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Abstract

Most countries in the world have brought inflation down to very low rates. While there is broad consensus on the fact that bringing down inflation has adverse (short-run) consequences on aggregate demand, we know little about the distributional impact of disinflations. We show that along disinflations the income distribution tends to worsen and discuss the implications for monetary policy of this finding.

Keywords: Monetary Policy, Central Banks, Inflation, Disinflation, Income distribution.
JEL codes: E31, E32, E43, E52, E58, D31

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1. Introduction

In 1980 the world's median inflation rate[2] was 13.8%. By the turn of the Century the statistic had dropped to 4%, a figure that some scholars have recently proposed as a reasonable long-term inflation target (Blanchard et al. 2010; Ball, 2014). Nevertheless, the downward trend in world inflation did not stop at 4%: from 2013 onwards, more than half of the countries of the world have kept inflation rates below 3% and a third kept numbers below 2%.

Meanwhile, the rising inequality in many countries of the world has captured the attention of social scientists, governments and the population in general. Are these two facts related? Does the income distribution deteriorate during disinflations? This is the question we address in this paper.

A large literature has shown that disinflations reduce aggregate output (see for instance Ball's, 1994, seminal contribution). This literature has quantified the output losses relative to the change in inflation and studied the determinants of these losses. We know little though as to how these output sacrifices are distributed and whether they affect some portions of the population more than others. As in this literature, our paper studies disinflations, but this time by focusing on their distributive effects rather than their aggregate consequences.

Another more recent branch of the literature related to our paper has studied the distributional consequences of monetary shocks. Several papers have found that contractionary monetary policies lead to a deterioration of the income distribution: Coibion et al. (2017) report this finding for the US, Mumtaz and Theophilopoulou (2017) obtain similar conclusions for the UK and Furceri et al. (2018) corroborate the findings for a panel of 32 advanced and emerging countries. Cantore et al. (2019), find that following a monetary tightening the share of output allocated to wages temporary increases in five developed economies. In our paper, we do not rely on the identification of monetary shocks—as these papers do—to study their impact on distributional outcomes. Our unit of analysis—as in the sacrifice ratio literature—are disinflation episodes.

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[2] International Monetary Fund, World Economic Outlook Database

In particular, we use Mazumder's (2014) global sample of disinflations to analyze the effects on income distribution of bringing down inflation. Disinflations in Mazumder's sample are identified following Ball's (1994) methodology: episodes where trend inflation falls between peak and trough by at least 1.5 percentage points. Moreover, it considers only episodes with inflation peaks below 20%, where the trade-offs between inflation and aggregate economic activity have been found to be relevant.

Using a sample of disinflations rather than monetary shocks implies that our results do not hinge on estimated measures of monetary shocks (across countries and over time). Moreover, using disinflations as the unit of analysis allows us to extend the study to a broader set of countries: papers relying on the identification of monetary shocks require either long/high frequency data on economic expectations, or data that relies on narrative identification strategies as in Romer and Romer (2004), both of which are harder to come by. Finally, looking directly at disinflations provides an important complement to the previous literature: it is a well-established fact that disinflations scar the aggregate economic performance, but we know less about the distributive consequences, if any, of these episodes.

Since we look directly at episodes where inflation actually fell by a significant amount, our analysis does not incorporate the failed attempts by Central Banks to bring down inflation rates. If these failed attempts have consequences on the income distribution, our results should be interpreted as a lower bound of actual effects. The reason for this will become clear once we explain the empirical strategy, based on Jorda's (2005) local projections methodology.

We find that during disinflations the Gini coefficients worsen. In the baseline estimates, after four (six) years within a disinflation, the Gini coefficients increase by 5.2% (11.5%) of their standard deviation.[3] Relative to the sample mean these figures correspond to an increase in Gini coefficients of 0.8 and 1.7 percentage points, respectively.

[3] The average disinflation lasts 4.6 years.

Significant changes in inflation as the ones identified in Mazumder's sample generally reflect falls in aggregate demand. As Ball (1994) or Hofstetter (2008) discuss, these are often triggered by Central Banks—they are the byproduct of monetary policies designed precisely to bring down inflation. The results thus highlight another set of collateral effects of (successful) monetary anti-inflationary policies. Interpreted this way, they are coherent with the findings of Coibion et al., (2017) or Furceri et al., (2018), among others.

Our results also imply that long disinflations have stronger effects on Gini coefficients than short ones. This result is coherent with the sacrifice ratio literature that finds that long disinflations are associated with greater output losses (Mazumder, 2014; Smith and Senda, 2008).

The baseline results are estimated using Gini coefficients before taxes and government transfers. These results, though, are not washed away when using measures that incorporates taxes and transfers: even considering the government's role in improving the income distribution, it worsens along disinflations.

We also test how disinflations affect the proportion of national income that goes to the different portions of the population (via Lorenz Curves). Here we find evidence pointing at a gain in participation in national income of the richest decile during disinflations. The size of the effect increases with the length of the disinflation. After four (six) years within a disinflation, the richest decile gains participation in national income by a size corresponding to 5.5% (10.2%) of its standard deviation. Relative to the mean participation by decile this gains reach 1.3% (2.4%). This gain in participation is compensated by a loss of the first seven deciles of the distribution, especially those in the middle: 4th to 6th deciles.

We also study how the participation of the top 1% in national income changes along disinflations. The figures are even higher than for the top 1%: relative to its mean, the participation of the top centile in national income raises by as much as 4.5% (8.4%) after being for four (six) years within a disinflation.

Why would the income distribution change during disinflations? As we mentioned, disinflations are typically periods of falling aggregate demand often triggered by tight monetary policies aimed precisely at taming the inflation rate. Some of the main channels by which tight monetary policies can have distributive effects are the following: (for a longer discussion see for instance Koedijk et al., 2018, and Nakajima, 2015).

- The proportion of labor and capital income is heterogeneous across households, with poorer households depending more on labor income. As long as monetary policies affect these sources of income in different ways, they will have an impact on income distribution.
- The risk of becoming unemployed during downturns is also unevenly distributed: for instance, Elsby et al. (2010) document that during recessions the unemployment rate of young or less educated individuals increases more than for other groups of the population.
- On the capital income side, the impact of monetary policies does also have heterogeneous effects across the returns of different assets. Thus monetary policies will affect the income distribution through this channel, given that households do not hold homogenous portfolios.
- The change in inflation itself can also have distributive consequences. Debtors tend to lose and creditors benefit from (unexpected) lower inflation, which increases the real value of debts, potentially increasing the inequality. Moreover, lower inflation could reduce the inflation tax which could favor lower-incomes households that rely more on cash than richer households (Erosa and Ventura, 2002).

In what follows, section 2 describes de data, section 3 the methodology while sections 4 and 5 report the results. Section 6 focuses on testing their robustness. The final section concludes, discusses policy implications and tasks for future research.

