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Inflation crises and long-run growth

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Abstract

Recent articles in the new growth literature find that growth and inflation are negatively related, a finding that is usually thought to reflect a long-run relationship. But the inflation–growth correlation is only present with high frequency data and with extreme inflation observations; there is no cross-sectional correlation between long-run averages of growth and inflation. We propose that examination of discrete high inflation crises (periods when inflation is above some threshold, which we propose to be 40% annual) helps unravel these empirical paradoxes. We establish a robust finding that growth falls sharply during discrete high inflation crises, then recovers rapidly and strongly after inflation falls. © 1998 Elsevier Science B.V. All rights reserved.

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1. Introduction

Is inflation harmful to growth? The ratio of fervent beliefs to tangible evidence seems unusually high on this topic, despite extensive previous research.

A recent wave of articles has indeed found a negative empirical relationship between growth and inflation (Fischer, 1993; De Gregorio, 1993; Barro, 1995).

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¹ Michael Bruno passed away in December 1996; this paper is dedicated to his memory.

At first blush, this seems to resolve the issue of the long-run growth–inflation relationship. At second blush, however, there’s a paradox: the results on inflation and growth are stronger the higher is the frequency of the data – results get stronger as one goes from the cross-section to ten year averages to five year averages to annual data. The pure cross-section relationship between growth and inflation – using averages of 30-some years, say – is nonexistent. Even the higher-frequency relationships seem to be driven by the higher inflation observations. Why is there a strong growth–inflation relationship with pooled annual data but not with cross-section data? Why are the high inflation observations so crucial?

In this paper, we suggest that characterizing the behavior of output growth before, during, and after discrete high inflation crises sheds some light on these empirical paradoxes. Our nonparametric approach is simple – we will define a country as in a high inflation crisis when it is above some threshold level of inflation – 40% is a useful threshold as we explain later. We find that there is no robust evidence of a growth–inflation relationship at any frequency excluding these discrete high inflation crises. We do find robust evidence that growth turns sharply negative during these discrete high inflation crises. After the end of a high inflation crisis, inflation returns to its pre-crisis level and there is a fast growth recovery. This recovery occurs in *both* exchange-rate-based and money-based stabilizations, contrary to the conventional wisdom that explains booms as purely a feature of exchange-rate-based stabilizations. The rapid recovery after inflation returns to its pre-crisis level cancels out some – or possibly all – of the output lost during the high inflation crisis. Thus, this helps explain why a growth–inflation relationship has been hard to detect in the cross-section data even though it is clear in higher-frequency data.

We do not address causality in this paper, nor do we estimate any structural relationship. Our task is a historical description of what happened during high inflation crises. We believe that establishing a robust pattern of growth associated with high inflation crises will give guidance for theory even if causality between inflation is unresolved.

2. Inflation–growth correlations across time and across inflation ranges

Evidence for a relationship between inflation and growth has only appeared recently in the literature. Johnson (1967) suggested that there was no conclusive empirical evidence for either a positive or a negative association. At the IMF, no hotbed of inflationists, a series of studies in the *Staff Papers* around 1960 found little evidence of damage from inflation (Wai, 1959; Bhatia, 1960; Dorrance, 1963, 1966). In Latin America, where most higher rates of inflation were experienced, the evidence in the 1970s was ambiguous (Pazos, 1972; Galbis, 1979).

Contrary to this earlier literature, Fischer (1993) found negative associations between inflation and growth in pooled cross-section, time series regressions for a large set of countries. Other studies had similar findings (De Gregorio, 1992, 1993; Barro, 1995). These pooled, cross-section datasets featured decade averages, 5-yr averages, or even annual data. The results were stronger the higher the frequency of the data.

Inflation results were still nonexistent in the cross-section dimension that the growth literature emphasizes. Levine and Zervos (1993) showed that the cross-section correlation between inflation and growth, on the rare occasion when one can find it at all, depends on a couple of extreme inflation, low-growth countries (in their sample, Nicaragua and Uganda). Even compared with the many fragile results pointed out by Levine and Renelt (1992), Levine and Zervos (1993) found the inflation–growth relationship to be exceptionally fragile.²

We replicated these results in our data with a simple correlation between cross-section inflation and growth averages over 1961–1994; the correlation loses significance with the omission of a *single* observation – Nicaragua, which had hyperinflation and negative growth in the 1980s. What happened during hyperinflation in Nicaragua is not very informative for, say, the Bank of Canada.

More generally, the significance and sign of the cross-section correlation depends on the inclusion of the countries with high inflation crises – the above 40% episodes we are going to consider. Without these high inflation countries, the cross-section relationship switches sign and loses significance.

If we try pooled data, the results are stronger but still not robust to the exclusion of high inflation observations, or to changes of time periods. With five year averages, the significance of the correlation again is weakened with the omission of the high inflation countries – especially in the 1961–1975 subperiod (hence the lack of findings in the 1960s and 1970s literature). The pooled dataset with *annual* data does show a very significant negative correlation between inflation and growth. But even this pooled annual correlation does not survive the omission of the high inflation crises and the break into subperiods 1961–1977 and 1978–1994, since the correlation is not significant in the first subperiod without the high inflation observations. Our point is that *any* robust finding on the growth–inflation correlation seems to require the high inflation observations.

