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Mehdi el Herradi, Jakob de Haan, Aurélien Leroy

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Inflation and the Income Share of the Rich: Evidence for 12 OECD Countries

Abstract

This paper examines the distributional implications of inflation on top income shares in 12 advanced economies using data over the period 1920-2016. We use Local Projections to analyze how top income shares respond to an inflation shock, and panel regressions in which all variables are defined as five-year averages to examine the impact of inflation on the position of the top-one-percent in the long run. Our findings suggest that inflation reduces the share of national income held by the top one percent. Furthermore, we find that inflation shocks and long-run inflation have similar effects on top income shares.

JEL-Codes: D630, E500, E520.

Keywords: inflation, inequality, top income shares, income distribution.

*Mehdi El Herradi**
University of Bordeaux
Bordeaux / France
el-mehdi.el-herradi@u-bordeaux.fr

Jakob de Haan
De Nederlandsche Bank &
University of Groningen
Groningen / The Netherlands
jakob.de.haan@rug.nl

Aurélien Leroy
University of Bordeaux
Bordeaux / France
aurelien.leroy@u-bordeaux.fr

*corresponding author

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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 specifically 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 period 1920-2016 for a sample of 12 advanced economies (Australia, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, 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

[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)).

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 the nominal interest rate, 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 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 0.135 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 0.4 and 0.2 percent 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., Dotsey and Ireland (1996), 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. Also, Boel (2018) 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, households 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, who 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 indepen-

dence; 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 12 advanced economies over the period 1920-2016 for top income shares, inflation and macroeconomic controls. The 12 countries examined in our analysis include: Australia, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, 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*. 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.

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 globalization/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) for a review). To assess the impact of financial development, we employ private credit (as a share to GDP).

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 or 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). The political regime in place is assessed by the Democracy Index of Teorell et al. (2016) 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 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 the 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 the 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 subperiods.

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).[2] The LP method requires to estimate a

[2]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. For robustness purposes, we estimate a panel-SVAR model, where the identification of the structural shock of interest is done by the Cholesky

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 written as:

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

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 prices index; and $X_{i,t}$ refers to a vector of control variables. The latter includes the lags of $\Delta_t y_{i,t}$, $\pi_{i,t}$, and additional controls that could theoretically explain top income shares, namely: GDP per capita growth, Total Factor Productivity (TFP) growth, the credit-to-GDP ratio, the level of long-term interest rate, trade openness and the growth of government expenditures. To ensure that the inflation shock is orthogonal to monetary policy, we also add 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 related to globalization and institutional change.

Equation 1 is estimated by a fixed effects estimator that accounts for heteroscedasticity with robust standard errors for each $h = 0, ..., 5$ 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 prices changes, as well as contemporaneous and past changes in other macroeconomic variables. This ensures that the estimated dynamic effect of inflation is orthogonal to 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[3] and the type of political regime).

decomposition of residuals. The obtained results are in line with those of the LP approach (see Figure A2 in the Appendix).

[3]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 mean 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, no guarantees exist that averaging eliminates in a proper way business cycle fluctuations because the length of business cycles may vary over time and across countries and are difficult to estimate. Following previous studies like de Haan and Sturm (2017), we use 5-year averages. We 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 fixed time 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.

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 dynamic of long-run inequality. The vector of control variables consists of average GDP per capita growth, population growth, real stock prices, the real interest rate, Total Factor Productivity (TFP) growth, education, trade openness, central government expenditures (as share of GDP) and financial development.

5 Results

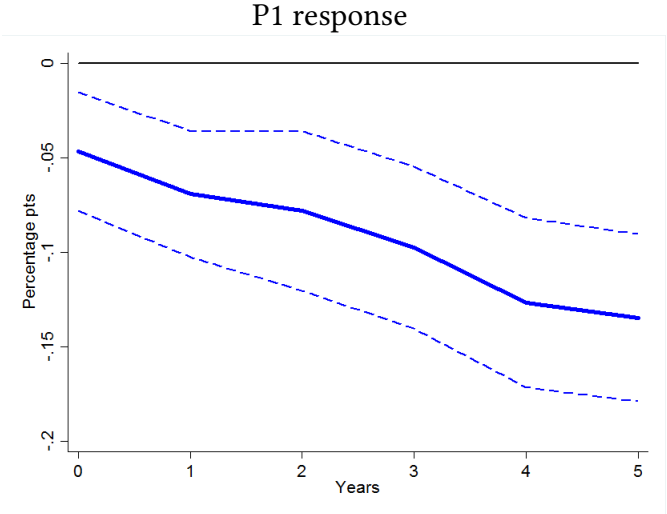
This section reports results on the effects of inflation on top income shares. We first discuss the LP estimates, then we examine the relationship between inflation and the share of top incomes in the long run.

