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Income Inequality: Does Inflation Matter?

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This paper contributes to the income inequality literature that is based on the traditional Kuznets model. Level of development, state employment, fiscal redistribution, and price stability are found to improve income inequality in a given country. The positive impact of price stability on income distribution is nonlinear. The reduction in inflation from hyperinflationary levels significantly lowers income inequality, while further reduction toward a very low level of inflation seems to bring about negligible additional gains in the Gini coefficient. [JEL D31, O15, E31, C21]

The distribution of income in a country is traditionally assumed to shift from relative equality to inequality and back to greater equality as the country develops. Intuitively, inequality will rise as some people move away from prevailing traditional activities, which yield a low marginal product, into more productive ventures. At some point, the marginal product of all economic activities converges and income differences narrow. Based on this reasoning, the so-called Kuznets hypothesis (Kuznets, 1955) postulates a nonlinear relationship between a measure of income distribution and the level of economic development. Income distribution is also a concern for policy makers: government policies can, by design, change income distribution to some degree through taxes, transfers, public sector employment, and other policy instruments.

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Empirical multicountry studies of income distribution have documented significant residuals in Kuznets-type models even after corrections have been made for explicit redistribution policies, employment by the state, regional development, the age profile of the population, and other factors.[1] The presence of country-specific contributions to income inequality, or "fixed effects," can account for 50 percent or more of the variation in the income distribution measure.

It is surprising that inflation, as opposed to the above-mentioned variables, has been largely omitted in cross-country empirical research. Besides Bulíř and Gulde (1995), the only exceptions are papers by Adelman and Fuwa (1992) and Sarel (1997). By way of comparison, time-series models, following the pioneering work by Schultz (1969) and Blinder and Esaki (1978), have found inflation to contribute to cyclical changes in income distribution in 12 developed and emerging economies. A link between inflation and income distribution was also established by microeconometric studies employing U.S. household data (see Minarik (1979)).

Why has inflation been omitted in most cross-country studies of income distribution? As noted by previous researchers, no comprehensive alternative to the simple Kuznets hypothesis has been suggested. So far, most authors have either estimated the simple Kuznets hypothesis or resorted to ad hoc augmentation of the original model. The latter approach is exemplified by Milanovic (1994, p. 3), who argues that "income distribution is determined (1) by factors that are in the short run, from the point of view of policy makers or society as a whole, 'given,' and (2) by social (or public policy) choice." While the former set of factors comprises income per capita and the regional heterogeneity of a country,[2] the latter includes the percentage of workers employed in the state sector and government transfers as a percent of GDP.

Following Milanovic, and using his original data, this paper augments the Kuznets hypothesis of income inequality by incorporating inflation. Using a cross-country database containing 75 countries (Table 1), it is found that past inflation affects current levels of income inequality as measured by Gini coefficients, and that these results are robust even after controlling for redistributive policies. The positive impact of price stability on income distribution is nonlinear—the reduction in inflation from hyperinflation levels significantly lowers income inequality, while further reduction toward a very low level of inflation seems to bring about negligible gains in the Gini coefficient.

When inflation is included, the results seem to contradict the traditional critique that the Kuznets model depends on the inclusion of Latin American

[1]Contributions to the empirical literature were surveyed in Bulíř and Gulde (1995). Practically no single-country study supports the simplest version of the Kuznets hypothesis. See Ram (1991) for a detailed analysis for the U.S. and Deininger and Squire (1996b) for analyses of several other countries.

[2]The list of "given" factors potentially determining income distribution is, of course, longer (see Deininger and Squire (1996a) or Vanhoudt (1997)). Over time, investment in human capital can lower income inequality. This measure, however, is usually found correlated with income per capita. A skewed age profile of a country's population affects income distribution, as younger cohorts tend to have lower earned and unearned incomes. Similarly, inequality in a society comprising mainly one-person households will likely be higher than inequality in a society where households contain multiple wage earners.

Table 1. Factors Affecting Income Distribution

Country[1]		Year of Gini Observation	Gini Coefficient	GDP per Capita[2]	Social Transfers[3]	State Employment[4]	Inflation[5]
1	Tanzania	1988	59.0	567	1.9	6.0	32.6
2	Madagascar	1980	48.9	670	3.2	3.1	9.4
3	Bangladesh	1983	35.0	700	1.1	4.2	13.2
4	Zambia	1973	57.0	868	6.9	13.2	4.5
5	India	1976	40.0	870	1.8	6.0	10.0
6	Ghana	1989	36.7	991	4.7	12.4	26.3
7	Kenya	1983	57.3	1,014	5.6	7.5	13.1
8	Sierra Leone	1976	49.0	1,031	1.8	1.3	12.5
9	Nigeria	1974	60.0	1,033	1.0	3.3	10.3
10	Senegal	1970	51.3	1,248	6.1	3.4	2.3
11	Zimbabwe	1970	50.1	1,371	12.2	15.2	1.9
12	Côte d'Ivoire	1985	54.0	1,434	7.3	11.3	5.6
13	Bolivia	1989	52.5	1,487	6.8	18.3	2,414.3
14	Honduras	1989	59.1	1,491	1.1	9.6	4.9
15	Pakistan	1984	38.3	1,790	1.6	2.8	8.4
16	Indonesia	1977	51.0	1,822	2.4	5.1	24.3
17	Egypt	1975	43.0	1,935	7.7	19.3	6.0
18	Swaziland	1974	57.0	2,113	5.9	7.5	7.5
19	Sri Lanka	1985	43.0	2,120	4.6	23.3	12.2
20	Philippines	1987	45.5	2,168	2.8	11.8	17.6
21	Morocco	1980	53.3	2,376	6.3	5.0	9.7
22	Guatemala	1989	59.5	2,431	3.3	5.8	18.0
23	China	1988	38.2	2,472	12.0	20.4	10.2
24	Jamaica	1975	44.5	2,628	5.5	11.0	14.6
25	Algeria	1989	39.9	2,662	8.6	50.8	9.1
26	Jordan	1986	39.7	2,684	5.4	22.2	3.8
27	Ecuador	1987	44.5	2,810	6.8	23.7	32.0
28	Peru	1981	57.0	3,084	3.4	14.8	59.4
29	Thailand	1989	47.8	3,282	4.3	6.2	3.2
30	Iran	1984	42.9	3,558	7.9	26.9	19.2
31	Panama	1989	56.5	3,794	13.2	17.3	0.5
32	Colombia	1987	51.6	3,807	2.0	10.7	20.4
33	Turkey	1987	43.8	3,904	7.3	13.6	39.6
34	Poland	1989	26.0	4,189	17.5	70.4	71.5
35	Gabon	1977	63.0	4,210	2.3	8.4	16.2
36	Costa Rica	1989	46.0	4,317	12.2	16.9	16.2
37	Argentina	1989	47.6	4,363	7.6	15.2	863.3
38	Romania	1991	25.7	4,597	11.7	95.2	47.9
39	Brazil	1989	63.3	4,621	5.5	11.7	514.2
40	Chile	1987	48.2	4,719	19.1	9.2	23.4
41	Yugoslavia	1989	37.9	4,857	13.1	78.9	343.4
42	South Africa	1980	57.0	4,936	8.9	13.2	11.9
43	Malaysia	1989	48.4	5,070	8.0	8.4	1.3
44	Mexico	1984	50.6	5,323	5.6	21.4	56.1
45	Venezuela	1989	44.1	5,648	5.6	19.3	33.0
46	South Korea	1982	35.7	5,682	2.9	9.3	18.0
47	Uruguay	1989	42.4	5,787	10.5	21.4	71.0
48	Hungary	1989	23.1	5,924	19.9	93.9	10.7