2. Data

Disinflations: we use Mazumder's (2014) world sample of disinflations. His panel includes 189 countries over the period 1969 through 2009. He uses Ball's (1994) method to identify the episodes: the strategy consists of identifying peaks and troughs on trend inflation. Disinflations are episodes where inflation falls by a significant amount, in particular by at least 1.5 percentage points between peak and trough. The upper limit of peaks is a 20% inflation rate.

157 out of the 189 countries in Mazumder's sample have at least one disinflationary episode. In total, he identifies 426 episodes, 78 of them in OECD countries. The average length of the episodes is 4.6 years for the whole sample, corresponding to an average of 5.6 years in the OECD sample and 4.4 years for non-OECD disinflations.

Gini: we obtain the Gini coefficients from the Standardized World Income Inequality Database (SWIID 6.1; Solt, 2018). For the baseline estimates reported in section 4, we use the pre-taxes and pre-transfers income based Gini coefficients. We extend the results by using after taxes and transfers income based Gini coefficients in section 5.

We use all the information available in SWIID for the countries and years included in Mazumder's panel. There are though no Gini coefficients for all country and years in Mazumder's sample, especially for the earlier part of the panel. In particular, the Gini's are available for 54.4% of the disinflations. Note that the empirical strategy, described in the next section, requires using all Gini's available for the country/years, not only those coinciding with disinflation episodes.

Table 1 summarizes the mean and standard deviation for the sample of Gini coefficients. Note that the mean Gini coefficients grow over the decades both in OECD and non-OECD countries.

	All countries		**Non-OECD**		**OECD**	
	Mean	**Stand. Dev.**	**Mean**	**Stand. Dev.**	**Mean**	**Stand. Dev.**
1969-1979	43.95	6.88	45.17	7.47	42.23	5.55
1980-1989	44.42	7.12	45.39	7.89	42.79	5.22
1990- 1999	45.58	6.72	45.77	7.15	45.03	5.33
2000-2009	46.17	6.42	46.00	6.81	46.77	4.70
1969-2009	**45.36**	**6.76**	**45.74**	**7.18**	**44.44**	**5.47**

Table 1. Descriptive statistics of Gini coefficients.

Lorenz Curves: we obtain the shares of income from the World Inequality Database (WID). The shares for the top 1% and every decile (1 is the poorest and 10 is the richest) correspond to pre-tax income for adults and the elderly. We also use all the information available in WID for the countries and years included in Mazumder's panel. We exclude shares that do not add up to one and the observations for which we do not have the whole distribution. There are 70 complete episodes in this dataset. However, the information in heavily concentrated in OECD countries: there are less than 9% complete Non-OECD episodes. For this reason, we chose to present in section 4 the results only for OECD countries, where there are 53.8% complete episodes.

Table 2 summarizes the mean and standard deviation for the share of income of each decile and the top 1% of the OECD sample.

	Decile 1 (poorest)		Decile 2		Decile 3		Decile 4	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1969-1979	0.011	0.00	0.029	0.00	0.043	0.00	0.056	0.00
1980-1989	0.030	0.02	0.048	0.01	0.059	0.01	0.070	0.01
1990- 1999	0.026	0.01	0.043	0.01	0.054	0.01	0.064	0.01
2000-2009	0.024	0.01	0.042	0.01	0.052	0.01	0.062	0.01
1969-2009	**0.026**	**0.01**	**0.044**	**0.01**	**0.054**	**0.01**	**0.065**	**0.01**
	Decile 5		Decile 6		Decile 7		Decile 8	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1969-1979	0.069	0.00	0.083	0.00	0.099	0.00	0.119	0.00
1980-1989	0.080	0.01	0.091	0.01	0.104	0.00	0.120	0.00
1990- 1999	0.075	0.01	0.086	0.01	0.099	0.01	0.116	0.01
2000-2009	0.073	0.01	0.084	0.01	0.097	0.01	0.114	0.01
1969-2009	**0.075**	**0.01**	**0.086**	**0.01**	**0.099**	**0.01**	**0.116**	**0.01**
	Decile 9		Decile 10 (richest)		Top 1%			
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.		
1969-1979	0.155	0.00	0.337	0.01	0.101	0.01		
1980-1989	0.144	0.01	0.253	0.05	0.062	0.02		
1990- 1999	0.143	0.01	0.295	0.08	0.085	0.05		
2000-2009	0.143	0.01	0.309	0.06	0.093	0.04		
1969-2009	**0.144**	**0.01**	**0.290**	**0.07**	**0.082**	**0.04**		

Table 2. Descriptive statistics of Lorenz curves. OECD countries.

3. Methodology

To estimate the effect of disinflationary episodes on inequality, we use an estimation strategy inspired in the local projections method (Jordà, 2005), with clustered standard errors. Other papers in the related literature that use variants of this methodology include Coibion et al., (2017) and Furceri et al., (2017). Our main regressions are as follows, for any income distribution measure, Y:

$$Y_{i,t+k} - Y_{i,t} = \alpha_i^k + \gamma_1^k trend_t + \sum_{j=1}^{2} \gamma_{1+j} \Delta Y_{i,t-j} + \beta_k D_{i,t}^k + \varepsilon_{i,t}^k \tag{1}$$

which we estimate for $k = 1, \dots, 6$.

$Y_{i,t}$ is the income distribution measure of country i in year t; α_i^k is a country fixed effect, $trend_t$ is a linear trend and $\Delta Y_{i,t-j}$ are lags of the changes in the income distribution measure. $D_{i,t}^k$ is a dummy variable equal to 1 *during* (as clarified below) a disinflationary episode, and zero otherwise.

The coefficient of interest is β_k. It captures the difference between two *Y'*s—that are *k* periods apart—within a disinflation, relative to two *Y'*s, also *k*-periods apart, outside of disinflations. Note that the $\beta_k{}'s$ do not represent a standard impulse response function where the estimates would report how the *Y'*s evolve *k* periods after the (inflation) shock.

We prefer this strategy over the impulse response version because disinflations are not a one period shock: the tight policies behind them usually last far more than a single year. Thus, we intend to explore how the *Ys* change while the disinflation (and the policies behind it) is under-way, relative to periods where there is no disinflation going on.