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 0.08 and 0.1 percentage points 2 and 3 years following the shock, respectively. After five years, the impact is 0.135 percentage points. This effect is economically significant, given that the average of P1 across the sample over the studied period amounts to 10 percent. 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 (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 5 years after the shock, the response of P9 becomes non-significant in later periods (see graph (a) of Figure A3 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. 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 reduce inequality *within* the *top* of the distribution (see IRFs reported in Figure A4 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 the 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. Finally, 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).

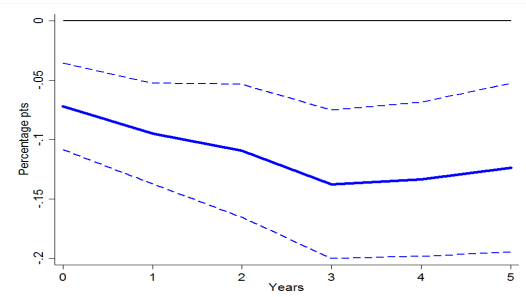
5.1.2 Transmission channel

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) from Figure 3 depicts the non-cumulated IRF of total returns on assets – i.e., the weighted average of real returns on housing, equity, bonds and bills[4] – to a 100 bps inflation shock. The latter reduces real asset returns by 0.68 percentage points in year 0 (when the shock is felt). The same exercise is conducted using real returns on housing.

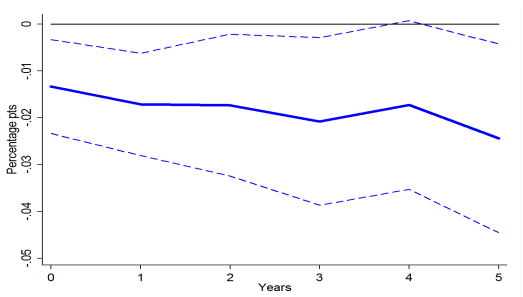
[4]Information on how the weighting of assets is done can be found in Jordà et al. (2019).