Table 1. (*concluded*)

Country[1]	Year of Gini Observation	Gini Coefficient	GDP per Capita[2]	Social Transfers[3]	State Employment[4]	Inflation[5]
49 Portugal	1974	38.1	5,984	17.1	14.2	11.9
50 Greece	1986	39.9	6,436	16.7	10.7	20.4
51 Ireland	1987	34.6	7,022	25.1	19.6	6.3
52 Czechoslovakia	1988	19.5	7,421	21.3	98.8	0.8
53 Spain	1988	31.5	8,253	18.1	13.7	7.8
54 Cyprus	1985	35.7	8,434	8.8	12.2	6.6
55 Singapore	1988	41.0	10,417	18.3	10.4	0.7
56 Israel	1979	33.3	10,864	22.1	27.1	46.8
57 Bahamas	1989	42.8	11,004	1.2	18.6	5.1
58 New Zealand	1986	30.0	11,308	19.6	24.7	11.7
59 Austria	1989	24.9	12,353	27.9	37.9	2.2
60 Netherlands	1983	32.1	12,684	31.1	15.0	5.2
61 Italy	1990	31.3	13,001	24.4	20.9	5.7
62 Belgium	1983	27.4	13,005	30.3	22.5	7.0
63 United Kingdom	1979	28.1	13,060	19.8	22.8	15.7
64 France	1981	30.7	13,584	31.0	21.2	11.2
65 Denmark	1989	28.0	13,607	33.3	29.4	4.3
66 Japan	1985	35.0	13,645	17.5	9.5	2.8
67 Norway	1979	26.9	13,819	27.1	24.8	8.6
68 Finland	1985	20.2	13,980	22.0	28.7	8.6
69 Hong Kong	1981	48.5	14,014	2.9	7.9	10.3
70 Australia	1982	31.6	14,529	17.1	29.3	9.6
71 Germany	1981	27.8	14,621	25.7	22.3	4.4
72 Sweden	1981	22.9	14,941	32.2	36.2	10.9
73 Canada	1981	32.0	17,681	21.5	24.1	9.7
74 Switzerland	1982	35.5	17,763	14.9	10.4	4.2
75 United States	1979	34.4	19,851	17.7	15.8	8.1
Full sample average		41.7	6,317	11.8	20.5	69.6
Excluding hyperinflationary countries		41.2	6,456	12.0	19.9	15.3

Source: Milanovic (1994), and IMF, *International Financial Statistics.*
[1]Ranked in ascending order by GDP per capita.
[2]In 1988 U.S. dollars; the same year as the observation of the Gini coefficient.
[3]In percent of GDP; the same year as the observation of the Gini coefficient.
[4]In percent of total labor force; the same year as the observation of the Gini coefficient.
[5]Five-year average preceding the year of the Gini coefficient.

countries.[3] Specifically, inclusion of a dummy for Latin America (or for any other region) does not lead to a breakdown of the Kuznets hypothesis, as in Deininger and Squire (1996b). This result suggests that inflation might be one of the

[3]See, for example, Campano and Salvatore (1988). In general, the critique, based on a simple regression of income distribution on per capita income, is overly simplistic; as shown by Milanovic, the level of development is a reversible factor of inequality.

"missing" variables in Kuznets-type models. It is not a coincidence that high-inequality countries, such as many in South America, have generally suffered from high inflation or hyperinflation, and that low-inequality Asian countries have had lower-than-average inflation rates.

I. Inflation as a Factor Affecting Income Distribution

Economic theory has identified various costs of inflation, as well as actions that can be taken to avoid those costs.[4] For example, optimizing holdings of domestic currency can prevent losses associated with expected inflation. Similarly, investing in inflation-indexed bonds or negotiating inflation-adjusted employment contracts helps protect against unexpected inflation. Protecting against inflation uncertainty may be difficult, however, or the transaction cost of doing so may be too high.

For the sake of simplicity, assume that the economy is inhabited by two types of workers: "outsiders," who accept nominal contracts; and "insiders," who accept inflation-adjusted wage contracts.[5]

Let us start with an outsider. She receives a wage, which is a product of her wage rate and hours worked, and also holds and trades in a non-interest-bearing asset, that is, currency. If inflation is positive, the value of this asset declines. The worker has to allocate her wage and nonwage income between current consumption and the holdings of the nominal asset.

How does inflation affect the outsider's behavior? First, the amount of labor supplied by the worker is affected by the change in the price level—inflation shifts the labor supply schedule inward, lowering the amount of hours worked and, eventually, total earnings. (This outcome assumes, of course, a horizontal labor demand schedule and an upward-sloping labor supply schedule in the usual labor-wage space.) The outsider responds to losses associated with the so-called shoe leather cost—the cost of being locked into nominal contracts—and the cost of protracted wage negotiations. In each of these cases, both expected and unexpected inflation "distracts" the outsider from working and forces her to engage in time-consuming activities to minimize her inflation-induced income losses (see Braun (1994), Fischer (1993), and King and Wolman (1996)).[6]

There is also a second type of cost, affecting outsiders: inflation reduces the value of a nominal asset they hold. Irrespective of time spent by the worker, the losses stemming from negative real returns can be avoided only if inflation is fully anticipated and if the holding of currency can drop to zero.[7] The latter is clearly an unsustainable assumption in a cash-in-advance economy.

