985, 1990 and 1995 as well as other predictors of income inequality (GDP per capita, trade-to-GDP, net FDI inflows (% of GDP), private credit by financial institutions (% of GDP), the presence of banking crises, government consumption (% of GDP), population and employment-to-population) during the period 1980–1998; see Section 5 for more details.

A.7 Inflation During the Post-Treatment Period

Subsection 6.5 argues that the savings redistribution channel and the portfolio channel did not play out in the absence of inflation during the post-treatment period. Indeed, while inflation was prominent during the pre-treatment period, Japan faced deflationary pressure afterwards as visualised by Figure 14. From 1999 onward, a positive inflation rate was realised only once in the year 2006 with nothing but an unsubstantial value of 0.3%.

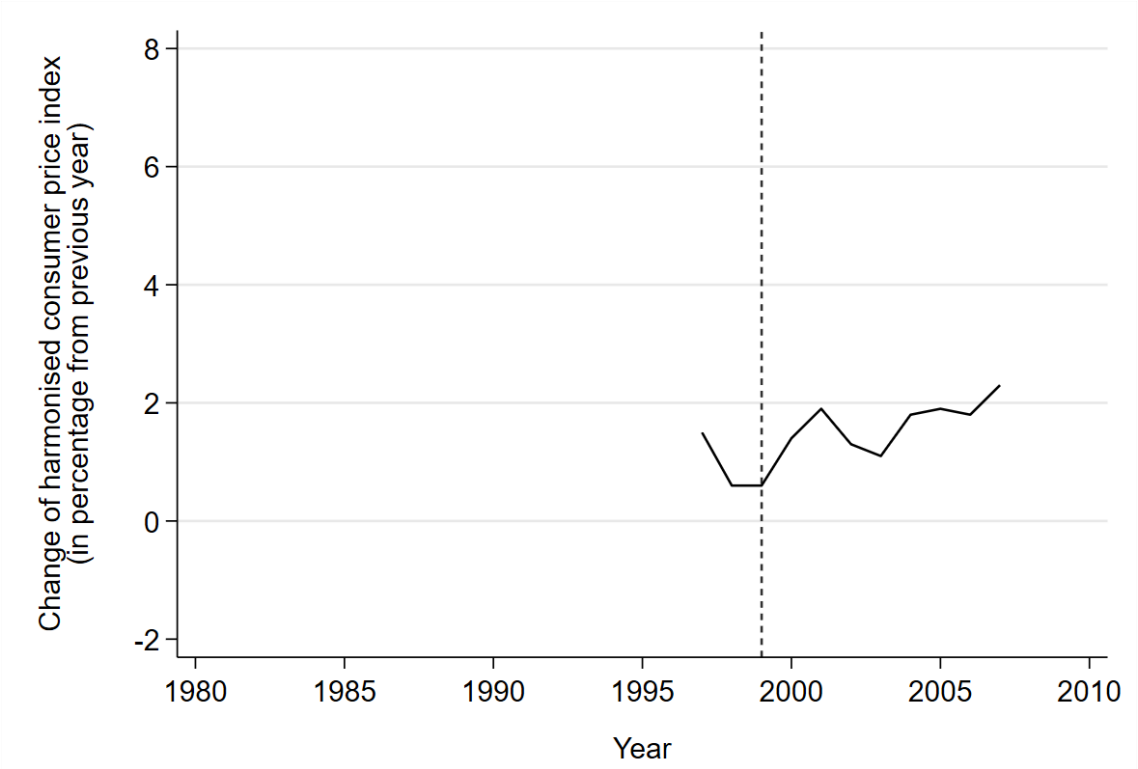
Figure 14: Yearly Inflation Rate in Japan



Notes: Graph depicts the annual percentage change in the consumer price index from the previous year for Japan during the pre-treatment period 1980–1998 and the post-treatment period 1999–2007 based on data by the Statistics Bureau of Japan (2023).

The savings redistribution channel and the portfolio channel bank on the presence of inflation. Despite its central bank's drastic measures Japan did not beat deflation and it is more than unrealistic that it would have done so without them. Because providing the synthetic control method with information on a measure of inflation to construct the cohort was rejected, it seems warranted to attest that the estimated effect is not distorted by inflation rates in the counterfactual being too high after the beginning of the intervention. Across different applications Germany is by far the primary contributor to synthetic Japan. Data from the Bundesbank (as plotted in Figure 15) covering the period from 1996 onwards clears up that Germany witnessed what is frequently defined as price stability.

Figure 15: Yearly Inflation Rate in Germany



Notes: Graph depicts the annual percentage change in the harmonised consumer price index from the previous year for Germany during the period 1996–2007 based on data by the Bundesbank (2024).