Note also that $D_{i,t}^k$, the dummy that we set equal to 1 during disinflations and zero otherwise, depends on *k*: for *k* = *1*, the dummy is turned on from the peak period (0) through one year before the trough (*T-1*). This way β_1 captures the one year changes in *Y* within the episodes relative to one-year changes outside of the episodes. Similarly, for *k* = *2*, the dummy is turned on up to *T-2*. Figure 1 presents a sketch illustrating the point. In general, for an episode in country *i*, with peak in period *0* and trough in period *T*,

$$D_{i,t}^{k} = 1 \qquad \text{for t = 0 up to t = T-k.}$$

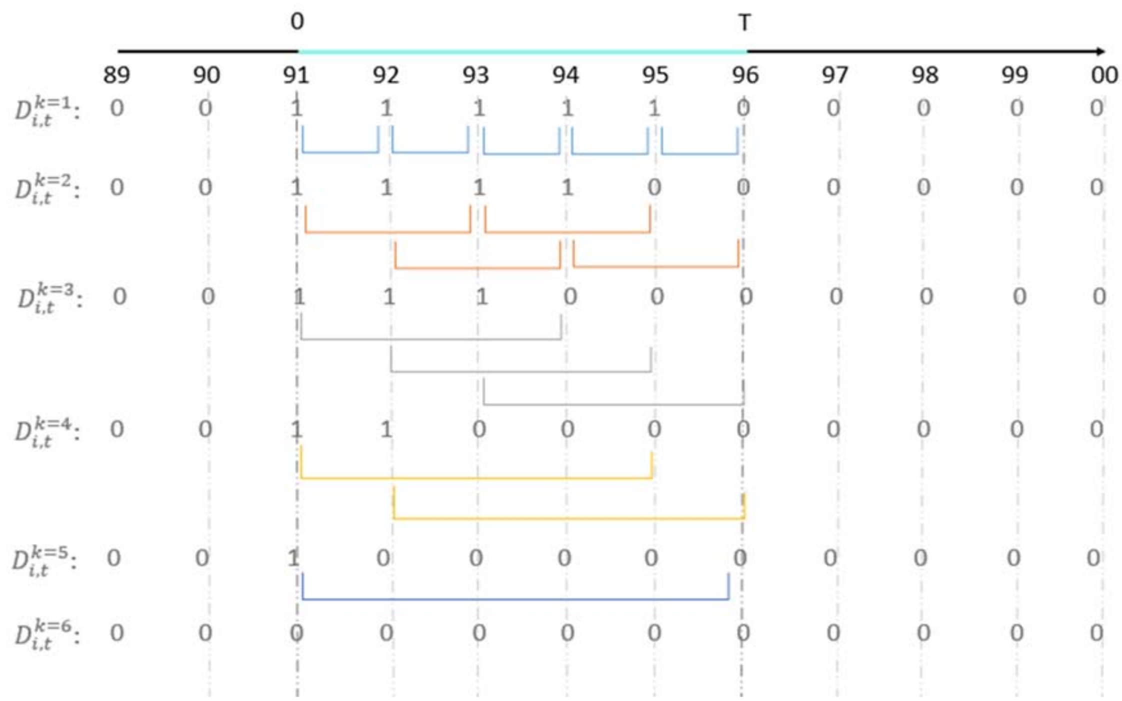

Figure 1 This figure sketches how $D_{i,t}^{k}$ changes with along *k*. It represents the way the dummy works for a disinflationary episode that goes from 1991 (inflation peak, 0) to 1996 (inflation trough, T). Every β_k represents the average effects of the lines of the same color.

4. Results

Gini

The β_k's represent the change in Gini coefficients that are *k* years apart within a disinflation, relative to the same change outside disinflation episodes. We plot the β_k's along with 90% confidence intervals in Figure 2. The plot on the left reports results for the whole sample, while the remaining ones separate the effects between OECD and non-OECD countries. The latter two are estimated using equation 1, with an extra interaction to estimate the differential effects over the two sets of countries.

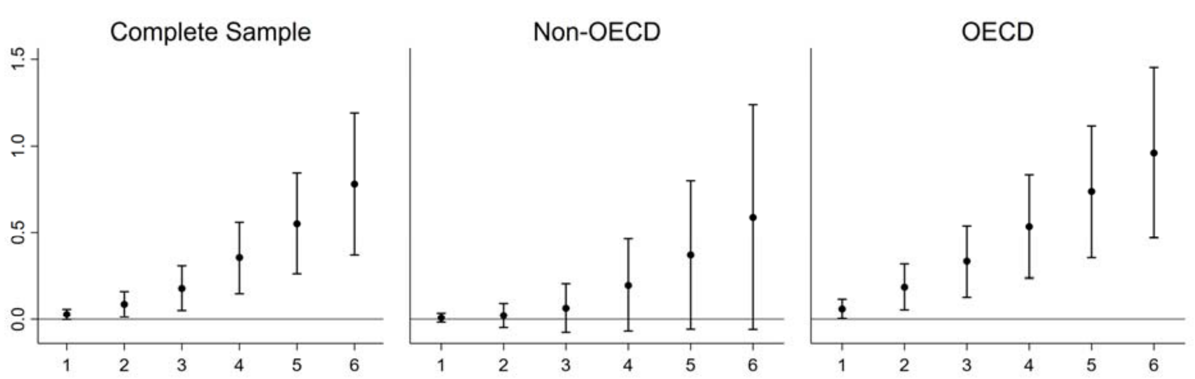

Figure 2. β_k for Y = Gini. Results based on estimations of equation 1 for the whole sample: the plots report β_k (vertical axes) for different k's (horizontal axes) along with 90% confidence intervals. The β_k's represent the change in Gini coefficients k periods apart within a disinflation relative to the same change outside disinflations.

For the *whole* sample the Gini coefficients deteriorate (within disinflation episodes) and they do so in an increasing manner as k increases. That is, the longer the time span between the two Gini coefficients within a disinflation, the greater the estimated effect on the income distribution (β_k). The statistical relevance does also increase with k.

What do the coefficients mean quantitatively? In ***Table 2*** we report the β_k's, along with their ratio relative to the standard deviation and the mean of the respective Gini coefficients in the sample. Take for instance β_5—the five year change in Gini indices within an episode, relative to five year changes outside of episodes. The coefficient is 0.55, which corresponds to an increase in the Gini of 8.2% relative to its standard deviation or 1.2% relative to the Gini's sample mean. If we look at β_6 the increase in the Gini within the disinflation reaches 11.5% of its standard deviation or 1.7% of its mean.

		Complete Sample			**Non-OECD**			**OECD**		
		β	**β/σ**	**β/mean**	**β**	**β/σ**	**β/mean**	**β**	**β/σ**	**β/mean**
k	**1**	0.02808	0.004	0.001	0.00883	0.001	0.000	**0.06021****	**0.011**	**0.001**
	2	**0.08689***	**0.013**	**0.002**	0.02151	0.003	0.000	**0.18611*****	**0.034**	**0.004**
	3	**0.17859****	**0.026**	**0.004**	0.06446	0.009	0.001	**0.33281*****	**0.061**	**0.007**
	4	**0.3540*****	**0.052**	**0.008**	0.19656	0.027	0.004	**0.53443*****	**0.098**	**0.012**
	5	**0.55118*****	**0.082**	**0.012**	0.36902	0.051	0.008	**0.73516*****	**0.134**	**0.017**
	6	**0.77797*****	**0.115**	**0.017**	0.5878	0.082	0.013	**0.96042*****	**0.176**	**0.022**

Table 2. β_k for Y = Gini. Results based on estimations of equation 1. The β_k's represent the change in Ginis k periods apart within a disinflation, relative to the same change outside disinflations. σ and 'mean' correspond to the standard deviation and the mean of the respective Gini coefficients. In Bold: lines with statistical significance for the respective β_k's. *** p<0.01; ** p<0.05; * p<0.1.