[4]Naturally, this paper will not consider all costs discussed in the literature. See Driffill, Mizon, and Ulph (1990) for a review.

[5]A formal derivation of the model is contained in the Appendix.

[6]King and Wolman (1996) estimate that annual inflation of 12 percent would result in a loss of six more hours per quarter than would inflation of 5 percent. By way of comparison, price stability would result in a gain of seven hours per quarter.

[7]Quadrini and Ríos-Rull (1997) discuss a similar issue (earning uncertainty) in the context of the dynastic model of income and wealth distribution.

Inflation reduces outsiders' available resources for consumption both through limiting the amount of hours worked and through a loss in asset principal. A more interesting question, however, is, what does this framework say about relative incomes of workers whose earnings have different inflation sensitivity? To answer this question, we will introduce an "insider" worker.

Let us assume that another worker (the insider) holds assets other than currency and is employed under a different wage regime than the outsider. For example, she might receive most of her compensation in stock options or inflation-adjusted nonwage benefits, the market value of which is uncorrelated with inflation. Alternatively, she might be employed in a unionized sector with indexed wages (through a cost of living adjustment or similar mechanism). Therefore, she faces little or no inflation distraction, and her marginal product of labor is unchanged. It is reasonable to assume that these compensation characteristics exclude wage earners at the bottom of the income scale, who are generally much less protected from cyclical real-wage fluctuations.[8]

Returns on assets owned by a wealthy insider might also be better protected from inflation. She might buy assets, returns on which (i) are uncorrelated or weakly correlated with inflation or (ii) grow faster than inflation. The conditions that must hold if temporary financial investments of periodic income are to be advantageous are quite severe and might exclude low-income households from those activities.[9] The severity of those conditions declines with the level of development of financial markets in the country.

The effects of inflation can be summarized as follows. First, workers whose earnings are protected against price level changes (insiders) would increase their incomes relative to the first, unprotected group (outsiders), and the pretransfer income distribution would widen. Second, in absolute terms, incomes of both groups would fall.[10] Third, while government policies can prevent outsiders from falling into poverty by, say, taxing the rich and making transfers to the poor, those policies are likely to be insufficient to narrow the inflation-generated income distribution gap, as the number of transfer-receiving outsiders is typically larger than the number of taxed insiders. Therefore, one would expect the effects of fiscal equalization measures to be weakly correlated, if at all, with inflation-generated changes in income inequality.

II. Cross-Country Empirical Evidence

In this section, we will test the hypothesis that a part of the variation in income distribution among countries can be explained by previous inflation in those countries.

[8]Between 1981 and 1996, for example, the U.S. federal minimum wage was raised only once, and its value in 1996 dollars declined from about US$6 per hour in 1981 to the 1996 level of US$4.25 per hour.

[9]For example, Goodhart (1989) shows that, with an annual interest rate of 6 percent and fixed cost per transaction of US$2, it would require a monthly salary of about US$1,600 in order for it to be economical for the agent to purchase and resell any temporary assets.

[10]In the short term, the indexation scheme can overcompensate insiders for inflation, as shown by Brandolini and Sestito (1994) on the example of Italy's *scala mobile*. It can be argued, however, that this policy is not sustainable because it would lead to changes in the labor-capital ratio.

The Data and the Original Milanovic Results

The original sample, which was compiled by Milanovic (1994), consists of 80 countries ranked by GDP per capita in ascending order; it was used to test his so-called Augmented Kuznets Hypothesis. Gini observations (one per country) range over a period of 22 years (1970–91), a result of the scarcity of consistent Gini observations. Moreover, these observations had to be paired with almost equally scarce state employment and transfers data.[11] We have narrowed the Milanovic sample to 75 countries for which we could collect the appropriate inflation data from *International Financial Statistics* (*IFS*) see Table 1. Countries are ranked by their GDP per capita in ascending order: the poorest country is Tanzania (US$567 in 1988 dollars), the richest is the United States (US$19,850 in 1988 dollars).

Milanovic tested the hypothesis according to which government policies can significantly change income distribution: "inequality in richer societies does not decrease because of economic factors, but because societies *choose* less inequality" (p. 33). His preferred variables, the so-called social choice factors, included the percentage of all employed who work in the state sector (inclusive of government administration), the percentage share of cash and in-kind social transfers in the country's GDP, and a dummy for Asian countries.

While the Kuznets hypothesis held in Milanovic's results, the effect of social choice variables was substantial and rose with the level of income per capita. For example, state employment and transfers lowered the Gini coefficient three times more on average in countries with GDP per capita between US$6,000 and US$10,000 than in countries with GDP per capita below US$1,500 (see Table 5 in Milanovic (1994)). On average, social choice variables reduced the Gini coefficient from 54 Gini points to 41 Gini points, that is, by one-fourth.

New Hypotheses

While Milanovic was mainly concerned with fiscal and quasi-fiscal channels of redistribution, either through explicit transfers or through broadly defined state sector employment, we add inflation to the list of explanatory variables. We expect the impact of inflation on income distribution to be stronger at higher inflation rates. In principle, the impact of inflation should be independent of the level of development and of the level of fiscal redistribution.

Our sample and regression estimates differ in two ways from the original Milanovic results. First, inflation data are not available for 5 out of the 80 countries in his sample. Restricting the number of observations to 75, however, changes neither the level of statistical significance nor the size of the regression coeffi-

[11]Hypothetically, this lack of data might create interpretation problems. For example, did the first oil shock affect the countries' income distribution? Are there secular cycles in income distribution across countries? Even though very little is known about the impact of these shocks on income distribution, time per se has no effect in our regressions: all experiments with various time dummies yielded statistically insignificant results. One can speculate that these shocks are correlated with variables already contained in the regressions, most notably with income, inflation, and transfers.

cients as compared with Milanovic's results. Coefficients of determination and standard errors of regression are only marginally worse. Second, owing to multicollinearity, we exclude two explanatory variables from Milanovic's preferred equation: the ratio of average incomes between the richest and the poorest region within a country, and a dummy for Asian countries. This exclusion—like the change in the number of observations—changes neither the significance of individual parameters of the remaining variables nor the overall results. A correlation matrix of variables employed in our regressions is presented in Table 2.