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

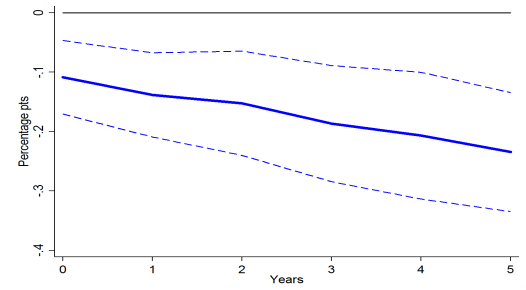
(a) P10 response



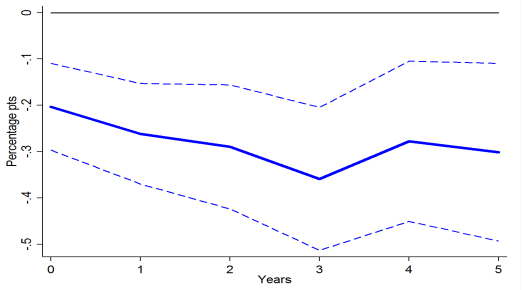
(b) P01 response



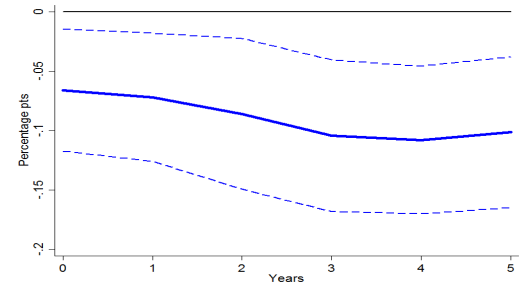
(c) P1/B90 response



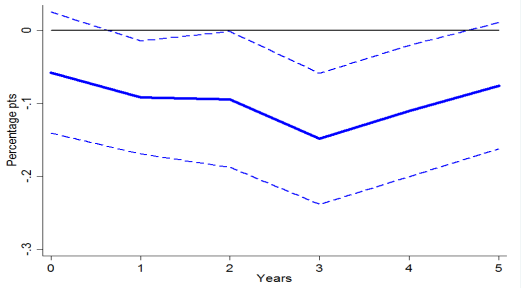
(d) P10/B90 response



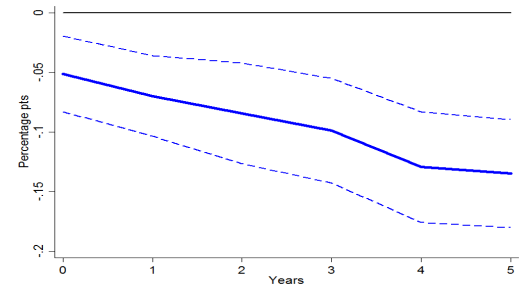
(e) P1 response - post-WWII



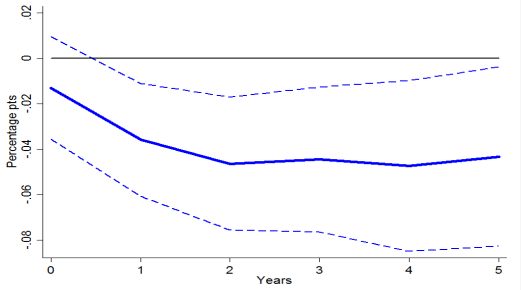
(f) P1 response - post-1970



(g) P1 response - without the Great Recession



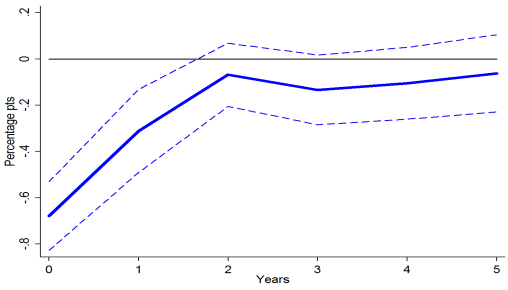
(h) P1 response - P1 response - No controls



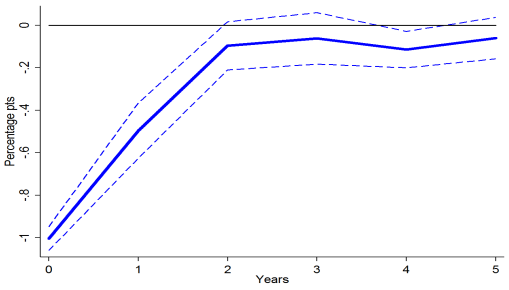
Note: The figures show cumulated impulse responses of the top-one-percent income share to a 100 bps increase in inflation. The dashed lines depict the OLS estimates around 90% confidence bands based on robust standard errors estimates.

Figure 3: Insights on the transmission channel

(a) Total return on assets



(b) Housing return



Note: The figures show non-cumulated impulse responses of total asset and housing returns (in real terms) 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.

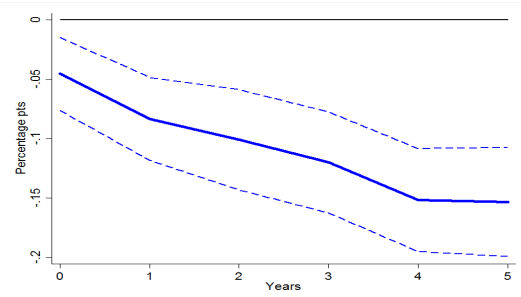
From a historical perspective, the dynamics of housing returns are as important as those of other assets. Jordà et al. (2019) document that: "*although aggregate total returns on equities exceed those on housing for certain countries and time periods, equities do not outperform housing in simple risk-adjusted terms*". In particular, real estate tends to be less tradable at the global level than other financial assets and is more exposed to idiosyncratic country-level shocks. Graph (b) above indicates that following an inflation shock, housing real returns decrease by 1 and 0.5 percentage points in year 0 and year 1, respectively. Further, Figure A5 in the Appendix shows that inflation shocks also lower real returns on safe assets (weighted average of bonds and bills) and risky assets (weighted average of housing and equity).

5.1.3 State-dependent effects

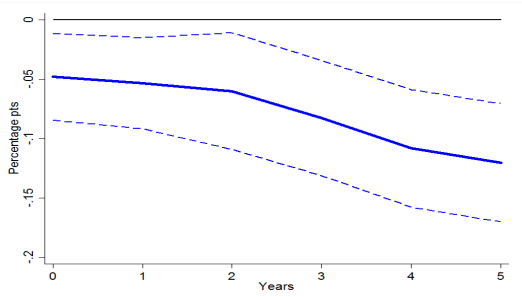
Are the effects of surprise inflation on top incomes state-dependent? This question is relevant in the view of our historical sample that covers several economic and monetary regimes. We estimate equation 2 that allows the response of P1 to depend upon four specific regimes/factors: business cycle, inflation 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 fourth quartile. Conversely, a country features a low-inflation regime when the inflation rate is below its first quartile. As for financial openness and the political regime, we define two binary variables taking the value of one when the capital mobility/democracy index exceeds the fourth quartile of its respective sample distribution and 0 when it is below its country-specific first quartile.