The sacrifice ratio literature—studying the output losses per inflation point during disinflations—has established that long disinflations tend to be more costly.[4] The fact that the β_k's are increasing over k suggests that the adverse effects on income distribution are also a positive function of the length of disinflations. While k does not exactly represent the length of disinflations, it reports how much the Gini changed over k years within a disinflation (relative to k-year changes in Gini outside disinflations). In other words, β_k is estimated only with episodes that are at least k years long. In this sense, the deterioration of the income distribution that we identify, is also a positive function of the disinflation episodes' length.

We also estimate equation 1, splitting the sample between OECD and non-OECD countries, following the classification in Mazumder's sample of disinflations. The results are also reported in Figure 2 and *Table 2*. While the coefficients follow similar patterns across the two samples, the effects are stronger and only statistically relevant for the OECD countries. Mazumder (2014) shows that the sacrifice ratios—that is, the output losses per inflation point during disinflations—are on average smaller in non-OECD countries: the OECD figure is 1.15 while the mean in non-OECD countries is 0.48. Finding, as we do, that the deterioration of the income distribution is particularly significant in the OECD case is consistent with Mazumder's findings.

The size of the effects for the OECD countries is larger than the one estimated above for all countries. For instance for $k = 5$, the coefficient implies an increase in Gini that corresponds to 13.4% of its standard deviation or 1.7% of its mean. For $k = 6$, this figure climbs to 17.6% and 2.2% respectively.

Summing up, we find that the Gini coefficients deteriorate along disinflations, more so the longer the disinflation, and the results are significant for the whole sample and for the OECD countries.

[4] Many papers use the speed (inflation points per year) of the episode as a determinant rather than the length. Nevertheless, the length on its own has been shown to positively affect the sacrifice ratios (e.g. Hofstetter 2008; Mazumder, 2014; Smith and Senda, 2009).

Lorenz curves

Provided that the income distribution worsens, as shown by the results discussed above, which deciles gain or lose participation in national income along disinflations? We use the same empirical strategy described in equation 1, now with Y corresponding the Lorenz curve estimates for each decile instead of the Gini. We do that for OECD countries only as the data for non-OECD covers less than 10% of the disinflations. We report the estimates for $k = 1$ through 6, in Figure 3.

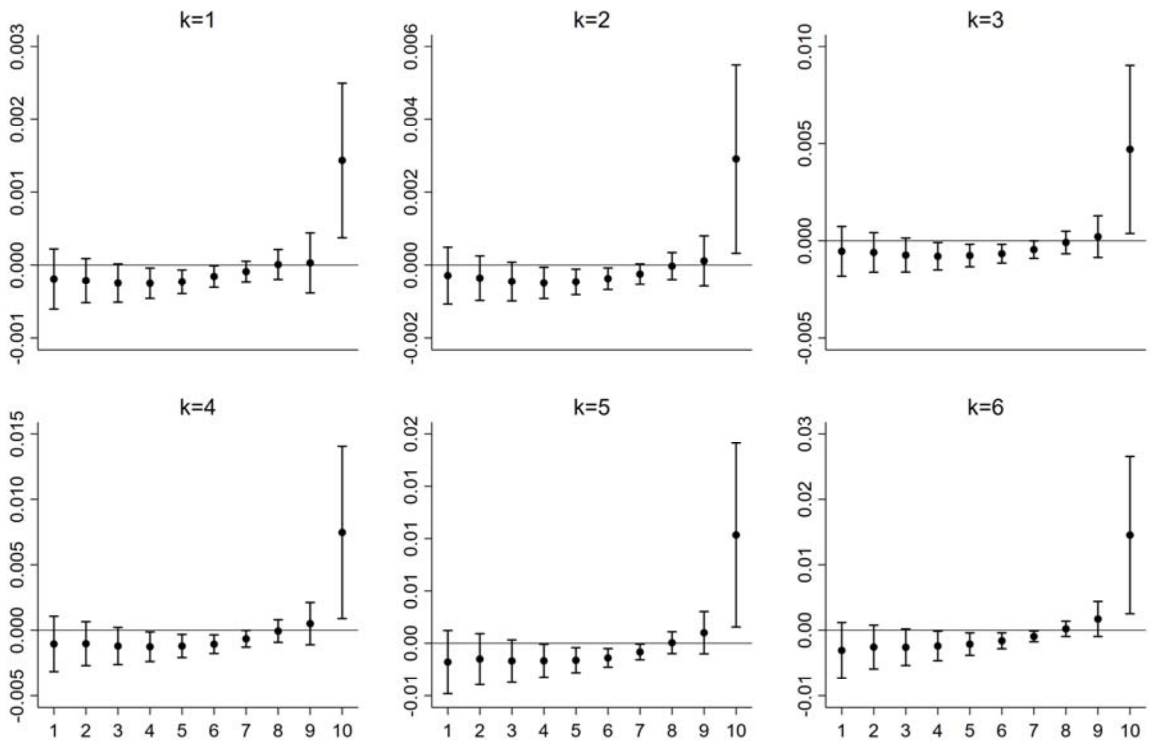

Figure 3. β_k, for Y = Lorenz curves for each decile. Results based on estimations of equation 1 for OECD countries. The plots report β_k (vertical axes) for different deciles (horizontal axes) along with 90% confidence intervals. The β_k's represent the change in income participation of each decile, *k* periods apart within a disinflation relative to the same change outside disinflations.

The income participation of the top decile increases along disinflations, for all *k*'s. This is the only decile gaining participation in income along the disinflations. If the upper decile's participation increases it must be the case that others' decrease. For all *k*'s, the first seven deciles have negative coefficients, meaning that all of them lose participation in national income along the disinflations. These coefficients are statistically relevant for the deciles 4, 5 and 6. The story that comes out is one where the income distribution deteriorates along disinflations, and this deterioration is explained by a gain in participation of the richest decile at the expense of the middle class.

How big are these effects? In ***Table 3*** we report for each decile the B_k's along with their ratio relative to the respective standard deviation and mean of the income participation (which also vary by decile).