There is little reason to assume that changes in inflation can cause a major swing in a country's income distribution rapidly. If this were so, we would observe much larger annual swings in income distribution because inflation is prone to cyclical fluctuations.[12] More likely, the full effects of inflation take time to feed through the system. Thus, one should look at cumulative or average changes preceding the period of observation of the income inequality indicator. Interestingly, a country ranking by average inflation changes little whether three-, five-, or seven-year averages are used. Hence, we use a five-year average for inflation based on goodness-of-fit criteria.

The regression equation, with the Gini coefficient as the dependent variable, includes a constant, a quadratic expression for GDP per capita to capture the nonlinearity of the Kuznets hypothesis, state employment, transfers as a percentage of GDP, and either three or four measures of inflation. Income inequality is assumed to initially rise with development (as proxied by GDP per capita) but to decline in higher stages of development; therefore, the expected signs of Y and Y^2 are positive and negative, respectively. State employment and fiscal transfers are expected to lower inequality and have negative expected signs.[13] Finally, high inflation should unambiguously increase inequality vis-à-vis low inflation.

The literature suggests that most macroeconomic effects of inflation are nonlinear.[14] Therefore, adding average inflation rates to the Kuznets model yields statistically insignificant results even when various nonlinear transformations of inflation are used, similarly to results in Sarel (1997). To correct for nonlinearity, we distinguish several levels of inflation. First, we divide the inflation sample into three groups: hyperinflation (more than 300 percent annually for four countries, with a mean of 1,034 percent), high inflation (between 300 percent and 41 percent annually for seven countries, mean of 56 percent), and low inflation (A) (less than 40 percent annually for 64 countries, mean of 9 percent). Second, we split the last group of countries (the so-called low inflation (A)) into those with inflation between 40 percent and 5 percent annually (called low inflation (B), 47 countries, mean of 14 percent), and those below 5 percent (called very low inflation, 17 countries, mean of 3 percent).

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[12]Nevertheless, several countries have pronounced procyclical or countercyclical patterns of inequality. Procyclical patterns of inequality have been observed in Brazil (Cardoso, 1993) and Greece (Livada, 1992), while countercyclical patterns have been observed in Italy (Brandolini and Sestito, 1994) and the United States (Blinder and Esaki, 1978).

[13]See Milanovic (1994) for discussion of a possible confusion in determining the signs.

[14]See, for example, Bruno (1995), Barro (1996), Sarel (1996), and Ghosh and Phillips (1998).

Table 2. Estimated Correlation Matrix of Variables

					Inflation		
	Gini[1]	GDP	State Employment	Transfers	Hyper-inflation	High	Low
GDP[2]	–0.63						
State employment[3]	–0.57	0.28					
Transfers[4]	–0.73	0.74	0.38				
Hyperinflation[5]	0.18	–0.05	0.12	–0.09			
High inflation[6]	–0.05	0.05	0.27	–0.02	–0.07		
Low inflation[7]	–0.02	–0.11	–0.22	–0.08	–0.31	–0.42	
Very low inflation[8]	–0.04	0.13	0.00	0.17	–0.13	–0.17	–0.70

Source: Calculations based on Table 1.

[1]Gini coefficient of disposable income (for Organization for Economic Cooperation and Development members and socialist economies) and Gini coefficient of gross income for African, Asian, and Latin American countries. The year of the Gini coefficient observation for each country is the same as that of the other variables.

[2]The country's GDP per capita in thousands of 1988 U.S. dollars.

[3]The percentage share of workers in the state sector (including government administration) in total employment.

[4]The percentage share of cash and in-kind social transfers in the country's GDP.

[5]Dummy variable: 1 if five-year average annual inflation more than 300 percent; zero otherwise.

[6]Dummy variable: 1 if five-year average annual inflation more than 40 percent but less than 300 percent; zero otherwise.

[7]Dummy variable: 1 if five-year average annual inflation more than 5 percent but less than 40 percent; zero otherwise.

[8]Dummy variable: 1 if five-year average annual inflation less than 5 percent; zero otherwise.

While the 40 percent breakpoint is taken from Bruno (1995)[15] and hyperinflationary countries are distinguished mechanically, the breakpoint between low and very low inflation is chosen heuristically. Although we have experimented with several breakpoints for very low inflation (from 2 percent to 7 percent), none of them is clearly superior to the 5 percent breakpoint. Consequently, the Kuznets equation is estimated for both three and four inflation steady states, with the former omitting the distinction between low and very low inflation. In addition, the equation is also estimated without the four hyperinflation countries, narrowing the sample to 71 observations.

We select intercept dummies as the best transformation of the inflation variable. In principle, one can regress Gini coefficients either on intercept dummies (the inflation variable is 1 if the actual average is within its specified bounds and zero otherwise) or on slope dummies (actual inflation multiplied by its dummy value). While the first approach presents an average impact of a particular level of inflation on income distribution, the second approach shows how much income distribution changes owing to a 1 percent change in inflation. Slope dummies have lower estimates of residual sums of squares and higher R^2, however, because of

[15]It was successfully tested against 30 percent and 50 percent breakpoints.

higher multicollinearity, usually one or more parameter estimates are statistically insignificant or the overall improvement in fit is marginal. Including both dummies leads to statistically insignificant estimates.

Overview of Results

The empirical results, summarized in Tables 3 and 4, are divided into two parts: the estimated parameters of the Augmented Kuznets Hypothesis as proposed by Milanovic and the estimated parameters of the newly added inflation variables. The inclusion of the new explanatory variables only marginally affects the estimated parameters of the Augmented Kuznets Hypothesis, and most of the regressions' variation vis-à-vis the new variables is captured by changes in the statistically insignificant intercept. As in the Milanovic regressions, the inverted U-shaped income distribution profile seems to hold.

The results lend additional support to the Kuznets hypothesis because some of the previously unexplained regional differences can be attributed to past inflation developments. For example, the high inequality in middle-income Latin American countries (with an average Gini coefficient of 50.6 compared with the sample average of 41.7) can be viewed as a consequence of the comparatively high inflation rates. Excluding countries in hyperinflation, the five-year Latin American inflation rate is 27 percent, compared with the sample average of 14 percent. By way of comparison, the low inequality in middle-income Asian countries (with an average Gini coefficient of 42.1) can be rationalized by the low inflation rates (10 percent).

