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Inflation and Growth: In Search of a Stable Relationship

Michael Bruno and William Easterly

Are inflation and growth inversely associated, directly associated, or not associated? Is the empirical inflation-growth relationship primarily a long-run relationship across countries, a short-run relationship across time, or both? Like a bickering couple, inflation and growth just cannot seem to decide what their relationship should be.

In this article, we characterize the literature on inflation and growth. Aware of the limits of our comparative advantage, we do not intend to do a general survey of the literature. Instead, we look at the aspects of the literature that motivated us to pursue one particular angle in our own recent work: the behavior of growth before, during, and after discrete high inflation crises.

INFLATION AND GROWTH: A TOUR ACROSS THE DECADES

Observers of extreme inflation have never had much doubt that inflation was bad for the economy. Keynes, as usual, gave the most eloquent statement, “As the inflation proceeds and the real value of the currency fluctuates wildly from month to month, all permanent relations between debtors and creditors, which form the ultimate foundation of capitalism, become so utterly disordered as to be almost mean-

ingless; and the process of wealth-getting degenerates into a gamble and a lottery.”¹ The emphasis on information and the financial system has returned to the literature today.² But inflation and growth relationships have looked very different over time. We take snapshots of the literature in the 1960s and then in the 1980s.

The View from the 1960s

In the high-growth, low-inflation 1960s, the traditional view that inflation was destructive no longer seemed so compelling. It was the Golden Age of the Phillips Curve, in which inflation and growth were positively related in the short run. Even in the long run, Tobin and Sidrausky suggested a positive effect on growth from higher inflation. When inflation was high, wealth would be reallocated away from money and into physical capital.

Similarly, some development theories suggested that inflation was as good a way as any to mobilize resources for capital accumulation. There was little in the early experience of developing countries to contradict this view. Israel’s economy, for example, grew at around 10 percent per annum between 1948 and 1973, with an inflation rate of around 6 percent to 7 percent per annum. Both of these figures were double the Organization for Economic Cooperation and Development (OECD) numbers for the same period. The higher, largely anticipated inflation was a price considered well worth paying, especially as widespread indexation of wages, exchange rates, and savings minimized the distortionary costs of inflation. Israel was no exception—several growing economies in Latin America and Asia seemed to be following the same strategy.

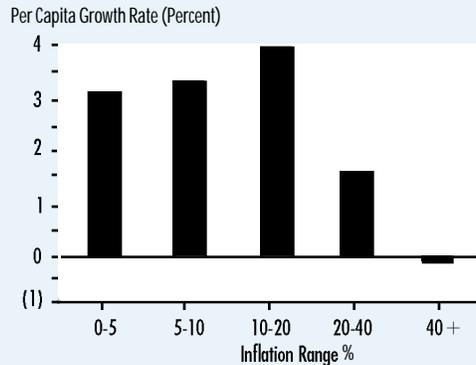
The early empirical studies of inflation and economic development were as ambiguous as the theory set forth in the preceding paragraph. Harry G. Johnson in 1967 suggested that there was no conclu-

¹ Keynes (1920), p. 220.

² See, for example, Ball and Cecchetti (1990), Tommasi (1994), and De Gregorio and Sturzenegger (1994).

Figure 1

Inflation and Per Capita Growth (1960-72*)



*Pooled Annual Observations.

Inflation Range %	0-5	5-10	10-20	20-40	40+
Number of Observations	415	194	88	29	19

sive evidence one way or the other. The International Monetary Fund (IMF) was certainly no hotbed of inflationists, but studies in the IMF Staff Papers around that time could detect no relationship between growth and inflation.³ Latin America had double-digit inflation rates in the 1950s and 1960s, but economic growth was respectable.⁴ Brazil was often cited as a high-inflation, high-growth counterexample to the antiquated notion that inflation was bad for the economy.

One interesting exception to this lack of findings in the literature was Wallich's (1969) pooled time series, cross-section (43 countries) study, using two five-year averages over the period 1956-65. Typical of the literature of the time, he had postulated a positive relationship between inflation and growth. But he found instead a significant negative relationship.