Decile	k=1			k=2			k=3		
	β	β/σ	β/mean	β	β/σ	β/mean	β	β/σ	β/mean
1	-0.00019	-0.016	-0.007	-0.00029	-0.024	-0.011	-0.00055	-0.045	-0.021
2	-0.00021	-0.019	-0.005	-0.00036	-0.031	-0.008	-0.00060	-0.052	-0.014
3	-0.00025	-0.022	-0.005	-0.00045	-0.041	-0.008	-0.00074	-0.067	-0.014
4	-0.000249*	-0.024	-0.004	-0.000489*	-0.047	-0.008	-0.0008*	-0.077	-0.012
5	-0.000229**	-0.024	-0.003	-0.000462**	-0.047	-0.006	-0.00076**	-0.078	-0.010
6	-0.000157*	-0.017	-0.002	-0.000375**	-0.042	-0.004	-0.000669**	-0.074	-0.008
7	-0.00009	-0.011	-0.001	-0.00025	-0.030	-0.002	-0.00046	-0.055	-0.005
8	0.00001	0.001	0.000	-0.00003	-0.004	0.000	-0.00009	-0.012	-0.001
9	0.00003	0.003	0.000	0.00011	0.012	0.001	0.00021	0.021	0.001
10	0.000893**	0.013	0.003	0.001614*	0.024	0.006	0.002369*	0.035	0.008
	k=4			k=5			k=6		
1	-0.00106	-0.088	-0.041	-0.00180	-0.149	-0.069	-0.00309	-0.257	-0.119
2	-0.00104	-0.090	-0.024	-0.00151	-0.131	-0.034	-0.00259	-0.225	-0.059
3	-0.00121	-0.110	-0.022	-0.00170	-0.154	-0.031	-0.00262	-0.238	-0.048
4	-0.001268*	-0.122	-0.020	-0.001677*	-0.161	-0.026	-0.002419*	-0.232	-0.037
5	-0.00121**	-0.124	-0.016	-0.001626**	-0.167	-0.022	-0.002135*	-0.220	-0.028
6	-0.001071**	-0.119	-0.012	-0.001402**	-0.156	-0.016	-0.001626**	-0.181	-0.019
7	-0.00066	-0.080	-0.007	-0.000834*	-0.101	-0.008	-0.000957*	-0.116	-0.010
8	-0.00007	-0.009	-0.001	0.00005	0.007	0.000	0.00020	0.026	0.002
9	0.00050	0.051	0.003	0.00101	0.102	0.007	0.00171	0.174	0.012
10	0.003715*	0.055	0.013	0.005238*	0.077	0.018	0.006951*	0.102	0.024

Table 3. β_k for Y = Lorenz curves for each decile. Results based on estimations of equation 1 for OECD countries. The B_k's represent the change in income participation of each decile, *k* periods apart within a disinflation, relative to the same change outside disinflations. σ and 'mean' correspond to the standard deviation and the mean of the Lorenz curves for the respective deciles. In Bold: lines with statistical significance for the respective β_k's. ** p<0.05; * p<0.1.

As with the Gini, the size of the coefficients (in absolute terms) rises with *k*. Again, inasmuch as *k* works as a proxy of the length of the episode as discussed earlier, it appears that the consequences on the different deciles are also a positive function of how long disinflations last.

The biggest gain in participation corresponds to the upper decile and for k = 6. The coefficient corresponds to a 10.2% gain relative to its standard deviation and 2.4% relative to its mean. As for the loss of participation, the largest estimate is the 4th decile's for the k =

6 case. It signals a loss corresponding to 23.2% of its standard deviation (note that the 10th decile is much volatile—see the descriptive statistics in section 2). With respect to its mean, the coefficient implies a loss of participation of 3.7%.

5. Further results

Gini: after taxes and transfers

The results reported so far are based on pre-tax and transfers Gini measures. Of course, it could well be that while tight monetary policy, or more in general the fall in aggregate demand, deteriorate the income distribution before taxes and transfers, these effects are washed out by the fiscal policy, precisely through taxes and transfers. In Figure 4 and Table 4, we report the results of estimating equation 1 with the disposable income measure of Gini coefficients, i.e. Gini after taxes and transfers.

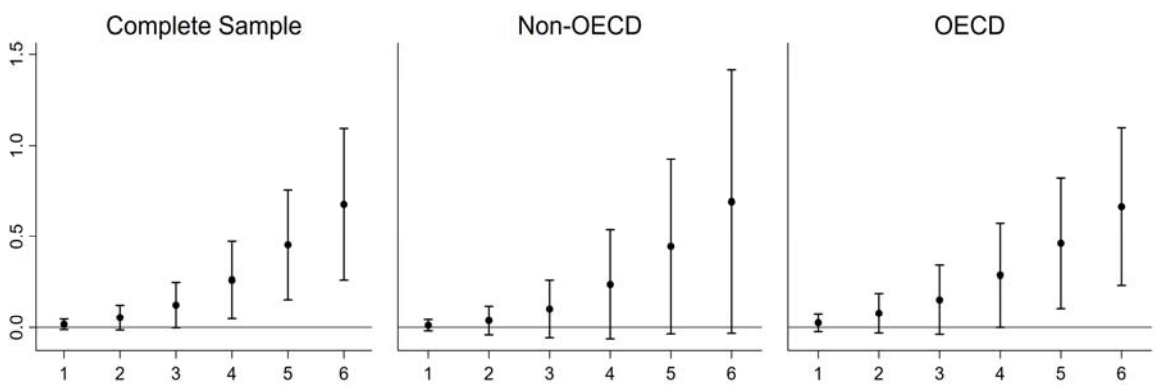

Figure 4. β_k for Y = Gini after taxes and transfers. Results based on estimations of equation 1. The plots report β_k (vertical axes) for different k's (horizontal axes) along with 90% confidence intervals. The β_k's represent the change in Gini coefficients k periods apart within a disinflation relative to the same change outside disinflations.

		Complete Sample			Non-OECD			OECD		
		β	β/σ	β/mean	β	β/σ	β/mean	β	β/σ	β/mean
k	1	0.01699	0.002	0.000	0.01186	0.002	0.000	0.02547	0.004	0.001
	2	0.05393	0.006	0.001	0.03790	0.005	0.001	0.0781	0.011	0.003
	3	0.12324	0.014	0.003	0.10205	0.014	0.002	0.15170	0.022	0.005
	4	**0.26045****	**0.029**	**0.007**	0.23752	0.032	0.006	0.28664	0.041	0.010
	5	**0.45318****	**0.050**	**0.012**	0.4445	0.059	0.011	**0.46190****	**0.067**	**0.015**
	6	**0.67795*****	**0.075**	**0.018**	0.6913	0.092	0.017	**0.66518****	**0.096**	**0.022**

Table 4. β_k for Y = Gini after taxes and transfers. Results based on estimations of equation 1. The β_k's represent the change in Ginis k periods apart within a disinflation, relative to the same change outside disinflations. σ and 'mean' correspond to the standard deviation and the mean of the Ginis. In Bold: lines with statistical significance for the respective β_k's. *** p<0.01; ** p<0.05; * p<0.1.