Taking into account persistent heteroscedasticity,[16] we reestimate the standard errors using the White heteroscedastic-consistent standard errors procedure. No spatial autocorrelation was observed and, therefore, we do not report the results of autocorrelation tests. On the one hand, the overall fit is quite robust in the sense that dropping or adding variables or shortening the sample affects parameter estimates only marginally. On the other hand, as can be seen in Tables 3 and 4, some of the newly included variables are not always statistically different from zero at the 5 percent significance level.[17] This is an unfortunate but inescapable effect of multicollinearity of variables: the standard errors of parameters rise when mutually correlated explanatory variables are added to the regression (for example, state employment and low inflation).

We also address the possibility that some variables may be determined endogenously. For example, it is well known that transfers tend to be higher in more developed countries: indeed, the correlation coefficient in our sample is 0.73. Hence, in Tables 3 and 4 we display along with OLS regressions also instrumental variable (IV) regressions, where transfers are instrumented by their

[16]The null hypothesis of heteroscedasticity of residuals cannot be rejected at the 1 percent significance level for all estimates.

[17]This is especially true for the two-tail *t*-test (the 1 percent and 5 percent critical values are 2.63 and 1.99, respectively). However, no parameter estimate would have missed the 5 percent threshold had we applied the one-tail test (the 1 percent and 5 percent critical values are 2.38 and 1.67, respectively). The one-tail test would be adequate here, since we know the expected sign of each parameter.

Table 3. The Augmented Kuznets Hypothesis: Adding Inflation
(*Ordinary least squares (OLS) and instrumental variable technique (IV), heteroscedastic–consistent standard errors*)

Eq	Constant	Y	Y^2	State Employment	Transfers	Hyper-inflation	High Inflation	Low Inflation(A)	No. of obs.	Adj. R^2	Heterosce-dasticity	Normality	RSS	LM Test
1a	–97.08	39.800	–2.608	–0.223	–0.416				80	0.710	n.a.	n.a.	n.a.	. . .
OLS	(0.21)	(0.04)	(0.00)	(0.00)	(0.00)									
1	–111.58	43.326	–2.814	–0.230	–0.421				75	0.674	11.82	0.274	2912	. . .
OLS	(1.42)	(2.30)	(2.53)	(8.21)	(3.96)									
I	–120.89	45.929	–3.000	–0.238	–0.350				75	0.672	11.80	0.106	2924	. . .
IV	(1.48)	(2.33)	(2.53)	(8.13)	(2.02)									
2	–96.30	39.455	–2.579	–0.242	–0.397	7.815			75	0.694	12.52	0.529	2692	2
OLS	(1.23)	(2.10)	(2.32)	(11.09)	(3.78)	(2.66)								
2	–102.15	41.096	–2.697	–0.247	–0.351	7.902			75	0.693	13.18	0.036	2697	2
IV	(1.26)	(2.10)	(2.29)	(10.34)	(2.01)	(2.65)								
3	–82.463	38.062	–2.497	–0.249	–0.388		–6.673	–8.105	75	0.691	11.99	0.463	2682	5
OLS	(1.02)	(1.97)	(2.18)	(10.87)	(3.64)		(2.08)	(2.67)						
3	–87.29	39.462	–2.599	–0.254	–0.345		–6.667	–8.207	75	0.690	12.57	0.317	2685	5
IV	(1.05)	(1.96)	(2.15)	(9.85)	(1.95)		(2.05)	(2.66)						

Notes: (1a) is the original Milanovic (1994) equation with 80 observations; values in parentheses are the complements of the level of confidence with which the null hypothesis is rejected. For example, 0.21 in the first column indicates that the hypothesis of the first parameter being equal to zero can be rejected at the 21 percent confidence level.

Absolute value of *t*-statistics in parentheses, except equation (1a). The 1 percent and 5 percent critical values for the one-tail *t*-statistics are 2.38 and 1.67, respectively; Adj. R^2 is coefficient of determination adjusted for the number of variables, and RSS is a residual sum of squares. Heteroscedasticity is the simple test of the unconditional homoscedasticity assumption, distributed as $\chi^2(1)$. Normality test is based on a test of skewness and kurtosis of residuals, distributed as $\chi^2(2)$. The Lagrange multiplier (LM) test is the probability of rejecting the null hypothesis that the parameters of the new explanatory variables are jointly equal to zero. For example, in equation 2, a value of 2 means that the null hypothesis can be rejected at approximately the 2 percent significance level.

Table 4. The Augmented Kuznets Hypothesis: Is There a Kink in the Inflation Effect?
(*Ordinary least squares (OLS) and instrumental variable technique (IV), heteroscedastic-consistent standard errors*)

Eq.	Constant	Y	Y^2	State Employment	Transfers	High Inflation	Low Inflation (B)	Very Low Inflation	No. of obs.	Adj. R^2	Heterosce-dasticity	Normality	RSS	LM Test
4	–84.07	38.552	–2.531	–0.249	–0.401	–6.605	–8.783	–5.953	75	0.697	11.42	0.154	2584	4
OLS	(1.03)	(1.97)	(2.17)	(10.66)	(3.74)	(2.05)	(2.84)	(1.83)						
4	–89.02	39.987	–2.635	–0.255	–0.357	–6.599	–8.879	–6.086	75	0.697	11.72	0.069	2588	3
IV	(1.06)	(1.97)	(2.16)	(9.87)	(2.09)	(2.02)	(2.82)	(1.86)						
5	–89.03	37.633	–2.476	–0.262	–0.388	3.416		2.935	71	0.694	11.07	0.361	2457	16
OLS	(1.10)	(1.94)	(2.16)	(9.98)	(3.67)	(1.83)		(1.82)						
5	–93.23	38.828	–2.563	–0.267	–0.351	3.511		2.885	71	0.694	11.43	0.252	2460	18
IV	(1.12)	(1.94)	(2.13)	(9.35)	(2.05)	(1.83)		(1.82)						

Notes: Absolute value of *t*-statistics in parentheses. The 1 percent and 5 percent critical values for the one-tail *t*-statistics are 2.38 and 1.67, respectively; Adj. R^2 is coefficient of determination adjusted for the number of variables, and RSS is a residual sum of squares. Heteroscedasticity is the simple test of the unconditional homoscedasticity assumption, distributed as $\chi^2(1)$. Normality test is based on a test of skewness and kurtosis of residuals, distributed as $\chi^2(2)$. The Lagrange multiplier (LM) test is the probability of rejecting the null hypothesis that the parameters of the new explanatory variables are jointly equal to zero.

natural logarithms. Clearly, the parameters are not affected. While we experimented with various instruments, none of them changed the OLS results in a significant way.