We can see why the 1950s and 1960s yielded ambiguous findings when we look at the data for that period. Figure 1 shows that the per capita growth rate actually rose as one went from single- to double-digit inflation.⁵ Only when the annual inflation rate exceeded 20 percent did the relationship seem to turn negative. Since there were not many observations with

inflation rates greater than 20 percent, estimated relationships were sensitive to which observations were included—a problem that recurred in the 1980s.

In sum, the view from the 1960s on inflation and growth was surprisingly ambiguous. Theory presumed that the short-run relationship was definitely positive, whereas the long-run relationship could go either way. Empirical studies usually found nothing.

The View from the 1980s

Because research on growth went into hibernation in the 1970s, we jump next to the 1980s and new waves of research.

The 1970s and 1980s had provided a new set of extreme inflation experiences, which were investigated by an interesting case study literature after the 1980s.⁶ This literature's treatment of output behavior usually focused on the short-run output costs of stabilization of high inflations. The consensus was that stabilization of hyperinflation had little or no output costs, whereas stabilization of mere high inflations was indeed costly.

Thus the presumption remained in the 1980s that there was a positive short-run relationship between growth and inflation. This presumption in case studies of high inflation in developing countries was probably inspired in part by the industrial country literature, which continued to confirm that stabilization of low inflation was costly. Ball (1993), to take one recent example, calculated large sacrifice ratios for foregone growth in inflation stabilizations in OECD countries.

The case study literature pointed out that high inflation was inherently unstable. Once inflation got above a certain range, it was prone to sudden accelerations. Increased indexation of the economy weakened the nominal anchor that tied down the price level. Countries cannot tolerate such high and unstable inflations, so they pursue stabilization fairly quickly after such inflations develop. Hence high inflation was not so much a steady-state phenomenon as a

³ Wai (1959), Dorrance (1963 and 1966), and Bhattia (1960).

⁴ Pazos (1972).

⁵ The figure is from Bruno and Easterly (1995).

⁶ See, for example, Bruno et al. (1991); Dornbusch, Sturzenegger, and Wolf (1990); Kiguel and Liviatan (1988, 1992a and b); and Calvo and Vegh (1994).

discrete burst of inflation followed by stabilization.

In contrast, case studies pointed out that there was an intermediate range of moderate inflations around 15 percent to 30 percent.⁷ These moderate inflations can be sustained for long periods without disaster—Colombia is the archetypal example.

Inflation was slow in attracting attention as a key policy variable in the new growth literature. Barro and Sala-i-Martin's 1995 survey of the empirical growth literature discusses 10 right-hand-side variables for a basic growth regression. Inflation is not among them. They then mentioned 14 other possible right-hand-side variables. Inflation was not among them either. Inflation is not mentioned anywhere in the Barro and Sala-i-Martin text except in one of the end-of-chapter problem sets.

But inflation gradually attracted attention from new-growth theorists. Theorists postulated mechanisms by which inflation might affect growth adversely. Authors such as Jones and Manuelli (1993) and De Gregorio (1993) pointed out that inflation was a tax on capital in models with cash-in-advance requirements for investment.

Empirical studies in the new-growth literature now generally found a negative inflation-growth relationship. A pre-growth literature study in 1985 had already reported a finding that GDP growth was negatively related to the growth rate of inflation.⁸ Fischer (1993) reported findings that growth was related inversely to inflation. Other studies in the new-growth empirics reported similar findings.⁹

New-growth models of course focused on the long run. The collective wisdom of the literature could be made consistent by saying that inflation was positively related to growth at short-run, cyclical frequencies, but negatively related to growth at long-run, steady-state frequencies.

There was only one problem with this reconciliation of the short run and long run—there was no robust long-run, cross-section relationship between inflation and growth. The statistically significant negative relationships in the new-growth

literature were from pooled time-series, cross-section samples using decade averages, five-year averages, or even annual data.