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

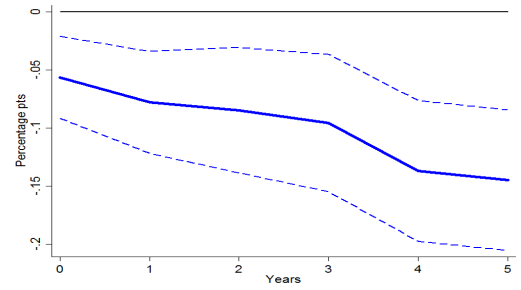
(a) Output gap > 0



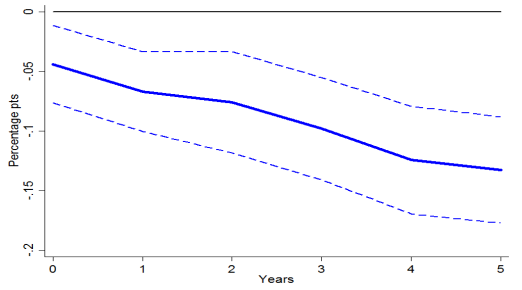
(b) Output gap < 0



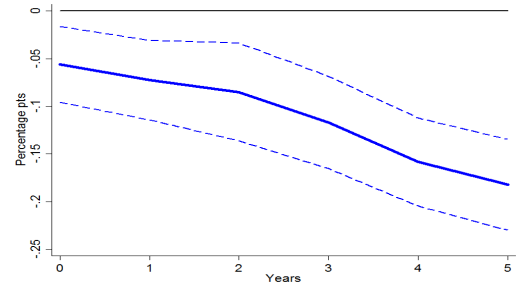
(c) Inflation < to the country's first quartile



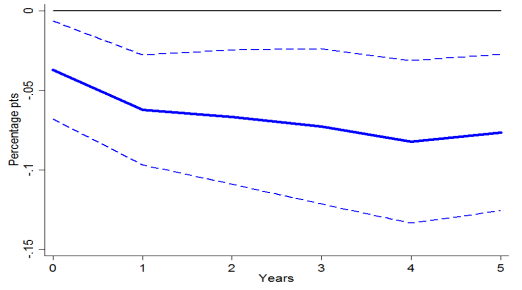
(d) Inflation > to the country's fourth quartile



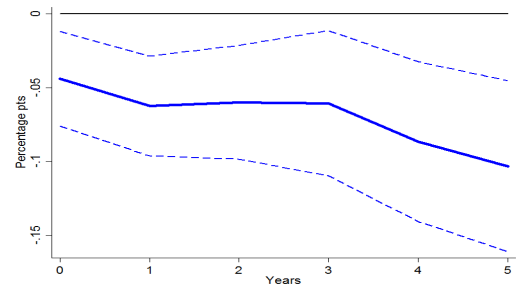
(e) Low financial openness



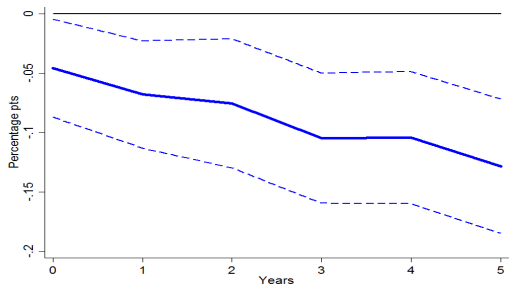
(f) High financial openness



(g) Low Democracy score



(h) High Democracy score



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.

The impulse responses from the state-dependent model are displayed in Figure 4. The baseline effect of unexpected inflation on P1 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 for a low level of financial openness: the maximum impact on P1 is three times higher than that obtained for a high level of capital mobility. This may unveil how top income households may 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. Lahiri and Ratnasiri (2010) suggest in their political economy model that the inflation-inequality nexus "*within any period or over time depends on institutional and preference related parameters*". IRFs depicted in graphs (g) and (h) suggest that the political regime does not matter: a 100 bps inflation shock has a negative effect on P1, regardless of the level of democracy.

5.2 Long-run inflation and top incomes

Our second empirical model focuses on the inequality effects of inflation in the long run. It introduces variables averaged over a fixed-length interval, which eliminates business-cycle fluctuations. This contrasts with the previous section where we focused on inflation shocks. The results of the two models may go in different directions as expected and unexpected inflation may have different effects on inequality due to the adjustment of the nominal interest rate to a change of the inflation rate.

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 (note, however, that while the inflation coefficient in the LP model is interpreted as a percentage point change, it is read here in the form of percentage change). The results in column (1) show that a 100 bps increase in the long-run inflation rate decreases P1 by 0.4 percent. The magnitude of the effect is broadly similar to that of (log) P10 (see column (2)). In addition, the percentile ratios (P1/B90 and P10/B90) shown in columns (3) and (4) suggest that inflation reduces the gap between top incomes and the rest of the population. Similarly, the top decile ratios (P1/P9 and P/P10) reported in columns (3) and 4 of Table A3 in the Appendix show that inflation lowers the gap among top income earners.

Our regressions provide also some evidence for other determinants of top income shares. We find that a larger government is associated with lower top income shares (this holds for P1, P10 and also for P9 as shown in column (1) of Table A3 in the Appendix). This is not the result of redistributive policies because we deal with gross (i.e. market) national income shares; yet, government expenditures could increase individual market opportunities by funding education, for instance. In fact, we show that an increase in the level of the population's educational achievement has a negative effect on top incomes shares. As expected, the growth of real stock prices also has a clear and stable positive effect on top incomes.