Qualitatively, the outcomes are very similar to the baseline case: there is a clear effect on distribution within disinflations, one that grows as more time goes by between the two periods analyzed. When looking at results for OECD vis-a-vis non-OECD countries, we see again that it is in the former that the outcomes are statistical significant. Nevertheless, this time this statistical relevance kicks in starting with k=5, while in the pre-tax and transfers case, all coefficients were significant. Analyzed through this lens, the distributive role of government attenuates the effects, especially of shorter disinflations.

As for the size of the effects, the hypothesis is that they should be smaller than in the original case, as the fiscal policy is expected to mitigate the impact of the falling aggregate demand on the income of the individuals. That is indeed what we find at least when the effects are measured relative to the standard deviation of after-tax and-transfers Gini coefficients. For instance, for the whole sample, the size of β_6 corresponds to 7.5% of the Gini's standard deviation. This figure was 11.5% in the baseline sample. For the OECD, this figure is now 9.6% of the standard deviation compared with the 17.6% of the baseline sample. Nevertheless, relative to its mean these differences between the two sets of results are negligible.

Summing up, the fiscal policy alleviates somewhat the consequences on income distribution of disinflations, but does not wash them out, especially if the episodes are long. Disinflations scar the income distribution even after accounting for the government's role to redistribute the resources.

Lorenz: what about the top 1%?

The top centile of the income distribution has received a lot of attention by scholars and media over the last few years (e.g., Alvaredo et al. 2013). We estimate equation 1, as we did in the previous section along the income deciles, but now analyzing how the participation of the top 1% changes along disinflations. In ***Figure 5***, we report the B_k's for the top centile of the income distribution (OECD countries only) and in ***Table 5***, in addition to the B_k's, we report their ratios relative to the standard deviation and the mean of the top centile's distribution.

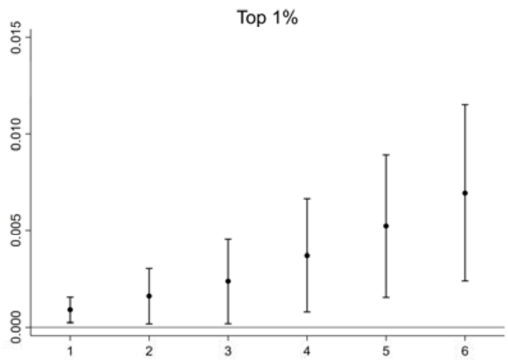

Figure 5. βk, for Y = Lorenz curves for the Top 1%. Results based on estimations of equation 1 for OECD countries. The plots report β_k (vertical axes) for different k's along with 90% confidence intervals. The β_k's represent the change in income participation of the top 1%, k periods apart within a disinflation relative to the same change outside disinflations.

	Top 1%		
k	β	β/σ	β/mean
1	**0.00088****	**0.023**	**0.011**
2	**0.00160***	**0.041**	**0.019**
3	**0.00236***	**0.061**	**0.029**
4	**0.00371****	**0.096**	**0.045**
5	**0.00517****	**0.134**	**0.063**
6	**0.00688****	**0.178**	**0.084**

Table 5. β_k for Y = Lorenz curves for Top 1%. Results based on estimations of equation 1 for OECD countries. The β_k's represent the change in income participation of the top 1%, k periods apart within a disinflation, relative to the same change outside disinflations. σ and 'mean' correspond to the standard deviation and the mean of the top 1%. In Bold: lines with statistical significance for the respective β_k's. ** $p<0.05$; * $p<0.1$.

The participation of the top 1% increases for all *k*'s within disinflations. Not only are the results statistically relevant but economically important: the size of the $\boldsymbol{\beta_k}$ relative to the mean (of the top 1% participation) start at 1.1% for $k = 1$, and climb to 8.4% for $k = 6$. The latter is almost four times larger than the figure we estimated for the top decile. Along disinflations, the participation of the top 1% rises notably.

6. Robustness

We evaluate the robustness of the baseline results to three changes. First, two changes the lag structure of equation 1. In the baseline case, we used two lags. We report results with one and three lags in for the Gini. We also test if our results are robust to the exclusion of the small countries in the sample, defined as those with less than a million people by 2000. In the three cases, reported in ***Figure 6***, the outcomes are very similar to those estimated for the baseline scenario.

