Society for the Study of Economic Inequality

Working Paper Series

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ECINEQ 2021 570

ECINEQ 2021 570
2021 January
www.ecineq.org

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JEL Cassification: D63; E50; E52

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The authors would like to thank Jérôme Héricourt, Etienne Farvaque and Carola Binder for very useful comments. Mehdi El Herradi would like to acknowledge the hospitality of DNB where part of this research was conducted during March-June 2019. The views expressed do not necessarily reflect the position of DNB.

1 Introduction

Rising income and wealth inequality over the past 40 years in many advanced economies has led to renewed interest in the drivers of the income and wealth distributions, inspired by the work of Piketty (2003), Piketty (2014) and Atkinson et al. (2011). One of the drivers of inequality that received considerable attention is inflation. Although Piketty (2014) argues that "*the redistributions induced by inflation are always complex, multidimensional, and largely unpredictable and uncontrollable*" (p. 575), most previous research suggests that inflation increases inequality and is bad for low-income households because they typically hold a disproportionate share of their assets in cash (see Colciago et al. (2019)). However, Binder (2019) challenges this view, arguing that the correlation between inflation and income inequality depends on the time period and sample of countries considered.

Previous research paid only limited attention to the effect of (un)expected inflation on the right tail of the income distribution. Our paper aims to quantify the distributional consequences of inflation on top income shares.[1] While the income of poor households primarily consists of labor income or transfers, the income of the rich mainly comes from business, capital incomes and rents (Atkinson and Piketty (2007)). This implies that the top income shares may be affected differently by inflation than income shares at the lower end of the distribution.

Using the pre-tax national income share held by the top 1% richest (P1) from the World Inequality Database (WID), we examine how inflation shocks and long-run inflation affect rich households using data over the 1920-2016 period for a sample of 14 advanced economies (Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, the U.K. and the U.S.). Data on tax-based top income shares has two advantages: (i) unlike survey-based estimates, the data provide a better coverage of business and capital incomes (Atkinson et al. (2011)), and (ii) they reflect the trend of income inequality since the 1980s more accurately. Using long-run data allows to cover major events, such as the Great Depression and the post-war boom, hence giving more variation in the data and in particular the top income variable.

Our empirical strategy is as follows. We first quantify the impact of an inflation shock on the income share of the top 1% richest and then investigate the relationship between inflation and top income shares in the long run. In the former part, we estimate the dynamic effects of changes of the inflation rate that are orthogonal to contemporaneous and lagged monetary policy de-

[1] The evolution of top income shares as such has received significant attention in the literature on inequality since the seminal works of Piketty (2003) and Piketty and Saez (2003). In fact, it is now well established that the growing income inequality witnessed since the 1980s in the developed world is, to a large extent, the result of a sharp increase of top incomes (see e.g., Alvaredo et al. (2013) and Alvaredo et al. (2017)).

cisions, aggregate demand or past and anticipated inflation, while in the latter we evaluate how long-term inflation shapes top income shares. The rationale behind this dual approach is to account for the possible contrasting effects between unexpected and long-run inflation on the top income distribution. We employ different methodologies in both analyses. In the first part, we use the Local Projection (LP) method proposed by Jordà (2005) to generate Impulse Response Functions (IRFs) of top income shares to an inflation shock, taking into account that the relationship between the inflation shock and top incomes may be state-dependent. To be more precise, we allow the response of the top-one-percent income share to an inflation shock to depend on the regime of a specific variable (i.e., the business cycle, the inflation regime, financial openness and political institutions). This is particularly relevant in view of our use of a long sample period with various economic and monetary arrangements in place. In the second part of our analysis, we use panel regressions in which all variables are defined as five-year averages. By doing so, we eliminate business-cycle fluctuations, which allows us to examine the impact of inflation on the income share of the top-one-percent in the long term. Here, we control for structural factors driving top incomes, such as globalization, technological progress, education and labor market institutions.

Our evidence suggests that inflation reduces the share of national income held by the top one percent (P1). In particular, a 100 bps inflation shock reduces P1 by around 0.12 percentage points over a five year horizon. This baseline finding is robust to alternative top income measures (i.e. the shares of national income held by the top 10% and top 0.1%) and also holds for sub-periods covering different monetary regimes. We demonstrate that insofar as inflation shocks reduce real interest rates, the negative effect of inflation on top incomes is likely to be channeled via lower real assets returns (housing, equity, bonds and bills). On top of that, the state-dependent version of our LP estimation indicates that the distributional consequences of inflation shocks on P1 are stronger for low levels of financial openness. As to long-term inflation, our findings indicate that a high average inflation rate is associated with lower top income shares: a one percent increase of inflation reduces the income share of the top 1% and top 10% by 0.05 and 0.085 percentage points in the long run, respectively.

The paper is structured as follows. Section 2 reviews the theoretical and empirical literature on the effects of inflation on income and wealth distribution. Next, section 3 describes the data while section 4 presents the empirical strategy. Section 5 highlights key results from the LP estimations and the panel regressions. The final section draws conclusions and outlines a road-map for future research.

2 Related literature

This section reviews previous studies – both theoretical and empirical – on the inflation-inequality nexus. The distributional effects of inflation have attracted a great deal of interest (Baumol (1952), Tobin (1992)), particularly in terms of its welfare implications (see e.g., Lucas (2000) and Ireland (2009)). Recent theoretical models have contributed to this literature by studying the effects of (un)anticipated inflation on income and wealth distribution.

The first strand of theoretical contributions relied on cash-in-advance models in which low-income households are assumed to hold a disproportionate share of their assets in cash, while rich households have more diversified portfolios. In this context, Erosa and Ventura (2002) and Kakar and Daniels (2019) study the asymmetric incidence of the inflation tax and derive a positive correlation between inflation and inequality. Albanesi (2007) uses a similar model to analyze the distributional effects of expected inflation from a political economy perspective. In the model, the inflation rate is the outcome of a bargaining game between households with uneven economic attributes. The rich exert pressure for monetary financing of public spending rather than tax financing, which leads to higher inflation and more inequality.

In another strand of the literature, models have been developed with incomplete markets and/or heterogeneous agents, calibrated using household wealth surveys. A good example is the work by Gottlieb (2015), who introduces portfolio choice in his model and finds that the welfare costs of inflation in the U.S. are low. He also departs from the literature discussed above as he concludes that expected inflation may act as a progressive tax. Boel (2018) also finds a non-linear relationship between inflation and inequality in a matching model where agents differ in their consumption risk: inequality declines for low to moderate inflation rates while the opposite is true when inflation moves from moderate to high levels. Menna and Tirelli (2015) reconsider inflation optimality in a DSGE model with limited access to the market for interest bearing assets. Interestingly, they demonstrate that higher inflation together with lower income taxes reduce inequality: nontaxable monopoly profits shift the financial burden of the inflation tax towards asset holders. Finally, Camera and Chien (2014) specify that three features of an economy determine the extent of the inflation-inequality nexus, namely: financial structure, elasticity of labor supply, and the process underlying earnings shocks.

Scenario analysis has been used for studying the impact of unexpected inflation on wealth distribution through the *Fisher channel* (i.e. the revaluation of nominal balance sheets due to inflation shocks). Specifically, household's balance sheet exposures under different inflation scenarios are estimated, which allows identifying potential winners and losers from an inflation shock.

Doepke and Schneider (2006) distinguish the nominal wealth positions of U.S. households by age, by level of net worth, and by type of instrument held. They point out that rich households are the main losers from inflation: rich households tend to invest more in long-term bonds – which are strongly hit by inflation – while the poor rely more on short-term deposits. Similar policy scenarios have been conducted by Meh and Terejima (2011) for Canada and Adam and Schneider (2016) for the Eurozone. These studies also document that inflation benefit young, middle-class households with mortgage debt. Recently, Auclert (2019) has introduced the *interest rate exposure channel* to explore the effects of a change in the real interest rate. This author argues that unhedged interest rates exposures, i.e. the difference between all maturing assets and liabilities at a point in time, is the correct measure of households' balance sheet exposures to real interest rate changes. He identifies the same winners and losers as those resulting from the *Fisher channel*: a fall in the real interest rate (due to higher inflation) harms net savers whose wealth is concentrated in long-term assets and net borrowers with relatively short-term liabilities.