Effects of Inflation and Financial Deepening on Income Inequality

What is the impact of the newly added variables? Inflation increases income inequality, and the impact is strongest in hyperinflation countries. The largest improvement in income distribution, compared with the hyperinflationary subsample, is in the group of low-inflation countries (0–40 percent annually). Within this group, however, countries with very low inflation (below 5 percent annually) seem to benefit less from the virtual price stability than the countries in the 5–40 percent annual inflation range.

The results are as follows. First, hyperinflation dramatically worsens income distribution: the four hyperinflationary countries face an increase of 8 points in the Gini coefficient over the average of 50 Gini points for the rest of the sample (Table 3, equation 2). Second, countries with either high or low inflation have Gini coefficients that are lower by about 7 or 8 Gini points, respectively, than countries with hyperinflation (Table 3, equation 3).[18] On inspection, these results are fairly invariant with respect to the technique used.

Third, we find that the impact of inflation on income distribution has a kink at very low rates of inflation. As a sign of parameter misspecification, the estimated parameters for high inflation and low inflation in equation 3 are statistically indistinguishable, see below. Hence, equation 4 of Table 4 uses the distinction between low and very low inflation. While the improvements in high and low inflation compared with hyperinflation remain at around 7 and 9 Gini points, respectively, very low inflation implies only a modest gain in income distribution compared with hyperinflation, slightly below even that of high inflation (6 Gini points). These results are confirmed by running regressions on nonhyperinflationary countries only (equation 5). The estimated parameters imply an outturn for very low inflation worse by some 3 Gini points than that for low inflation and also a worse outturn than in the case of high inflation. These results are statistically significant using the one-tail 5 percent threshold.

On inspection, the estimated dummies for the various levels of inflation have similar values, especially those for high and low inflation, and high and very low inflation.[19] Therefore, the question is: are the differences in the estimated inflation coefficients statistically significant? To answer this question, we calculate the Wald tests for all pairs of inflation parameters estimated in equations 3, 4, and 5 in Tables 3 and 4 (see Table 5). On the one hand, the null hypothesis of identical values of parameters can be rejected at about the 7 percent significance level or less for all inflation rates vis-à-vis hyperinflation (in equations 3 and 4) and also

[18]Note that in equation 3 only two levels of inflation are distinguished: high inflation (dummy is 1 if inflation is over 40 percent annually and below 300 percent; zero otherwise); and low inflation (dummy is 1 if inflation is less than 40 percent; zero otherwise).

[19]However, inflation dummies are jointly significant at the 5 percent significance level. (See the Lagrange multiplier test in Tables 3 and 4.)

Table 5. Statistical Significance of the Differences Between Inflation Coefficients
(In percent)

	Hyperinflation	High Inflation	Low Inflation (B)
Equation 3 (OLS)			
High inflation	4		
Low inflation (A)	1	46	n.a.
Equation 4 (OLS)			
High inflation	4		
Low inflation (B)	1	27	
Very low inflation	7	77	7
Equation 5 (OLS)			
Low inflation (B)	n.a.	7	
Very low inflation	n.a.	83	7

Note: A Wald test for the null hypothesis of $\alpha - \beta = 0$, where α and β are parameters of two inflation coefficients. For example, a value of 4 in the second column of the first row means that the null hypothesis of the parameter of hyperinflation being identical to the parameter of high inflation can be rejected at the 4 percent significance level.

very low inflation is distinguishable from low inflation (equation 4). On the other hand, the high-inflation parameter fails this test badly vis-à-vis the low-inflation (A) parameter in equation 3, signaling possible parameter misspecification. By breaking the low-inflation (A) sample into low-inflation (B) and very-low-inflation subsamples (equation 4), the significance level of the nonzero difference between high and low inflation now improves markedly, even though it remains less than fully convincing.[20] The Wald test confirms that the impact of high inflation is indistinguishable from that of very low inflation. Finally, the estimation without hyperinflationary countries (equation 5) brings perhaps the most convincing results: the null hypotheses of the nonzero difference between high and low inflation can be rejected at about the 7 percent significance level. As before, very low inflation remains different from low inflation, but not from high inflation.

How Important Are the Newly Added Variables for Income Inequality?

The next question is threefold. First, what is the importance of inflation compared with the Milanovic social choice factors? Second, does the impact of inflation depend on the level of development? Third, does the impact of inflation depend on the location of the country? Using a simple comparative static analysis, we aim to show that the effect of inflation is, on average, almost as strong as that of the social

[20]Most likely, it would be possible to find such breakpoints among inflation rates that would minimize the values of the Wald test. However, we preferred to refrain from further data mining.

choice variables (it is certainly stronger in low-income countries), and that the benefits of low inflation are evenly spread across income levels and regions.

Inflation clearly exerts a strong impact on income distribution, but how exactly is the impact distributed across the levels of development? Using the estimated coefficients from equation 4 of Table 4,[21] we separate the effects of income variables, Milanovic social choice variables, and the inflation variables on income distribution. Those effects are smoothed and plotted against GDP per capita (Figure 1). First, taking into account an intercept and the Kuznets factors only[22] (solid line) overestimates the actual income inequality, as shown by the empty squares. Second, including the social choice variables shifts the Kuznets curve downward and pivots it at the intercept (long-dashed line).[23] Finally, inflation shifts the Kuznets curve further downward (short-dashed line). The narrowing effect on income distribution of lower inflation seems to be fairly independent of the level of development, and if anything, the effect of inflation is stronger in low- and high-income countries than in middle-income countries.