² In fact, they did not find inflation to be significant in any of the multifarious combinations of variables tried by their application of Leamer's extreme bounds analysis. The number of cross-section growth regressions that *did not* find inflation to be significant is notable. By way of illustration, inflation is not a right-hand-side variable in the economic growth regressions given in the text by Barro and Sala-i-Martin (1995) – either in the 10 right-hand side variables for a basic growth regression, or in the list of 14 other possible right-hand-side variables. In this text, the only place where inflation is mentioned is in one of the problem sets at the end of a chapter.

Table 1
Inflation instability across ranges of inflation

Range of inflation in current year	Percent of observations above 100% annual inflation in succeeding year	Percent that pass 100% sometime in next two years	Percent that pass 100% sometime in next three years	Percent that pass 1000% sometime in next three years	No. of observations
Below 0	0	0	0	0	220
0–20	0	0	0	0	2897
20–40	1	3	7	0	378
40–60	10	20	27	3	87
60–80	20	30	38	4	49
80–100	26	39	44	6	38
Above 100	72	79	78	29	104

In our dataset, 40% seems like a natural breakpoint between low and high inflation because it is where the risk of even higher inflation rises sharply. Table 1 calculates for the whole period 1961–1994 the probability of transition to 100% in the subsequent year for any given range of inflation in the preceding year. We note the sizable jump in that probability as one moves over 40% barrier, and even the risk of quadruple-digit inflation becomes nonzero. These transition calculations are consistent with the case studies discussed by Dornbusch and Fischer (1993), in which inflation in the moderate range of 15–30% does not usually accelerate to extreme levels.³ The higher risk beyond a certain threshold of even further loss of control over inflation may be due to the tendency at that threshold to index nominal magnitudes explicitly or implicitly.⁴

3. Inflation crises and growth

In this section, we examine what happens to per capita growth before, during, and after a high inflation crisis. We seek information on the following questions:

³ Our 40% definition of ‘above moderate’ roughly matches Dornbusch and Fischer’s 15–30% definition of ‘moderate’, because they use average year over year inflation, while we use end-of-period over end-of-period. The former induces some averaging over time of inflation rates and is subject to less pronounced spikes than the latter. (For example, several of their moderate inflation episodes include inflation rates that range as high as 35–38% in our data).

⁴ See Bruno (1993), Section 3.6, for an analysis of the path-through of price level shocks into ever accelerating inflation rates.

(1) Was growth already below normal prior to an inflation crisis? (2) Is growth significantly below normal during the period of the inflation crisis? (3) Is growth above normal after a crisis is over? We will see that the answers are (1) inconclusive, (2) yes, and (3) yes.

Our threshold for an inflation crisis is annual CPI inflation at or above 40%, measured December to December, for two consecutive years or more. Our CPI is from the *International Financial Statistics* of the IMF, which reports monthly data. Our output growth is the log change in yearly constant price GDP per capita, compiled from national statistical agencies' national accounts by the World Bank and reported in the World Bank publication *World Tables*.⁵

We prefer December over December inflation over the usual year average over year average, because we want to be as precise as possible about timing of inflation rates.⁶ We exclude one-year inflation crises because they may reflect one-time price liberalizations or abrupt corrections of overvalued official exchange rates. By the same token, our definition of ending the crisis is to have achieved inflation below 40% for two years or more. The 40% threshold is chosen because it is above the range of moderate inflations of Dornbusch and Fischer (1993) and into the range where inflation is prone to be volatile and subject to sharp accelerations.

Inflation crises according to this definition may last only a couple of years, or at the other extreme, may drag on for 20 years (Argentina). The median length of our inflation crises is 6 years. Case studies make clear that high inflation even in the very long crises is not a steady state, since there are continual (unsuccessful) attempts to stabilize inflation. In any case, we will check sensitivity of our results to the period length of the crisis.

⁵ World Bank per capita growth rates are highly correlated with Summers and Heston (1991, 1993) per capita growth rates, since the information content of Summers and Heston is much more in the level of income than in the growth rate. The World Bank growth rates are more up to date for our purposes. We also filled in a few missing output observations for inflation crises from internal World Bank and IMF country reports.

⁶ We are using annual averages for real GDP, so there could still be some mismatch of timing between the CPI and GDP measures. Unfortunately only four countries in our sample have quarterly GDP data, and that only for some years, so end of period GDP over previous end of period is not feasible. Only five countries have monthly industrial production data, again only for part of the sample period. We did check the sensitivity of our choice of measures to these kind of timing issues by using CPI average over average inflation as an alternative to the December over December measure. (The CPI average year over year does *not* solve the problem of a timing match with the GDP average year over year, because both measures are indeterminate over a two year period as to when the shocks to prices and output, respectively, actually happen. Average over average CPI inflation rates for say, 1996, could reflect price shocks early in 1995 or late in 1996.) However, none of these timing subtleties matter much in practice: the results turn out to be virtually identical using the inflation rate average over average (comparison results available upon request).

We acknowledge that there is some arbitrariness in the choice of a threshold. We do not claim great precision for the 40% breakpoint. Moreover, the date on which inflation passes 40% may not accord with the subjective perception of when a crisis begins inside a particular country. For example, in Israel, our definition of a crisis will date the high inflation as beginning in 1977, while many case study analyses of Israel would date the crisis as beginning in 1974.⁷ However, what we lose in flexibility to analyze each set of country circumstances, we gain in the ability to test a pre-determined criterion across countries. To check the robustness of our 40% criterion, we will also conduct similar tests for inflation crises in the 20–40% range.