Early empirical country-level investigations of income inequality mainly covered advanced economies and reported mixed findings. For instance, while Blinder and Esaki (1978) and Mocan (1999) find that inflation increased quintile shares of bottom income families in the U.S., Yoshino (1993) documents the opposite effect for Japan. Cross-country studies frequently point to a positive correlation between inflation and inequality (see (Colciago et al., 2019)). For instance, based on a large panel of developed economies, Romer and Romer (1999) show that long-run inflation reduces the average income of the bottom quintile. Similarly, Bulíř and Gulde (1995) find that inflation tends to be a regressive tax, particularly in lower-income countries with a relatively unsophisticated financial sector. Easterly and Fischer (2001) argue that inflation hurts poor households, which are more reliant on state-determined income that is not fully indexed to inflation. Inflation reduces the real minimum wage and transfers to the bottom quintiles of the income distribution, whereas rich households are less affected. Other research suggests that the relationship between inflation and income inequality is U-shaped. Bulíř (2001) reports for 75 economies that a reduction in inflation from hyper-inflationary levels significantly lowers income inequality, while a further reduction towards a very low level of inflation has little effects. Galli and van der Hoeven (2001) and Monnin (2014) also report a non-linear relationship for panels of OECD countries. However, Binder (2019) concludes that the correlation between inflation and inequality has fallen most notably in European countries. Her regression analysis suggests that the association of inflation and inequality depends on the interaction of political regime and central bank independence; the inflation-inequality nexus becomes more negative as central bank independence increases in democratic countries.

Thus, although theoretical studies have managed to identify various transmission channels of inflation towards inequality, the empirics of the link between inflation and income distribution remain ambiguous. Most importantly, as Binder (2019) noticed, the sign of the correlation between inflation and inequality depends on the sample of countries, the time period and also the measure for inequality used. In this respect, our paper departs from previous studies as it (i) focuses on the top of the distribution using income tax-based data and (ii) covers a century of modern economic history.

3 Data

Our empirical analysis relies on a country-level yearly dataset for 14 advanced economies over the period 1920-2016 for top income shares, inflation and macroeconomic controls.[2] The 14 countries examined in our analysis include: Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, the U.K. and the U.S.

3.1 Top income shares

We rely on top income data, which are extracted from the World Inequality Database (WID). To compute top income shares, the WID uses national accounts together with census data and as explained by Roine and Waldenström (2015), it subsequently matches tax units in the top and their incomes with the reference tax population and reference total income. The share of pre-tax national income held by the richest one percent (P1) is used as the main variable of interest. The top one percent are generally considered as very rich because they receive a significant share of their income in the form of rents, dividends and capital gains (Atkinson and Piketty (2007)). As an alternative, we test our empirical models using the top 10 percent's pre-tax national income share (P10). Roine et al. (2009) demonstrate that P10 includes the *upper middle class*, i.e. the lower 9 percent of the top decile. Our empirical analysis introduces percentile ratios to provide insights into how inflation affects the gap between top incomes and the rest of the population. The latter is approached by the residual share received by the lowest 90 percent of the population (B90). Our percentile ratios, i.e., P1/B90 and P10/B90, can serve as proxies for assessing the impact of inflation on income inequality. Finally, we estimate the effect of inflation *within* top income earners using the P1/P10 and P1/P9 ratios, defined as the share of the top percentile in relation to the top decile.

[2]We omit World War II covering the period from 1939 to 1945.

3.2 Determinants of top income shares

Some studies on the drivers of income inequality consider the role of economic factors, such as technological progress and international competition, while others emphasize the importance of institutional and political factors. We try to control for these factors where the challenge is to find data measuring them for the long time span we consider. For this purpose, we primarily use the Jordà-Schularick-Taylor Macrohistory Database.

Addressing globalization through the volume of economic flows is relatively common in the literature. We opt here for a *de facto* measure of openness by using the ratio of trade (i.e. the sum of exports and imports) to GDP. Alternatively, we use the capital account openness measure proposed by Quinn et al. (2011) as an indicator of financial openness. Recently, Helpman (2018) argued that international trade is responsible for only a small part of the inequality increase: the skill-premium stemming from skill-biased technological change appears to have contributed more to the increase of inequality than trade liberalization (see Acemoglu and Autor (2011) for a review). Total Factor Productivity (TFP) is the usual way to measure technological progress. We draw on the productivity database constructed by Bergeaud et al. (2016) that offers estimates of TFP per hour worked over a long period. Financial development is another potential driver of inequality. The interaction between finance and inequality remains an open question. Although financial development could make access to credit easier for financially constrained households thereby reducing inequality (see Galor and Zeira (1993) and Piketty (1997)) there is growing evidence that more finance only benefits top incomes (see de Haan and Sturm (2017) and Bazillier and Hericourt (2017) for reviews of the literature). Following most empirical studies on the drivers and consequences of financial development (see Doucouliagos et al. (2020)), we employ private credit (as a share to GDP) to assess the impact of financial development.

Redistribution policies, labor market institutions, the political regime in place, and education may also affect the income distribution in the long run. We proxy redistribution policy by the ratio of government expenditures to GDP and through top marginal tax rates. As proxies for labor market institutions reflecting the power of workers, we use the number of labor conflicts (strikes and lockouts) and trade union density. The political regime in place is assessed by the Polyarchy Index of Teorell et al. (2019) from the V-Dem database, and communist influence from Madsen et al. (2017). The former evaluates the extent to which the ideal of electoral democracy in its fullest sense is achieved, while the latter measures foreign communist influence and is constructed as the cultural distance fraction of the world population having communist governance. As stated by Madsen et al. (2017), a rise of the communist threat may influence the stance of non-communist governments regarding workers' wage aspirations. Finally, the level

of human capital is taken into account by the share of the population with secondary education from the Barro and Lee Educational Attainment Dataset (Lee and Lee (2016)). Table A1 in the Appendix provides an overview of the data used.

3.3 Top income shares and inflation in the twentieth century

Figure A1 in the Appendix shows the average income share of the top one percent and the inflation rate. The 1925-1939 period is characterized by both a deflationary environment and a high share of national income going to the top. During the inter-war period, inflation settled around 1 percent and P1 slightly decreased. The two world wars and the political transformations that followed resulted in relatively low income inequality (Piketty (2014) and Acemoglu et al. (2015)). Under the Bretton Woods system, inflation was moderate up to the latter half of the 1960s. During the 1970, average inflation rate drifted, fueled by inflationary U.S. policies and the oil crises, while P1 dropped from 10 to 6 percent. In the 1980s, a considerable trend reversal took place. Wealth-income ratios in rich countries jumped back to pre-war levels (Piketty and Zucman (2014)) and also income inequality increased. This shift in inequality dynamics came along with a new paradigm in monetary economics that emphasizes the welfare gains from low inflation and supports credible and predictable monetary policies. Average inflation gradually fell to even below 2%.

4 Empirical methodology

Our empirical strategy accounts for the possible contrasting effects between unexpected inflation and long-run inflation on the income share of the rich. Specifically, we are considering two different empirical approaches. First, we use the Local Projection method proposed by Jordà (2005) to estimate the dynamic effects of inflation shocks on the income share of top income earners. Second, we analyze the long-run effect of inflation on P1 using a standard panel-data approach for non-overlapping five year sub-periods.