The results for financial development, technical change and openness are rather mixed. We observe that financial development is negatively associated with top income shares, yet the effect is not statistically significant across all regressions. This contrasts with the result of Roine et al. (2009) showing that financial development is "pro-rich" over the long run.

We find that TFP growth increases the income share of P9 while its effect on P1 and P10 is non-significant. One possible explanation for this finding is that technological progress mainly benefits highly skilled workers, which are well described by the national income share held by P9. The top one percent mainly consist of business owners and rentiers. For this reason, the increase of the wage-bargaining power stemming from technical change is not relevant for P1.

Finally, trade openness, i.e. our proxy of globalization, is not significantly associated with top income shares. Recent literature on the globalization-inequality nexus converges towards the idea that globalization is neutral *vis-à-vis* inequality (see Helpman (2018)). Note, however, that the non-significance of the variable "openness" may be explained by the fact that our baseline model includes time-fixed effects and hence focuses on country specific deviations from the common globalization process.

The robustness of our results is assessed in several ways. Tables 2 and 3 display the outcomes of several tests. First, we check whether our findings are robust when using a longer period for averaging our variables. We find that the baseline effect remains intact when using panel data for 10 years sub-periods (column (1)). Second, focusing only on the post-war period does not change our findings (column (2)). Column (3) of Table 2 reports GLS estimates with panel-wide AR(1) correction – to take account of the fact that top income data may display strong autocorrelation. The results suggest that a decrease in the long-run inflation of 1 percent increases the income share of the top-one group by 0.35%.

Finally, we include covariates related to several country-level institutional 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 labor conflicts, top marginal taxation, communist influence and democracy. 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, a higher top income tax rate and more communist influence are associated with a lower top one percent's income share, which is in line with our expectations.

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

	(1) P1	(2) P10	(3) P1/B90	(4) P10/B90
Inflation	-0.004***	-0.002***	-0.0023***	-0.001***
	(0.00)	(0.00)	(0.00)	(0.00)
GDPpc	1.17	-0.02	0.51	-0.04
	(0.86)	(0.50)	(0.45)	(0.20)
Population growth	0.02	0.00	0.01	0.00
	(0.02)	(0.01)	(0.01)	(0.00)
Stock Prices	0.13***	0.05***	0.07***	0.02***
	(0.02)	(0.01)	(0.01)	(0.01)
TFP	-0.77	0.74	-0.25	0.34
	(1.03)	(0.62)	(0.57)	(0.25)
Education	-0.01***	-0.005***	-0.006***	-0.002***
	(0.002)	(0.001)	(0.00)	(0.00)
Openness	-0.20	-0.01	-0.04	-0.01
	(0.16)	(0.1)	(0.1)	(0.04)
Government spending	-0.75**	-0.58***	-0.43***	-0.24***
	(0.33)	(0.18)	(0.2)	(0.07)
Real interest rate	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Financial development	-0.16	-0.08*	-0.06	-0.04*
	(0.11)	(0.06)	(0.05)	(0.02)
Observations	198	185	185	185
N countries	12	12	12	12

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)). Robust 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 1% income share (Robustness check 1)

	(1)	(2)	(3)
	10 Years-average	Post-war	GLS estimator
Inflation	-0.002***	-0.006***	-0.0035***
	(0.0004)	(0.01)	(0.001)
GDPpc	1.38**	1.16	0.63
	(1.70)	(1.21)	(0.58)
Population growth	0.03	0.005	0.004
	(0.04)	(0.03)	(0.01)
Stock Prices	-0.14***	0.11***	0.10***
	(0.02)	(0.03)	(0.02)
TFP	-0.84	-1.00	-0.74
	(0.76)	(1.44)	(0.64)
Education	0.01***	0.013***	0.008***
	(0.002)	(0.002)	(0.001)
Openness	-0.28	0.01	-0.07
	(0.19)	(0.22)	(0.12)
Government spending	-1.03***	-0.04	-0.008
	(0.39)	(0.41)	(0.18)
Real interest rate	0.005	0.03	0.00
	(0.004)	(0.02)	(0.00)
Financial development	-0.26**	-0.30***	0.03
	(0.12)	(0.10)	(0.06)
Observations	112	161	198
N countries	12	12	12

Note: This table shows results from panel regressions with country and time fixed effects for the top 1% income share using: 10-years averaged variables (column (1)), the post-war period (column (2)) and a GLS estimator (column (3)). Robust 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 1% income share (Robustness check 2)