3.1. *Basic result*

We first show the pattern of growth before, during, and after the inflation crisis. We calculate both the per capita growth rate and the per capita growth rate differenced from the world average (for whatever countries have available data) for each before, during, and after period shown in each country case. The Appendix gives the list of 31 countries that had 41 high inflation crises at some point over 1961–1994.

Table 2 gives the averages of annual data over 1961–1994 before, during, and after inflation crises for the whole sample. The definition of inflation crisis as periods above 40% inflation leads to unsubtle differences in inflation between crisis and noncrisis periods: inflation averaged above 150% in the former and 20% or below in the latter.

The growth pattern is also unsubtle. Per capita growth is significantly negative during the inflation crisis, and significantly positive afterwards. Growth declines by 2.4 percentage points from the pre-crisis period to the crisis period; after the crisis, growth accelerates by 3.3 percentage points. The post-crisis growth rate is 0.9 percentage points above the pre-crisis growth rate. All of these growth differentials are statistically significant, as shown in the table.

3.2. *Robustness checks*

The remainder of Table 2 performs a variety of robustness checks. There has been a global trend towards falling growth.⁸ Is such a common global factor affecting our results? The fourth column of Table 2 examines whether the

⁷ Bruno (1993), pp. 54–55. Annual percentage Israeli inflation from 1973 to 1977 was 26, 56, 24, 38, and 42.

⁸ Bruno (1995) shows how a number of industrial and middle-income countries moved over the past three decades through a long cycle, with successive phases of first accelerating growth and inflation, then falling growth and rising inflation, and finally rising growth and falling inflation.

Table 2
Growth before and after inflation crises of 40% and above, 1961–1994^a (*t*-statistics in parentheses)

	No. of annual observations	Inflation rate (%) ^b	Per capita growth ^b	Per capita growth, deviation from world average	Per capita growth, deviations from world average, robustness checks				
					Sample excluding growth deviations > 10% and < - 10%	Sample prior to 1978	Sample excluding hyperinflationary countries ^c	Sample excluding war years ^d	
Before first inflation crises	518	11% (24.46)	1.3% (4.91)	- 0.8% (- 3.25)	- 0.5% (- 2.60)	- 0.5% (- 1.58)	- 0.9 (- 3.20)	- 0.5% (- 1.83)	
During inflation crises	269	151% (17.22)	- 1.1% (- 3.23)	- 2.1% (- 6.49)	- 1.4% (- 5.66)	- 2.8% (- 4.26)	- 1.7% (- 5.43)	- 2.0% (- 6.01)	
After inflation crises	176	17% (24.11)	2.2% (8.18)	1.4% (5.81)	1.6% (7.65)	1.8% (3.02)	1.3% (5.81)	1.5% (5.94)	
<i>t</i> -stat for H ₀ : equality of means during–before		15.17	- 5.57	- 3.11	- 3.04	- 3.24	- 2.36	- 3.67	
<i>t</i> -stat for H ₀ : equality of means after–during		- 14.12	7.64	8.68	9.24	5.17	7.81	8.37	
<i>t</i> -stat for H ₀ : equality of means after–before		6.70	2.42	6.37	7.46	3.40	6.33	5.46	

^aThere were 41 high inflation crises in 31 countries, with a median crisis length of 6 years (see Appendix for listing).

^bGDP per capita growth from World Bank Economic and Social Database (BESD), inflation from International Financial Statistics (CPI December over December); averages are geometric averages.

^cCountries that had hyperinflation: Argentina, Bolivia, Brazil, Nicaragua, Peru, Yugoslavia, Zaire (hyperinflation defined as > 1000%.

^dWars taking place on national territory as listed in Sivard (1993), updated to 1994 from Center for Defense Information, 1995.

pattern of inflation and growth holds up when we difference each country's growth rate from the world average for each year. The pattern is the same and remains statistically significant. We find that countries were significantly below world average growth during the crisis, and significantly above both world average growth and pre-crisis growth after the crisis. Given the downward trend in world average growth, the swing of growth rates from the before-crisis to the after-crisis period is even larger for the growth rates differenced from the world average than for simple growth rates – 2.2 percentage points.

We saw earlier that cross-section growth–inflation associations were sensitive to large outliers (e.g. Nicaragua) and changes in sample period. In the next two columns of Table 2, we omit extreme growth observations and we examine the pattern for the pre-1978 period. The pattern is robust. Although magnitudes shift somewhat, growth is consistently and significantly below the world average during the crisis, and above the world average after the crisis. (Omitting Nicaragua, by the way, does not change our results.) The result that precrisis growth is below the world average is *not* robust to the pre-1978 period.

In the second-to-last column of Table 2, we exclude countries with hyperinflations. Since we saw the sensitivity of growth–inflation regressions to extreme inflation observations, it is worth checking whether the very extreme inflations (above 1000%) are determining our high inflation results. The inflation case study literature has also suggested that stabilization of hyperinflations does not have output costs (Sargent, 1982; Kiguel and Liviatan, 1988, 1992), so this may affect our estimate of the output expansion in the 'after' period. However, when we omit countries with extreme inflations, the growth pattern is unchanged.