4.1 Local projection

Impulse responses are common means to assess the dynamic empirical regularities between two variables. We use the Local Projection (LP) method introduced by Jordà (2005) to compute Impulse Response Functions (IRFs).[3] The LP method requires to estimate a sequence of projections of the endogenous variable shifted forward in time onto its lags and a set of real and monetary controls. The baseline regression equation is:

[3]The LP approach has several advantages over VARs. LP is (i) more robust to model misspecification, (ii) does not suffer from the curse of dimensionality, (iii) can more easily accommodate non-linearities and (iv) can also be estimated with simple regression techniques.

$$\Delta_h y_{i,t+h} = \alpha_i^h + \gamma_t^h + \beta^h \pi_{i,t} + \theta^h X_{i,t} + \varepsilon_{i,t}^h \quad (1)$$

where $\Delta_h y_{i,t+h} = y_{i,t+h} - y_{i,t-1}$ and corresponds to a change in the top income variable from the base year $t-1$ up to year $t+h$, with $h = 0, ..., H$; $\pi_{i,t}$ denotes the change in the (log) consumer price index; and $X_{i,t}$ refers to a vector of control variables. The latter includes two lags of $\Delta_t y_{i,t}$, $\pi_{i,t}$, and the contemporaneous value and two lags of the first-difference of additional macroeconomic controls that could theoretically explain top income shares.[4] The list of the additional controls includes the log of real GDP per capita, real consumption per capita, real investment, Total Factor Productivity (TFP) along with the level of the credit-to-GDP ratio, trade openness, central government expenditure ratio, the long-term interest rate and the variation of the short-term interest rate. Finally, time fixed effects are included to control for common trends in the evolution of top incomes.

Equation 1 is estimated by a fixed effects estimator that accounts for heteroscedasticity with Stock and Watson (2008)'s robust standard errors for each $h = 0, ..., 4$ in our analysis. As shown by Jordà (2005), the sequence of estimates β^h gives an accurate estimate of the local IRF, while the respective standard errors can be used to build confidence bands. This means that, unlike in a VAR approach, the estimated coefficients contained in θ^h are not used to build the IRF. Instead, they only serve as controls and cleanse the β^h from the effects of past top income shares and consumer price changes, as well as contemporaneous and past changes in other macroeconomic variables. Our rich set of controls ensures that the estimated dynamic effect of inflation is orthogonal to contemporaneous and lagged effects of monetary policy decisions, aggregate demand or past and anticipated inflation.

LP can easily accommodate state-dependence. This is a great advantage, as our analysis covers a long time span encompassing different monetary regimes and economic situations. To test for state-dependent effects in the response of the top income variable to an inflation shock, we consider the following regression model:

$$\Delta_h y_{i,t} = \alpha_i^h + \gamma_t^h + \beta_1^h \pi_{i,t} * State_{i,t} + \beta_2^h \pi_{i,t} * (1 - State_{i,t}) + \theta^h X_{i,t} + \varepsilon_{i,t}^h \quad (2)$$

where $State_{i,t}$ is a variable indicating a specific state (i.e. business cycle, inflation regime, the level of financial openness[5] and the type of political regime).

[4] By considering contemporaneous macroeconomic variables, our identifying assumption is equivalent to a Cholesky identification whereby P1 would be ordered at the top.

[5] International financial openness is approached by the capital mobility index (which ranges from 0 to 100) introduced by Quinn et al. (2011).

4.2 The long-term inequality process

Responses of inflation shocks may provide misleading results about the effect of inflation in the long term. A positive inflation shock might be offset by a negative one and therefore be only a source of short and medium-run fluctuations in the top income variable. In order to explore the long-run relationship between inflation and top incomes, we have to eliminate fluctuations at the business-cycle frequency.

Using *n*-year averages is an easy and standard way to identify long-run relationships. Averaging our variables of interest over a given time window allows estimating the effect of inflation on top income shares in the long run. This is also a method to reduce the impact of measurement errors (provided that measurement errors are not perfectly correlated over time). However, averaging has some limitations as well. In particular, averaging may not fully eliminate business cycle fluctuations because the length of business cycles may vary over time and across countries. Following previous studies like de Haan and Sturm (2017), we use 5-year averages (and 10-year averages as a robustness check). We particularly extend the model of Roine et al. (2009) and add inflation as a determinant of the share of top incomes:

$$\bar{y}_{i,p} = \alpha_i + \gamma_t + \beta\bar{\pi}_{i,p} + \theta\bar{X}_{i,p} + \varepsilon_{i,t} \tag{3}$$

This standard regression includes time fixed effects γ_t and country-specific trends (here captured by a country specific effect α_i). Further, p refers to an interval of five years and $\bar{y}$, $\bar{\pi}$, $\bar{X}$ refer to the average over five years of the top income variable, the inflation rate and the set of control variables, respectively.[6]

We estimate equation 3 using an OLS estimator that accounts for potential country-specific serial correlation in the error terms. The control variables in equation 3 slightly differ from those used in equation 1. We add other factors that account for the dynamics of long-run inequality. The vector of control variables in our baseline model consists of the log of average real GDP per capita and population size along with the level of education (proxied by school enrollment ratios for the secondary level), trade openness, the credit-to-GDP ratio, central government expenditures (as share of GDP) and the top marginal tax rate.[7]

[6] In our robustness analysis, we also estimate equation 3 using trend inflation. The latter is obtained from a standard Hodrick-Prescott filter.

[7] Note that these controls are the same as in Roine et al. (2009) with the exception of education.

5 Results

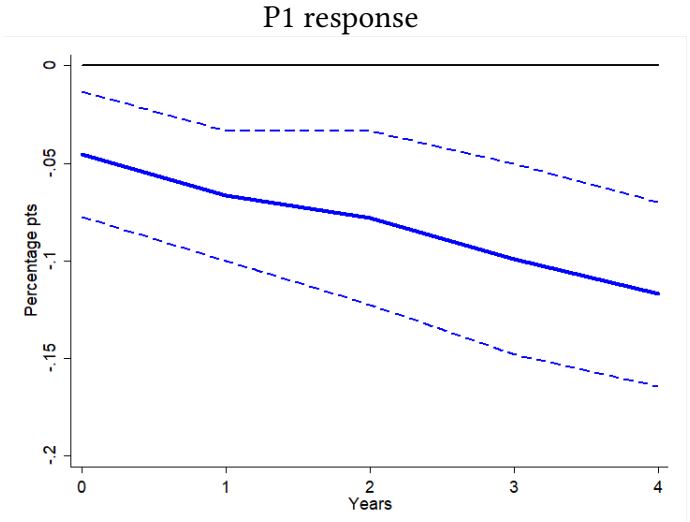
This section reports results for the effects of inflation on top income shares. We first discuss the LP estimates, then we examine the relationship between inflation and the share of top incomes in the long run.

5.1 Local projections

5.1.1 Baseline results

The baseline result is displayed in Figure 1, which depicts the cumulated IRF of P1 to a 100 bps increase in the inflation rate. It shows that inflation has an effect on incomes at the very top: P1 declines by 0.05 and 0.08 percentage points at the impact and two years following the shock, respectively. Over the horizon of 5 years, the impact amounts to 0.12 percentage points. This effect is economically significant, given that the average of P1 across the sample over the studied period is 10 percent.[8] This finding is consistent with the strand of the literature that documents the negative implications of unexpected inflation on rich households via the revaluation of nominal balance sheets (see Doepke and Schneider (2006), among others). The key difference between this literature and our paper is that the former deals with wealth distribution.

Figure 1: Local Projection response of top 1% income share to a 100 bps inflation shock



Note: The figure shows the cumulated impulse response of the top-one-percent income share to a 100 bps increase in inflation. The dashed lines depicts the OLS estimates around 90% confidence bands based on robust standard errors estimates.