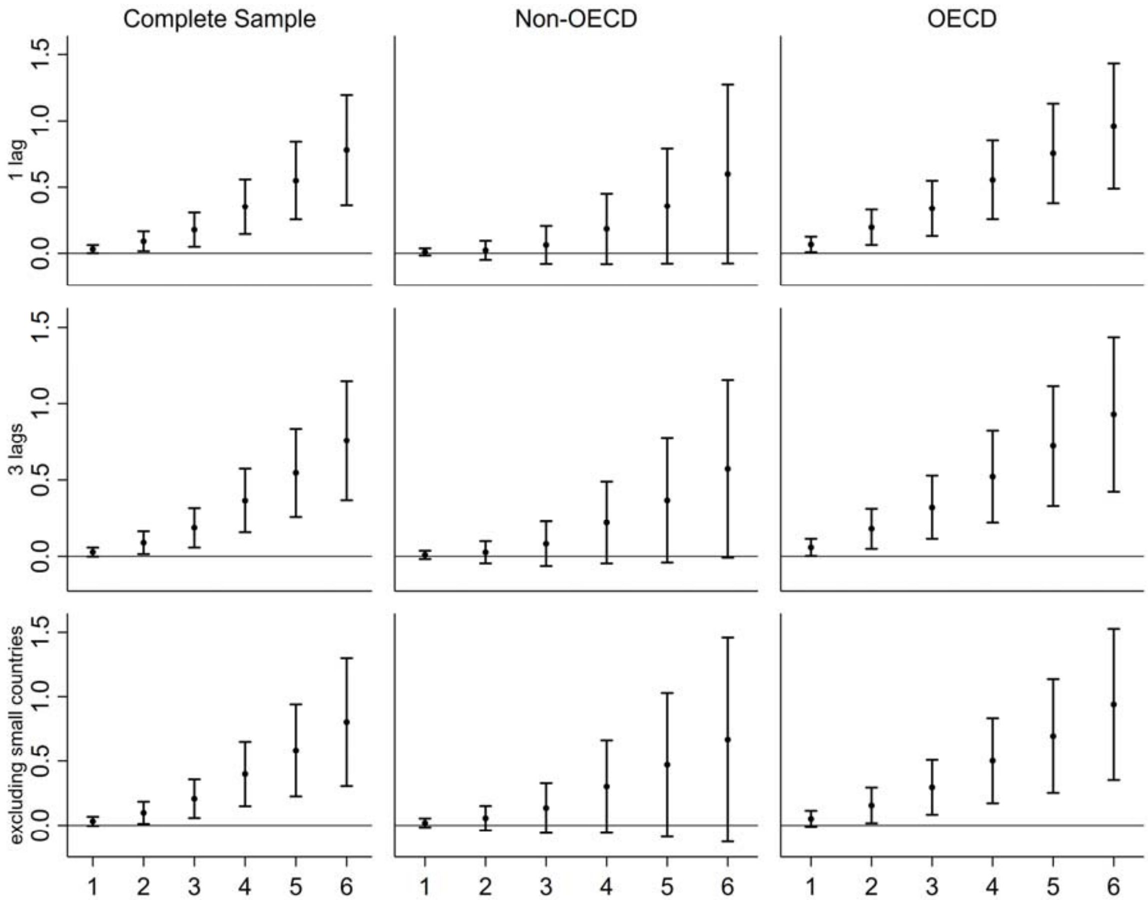

Figure 6. β_k for Y = Gini. Results based on estimations of equation 1. The first and second lines use one and three lags, respectively. The third line uses the baseline equation, but excludes countries with less than a million people from the sample. The plots report β_k (vertical axes) for different k's (horizontal axes) along with 90% confidence intervals. The β_k's represent the change in Gini coefficients *k* periods apart, within a disinflation, relative to the same change outside disinflations.

The same robustness checks, now for the income deciles, are reported in the next figures. In Figure 7, we report the estimates with one lag in equation 1, in Figure 8 we use three lags, and in Figure 9 we restrict the sample to countries with at least one million people.

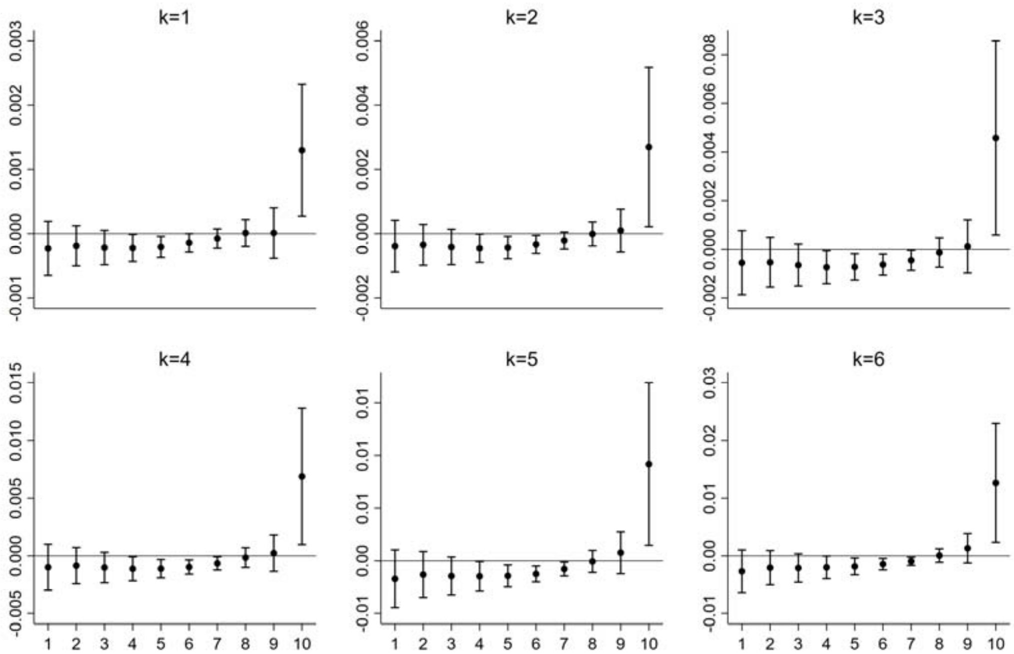

Figure 7. β_k, for Y = Lorenz curves for each decile. Results based on estimations of equation 1, with **one lag**, for OECD countries. The plots report β_k (vertical axes) for different deciles (horizontal axes) along with 90% confidence intervals. The β_k's represent the change in income participation of each decile, *k* periods apart within a disinflation relative to the same change outside disinflations.

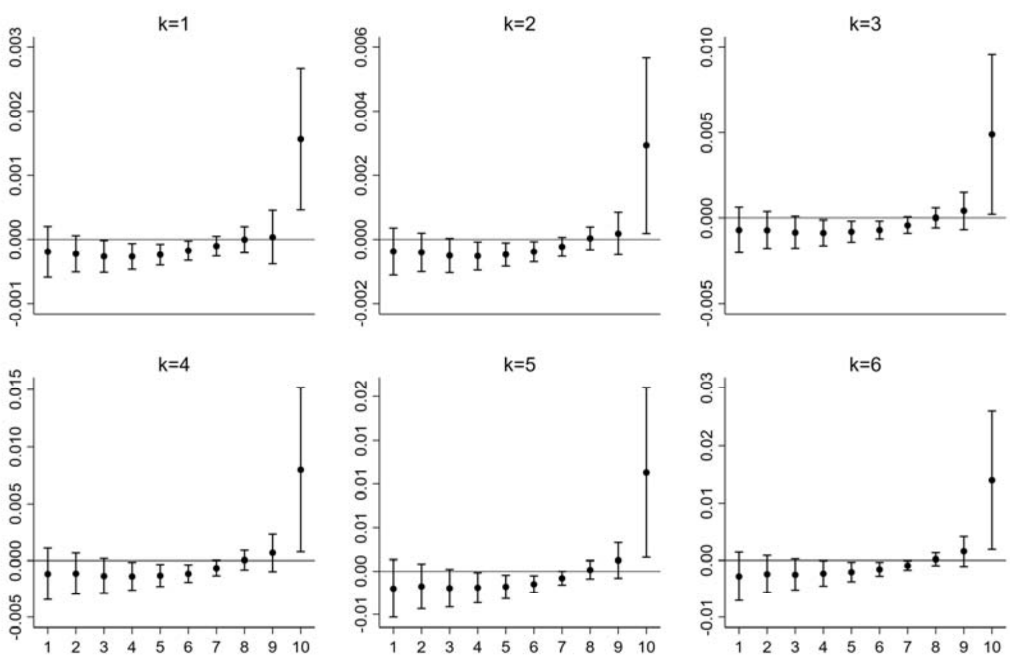

Figure 8. β_k, for Y = Lorenz curves for each decile. Results based on estimations of equation 1, with **three lags**, for OECD countries. The plots report β_k (vertical axes) for different deciles (horizontal axes) along with 90% confidence intervals. The β_k's represent the change in income participation of each decile, *k* periods apart within a disinflation relative to the same change outside disinflations.