Another check is to omit war years from the sample. There is some association between inflation crises and wars, and wars also may cause output drops. The below-average growth prior to the crisis is not robust to exclusion of wars, as it was not robust to change of time period. However, the pattern of growth decline and recovery during and after the inflation crisis is unchanged when wars are omitted.⁹

As noted earlier, one uncomfortable feature of our approach is that we are lumping together episodes with long inflation crisis periods and short crisis periods. Perhaps behavior is different during a two-year outburst of high inflation and a 20-year episode of high inflation. We checked this by segmenting

⁹We tried another robustness check that we do not report in the table. There was a high coincidence between countries with inflation crises and countries that were affected by the international debt crisis of the 1980s. Are the inflation crisis effects just picking up the calamitous synchronized effects of the international debt crisis? We address this by differencing growth rates not from the world average, but from the average of all debt crisis countries in each year (there were 31 other countries that rescheduled debt but did not have inflation crises). Countries in the middle of inflation crises were still significantly *below* the average for debt reschedulers over the same time periods, and were significantly *above* the debt crisis average after the inflation crisis.

Table 3
Growth before, during, and after inflation crises of 40% and above 1961–1994: standardized period lengths (*t*-statistics in parentheses)

	Inflation rate (%)	Per capita growth	Per capita growth, deviation from world average	No. of observations
Last two years before inflation crises	20% (16.41)	0.7% (1.24)	– 0.4% (– 0.72)	78
First two years during inflation crises	76% (13.54)	– 1.9% (2.96)	– 3.3% (– 5.34)	82
First two years after inflation crises	16% (9.24)	1.9% (3.54)	1.2% (2.58)	59
<i>t</i> -stat for H ₀ : equality of means during–before	8.80	– 3.28	– 3.39	
<i>t</i> -stat for H ₀ : equality of means after–during	– 6.31	3.21	4.06	
<i>t</i> -stat for H ₀ : equality of means after–before	– 0.42	1.61	2.20	

the inflation crises into those with duration above the median of six years, and those equal to or less than the median length. (There are 18 crises in the first group, and 23 in the second – 6 crises lasted the median length of 6 years. We report results only here in text to keep it brief.) The per capita growth rate differenced from the world average during crisis in the long duration group is – 1.9% and in the short duration group is – 2.6%; the difference is not statistically significant. Similar results obtain with the undifferenced per capita growth rates. We conclude there are no systematic differences between long-duration and short-duration crises.

The uneven lengths of crises also mean that some crisis periods are weighted more heavily than others in the pooled averages reported in Table 2. In Table 3, we consider a different way to slice the data, standardizing period lengths – we examine the last two years before entry into high inflation, the first two years of high inflation, and the first two years after exiting from high inflation. The last two years before the onset of crisis are not significantly below average. The pattern of growth during and after is the same – sharp decline during the crisis, sharp recovery after the end of crisis.

The strong output expansions after the inflation crises end is contrary to conventional wisdom. As Rebelo and Vegh (1995), p. 125 note in a literature survey of recent disinflations from initial high inflation, conventional wisdom is that “inflation can only be reduced at the cost of a short-term contraction.” They note however the literature’s stylized fact that “countries that use the

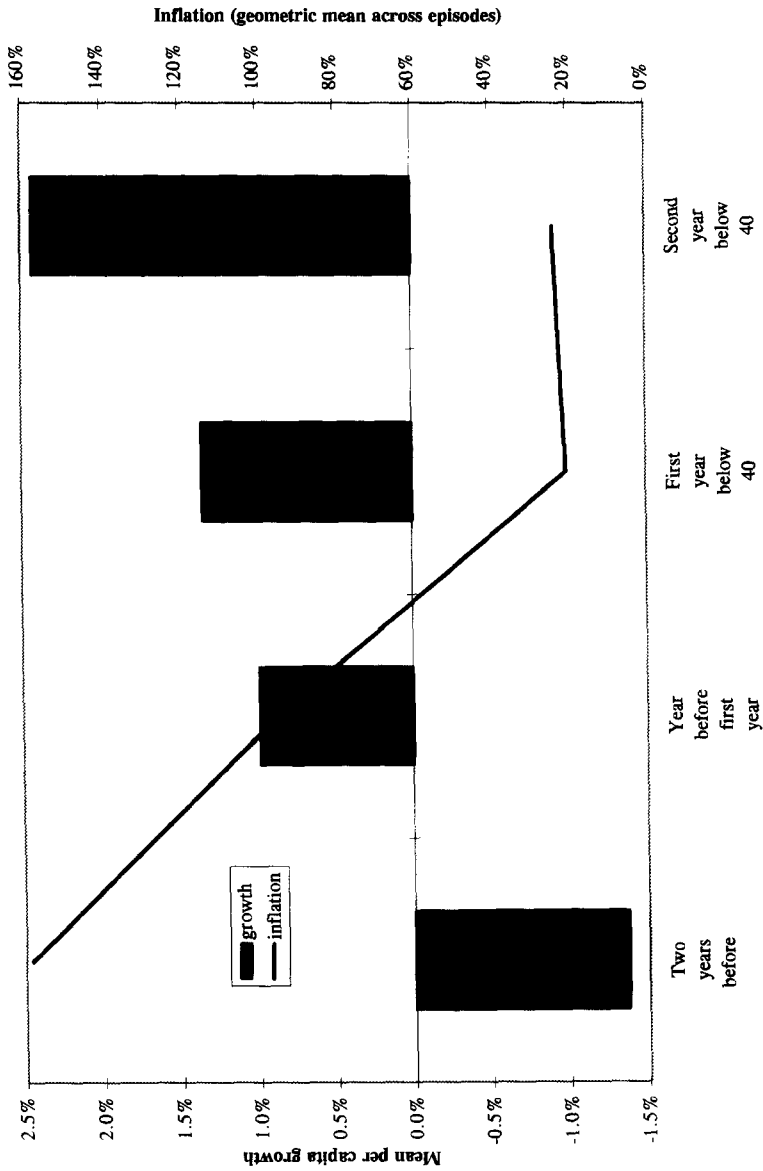
exchange rate as a nominal anchor experience a {short-term} boom.” (p. 126) This stylized fact was based on case studies, mainly in the Southern Cone of Latin America. Is output behavior during exchange-rate-based stabilizations really different from that during other disinflations? We examined this question (results available on request). We classify stabilizations as exchange rate based if they are so classified by the survey of Calvo and Vegh (1994). For those not covered by Calvo and Vegh, we follow the classification of Easterly (1996) based on World Bank and IMF reports of whether the nominal exchange rate was fixed and whether there was at least current account convertibility.¹⁰ We use both our basic definition of periods and the standardized two-year period lengths. In both samples, both the exchange rate based and other stabilizations (which we call ‘money based’ by default) show the pattern of growth decline during crisis and growth increase afterwards. The postcrisis expansions are actually stronger in the ‘money based’ stabilizations, although the difference is not statistically significant. These results contradict the stylized fact that output expansions are limited to exchange rate based stabilizations.¹¹ We conclude that output expansion – even in the short run – after exiting from high inflation is a more general phenomenon than the ‘exchange-rate-based stabilization’ literature had detected.