We perform several sensitivity analyses to check the robustness of our result. These are shown in Figure 2. In the first set of checks, we use alternative measures for top income shares. Graph

[8] The sample standard deviation of inflation amounts to 4.

(a) reports the impulse response of P10 and suggests that the baseline effect of inflation seems to hold for the entire top decile. However, the response of P10 hides a contrasting effect between P1 and the *upper middle-class, P9* (i.e. P10-P1): while the decline of P1 is still strong 4 years after the shock, the response of P9 becomes non-significant in later periods (see graph (a) of Figure A2 in the Appendix). Saez and Zucman (2016) have noticed for the last decades in the U.S. that the share of national income held by the top 0.1% grew even faster than that of P1. That is why we are interested in understanding the effect of unexpected inflation on the *ultra-rich*. The impulse response shown in Graph (b) demonstrates that inflation reduces the top 0.1%'s income share. Although the coefficient estimates are noticeably lower than those obtained for P1, the semi-elasticity is comparable and slightly higher than 1. Besides that, the responses of percentile ratios (P1/B90 and P10/B90) in graphs (c) and (d) provide a picture of how inflation lowers the gap between top incomes and the rest of the population. Using the P1/P10 and P1/P9 ratios, we find that inflation shocks also reduce inequality *within* the *top* of the distribution (see IRFs reported in Figure A3 in the Appendix).

In the second set of robustness tests, we examine several sample splits of the data, bearing in mind the obvious differences in monetary arrangements before and after WW2. Graph (e) shows that the response of P1 does not depart from the baseline estimation when we only consider the post-WW2 period. Similarly, the negative effect of unexpected inflation on P1 continues to hold when the sample starts from the 1970s. Furthermore, our finding is not impacted when (i) the episode of the Great Recession is omitted (Graph g) and (ii) the vector of control variables is removed (Graph h).[9]

5.1.2 Transmission channel

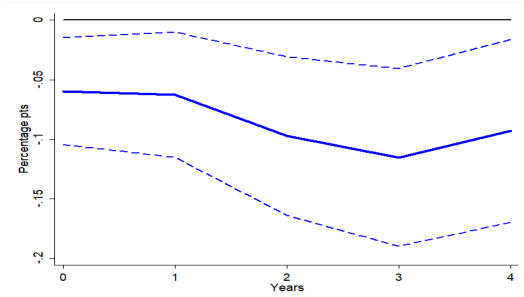
We explore one of the transmission mechanisms of inflation towards top incomes. Specifically, we test the following hypothesis: an inflation shock reduces real interest rates, which can have a negative impact on the (real) rate of return on capital. Rich households would then be worse-off given that capital and business incomes account for a large share of their total income. To this end, we estimate impulse responses of returns on various financial and real assets to surprise inflation. Graph (a) in Figure 3 depicts the cumulated IRF of total returns on assets – i.e., the weighted average of real returns on housing, equity, bonds and bills[10] – to a 100 bps inflation shock. The latter reduces real asset returns by 0.6 percentage points immediately. The same exercise is conducted using real returns on housing and equity.

[9]We also estimated our model with a mean group (MG) estimator to assess whether our results are affected by the slope homogeneity assumption of the pooled models. The results (available on request) show that allowing all parameters to differ across group does not change our main conclusion: inflation shocks matter for the income of the rich.

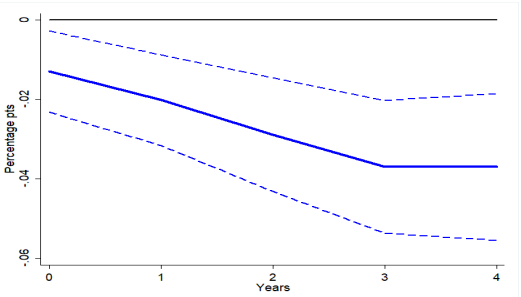
[10]Information on how the weighting of assets is done can be found in Jordà et al. (2019).

Figure 2: Local Projection responses of top 1% income share to a 100 bps inflation shock - Robustness checks

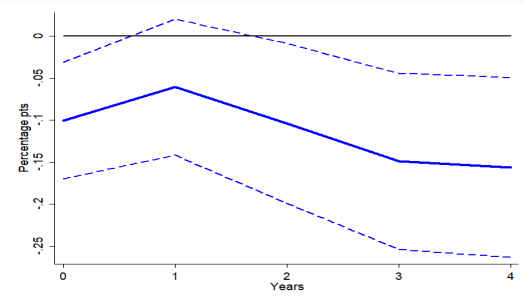
(a) P10 response



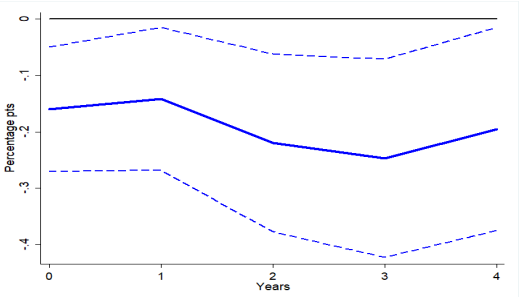
(b) P01 response



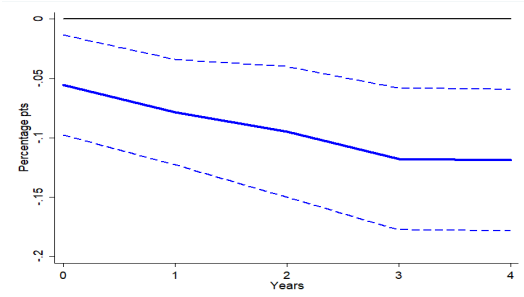
(c) P1/B90 response



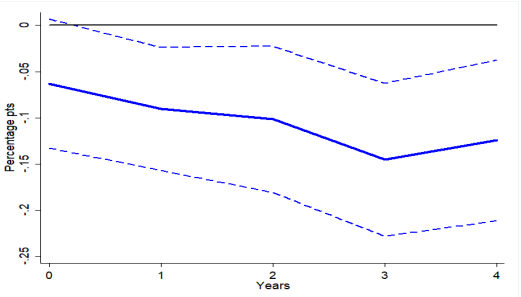
(d) P10/B90 response



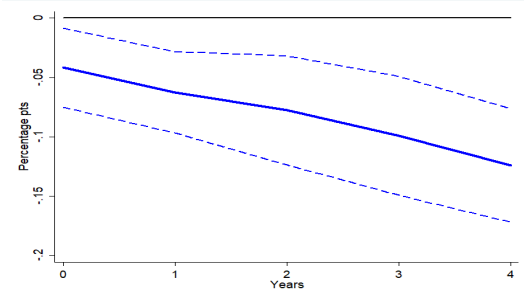
(e) P1 response - post-WWII



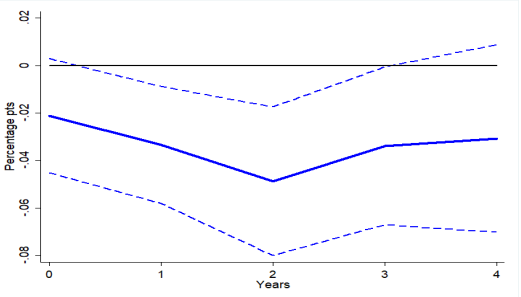
(f) P1 response - post-1970



(g) P1 response - without the Great Recession



(h) P1 response - P1 response - No controls



Note: The figures show cumulated impulse responses of the top-one-percent income share to a 100 bps increase in inflation. The dashed lines depict the OLS estimates around 90% confidence bands based on robust standard errors estimates.

Figure 3: Insights on the transmission channel

Note: The figures show impulse responses of total asset, housing and equity returns (in real terms) and the "$r-g$" gap to a 100 bps increase in the inflation rate. The dashed lines depict the OLS estimates around 90% confidence bands based on robust standard errors estimates.