Cross-section inflation and growth equations just did not work. Levine and Renelt (1992) and Levine and Zervos (1993) used Leamer's extreme bounds analysis to study how inflation entered into cross-section growth regressions. Not only was inflation not robustly significant in Levine and Renelt (1992), it was not ever significant in their many combinations of variables in growth regressions. Levine and Zervos (1993) found that any cross-section relationship that did show up depended on a couple of influential points—Nicaragua and Uganda. In tests we ran with our data set, we found the significance of the cross-section relationship to depend entirely on Nicaragua. Nicaragua and Uganda, both of which had discrete bursts of extreme inflation during civil wars, do not form much of a basis for anti-inflation counsels to, say the Bank of Canada.

The cross-section relationship was not working in part because it had a number of high-inflation, high-growth outliers offsetting Nicaragua and Uganda. Brazil continued to be the star outlier, with only slightly less dramatic counterexamples like Indonesia and Israel.

The robustness problem also complicated attempts to resolve two other econometric problems about growth-inflation relationships. First is the causality problem. It was difficult to think of plausibly exogenous instruments for inflation that could be plausibly excluded from the growth regression. The leading candidates for such instruments are measures of institutions or history that affect inflation propensities, such as central bank independence¹⁰ or colonial heritage.¹¹ Unfortunately, these instruments have only a cross-section dimension, so they are subject to the same fragility that plagued the ordinary least squares growth-inflation regression.

Second was the nonlinearity problem: It seemed implausible that an additional 100 percentage points of inflation meant

⁷ See, for example, Dornbusch and Fischer (1993).

⁸ Kormendi and Meguire (1985).

⁹ De Gregorio (1992 and 1994), Cardoso and Fishlow (1989), Corbo and Rojas (1993), and Barro (1995).

¹⁰ Cukierman et al. (1993).

¹¹ Barro (1995).

Table 1

Growth Before and After Inflation Crises of 40 percent and Above (1961-92)

	Inflation Rate (%)	Per Capita Growth (%)	Deviations from World Average		
			Inflation Rate (%)	Per Capita Growth (%)	Per Capita Growth in Sample Excluding Growth Deviations (>10% and <-10%)
Before first inflation crisis	13	1.6	2	-0.6	-0.4
During inflation crisis	155	-1.2	112	-2.3	-1.5
After inflation crisis	20	2.6	0	1.7	1.8

Source: Bruno and Easterly (1995)

the same at 0 as it meant at 1,000. But attempts at spline regressions are extremely sensitive to the one or two points in the relevant intermediate ranges, as Levine and Zervos show.

The nonlinearity problem is related to another dimension of the lack of robustness of growth-inflation regressions—the dependence of the results on the high inflation observations. The article by Barro in this issue finds no relationship between pooled decade averages for growth and inflation in economies with annual inflation less than about 15 percent. We find more generally that growth-inflation correlations go away even in pooled time-series, cross-country data sets if we omit all countries that have ever had annual inflation greater than 40 percent (a break point we will return to in a moment). Even the strong correlations in the pooled data sets depend on the extreme inflation observations.

HIGH INFLATION CRISES AND GROWTH

With the failure of the cross-section relationship, it was a puzzle where the strong inflation-growth relationships in pooled data were coming from. We examined this puzzle by taking another angle on the issue—What was the pattern of growth before, during, and after discrete high inflation crises?¹² The case study literature had made clear that episodes of high inflation were discrete events. High inflation was less like the steady-state flow of a river

and more like a flash flood. And it was these discrete high inflation episodes that seemed to account for the results in the pooled growth-inflation regressions.

We defined high inflation crisis as annual inflation greater than 40 percent for two years or more. We chose the 40 percent threshold because the moderate inflation literature had suggested that inflation around 15 percent to 30 percent can be sustained for long periods without catastrophe.¹³ Our criterion picked out 32 inflation crises in 26 countries. Inflation on average during the crisis periods was in triple digits; it was around 20 percent in the noncrisis periods.

We found a simple robust pattern. Table 1 shows the pattern of growth before, during, and after these discrete inflation crises. We use two alternative measures of growth: (1) per capita growth and (2) per capita growth relative to the world average. We also tried omitting extreme observations, mindful of the Nicaragua-Uganda problem that bedeviled the cross-section relationship. The pattern was simple. Growth went down sharply during the inflation crisis. Then growth increased above the precrisis growth rate after the crisis was over. (There were some indications that growth was below average before the crisis, but this was not robust to omitting extreme observations.)