But does our ‘crisis’ period contain the initial phase of a contractionary stabilization from even higher inflation levels? Fig. 1 shows the averages of the year-by-year growth and inflation data for 29 high inflation crisis episodes for which there was a later disinflation. We show the last two years of the ‘crisis’ period and the first two years of the ‘recovery’ period. No output contraction associated with the reduction in inflation is obvious in this data, either in the late stages of the ‘crisis’ period or the early stages of the ‘recovery’ period. Growth is improving monotonically as inflation comes down. The sacrifice ratios calculated for stabilizing low to moderate inflation in industrial countries (see Ball, 1994; Ball et al., 1988) change sign when stabilizing from high inflation. In our findings, the output sacrifice associated with *high* inflation happens when the high inflation begins, not when it ends.¹²

¹⁰ Exchange rate based stabilizations are Argentina, Brazil (after 1961–1966 crisis), Ecuador, Iceland (after 1978–1983 crisis), Israel, Mexico, Nicaragua, and Uruguay (following both 1963–1968 and 1972–1980 crises).

¹¹ The above-average growth during the exchange rate based stabilizations is not even statistically significant for exchange rate based stabilizations for the very few observations with the standardized two-year period lengths. It is significant for our standard period lengths. The change from during to after is significant in both the exchange rate based and money based stabilizations.

¹² Ball et al. (1988) in a sample of 43 countries did note that the output–inflation tradeoff seemed to disappear at higher rates of inflation, though not that it switched sign. Easterly (1996) did a year by year analysis of the reduction of inflation from high initial levels, and found that the output expansion begins with the first year that inflation declines. The output expansion continues uninterrupted (even accelerating) for at least seven years for countries that have that much post-inflation data.



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Fig. 1. Growth and inflation during transition after high inflation crises, 29 episodes.

Table 4

Total factor productivity and capital growth before and after inflation crisis, 1961–1994 (*t*-statistics in parentheses)

	TFP growth ^a	Capital growth per worker	Investment/GDP ^b
Before first inflation crisis	0.2% (0.57)	2.7% (17.03)	18.7 (43.13)
During inflation crises	– 1.3% (– 3.18)	0.0% (– 0.19)	15.2 (29.46)
After inflation crises	1.2% (4.60)	1.6% (4.97)	15.9 (23.95)
<i>t</i> -stat for H ₀ : equality of means during–before	– 2.98	– 11.39	– 5.13
<i>t</i> -stat for H ₀ : equality of means after–during	5.16	4.42	0.79
<i>t</i> -stat for H ₀ : equality of means after–before	2.86	– 3.16	– 3.53

^aTFP and capital growth from Nehru and Dhareshwar (1993) exercise constructing capital stocks by perpetual inventory method, updated to 1993 by same authors in unpublished database.

^bInvestment/GDP in 1985 world prices from Summers and Heston (1993) through 1990, spliced with World Bank Investment/GDP for 1991–1992.

3.3. Results for other measures of growth

We probe deeper into this pattern of growth decline and recovery by examining the components of TFP growth and capital growth. For TFP growth, we use the large dataset of cross-country estimates of capital stocks with the perpetual inventory method of Nehru and Dhareshwar (1993) (since updated).¹³ (Since we have no measure of capacity utilization or employment in the Nehru–Dhareshwar dataset – or any other international dataset – what we are calling ‘TFP growth’ would include changes in factor utilization as well as productivity changes.) Table 4 shows that TFP growth shows a similar pattern to that of growth per capita: significantly negative during crisis, and significantly positive after the crisis. TFP growth during the crisis is significantly below the pre-crisis level; after-crisis TFP growth is significantly above both the during-crisis level and the pre-crisis level.