Numerically, the average effect of the additional variables (and unexplained errors) is somewhat less than 20 Gini points (see Table 6). The average effect of inflation is rather stable, at about 7–8 Gini points. In contrast to Milanovic, the gap between the simple Kuznets hypothesis and the actual Gini coefficients owing to social choice variables widens earlier, at about US$4,501–6,000 per capita. As before, the impact of social choice variables is strongest in the high-income countries and, on average, their impact is somewhat larger than the aggregated impact of the inflation variables. As predicted, the correlation between the effects of social choice variables and inflation on income distribution is close to zero (–0.13).

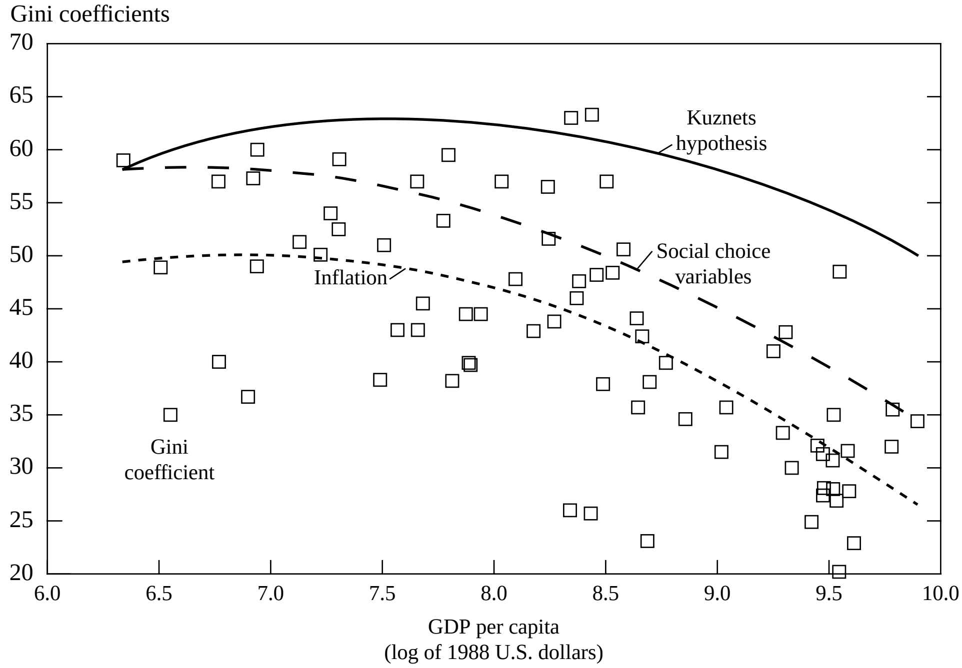
Further insights can be obtained from an analysis of the relative impact of inflation at different levels of development (Table 6). Low-income countries (from US$501–3,000 per capita) benefit from low inflation, which improve their theoretical income distribution by about 8 Gini points, or by almost double the amount generated by the social choice variables. The relationship is reversed, however, in the three upper brackets of income per capita (over US$5,401): social choice variables are twice as important in explaining deviations from the simple Kuznets hypothesis. Middle-income countries (US$3,001–6,000 per capita) gain relatively little from lower inflation: this can be attributed mostly to the larger proportion of high-inflation countries among this group.

To summarize, while lowering income inequality through the social choice variables is likely to be costly and may be open only to middle- or high-income countries, substantial income equality gains seem to be obtained through low inflation at any stage of development. In fact, only with income per capita of more than US$4,500 can a country expect effects of social choice variables to outweigh significantly the positive effect of low inflation.

The effects of the newly introduced variables are even more eye opening when countries are sorted regionally (Table 7). Clearly, the less-developed regions have

[21]Equations 3 and 4 produced very similar aggregated results.
[22]Social choice variables and inflation are set equal to zero.
[23]Inflation is set equal to zero.

Figure 1. Gini Coefficients and the Augmented Kuznets Hypothesis



more to gain from price stability than members of the Organization for Economic Cooperation and Development (OECD). Only in Europe (OECD countries are almost the same subsample), owing to massive transfers, and in Eastern Europe, because of state employment, is the effect of the social choice variables significantly stronger than that of inflation. By way of comparison, the effect of inflation in Africa and Asia is double that of the social choice variables.

Do the results confirm the special status of certain regions? Only two regions, Africa and Asia, have relatively large unexplained residuals. Africa's inequality is higher than the estimated value, Asia's inequality is lower. Still, these residuals seem to be far too small to conclude that the Kuznets hypothesis is a result of a few regionally concentrated outliers.

III. Conclusions and Policy Implications

This paper offers a contribution to the income inequality literature within the traditional Kuznets model. Lower inflation rates—in addition to the level of development and fiscal redistribution—are found to improve income equality and their impact is uniform for all levels of GDP per capita. In line with the cost-of-inflation literature, the negative impact is most pronounced during hyperinflation. Effects of price stabilization on income distribution are nonlinear—countries with inflation below 5 percent a year seem to benefit less than countries with inflation between 5 percent and 40 percent.

Table 6. Impact of Selected Variables on Income Distribution at Different Income Levels

(Simple unweighted averages, in Gini points)

			Total	*Of which:*					
			Effect of		Inflation[4]				Unexplained
Per Capita GDP	Actual	Kuznets	Additional	Social	Total	*Of which:*			Part of Gini
(in U.S. dollars)	Gini	Hypothesis[1]	Variables[2]	choice[3]		Very low	Low	High	Coefficients
Less than 1,500	50.7	61.4	–10.7	–3.8	–7.3	–1.3	–5.4	0.0	0.5
1,501–3,000	46.0	62.8	–16.8	–6.2	–8.6	–0.4	–7.7	0.0	–2.0
3,001–4,500	48.2	61.8	–13.6	–8.1	–6.7	–0.9	–3.4	–2.1	1.2
4,501–6,000	42.9	60.6	–17.7	–12.5	–6.5	–0.4	–4.2	–1.7	1.3
6,001–10,000	31.4	58.7	–27.4	–17.0	–8.1	–1.2	–6.3	0.0	–2.3
Over 10,000	31.8	53.8	–22.0	–13.8	–7.7	–1.7	–5.0	–0.3	–0.5
Average	41.7	59.2	–17.5	–9.8	–7.5	–1.0	–5.3	–0.6	–0.2

Source: Calculations based on equation 4 (OLS) in Table 4.
[1]Income variables and an intercept. All other parameters set equal to zero.
[2]The difference between the actual Gini coefficients and predictions from the simple Kuznets hypothesis.
[3]State employment as percentage of total employment and transfers as percentage of GDP.
[4]Relative to hyperinflationary countries. For definitions of variables see the text.