From a historical perspective, the dynamics of housing returns are as important as those of other assets. Jordà et al. (2019) document that: "*although aggregate total returns on equities exceed those on housing for certain countries and time periods, equities do not outperform housing in simple risk-adjusted terms*" (p. 1274). In particular, real estate tends to be less tradable at the global level than financial assets and is more exposed to idiosyncratic country-level shocks. Graph (b) in Figure 3 indicates that following an inflation shock, housing real returns decrease by 0.6 and 0.9 percentage points in year 0 and year 4, respectively. Further, Graph (c) in Figure 3 shows that inflation shocks also lower real returns on equity by a similar magnitude.

Our statement about the transmission channel operating through lower real asset returns may be only part of the story if an inflation shock would also compress real wages. In such a case, the final outcome on income inequality would depend on which of the two effects dominate. Unfortunately, data on the distribution of wages are not widely available. As an alternative, we consider Piketty's "$r-g$" concept, i.e. the difference between the real return to capital and the growth rate of output. A decrease of "$r-g$" following an inflation shock indicates that the real return on assets transmission channel dominates the wage channel. The impulse response shown in Graph (d) supports this view as it suggests that an inflation shock significantly reduces the $r-g$ gap.

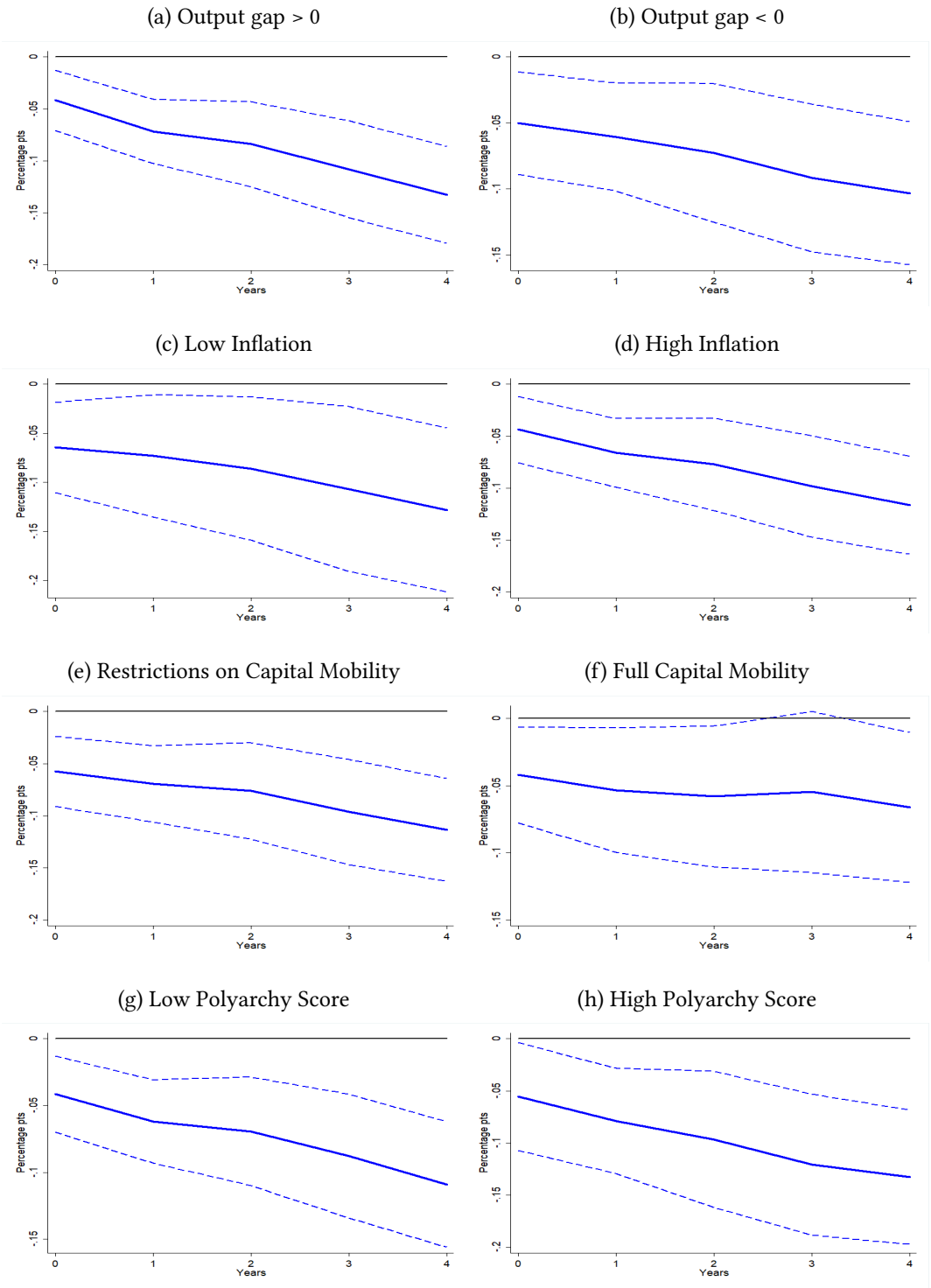
5.1.3 State-dependent effects

Are the effects of surprise inflation on top incomes state-dependent? This question is relevant in view of our historical sample that covers several economic and monetary regimes. We estimate equation 2 that allows the response of P1 to depend upon four specific regimes/factors: business cycle, inflation regime, financial openness and political institutions. Business cycle episodes are identified using the Hodrick-Prescott (HP) filter – with λ=6.25 – and take the value of one when the output gap is positive and zero when it is negative. With respect to the inflation regime, high-inflation refers to a period during which inflation is above its country-specific median. Conversely, a country features a low-inflation regime when the inflation rate is below its median. As for financial openness, we compare the states of incomplete and full capital liberalization (index of capital mobility lower and equal to 100, respectively). Finally, we define for the political regime two states of democratic intensity, based on the median sample of our Polyarchy Index.

The impulse responses based on the state-dependent models are displayed in Figure 4. The effect of unexpected inflation on P1 as found in the baseline model continues to hold, irrespective of the state of the economy. Particularly, business cycle fluctuations (graphs (a) and (b)) and different inflation regimes (graphs (c) and (d)) do not change the response of P1 to an inflation shock. Interestingly, graph (e) shows that the negative effect of surprise inflation is stronger when there are restrictions on capital mobility: the maximum impact on P1 is two times higher than that obtained when the economy is fully open.[11] This may unveil how top income households use arbitrage strategies and trade across global equity markets to diversify risk and avoid lower (real) asset returns due to inflation. Finally, we analyze how a country's political regime shapes the effect of inflation on top incomes. The political economy model of Lahiri and Ratnasiri (2010) suggests that the inflation-inequality nexus "*within any period or over time depends on institutional and preference related parameters*" (p. 1199). However, the IRFs depicted in graphs (g) and (h) suggest that the political regime in place does not matter.

[11] The difference is significant at the 10% level.

Figure 4: Local Projection responses of top 1% income share to a 100 bps inflation shock: state-dependent effects



Note: The figures show, under several regimes, the cumulated impulse responses of the top-one-percent income share to a 100 bps increase in inflation. The dashed lines depict the OLS estimates around 90% confidence bands based on robust standard errors estimates.

5.2 Long-run inflation and top incomes

Our second empirical model focuses on the inequality effects of inflation in the long run. It employs variables averaged over a fixed-length interval in order to eliminate business-cycle effects and to identify long-run effects of inflation on top-income shares. This contrasts with the previous section where we focused on inflation shocks.