¹³ Nehru and Dhareshwar’s capital stock numbers are correlated fairly strongly with those of Benhabib and Spiegel (1994) and King and Levine (1994). We prefer the former because they are the only ones to have been updated as far as 1993.

The pattern of capital growth is different – capital growth definitely declines during the crisis, but only partially recovers afterward. Investment/GDP ratios show a similar pattern – significantly declining during the crisis but not recovering afterward. Both post-crisis capital growth rates and investment rates remain *below* their pre-crisis levels. In short, the strong post-crisis growth recovery we saw in Tables 2 and 3 is explained by TFP growth and not by capital growth.

Capital accumulation is thus a big exception to the general pattern of post-crisis recovery. Previous research has noted a slow investment response to changes in inflation. The slow response may be due to the uncertainty and loss of credibility created by the previous inflation, as investors wait to see if stabilization is permanent (Pindyck and Solimano, 1993; Serven and Solimano, 1993). The slower response of investment compared to growth may also be related to the findings of Blomstrom et al. (1996) that investment follows growth, rather than the other way around.

3.4. *More extreme and more moderate inflations*

Is our 40% threshold a meaningful break point for discrete high inflation crises? Discussing first whether the threshold should be even higher, the data do not allow us to be precise. We have already noted the high transition probabilities for inflation above 40 towards even higher inflation (Table 1). If we wanted to test whether the threshold should be increased another 20, or even 40 percentage points, we need data on the intermediate range 40–60 or 40–80. There is little such data. Of the 41 crises in which inflation goes above 40, inflation stays below 60 only in 2 and stays below 80 only in another 4. Hence, we cannot claim great precision for 40% as a breakpoint as compared to 60 or 80. The 40% threshold is successful as a breakpoint for picking out crises of sustained high inflation, but we cannot say precisely whether 60 or 80 would have served as well.

We have much more data to test whether the threshold for inflation crises should be *lower*, because the number of observations increases dramatically with lower rates of inflation (and because inflation in the 20–40 range is not so likely to go even higher). We examine 41 episodes of 20–40% inflation that lasted two or more years. We do not get a robust finding that growth is below average during episodes of 20–40% inflation, as shown in Table 5. Although the growth deviation from the world average during the ‘moderate’ crisis is significant, this deviation is not significant at 5% levels if extreme observations are omitted, or if the later years are omitted, or if wars are omitted. Actually, the significance of the negative growth during 20–40% inflation vanishes if a *single* extreme annual observation is omitted – Iran in 1980.

The difference between pre-crisis and during-crisis growth loses its significance if the later years are omitted, although the difference is negative and significant for the whole period sample. The recovery after crisis also does not

Table 5
Growth before, during, and after moderate inflation crisis of 20–40%, 1961–1994 (*t*-statistics in parentheses)

	No. of annual observations	Inflation rate (%)	Per capita growth	Per capita growth, deviation from world average	Per capita growth, deviations from world average, robustness checks				
					Sample excluding Iran outliers ^a	Sample excluding growth deviations > 10% and < -10%	Sample prior to 1978	Sample excluding war years	
Before first inflation crisis	380	7% (21.99)	2.6% (10.07)	0.3% (1.23)	0.3% (1.23)	0.3% (1.42)	0.5% (1.80)	0.6% (2.19)	
During inflation crises	104	27% (34.88)	0.0% (0.02)	-1.2% (-2.10)	-1.0% (-1.86)	-0.6% (-1.77)	-0.6% (-0.64)	-1.3% (-1.93)	
After inflation crises	333	9% (4.12)	1.2% (4.45)	0.5% (2.00)	0.5% (1.90)	1.1% (5.21)	1.0% (1.20)	0.9% (2.97)	
<i>t</i> -stat for H ₀ : equality of means during-before		34.88	-3.96	-2.41	-2.20	-2.23	-1.14	-2.61	
<i>t</i> -stat for H ₀ : equality of means after-during		-26.79	1.85	2.75	2.51	4.14	1.27	3.00	
<i>t</i> -stat for H ₀ : equality of means after-before		4.12	-3.61	0.65	0.58	2.89	0.54	0.80	

^aModerate inflation crisis are two years or more of inflation between 20% and 40%. Episodes are: Algeria 90–92, Bahrain 76–77, Barbados 73–74, Burma 73–75 and 90–91, Burundi 78–79, Colombia 73–82 and 85–94, Dominica 73–74 and 79–80, Egypt 88–89, Gambia 75–76 and 84–85, Greece 79–81, Grenada 79–80, Guatemala 85–86, Guyana 87–88, Honduras 90–91, Hungary 90–94, India 73–74, Iran 76–77, 80–82, and 93–94, Korea 74–75, 79–80, St. Lucia 73–74, Madagascar 80–82, Maldives 79–82, Mauritius 79–80, Malawi 87–88, Pakistan 73–74, Philippines 73–74, Portugal 76–79 and 83–84, Paraguay 84–87, Saudi Arabia 73–76, Syria 80–81 and 87–88, Western Samoa 79–80, Burkina Faso 77–78, El Salvador 85–86.

show a consistent pattern (its significance also vanishes with the omission of a single extreme Iran observation – the later recovery in 1983). There is no consistent tendency for growth after these moderate crises to be above the pre-crisis growth. The mixed results between 20% and 40% inflation seem to confirm that 40% is a useful threshold to identify the discrete high inflation crises associated with output movements.