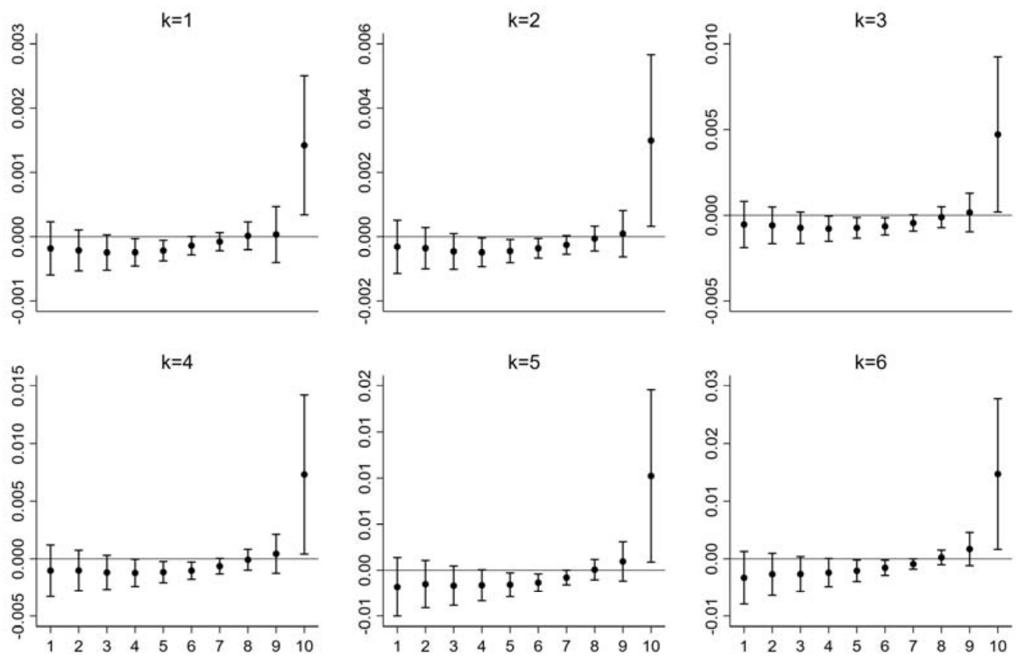

Figure 9. β_k, for Y = Lorenz curves for each decile. Results based on estimations of equation 1 for OECD countries with **more than a million people**. The plots report β_k (vertical axes) for different deciles (horizontal axes) along with 90% confidence intervals. The β_k's represent the change in income participation of each decile, *k* periods apart within a disinflation relative to the same change outside disinflations.

Again, the patterns discussed previously, with the upper decile gaining participation in national income along disinflation at the expense the middle class, are again present in these additional estimations.

7. Conclusions

We study the link between disinflations and income distribution. We explore whether the fall in inflation over the last few decades enjoyed by most of the world, deteriorated the income distribution.

Disinflation episodes as the ones used in our paper are generally triggered by monetary policy actions that cool off the aggregate economic activity. While there seems to be consensus on the fact that tight monetary policies reduce the economic activity at least in the short run, the distributional consequences of the sacrificed economic activity have not received as much attention in the literature. Only recently some papers have identified the evolution of income distribution variables following monetary policy shocks (e.g. Coibion et al., 2017; Mumtaz and Theophilopoulou, 2017; Furceri et al., 2018).

Our unit of analysis are the disinflations—our paper does not rely on the identification of monetary shocks. We use a global sample of disinflations running from 1969 to 2009, for 189 countries (Mazumder, 2014). We find that within disinflations, the income distribution measured with Gini coefficients, deteriorates: after five (six) years within a disinflation, the Gini coefficients increase by 8.2% (11.5%) of its standard deviation which corresponds to 1.2% (1.7%) of its mean. The effect is stronger for OECD disinflations.

Our results also show that long disinflations have stronger effects on Gini coefficients than short ones. As in the sacrifice ratio literature, it becomes apparent that the collateral damages of disinflations get worse the longer they last.

These baseline results are estimated with Gini measures before taxes and transfers. We also verify the results using disposable income Gini coefficients (after taxes and transfers). While the fiscal policy via taxes and transfers attenuates somewhat the consequences on income distribution of disinflations for short episodes, long episodes remain related to a deterioration of the income distribution: disinflations scar the income distribution even after accounting for the government's role to redistribute the resources.

For OECD countries only, we estimate how the participation of the different population deciles in income changes within disinflations. The results point at a strong gain in participation by the upper decile of the income distribution. For instance, after five (six) years within an episode of falling inflation, this decile's participation in income increases by 1.8 (2.4) percentage points relative to its mean. The middle class—fourth to sixth deciles—is the one losing participation in income in a statistically significant manner.

We also study how the participation of the top 1% in the income distribution changes along disinflations. Along disinflations, the participation of the top 1% rises notably: relative to its mean, the increase of the top 1% participation in income along disinflation is as high as 8.4%.

There is broad consensus around the fact that there is a significant amount of output sacrificed during disinflations (Ball, 1994, Mazumder, 2014; Romer and Romer 2004). Our results point at the fact that these losses are not evenly distributed: the Gini worsens during disinflations and the top decile—and even more strongly the top 1%—gains participation in income at the expense of the middle class.

Disinflations have often been advertised as a policy aimed at protecting the poor, under the reasoning that they are the ones least able to protect themselves from price increases. Our results though, suggest that the process of bringing inflation down, hurts the poor and especially the middle class, while the richest portions of the population seem to benefit.

It is in the hands of Central Banks and the mandates that the societies give them, to balance the different goals and the side-effects of the policies needed to achieve them. Our results argue against having Central Banks with single mandates focused on price stability exclusively—where the output losses and their distributive implications could be ignored. Voinea and Monnin (2017) pointed out that securing a fair distribution of the benefits and costs of price stability is a public good. The same could be argued of disinflations.

Throughout the paper, we have interpreted the results as evidence that disinflations, often triggered by Central Banks' policies, deteriorate economic activity, a deterioration that is unevenly distributed along the population's income. There is of course, the possibility of reverse causality: rising inequality could imply falling aggregate demand, because those at the top of the wealth distribution tend to consume a smaller share of their income than those at the bottom. This could *cause* the disinflation. Nevertheless, Ball (1994) or Hofstetter (2008) show that large disinflations as the ones used in this paper are the consequence of monetary policies aimed at producing lower inflation rates. Moreover, it looks unlikely to observe changes in income distribution that are rapid and strong enough to produce such sizeable disinflation processes. Nonetheless, the issue remains an interesting one for the literature to study.

Another open question for future research is whether this redistributive effects average out over the business cycle. What we show here is that during disinflation the distribution deteriorates. It may be that at times of stable or rising inflation these effects reverse. One related piece of evidence suggests that this is likely not the case: Furceri et al. (2018) show that the effects on income distribution of contractionary monetary shocks are stronger than those of expansionary shocks. Future research should look at the long-run consequences of disinflations on income distribution to shed light on this important issue.

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