Table 2 shows seven countries with long before-, during-, and after-crisis periods. It is notable that some of the countries that were outliers in the cross-section rela-

¹² Bruno and Easterly (1995).

¹³ Dornbusch and Fischer (1993) used average CPI, whereas we use end-of-year CPI because we want to be more precise about timing. Our measure is subject to more extreme spikes, so some of Dornbusch and Fischer's 15 percent to 30 percent episodes of moderate inflation actually are as high as 38 percent, according to our measure.

Table 2

Growth and Inflation Crises¹

Country	Years		Per Capita Growth		Annual Inflation Rate (%)
			Per Capita Growth (%)	(Difference from World Average) (%)	
Bolivia	1961	1981	1.6	-0.8	13
	1982	1986	-4.9	-5.3	781
	1987	1991	0.8	0.1	16
Brazil	1950	1961	3.6	1.2	21
	1962	1966	1.6	-1.0	58
	1967	1975	6.8	4.3	23
	1976	1992	0.6	-0.4	259
Chile	1960	1971	2.4	-0.4	27
	1972	1977	-2.8	-5.1	240
	1978	1992	3.0	2.3	22
Ghana	1964	1974	0.4	2.4	11
	1975	1983	-4.7	-5.8	71
	1984	1992	1.7	1.0	23
Indonesia	1951	1960	1.2	-1.1	21
	1961	1968	0.9	-2.9	189
	1969	1990	4.2	3.2	13
Israel	1961	1976	4.4	1.8	14
	1977	1985	1.5	0.7	135
	1986	1992	2.3	1.6	17
Mexico	1961	1981	3.6	1.3	11
	1982	1988	-1.9	-2.5	86
	1989	1992	1.6	1.3	20

¹Crisis defined as more than 40 percent inflation for two or more years, shown in *italic*.

tionship—for example, Brazil, Indonesia, and Israel—fit the collapse-and-recover pattern quite well.

So why wasn't the cross-section relationship working? We examined whether collapse and recovery were averaging out such that no mark was left on growth after inflation crises.

Our idea was the following. Suppose that Country A and Country B are identical except that Country A has a discrete inflation crisis and Country B does not. In the first period, Country A and Country B have an identical growth rate (g_1) and identical inflation rates. In the second period, Country A has an inflation crisis—inflation goes up to some triple-digit number—and growth goes down to $g_2 < g_1$. Country B's inflation rate is unchanged, and its growth rate stays at g_1 . In the third period, Coun-

try A lowers inflation back to its original level and recovers to $g_3 > g_1$, whereas Country B still boringly sticks to g_1 . Suppose that the average of g_2 and g_3 (weighted by length of period) is g_1 . Then Country A has caught up to its precrisis trend, and its average growth over the period is the same as Country B's, that is, g_1 . Country A's inflation rate averaged over the period is higher than Country B's but its growth averaged over the period is the same. A cross-section regression based on these two countries will not detect any growth effects associated with inflation.

This is roughly the situation we find with discrete high inflation crises. We used the famous Levine-Renelt (1992) regression of growth on investment, population growth, initial income, and secondary education (their core set of robust

variables) to control for non-identical country characteristics. Then we examined the residuals for this regression for the before-, during-, and after-subperiods for those countries with high inflation crises. We found that the negative during-crisis residual and the positive after-crisis residual tended to average out to be the same as the before-crisis residual. The before-crisis residual was not itself systematically negative in inflation-crisis countries. Hence there was no cross-section negative residual associated with high inflation, even though the residual during the discrete high inflation episode was strongly negative.

We see that the long-run relationship between inflation and growth is not on very solid ground. What about the short-run positive relationship between inflation and growth? The case study literature had noticed the surprising phenomenon of short-run output expansions associated with stabilizations from high inflation.¹⁴ This literature had attributed the output expansion to the (often unsustainable) use of the exchange rate as a nominal anchor, which might induce a short-lived consumption boom. Our findings, however, suggest that output expansion after reduction of high inflation may be a more general phenomenon.