3.5. *External influences and policy stances in high inflation crises*

We have seen that an inflation crisis almost invariably involves a reduction in the growth rate while recovery from a crisis is associated with a resumption of growth which even surpasses the pre-crisis growth rate. But are both growth and inflation during the crisis being jointly determined by some adverse supply shock, like a terms of trade shock? Is the recovery of growth following the reduction of inflation simply the joint improvement of growth and inflation following the reversal of a temporary negative shock? We cannot resolve this issue in general, but we can check some of the more obvious possible shocks like aid, wars, and terms of trade shocks to see whether these factors account for the simultaneous worsening of growth and inflation in our crisis cases.

Table 6 shows the association between inflation crises and external influences. A possible explanation for the growth decline and recovery is that donors and official lenders like the IMF and World Bank cut off aid at high inflation and restore it after the end of the high inflation. To test this explanation, we assemble data from the World Bank on Overseas Development Finance (ODF) as percent of GDP; ODF includes grants and loans from multilateral agencies (e.g. World Bank) as well as bilateral agencies (e.g. USAID or EXIMBANK). However, Table 6 shows that none of the pairs of means in the three periods are significantly different from each other. Official lenders and donors are indiscriminating in how much aid finance they give before, during, and after high inflation (which is a story in itself, but a story for another paper).

Terms of trade shocks show some tendency to be adverse during inflation crises. But the terms of trade movements are still adverse during recovery. More importantly, none of these terms of trade movements are statistically significant from zero or from each other across periods.

Wars during 1960–1994 are indeed more common during inflation crises than before or after such crises (as well as more common than in countries not having inflation crises). However, we have already seen in Table 2 that the growth decline and recovery pattern holds also in the non-war cases. And the probability of war after the crisis is no lower than before the crisis, so it could not be explaining the before to after growth increase. We do not detect any obvious explanation for the growth decline and recovery pattern in the external influences.

Table 6
External influences and policy stances: averages before, during, and after high inflation crisis of 40% and above (*t*-statistics in parentheses)

	External influences			Policy stances		
	Inflows of official development finance (% of GDP)	Terms of trade change per annum	Wars (% of annual observations with war going on)	Public sector balance/GDP	Base money growth	Current account balance/GDP
Before first inflation crisis	4.6 (9.41)	- 0.8% (- 0.41)	7% (6.37)	- 5.5 (- 13.14)	19% (19.17)	- 5.5 (- 13.50)
During inflation crises	6.3 (7.63)	- 2.1% (- 1.49)	22% (8.84)	- 8.1 (- 14.49)	134% (15.31)	- 7.7 (- 9.52)
After inflation crises	5.9 (7.46)	- 2.6% (- 1.49)	7% (3.58)	- 3.3 (- 8.44)	24% (11.04)	- 7.0 (- 9.67)
<i>t</i> -statistic for H0: equality of means during-before	1.86	- 0.57	5.71	- 3.67	12.02	- 2.39
<i>t</i> -statistic for H0: equality of means after-during	- 0.41	- 0.19	- 4.92	7.13	- 10.82	0.62
<i>t</i> -statistic for H0: equality of means after-before	1.43	- 0.69	0.04	3.99	1.86	- 1.79
No. of annual observations total before, during, after	643	255	1024	580	900	747

Notes: Official Development Finance, Terms of trade (percent change per annum), and Current Account Balance from World Bank Economic and Social Database (BESD). Wars is from Sivard (1993) and Center for Defense Information, dummy = 1 if war on national territory taking place in a given year, 0 otherwise. Public Sector Surplus is from Easterly and Schmidt-Hebbel (1994), updated to 1994; Base Money Growth from International Financial Statistics of IMF.

Are high inflation crises induced by loss of control of fiscal and monetary policy, as conventional wisdom has it? Is the subsequent disinflation associated with stabilization policies? We report in Table 6 data on budget deficits. The data are for consolidated public sector balances as percent of GDP recorded in IMF and World Bank reports (Easterly and Schmidt-Hebbel, 1994), updated by us to 1994.¹⁴ Countries entering into crisis have large budget deficits before the crisis, then even larger deficits during the crisis, and finally lower budget deficits during the post-crisis recovery. All of these differences are statistically significant.

Not surprisingly, base money growth is also higher during inflation crises and lower after the inflation crisis (but the difference precrisis and postcrisis is positive and insignificant). The current account deficit, on the other hand, does not significantly decrease after the inflation crisis. Although we can draw no inferences about causality, the data in Table 6 show that high inflation crises are associated with some loss of control of fiscal and monetary policy, and the end of the crisis with regaining control.

There are many other possible influences on growth and inflation for which we do not have good measures. What we have established is a descriptive historical fact, not a structural relationship. As already advertised, we are not addressing the possibility that causality runs the other direction, from poor growth to inflation crises. It is difficult to think of good time-varying instruments that could untangle the causality.¹⁵

4. Conclusions

The case for a negative association of inflation and growth is firmly established when we look at the temporal association of growth with discrete high inflation crises. This study does not show similarly robust associations of growth with variations in low to moderate rates of inflation. Of course, failure to robustly reject a zero growth–inflation relationship at lower inflation ranges is not equivalent to *accepting* a zero growth–inflation relationship at those ranges. Our conclusion is simply that, in contrast to what is said by the existing literature, pooled cross-country datasets are not informative about what happens at lower ranges of inflation. In contrast, the data on discrete high

¹⁴ We prefer these consolidated balances to the central government balances reported in the International Financial Statistics of the IMF, because the latter exclude public enterprise deficits that are significant in developing countries.