Table 7. Impact of Selected Variables on Income Distribution in Different Regions

(Simple unweighted averages, in Gini points)

	Per capita GDP (in U.S. dollars)	Number of Countries	Actual Gini	Kuznets Hypothesis[1]	Total Effect of Additional Variables[2]	*Of which:* Social choice[3]	*Of which:* Inflation[4]	Unexplained Part of Gini Coefficients
Africa	1,832	17	51.5	61.7	–10.2	–5.2	–8.1	3.2
Asia	4,829	14	42.2	60.3	–18.1	–5.2	–8.0	–4.9
Latin America	4,207	16	50.6	61.3	–10.7	–6.6	–6.2	2.1
Europe[5]	11,075	20	30.9	55.8	–24.9	–15.0	–7.7	–2.1
Eastern Europe	5,700	4	26.6	60.2	–33.6	–29.4	–5.3	1.2
Developed countries[6]	12,911	22	30.6	54.4	–23.8	–14.7	–8.0	–1.0

Source: Calculations based on equation 4 (OLS) in Table 4.

[1]Income variables and an intercept. All other parameters set equal to zero.

[2]The difference between the actual Gini coefficients and predictions from the simple Kuznets hypothesis.

[3]State employment as percentage of total employment and transfers as percentage of GDP.

[4]Relative to hyperinflationary countries. For definitions of variables see the text.

[5]Excluding Eastern European countries.

[6]Members of the Organization for Economic Cooperation and Development (OECD).

What are the policy implications? In the author's view, price stabilization offers a free lunch: there are no medium- or long-term income inequality costs of disinflation, only benefits. The improvement in income distribution from a hyperinflationary to a high-inflation steady state is substantial, and the benefits of moving from high to low inflation are tangible. Only in middle- and high-income countries (GDP per capita of US$4,501 or more) do social choice variables outweigh the impact of low inflation.

Our results are difficult to compare with alternative research, because very few cross-country studies have included inflation as an explanatory variable for income inequality. It remains to be seen if our results can be confirmed in a large cross-country or pooled sample, or in a sample with different definitions of income distribution.

APPENDIX
A Model

The general equilibrium model features an infinite number of periods and a single consumption good. Each worker receives a wage stream (y_t), which is a product of the wage rate and hours worked, and consumes c_t (real) units of the good in each period. The worker also trades in one nominal asset, that is, currency, w_t, which returns $(1 - \pi_{t+1})$ in period $t + 1$, where π is inflation. If π is positive, the value of savings in terms of the consumption goods declines. In each period, the worker must allocate her wage and nonwage income between consumption and the future holdings of the nominal asset. Therefore, she faces the usual budget constraint:

$$y_t + (1 - \pi_t) w_{t-1} = c_t + w_t. \tag{A1}$$

From the budget constraint, it follows that the worker has two sources of income: wage income and the nominal asset. For simplicity, assume that the worker is endowed with a stock of nondepreciating human capital $(\bar{h})$ that does not require further investment in education. The worker is paid her marginal product (m), which also defines the usual demand schedule for labor:[24]

$$L^d \equiv \text{wage rate} = m(\bar{h}) \tag{A2}$$

The amount of labor supplied is affected by the change in the price level: $L^s = l(\pi, \ldots)$.[25] First, inflation shifts the labor supply schedule inward, lowering the amount of hours worked and, eventually, also the worker's total earnings ($\partial y/\partial \pi < 0$) as the worker responds to inflation-induced losses. Second, inflation reduces the value of a nominal asset (w) held by the workers. The loss stemming from negative real returns can be avoided only if inflation is fully anticipated and if the holding of w can drop to or below zero.

Because of these costs, inflation unambiguously reduces resources available for consumption both by limiting the amount of hours worked and by generating a loss in the asset principal,

$$c_t = y_t(\bar{h}, \pi_t) + (1 - \pi_t) w_{t-1} - w_t, \tag{A3}$$

as both terms in $\partial c/\partial \pi$ are negative.

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[24]See, for example, Blanchard and Fischer (1989).

[25]One can consider a more extreme version of the model, in which wealth directly enters the wage function, $wage_t = m(\bar{h}(w_{t-1}(\pi_{t-i})))$. Past wealth is needed to buy health, education, or social status in a broad sense of the word (club membership, travel, reputable housing and schooling, etc). These "attributes of success" would then raise the worker's marginal product of labor.

The worker chooses c_t and w_t in each period to maximize the expected utility function

$$\max E_t \int_0^{\infty} \beta^j \, u\left(c_{t+j}\right) dt, \tag{A4}$$

subject to the above budget constraint, where E_t denotes the worker's expectation at the beginning of period t and $\beta^t = 1/(1 + r)$ denotes her subjective discount factor.

The solution to the worker's problem requires that

$$\partial m\left(\pi^*\right) / \partial \pi_t = -w_{t-1} \tag{A5}$$

and

$$E_t \beta^{t+1} \partial u_{t+1}\left(c^*\right) / \partial c_{t+1} = E_t \beta^t \left(1 - \pi_t\right) \partial u_t\left(c^*\right) / \partial c_t \tag{A6}$$

in each period $t = 0, 1, 2, \ldots$

Equation (A5) shows that, under uncertainty, the loss of wage income owing to higher inflation must be compensated by higher wealth in $t - 1$ to keep the worker's utility unchanged. Equation (A6) then states that marginal utility of consumption declines with inflation. Because both $(1 - \pi)$ and $u'(c_{t-1})/u'(c_t)$ cannot be predicted with the available information set, consumption follows a random walk.[26]

Moreover, one can confirm that inflation lowers wealth:

$$\frac{\partial w}{\partial \pi} = -\frac{-\beta^t \lambda_t + \lambda_t \dfrac{\partial^2 y}{\partial \pi^2}}{-\beta^{t+1} \lambda_{t+1}} < 0 \tag{A7}$$

as the change in the value of the asset is negative.

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[26]Employing a simple logarithmic utility function, $u_t = \ln(c_t)$, equation (A6) can be rearranged to yield the random walk property:

$c_{t+1} = \phi c_t + \varepsilon_t$,

where $\phi = 1/[\beta(1-\pi_t)]$ and ε_t is an error term.

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