The baseline estimates of equation 3, which are displayed in Table 1, indicate that long-run inflation has a negative effect on top income shares. This is consistent with the results reported in the previous section. The results in column (1) show that a 100 bps increase in the long-run inflation rate decreases P1 by 0.05 percentage points. The magnitude of the effect is twice smaller than the estimated effect of an unexpected inflation shock. The same holds for P10 in column (2). In addition, the percentile ratios (P1/B90 and P10/B90) shown in columns (3) and (4), respectively, suggest that inflation also reduces the gap between top incomes and the rest of the population. By contrast, the estimated (negative) coefficient of inflation is not significant for P01. This discrepancy does not appear when we consider 10-year averages instead of 5-year averages (see Table A3).

Our regressions provide also some evidence for other determinants of top income shares. We find that education, measured by the secondary school enrollment rate for the total population, is associated with lower top income shares (this holds for P1, P10 and P01). The same effect is found for the top marginal tax rate. The latter finding is not the result of redistributive tax policies because our dependent variables refer to gross (i.e. market) national income shares; yet, top marginal tax rates could affect incentives and individual market opportunities. Finally, trade openness is positively associated with top income shares. This result contributes to the literature on the globalization-inequality nexus and supports the findings of Dreher and Gaston (2008), Bergh and Nilsson (2010) and Lang and Tavares (2018).

The results for financial development, government spending, GDP per capita and population are rather mixed. We observe that financial development is negatively associated with top income shares, yet the effect is not statistically significant. This contrasts with the result of Roine et al. (2009) showing that financial development is "pro-rich" over the long run. By contrast, we obtain similar mixed results as Roine et al. (2009) regarding government spending. The estimated coefficients are positive but insignificant. Besides, a higher GDP per capita increases the concentration of the income at the top of the distribution. Finally, while there is no well-established literature on the relationship between population and income inequality, we find a positive but insignificant effect of population size on top income shares.

The robustness of our results is assessed in multiple ways. Table 2 displays the outcomes of several tests using 5-year averages.[12] First, we estimate our empirical model using trend inflation instead of 5-year averages and show that our results are not impacted (column (1)). Second, focusing only on the post-war era or the post-Bretton Woods period does not change our findings (columns (2) and (3), respectively). Further, columns (4) and (5) of Table 2 report estimates using the sample period before the 2008 financial crisis and without control variable, respectively, confirming our main result.

Finally, we include covariates related to several country-level characteristics. We do so by adding the corresponding variables one-by-one. As the sample size of these covariates varies considerably, we maximize the size of our estimation sample by adding them sequentially. Specifically, we test the confounding effects of the Kuznets curve, financial openness, labor disputes, trade union density, communist influence, democracy and technical progress. The results for our augmented baseline models as displayed in Table 3 confirm our previous result for the effect of long-term inflation on P1: the coefficients on inflation remain negative and highly significant. We also establish that an increase in labor conflicts and more communist influence are associated with a lower top one percent's income share, which is in line with our expectations.

[12] Tables A3, A4 and A5 in the Appendix report the same tests using 10-year averages.

Table 1: Long-run inflation and top income shares (Baseline)

	(1) P1	(2) P10	(3) P1/B90	(4) P10/B90	(5) P01
Inflation	-0.050***	-0.085***	-0.054**	-0.195***	-0.011
	(0.016)	(0.024)	(0.023)	(0.059)	(0.008)
GDPpc	0.542	0.734	3.085**	0.721	0.029
	(1.163)	(1.461)	(1.464)	(3.493)	(0.574)
Education	-0.043***	-0.102***	-0.098***	-0.258***	-0.017*
	(0.012)	(0.024)	(0.028)	(0.059)	(0.009)
Openness	7.366***	9.563***	12.863***	22.673**	5.643***
	(2.273)	(3.589)	(4.898)	(8.910)	(1.236)
Government spending	4.110	-7.434	-6.101	-17.139	3.677*
	(4.084)	(5.449)	(7.727)	(13.876)	(2.219)
Fin. development	-0.639	-1.978	-4.530**	-7.219**	-0.062
	(1.003)	(1.406)	(1.945)	(3.447)	(0.874)
Population	2.283	-0.842	0.742	-3.497	0.451
	(1.953)	(2.023)	(3.562)	(5.534)	(1.030)
Marg. tax	-6.175***	-6.743***	-8.148***	-12.133**	-3.311***
	(1.285)	(2.055)	(2.353)	(5.046)	(0.639)
Observations	210	191	191	191	164
N countries	14	14	14	14	11

Note: This table shows baseline results from panel regressions with country and time fixed effects for the top 1% income share (column (1)), the top 10% income share (column (2)), the P1/B90 (column (3)) and P10/B90 ratios (column (4)), the top 0.1% income share (column (5)). HAC standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Explanatory variables are defined in Table A1 in the Appendix.

Table 2: Long-run inflation and top income shares (Robustness checks 1)

	(1) Trend inflation	(2) Post-45	(3) Post-70	(4) Pre-2007	(5) Without controls
Inflation	-0.046***	-0.033**	-0.184***	-0.045**	-0.039***
	(0.007)	(0.015)	(0.065)	(0.017)	(0.013)
GDPpc	1.053*	2.314**	5.206**	1.186	
	(0.60)	(1.040)	(2.270)	(1.161)	
Education		-0.031***	-0.047***	-0.036***	
		(0.010)	(0.018)	(0.012)	
Openness	7.33***	5.544***	1.589	10.379***	
	(1.44)	(2.073)	(2.084)	(2.349)	
Government spending	5.23**	11.472***	5.773	1.997	
	(2.29)	(3.791)	(4.333)	(3.998)	
Fin. development	-1.20**	-0.752	-1.501*	-0.287	
	(0.51)	(0.845)	(0.779)	(1.255)	
Population	4.82***	6.385***	5.225**	1.703	
	(0.97)	(1.511)	(2.511)	(2.053)	
Marg. tax	-5.58***	-6.644***	2.058	-5.824***	
	(0.72)	(1.170)	(2.594)	(1.263)	
Observations	936	183	112	182	225
N countries	14	14	14	14	14

Note: This table shows baseline results from panel regressions with country and time fixed effects for the top 1% income share using trend inflation (column (1)), the top 1% income share post-WWII (column (2)), the top 1% income share post-Bretton Woods (column (3)), the top 1% income share before the 2008 financial crisis (column (4)) and the top 1% income share in a specification without control variables (column (5)). HAC standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Explanatory variables are defined in Table A1 in the Appendix.

Table 3: Long-run inflation and top income shares (Robustness checks 2)

	(1)	(2)	(3)	(4)	(5)	
Inflation	-0.055***	-0.052***	-0.028*	-0.224***	-0.062***	-0.
	(0.020)	(0.017)	(0.014)	(0.064)	(0.015)	(0
GDPpc	-2.641	0.574	2.159**	11.996***	1.975*	0
	(5.614)	(1.294)	(1.035)	(2.669)	(1.013)	(1
$GDPpc^2$	0.508					
	(0.801)					
Financial openness		0.010				
		(0.013)				
Labour disputes			0.066			
			(0.137)			
Trade union				0.080**		
				(0.039)		
Communist influence					-20.128***	
					(5.638)	
Political institutions						4.
						(2
Technical progress						
Observations	210	199	163	98	210	
N countries	14	13	12	14	14	

Note: This table shows results from panel regressions with country and time fixed effects fo income share using: Kuznets curve (column (1)), financial openness (column (2)), labor disputes (colu union (column (4), the communist influence (column(5)), democracy (column (6)) and TFP (colum standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 levels, respectively. Explanatory variables are defined in Table A1 in the Appendix.

6 Conclusion

This paper attempted to quantify the distributional consequences of inflation on top income shares using a sample spanning 97 years and 14 advanced economies. While it is commonly accepted that inflation harms the poor, much is less known about how it interacts with top income households. We combined tax-based top income shares from the World Inequality Database (WID) with other macroeconomic variables from the Jordà-Schularick-Taylor Macrohistory Database. Our empirical strategy featured a dual approach with two aims: (i) estimate the effects of inflation shocks on the share of national income held by the top one percent (P1) and (ii) study the relationship between long-run inflation and top income shares. The first part is based on the LP method proposed by Jordà (2005) to generate IRFs of P1 to an inflation shock, while the second part is based on panel regressions using five-year averages of all variables to evaluate the long-run dynamics between inflation and P1.