	(1) P1	(2) P1	(3) P1	(4) P1
Inflation	-0.005***	-0.004***	-0.006***	-0.003**
	(0.001)	(0.00)	(0.001)	(0.00)
Labor conflicts	-0.04**			
	(0.002)			
Marginal tax rate		-0.57***		
		(0.11)		
Communist influence			-1.13**	
			(0.58)	
Democracy index				0.17***
				(0.05)
GDPpc	2.47**	0.23	1.28	1.72**
	(1.04)	(0.84)	(0.87)	(0.97)
Population growth	0.83*	0.01	0.005	0.03
	(0.05)	(0.02)	(0.02)	(0.05)
Stock prices	0.08***	0.11***	0.12***	0.14***
	(0.02)	(0.02)	(0.02)	(0.17)
TFP	-2.11**	0.57	-0.73	-1.26
	(1.11)	(1.06)	(1.06)	(0.97)
Education	-0.008***	-0.007***	-0.01***	-0.01***
	(0.02)	(0.002)	(0.002)	(0.002)
Openness	-0.20	-0.08	0.35*	-0.12
	(0.17)	(0.15)	(0.19)	(0.15)
Government spending	-0.46	-0.11	-0.88***	-0.37
	(0.35)	(0.32)	(0.31)	(0.36)
Real interest rate	0.001*	0.00	0.00	0.00
	(0.00)	(0.00)	(0.01)	(0.00)
Financial development	-0.13	-0.14	-0.16*	-0.14
	(0.12)	(0.09)	(0.08)	(0.11)
Observations	174	198	198	198
N countries	12	12	12	12

Note: This table shows results from panel regressions with country and time fixed effects for the top 1% income share using: labor conflicts (column (1)), the top marginal tax rate (column(2)), the communist influence (column(3)) and democracy (column (4)). Robust 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.

6 Conclusion

This paper attempted to quantify the distributional consequences of inflation on top income shares using a sample spanning 97 years and 12 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 with five-year averaged 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 0.135 percentage points. This effect also holds for other top income measures (P10 and P9) 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 indicated 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 period and (iii) estimate the baseline model with a GLS estimator.

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 trans-

action 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 shapes the other tails of the income distribution and in particular 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 (index, 2005=100)	Macrohistory Database JST
Government spending	Central government expenditures	Macrohistory Database JST
Capital returns	Tot. return on wealth, nominal	Macrohistory Database JST
Housing returns	Housing total return, nominal	Macrohistory Database JST
Risky assets return	Tot. return on risky assets, nominal	Macrohistory Database JST
Safe assets return	Tot. return on safe assets, 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. (2016)
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
Education	% of population aged 15-64 with completed secondary education	Barro-Lee Educational Attainment Dataset

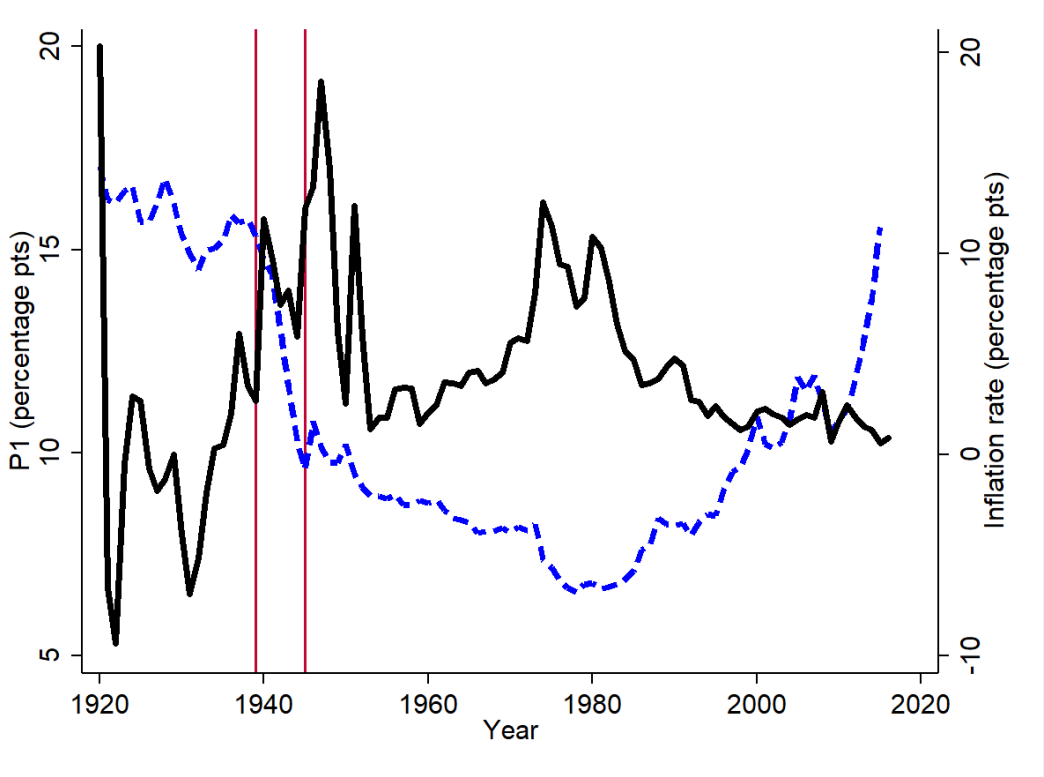
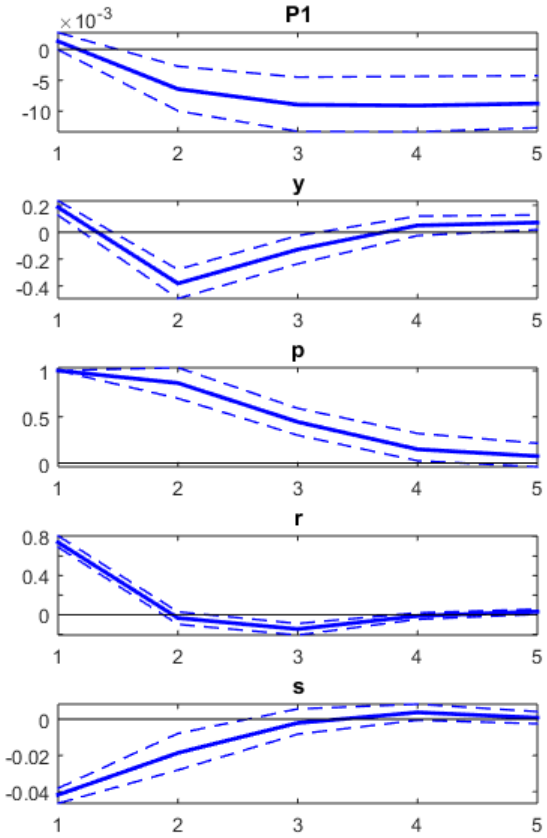