In a subsequent paper, Easterly (1996) examined the year-by-year pattern of decline and recovery during disinflation from high initial levels. This paper found that negative per capita growth occurred before and during the peak of the high inflation. Growth improved immediately in the first year of inflation decline after the peak and accelerated to high positive growth thereafter.

Ironically, the power of growth-inflation relationships in the empirical long-run growth literature seems to be coming from the short run rather than the long run. At high inflations, there is a negative relationship between inflation and growth even in the short run. There is no evidence of a long-run relationship—countries recover to their precrisis trend after resolving inflation crises.

Interpretations

We did not attempt to resolve the causality issue that plagues empirical work on inflation and growth—and that plagues most other empirical work on growth. We do not see time-varying instruments for inflation that are plausibly exogenous and excludable from the growth regression. But we still think it is useful to establish correlations even when causality is unresolved. We think Mankiw (1995) got it right: “Correlations among endogenous variables can rule out theories that fail to produce the correlations, and they can thereby raise our confidence in theories that do produce them.”

One possible theory consistent with our results is that supply shocks are the predominant factor in high inflation crises and those shocks explain the negative comovements of inflation and growth. We did not confirm this explanation when we looked at some of the more obvious supply shocks like terms of trade, wars, and debt crises, but other less-observable supply shocks could still be there.

Our results would seem to be more consistent with a neoclassical growth model than with an endogenous growth model because inflation (either itself or whatever it is proxying for) seems to be acting more like a level effect on output than a growth effect. The issues of exogenous vs. endogenous growth and unit roots vs. trend stationarity are much larger issues, which are not well resolved in wider literatures.

The inflation-growth relationship also can be interpreted from the viewpoint of the interesting political economy literature on macroeconomic crises. Alesina and Drazen's (1991) classic model of delayed stabilization made clear that the timing of inflation stabilization is endogenous. Inflation stabilization may occur at the moment when the largest output growth gains can be realized, which may result in a short-run negative association between high inflation and growth. If this is the story, this negative association is not a structural relationship that can be exploited by policymakers at any time.

¹⁴ See, for example, Kiguel and Liviatan (1988) and Rebelo and Vegh (1995).

Inflation has always been known as a traumatic crisis—witness Lenin’s famous dictum: “There is no subtler, surer means of overturning the existing basis of society than to debauch the currency.”¹⁵ The political economy literature has also raised the idea that such overturnings could be beneficial by ending interest group gridlock.¹⁶ By raising the stakes, high inflations may break the interest group stalemates that block reform. In this light, the increase in growth after crisis could actually be a permanent increase in endogenous growth, not reversion to an exogenous growth trend.

CONCLUSIONS

The early empirical literature on inflation and growth found little in the way of a relationship between the two. The growth literature detected a relationship between inflation and growth only after countries kindly provided some discrete high inflation crises in the 1980s. And even then it was still unclear whether there was a long-run or a short-run relationship because the empirical relationships were weak with long-period averages and strong with short-period averages. Despite extensive counseling by the new-growth literature, the indecisive couple of inflation and growth cannot decide whether they belong together in the short run or in the long run.

In our own recent work on high inflations and growth, we have reexamined the long-standing conventional wisdom that growth and inflation are positively related in the short run and negatively related in the long run. We find the conventional wisdom to be consistent—consistently wrong, that is. We find no evidence of any relationship between inflation and growth at annual inflation rates less than 40 percent—our definition of high inflation. We do find a short- to medium-run relationship between high inflations and growth, but it is a negative relationship. And we find there is no lasting damage to growth from discrete high inflation crises, as countries tend to recover back toward their precrisis growth rate.

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¹⁵ This quote was actually popularized by Keynes (1920, p. 220) and attributed by him to Lenin, although it has never been confirmed that Lenin ever said or wrote it.

¹⁶ Drazen and Grilli (1993), Tornell (1994), and Velasco (1994).

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