Our findings suggest that inflation reduces the share of national income held by the top one percent. LP estimates show that an inflation shock negatively affects P1, with an accumulated decrease of 0.12 percentage points. This effect also holds for other top income measures (P10, P09, P01) and sub-periods. The impulse responses of percentile ratios (i.e. P1/B90, P10/B90 and P9/B90) and top decile ratios (i.e. P1/P9 and P1/P10) show that inflation shocks reduce the gap between top income shares and the rest of the population as well as among the top of the distribution. Next, we demonstrate that inflation shocks are likely to affect P1 via lower real asset returns, especially because top income households receive considerable amounts of business income and capital gains. As for the state-dependent effects, our results indicate that the effect of inflation on P1 holds, irrespective of the state of the economy. Nonetheless, this effect is stronger for a low level of capital mobility. Further, results from our panel regressions yield similar results as the LP approach. An increase in the average long-run inflation rate is associated with lower top income shares. This correlation is robust when we: (i) use 10-year averaged variables, (ii) consider only the post-war and post-Bretton Woods periods and (iii) estimate the baseline model using trend inflation. These results suggest that policies that have brought inflation down may have favored the top of the income distribution.

Our empirical evidence is consistent with the scenario analyses conducted by Doepke and Schneider (2006) for the U.S. and Adam and Schneider (2016) for the Eurozone with respect to the effects of inflation on different groups of households, and in particular for the richest ones. However, while these studies quantify the implications of inflation on the wealth distribution, our paper focuses on the income distribution. Our results challenge the widely accepted predictions of the inflation tax literature developed by Erosa and Ventura (2002) and Albanesi

(2007). Although portfolio holdings and transaction patterns are different across households, we show that top incomes might be as much worse-off from inflation as households belonging to another tail of the income distribution. For future research, the challenge would be to deepen – from a historical perspective – our understanding about how inflation affects the other tails of the income distribution and poverty.

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Appendix

Table A1: Variables definition

Variable	Variable definition	Source
Inflation	Consumer Price Index year-over-year growth	Macrohistory Database JST
Stir	Short-term interest rate (nominal, percent per year)	Macrohistory Database JST
Financial development	Ratio of total loans to non-financial private sector to GDP	Macrohistory Database JST, own calculations
Openness	Ratio of imports and exports to GDP	Macrohistory Database JST, own calculations
TFP	Total Factor Productivity	Long-Term Productivity Database
Long-term rate	Long-term interest rate (nominal, percent per year)	Macrohistory Database JST
GDPpc	Country Real GDP per capita	Macrohistory Database JST
Investment	Country Real investment	Macrohistory Database JST
Consumption	Country Real consumption per capita	Macrohistory Database JST
Government spending	Central government expenditures	Macrohistory Database JST
Population	Population size	Macrohistory Database JST
Capital returns	Tot. return on wealth, nominal	Macrohistory Database JST
Housing returns	Housing total return, nominal	Macrohistory Database JST
Equity returns	Tot. return on equity, nominal	Macrohistory Database JST
Financial openness_quinn	Capital mobility index (0-100)	Quinn et al. (2011)
Democracy Index	Weighted average of freedom of association, clean elections, freedom of expression, elected officials and suffrage	Teorell et al. (2019)
Communist Influence	Cultural distance-weighed fraction of the world that has communist governance	Madsen et al. (2017)
Top taxation	Top marginal tax rates, statutory	Rubolino and Waldenström (2019)
Labor disputes	The annual number of labor conflicts	International Labor Organization
Trade union	Trade union density, percent of employees	Rubolino and Waldenström (2019)
Education	% of population aged 15-64 with completed secondary education	Barro-Lee Educational Attainment Dataset

Table A2: Local Projection - OLS estimation results

Δ ***OLS estimates - P1***	Year 0	Year 1	Year 2	Year 3	Year 4
Inflation rate	-0.05**	-0.07***	-0.08***	-0.10***	-0.12***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
R^2	0.342	0.428	0.459	0.478	0.494
Observations	824	804	784	765	748

Note: Stock and Watson-robust standard errors are reported in parentheses below the coefficient estimates. The controls include the twice-lagged terms of (i) the inflation rate; (ii) the change in top income variable; and the contemporaneous and twice-lagged terms of the difference of (iii) real GDP per capita (log), (iv) real consumption per capita (log), (v) real investment (log), (vi) Total Factor Productivity (TFP) (log), (vii) the credit-to-GDP ratio, (viii) trade openness, (ix) the central government expenditure ratio, (x) the short-term interest rate and (xi) the level of the long-term interest rate. Time fixed effects are also included. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

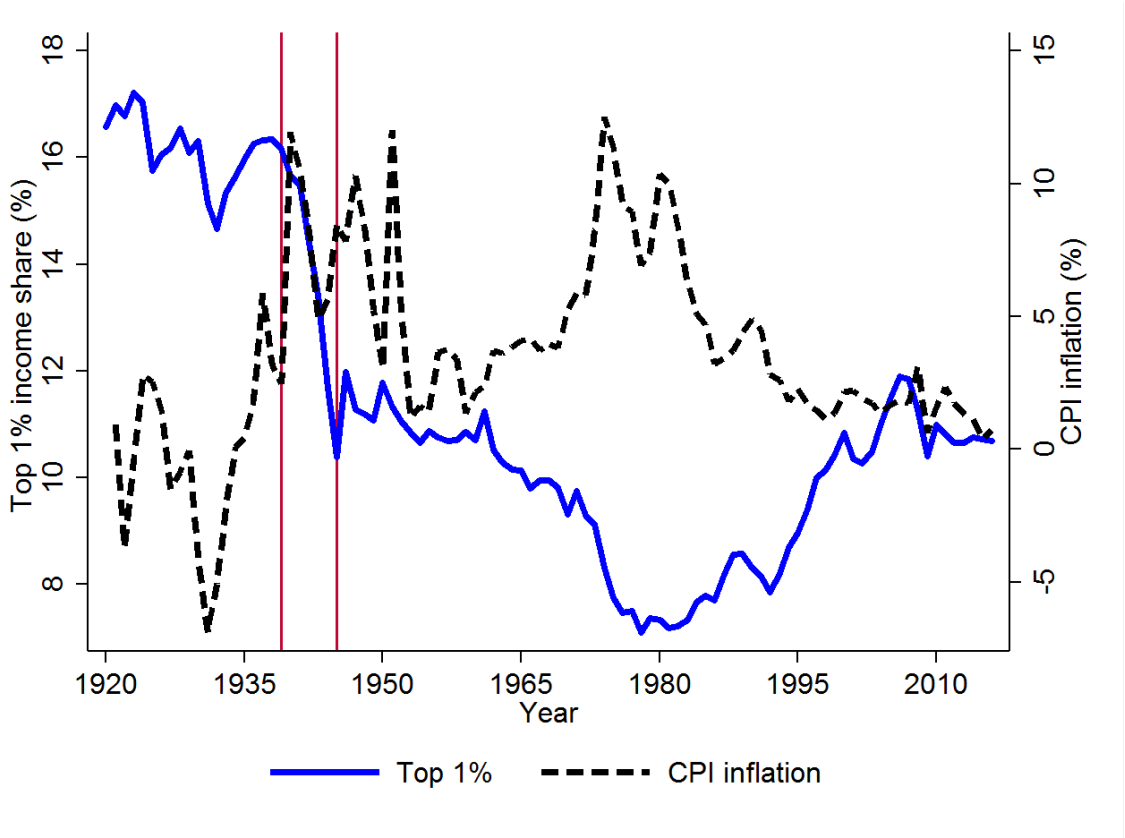
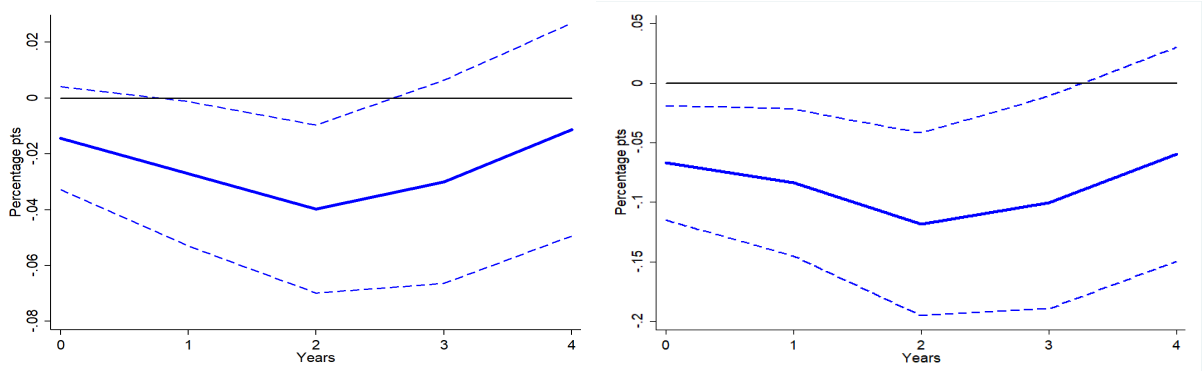