Figure A1: Average top 1% income share and inflation over time

Figure A2: Top 1% income share Panel-SVAR responses to a 100 bps inflation shock



Note: The figures show the impulse responses of the top 1% income share and other macroeconomic variables to a 100 bps inflation shock. The dashed lines represent 90% confidence bands based on robust standard errors estimates.

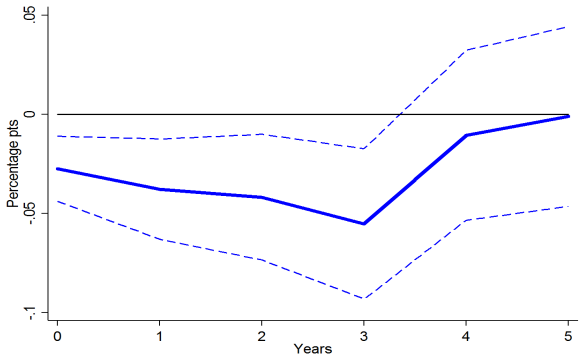
Table A2: Local Projection - OLS estimation results

OLS estimates - P1	Year 1	Year 2	Year 3	Year 4	Year 5
Δ *Inflation rate*	-0.07***	-0.078***	-0.097***	-0.13***	-0.135***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
R^2	0.37	0.41	0.46	0.49	0.52
Observations	733	715	696	677	657

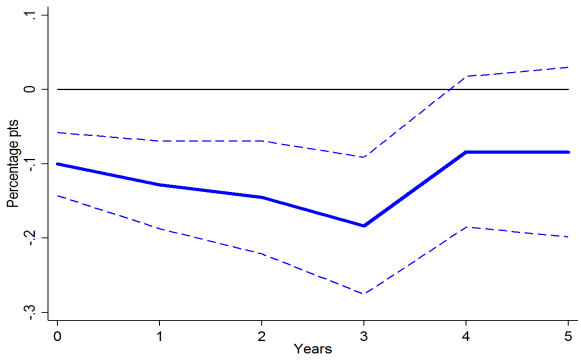
Note: Country-based cluster-robust standard errors are reported in parentheses below the coefficient estimates. The controls include the twice-lagged terms of (i) the change in the inflation rate; (ii) the change in top income variable; and the contemporaneous and twice-lagged terms of (iii) real GDP per capita growth; (iv) the variation of the short-term interest rate; (v) the variation of financial development; (vi) the variation of commercial openness; (vii) the growth of central government expenditures and (viii) the level of long-term interest rate and (ix) Total Factor Productivity (TFP) growth. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Figure A3: Top income shares LPs to an inflation shock (P9 and P9/B90)

(a) P9 response



(b) P9/B90 response

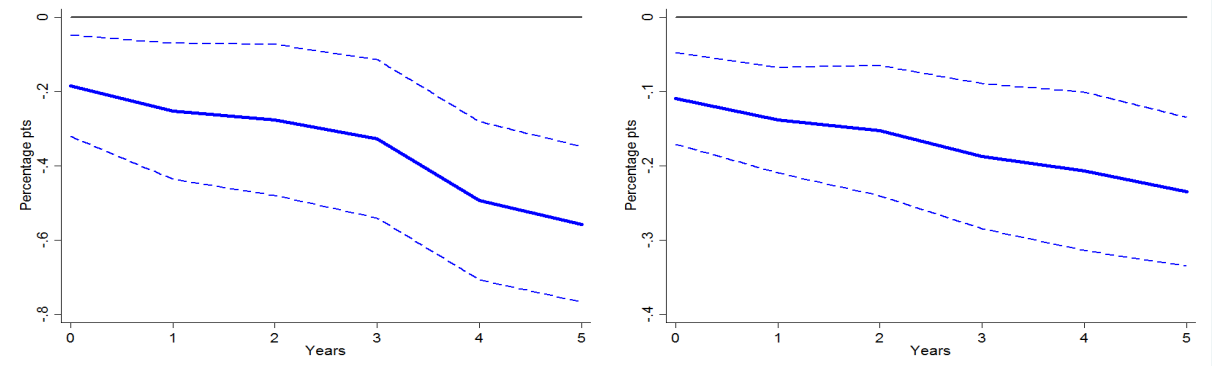


Note: The figure shows cumulated impulse responses of P9 and the P9/B90 ratio to a 100 bps increase in inflation. The dashed lines depict the OLS estimates around 90% confidence bands based on robust standard errors estimates.

Figure A4: Top income shares LPs to an inflation shock (P1/P10 and P1/P9)

(a) P1/P10 response

(b) P1/P9 response

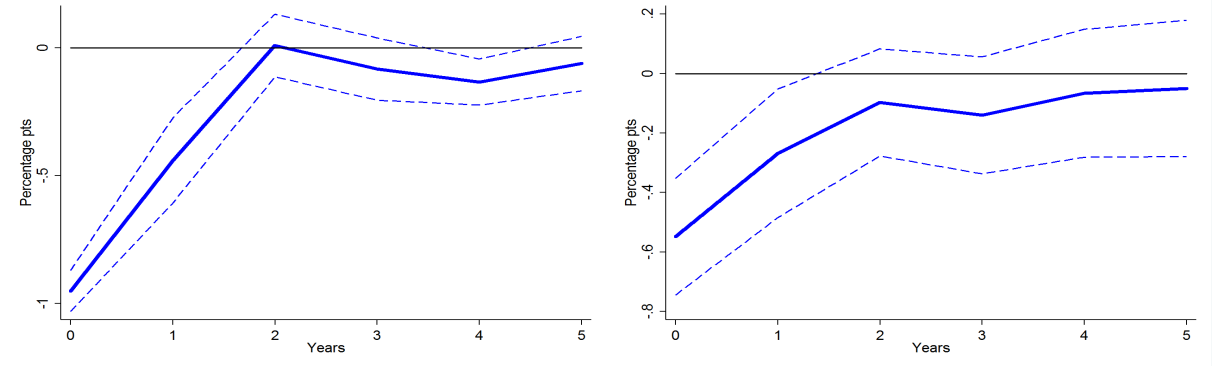


Note: The figure shows cumulated impulse responses of the P1/P10 and P1/P9 ratios to a 100 bps increase in inflation. The dashed lines depict the OLS estimates around 90% confidence bands based on robust standard errors estimates.

Figure A5: Insights on the transmission channel (Other assets)

(a) Total return on safe assets

(b) Total return on risky assets



Note: The figures show non-cumulated impulse responses of safe and risky assets' returns (in real terms) to a 100 b.p. increase in the inflation rate. 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 (Robustness check 3)

	(1) P9	(2) P9/B90	(3) P1/P9	(4) P1/P10
Inflation	-0.002**	-0.001***	-0.006***	-0.0013**
	(0.00)	(0.00)	(0.00)	(0.00)
GDPpc	-0.48	-0.2	0.62	0.54
	(0.64)	(0.25)	(1.07)	(0.37)
Pop	-0.01	-0.02	0.013	0.01
	(0.02)	(0.01)	(0.02)	(0.01)
Stock prices	0.011	0.01**	0.15***	0.05***
	(0.01)	(0.01)	(0.03)	(0.01)
TFP	1.29**	0.55**	0.66	-0.6
	(0.70)	(0.31)	(1.42)	(0.42)
Education	-0.003***	-0.002***	-0.02***	-0.004***
	(0.001)	(0.00)	(0.003)	(0.00)
Openness	-0.002	-0.001	-0.07	-0.04
	(0.11)	(0.04)	(0.25)	(0.07)
Government spending	-0.57***	-0.25***	-1.32***	-0.20
	(0.15)	(0.07)	(0.46)	(0.13)
Real interest rate	-0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Financial development	0.04	-0.03	-0.2	-0.03
	(0.05)	(0.02)	(0.00)	(0.04)
Observations	185	185	185	185
N countries	12	12	12	12

Note: This table shows results from panel regressions with country and time fixed effects for the top 9% income share (column (1)), the P9/B90 (column (2)), P1/P9 (column (3)) and P1/P10 ratios (column (4)). Robust 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.