Figure A1: Average top 1% income share and inflation over time

Figure A2: Top income shares LPs to an inflation shock (P9 and P9/B90)

(a) P9 response

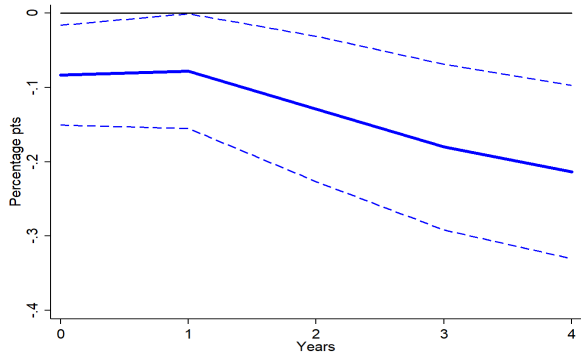
(b) P9/B90 response



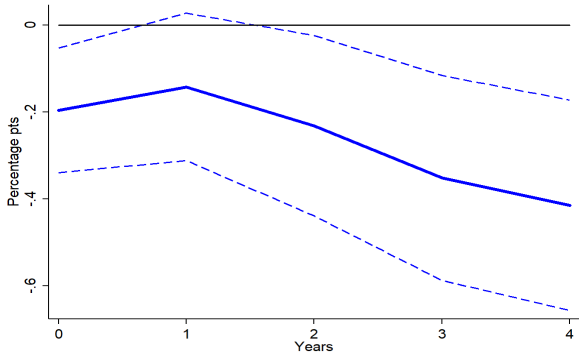
Note: The figure shows cumulated impulse responses of P9 and the P9/B90 ratio to a 100 bps increase in inflation. The dashed lines depict the OLS estimates around 90% confidence bands based on robust standard errors estimates.

Figure A3: Top income shares LPs to an inflation shock (P1/P10 and P1/P9)

(a) P1/P10 response



(b) P1/P9 response



Note: The figure shows cumulated impulse responses of the P1/P10 and P1/P9 ratios to a 100 bps increase in inflation. The dashed lines depict the OLS estimates around 90% confidence bands based on robust standard errors estimates.

Table A3: Long-run inflation and top income shares (10-year average - Baseline)

	(1) P1	(2) P10	(3) P1/B90	(4) P10/B90	(5) P01
Inflation	-0.028***	-0.032***	-0.061***	-0.089***	-0.013***
	(0.008)	(0.008)	(0.014)	(0.022)	(0.004)
GDPpc	0.160	0.904	2.575	0.603	0.072
	(1.539)	(2.256)	(1.754)	(5.619)	(0.778)
Education	-0.050***	-0.100***	-0.092***	-0.251***	-0.016
	(0.016)	(0.026)	(0.032)	(0.068)	(0.011)
Openness	5.725**	8.848**	10.662**	20.969**	6.200***
	(2.877)	(4.330)	(5.265)	(10.620)	(1.780)
Government spending	4.532	-0.615	-0.247	0.774	3.253
	(6.193)	(7.226)	(11.659)	(18.587)	(3.896)
Fin. development	-0.950	-2.242	-5.180**	-8.697**	-0.669
	(1.139)	(1.661)	(2.302)	(4.115)	(1.012)
Population	4.148*	1.241	4.840	2.108	0.906
	(2.226)	(2.719)	(4.709)	(7.404)	(1.133)
Marg. tax	-5.649***	-7.454***	-8.088***	-13.351*	-3.478***
	(1.683)	(2.829)	(3.032)	(6.853)	(0.805)
Observations	110	101	101	101	81
N countries	14	14	14	14	11

Note: This table shows baseline results from panel regressions with country and time fixed effects for the top 1% income share (column (1)), the top 10% income share (column (2)), the P1/B90 (column (3)), P10/B90 ratios (column (4)), the top 0.1% income share (column (5)). HAC standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Explanatory variables are defined in Table A1 in the Appendix.

Table A4: Long-run inflation and top income shares (10-year average - Robustness 1)

	Post-45	Post-70	Without controls
Inflation	0.019	-0.354***	-0.022***
	(0.095)	(0.086)	(0.004)
GDPpc	1.978	7.825**	
	(1.382)	(3.121)	
Education	-0.036***	-0.064**	
	(0.013)	(0.032)	
Openness	4.416*	1.174	
	(2.440)	(1.728)	
Government spending	13.916***	9.058**	
	(5.121)	(3.662)	
Fin. development	-0.857	-0.659	
	(0.996)	(0.838)	
Population	7.427***	2.673	
	(2.090)	(2.692)	
Marg. tax	-6.583***	6.119*	
	(1.657)	(3.198)	
Observations	95	56	111
N countries	14	14	14

Note: This table shows baseline results from panel regressions with country and time fixed effects for the top 1% income share post-WWII (column (1)), the top 1% income share post-Bretton Woods (column (2)) and the top 1% income share in a specification without control variables (column (3)). HAC standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Explanatory variables are defined in Table A1 in the Appendix.

Table A5: Long-run inflation and top income shares (10-year average - Robust

	(1)	(2)	(3)	(4)	(5)	
Inflation	-0.028***	-0.030***	-0.019***	-0.352***	-0.025***	-0
	(0.008)	(0.006)	(0.006)	(0.084)	(0.008)	(
GDPpr	-2.098	-0.168	1.361	10.383***	1.421	
	(6.869)	(1.807)	(1.440)	(3.147)	(1.383)	(
$GDPpc^2$	0.357					
	(0.940)					
Financial openness		0.023				
		(0.021)				
Labour disputes			0.112			
			(0.174)			
Trade union				0.110**		
				(0.045)		
Communist influence					-17.640**	
					(6.882)	
Political institutions						7
						(
Technical progress						
Observations	110	104	88	56	110	
N countries	14	13	12	14	14	

Note: This table shows results from panel regressions with country and time fixed effects fo income share using: Kuznets curve (column (1)), financial openness (column (2)), labor disputes (colu union (column (4), the communist influence (column(5)), democracy (column (6)) and TFP (colum standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 levels, respectively. Explanatory variables are defined in Table A1 in the Appendix.