¹⁵ Barro (1995) suggests some intriguing instruments for inflation such as colonial heritage, but these do not have a useful time dimension, and so do not address the problem of the fragility of the cross-section associations between growth and inflation.

inflation episodes speak clearly – there is a strong and robust relationship between high inflation and growth.

Causality remains unproven. Strong adverse supply shocks could cause both inflation and growth to worsen. However, we found no evidence that several obvious supply shocks – wars, aid, terms of trade – explain the negative growth–inflation crisis association.

Widely held conventional wisdom, originating in industrial country data, says that ‘inflation tends to rise in booms and fall in recessions’ (Mankiw, 1989, p. 88) and that ‘disinflation is a major cause of recessions in modern economies – perhaps the dominant cause’ (Ball, 1994, p. 155). Even Sargent’s (1982) classic challenge to that conventional wisdom, based on 1920s hyperinflations, is usually taken to imply simply *zero* output costs of credible stabilizations.¹⁶

Previous literature applied this conventional wisdom to high inflations in developing countries; even the booms supposed to follow exchange-based stabilization only postpone the inevitable recession (see survey in Rebelo and Vegh, 1995). Contrary to these views based on country case studies, we found on average that strong recoveries of growth follows reduction of high inflation in a full sample of all high inflation crises.

Our contradiction of a widely accepted stylized fact on output behavior after high inflation is somewhat analogous to the contradiction of a different set of stylized facts by the countercyclical price literature (Kydland and Prescott, 1990; Cooley and Ohanian, 1991; Backus and Kehoe, 1992; Chadha and Prasad, 1994). All of these articles refute the widely held conventional wisdom (based, as it turns out, on samples from pre-WWII periods) that prices deviate upward during booms and downward during recessions. These articles reach the opposite conclusion for the post-war period, based on more complete samples of price and output time series from the US and other OECD countries.

The *increase* in postcrisis growth above precrisis growth, while inflation simply returns to or even stays above its precrisis level, is interesting in itself.¹⁷ For one thing, it sheds light on why the growth decline associated with even a high inflation is hard to see in the cross-section. An inflation crisis will leave its mark on the country’s 34-year average inflation rate, since post-crisis inflation does not fall below its pre-crisis level. In contrast, the crisis-associated growth decline will be offset by the postcrisis increase in growth, leaving little or no mark on its 34-year average growth rate. The low growth, high inflation

¹⁶ Sargent’s own general conclusion about output costs in the 1982 article was that the conventional estimates of “the costs of stopping inflation in terms of foregone output ... are erroneous” (p. 42).

¹⁷ Unfortunately, our post-crisis time series are too short to address whether the the post-crisis growth increase merely represents a reversion to the previous output trend, or is a permanent increase in growth.

observations necessary to detect a growth–inflation association in the cross-section will be absent. In these circumstances, an inflation–growth relationship can still be detected with panels of annual, 5-year, or even 10-year averages, if these period breakdowns capture at least imperfectly the crisis and noncrisis periods.

Recent events fit the same pattern of growth response to inflation crises that we have been discussing, although some cases have obvious special circumstances. The recent hyperinflation in the constituent parts of the former Yugoslavia, for the little that this evidence is worth during such obvious wartime disruption, has been accompanied by output collapse; a fall in inflation in the successor states to the former Yugoslavia has been accompanied by output recoveries.¹⁸ The dramatic output collapse in Eastern Europe and the former Soviet Union has occurred simultaneously with high rates of inflation in many countries. While the economies in transition from planned systems are *sui generis*, their experience fits the larger pattern. Output growth has recovered in those ex-Communist economies that have stabilized inflation – Albania, Estonia, Latvia, Poland, Slovenia, Vietnam – while no recovery is in sight for those economies of the late Soviet Union where inflation remains high. Mexico, which had a below average recovery after the inflation crisis in our dataset, so far continues to be below average as vividly demonstrated by the crisis of December 1994. Brazil, which still had high inflation at the end of our sample period, finally started stabilizing in mid-1994. The Brazilian stabilization has been accompanied ever since by positive output growth per capita, conforming to our pattern.¹⁹

The long-run causal relationship between inflation and growth remains unclear. But it is clear that a discrete high inflation crisis is associated with low growth and that the end of such a high inflation crisis is associated with high growth.

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¹⁸ Slovenia stabilized in 1993 and began to recover (see Pleskovic and Sachs, 1994; Slovenia, 1993, 1994); Croatia also stabilized in late 1993 and began to recover in 1994 (Hayri, 1994); the part of the former Yugoslavia consisting of Serbia and Montenegro exited from hyperinflation in early 1994 and has shown strong output growth so far (see Bogetic et al., 1995, and World Bank updates.)

¹⁹ Boletim do Banco Central do Brasil, Janeiro 1997, Vol. 33, No. 1.

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Appendix A. Sample of high inflation crises (Table 7)

Table 7

Country	Period	Crisis period	Inflation rate (Geometric average)	Per capita growth rate (log)	Per capita growth rate, deviation from world average (log)
Argentina	1960	1971	23%	2.9%	0.1%
	1972	1991	X	254%	-0.4%
	1992	1994		9%	3.8%
Bangladesh	1960	1971	4%	0.3%	-2.5%
	1972	1974	X	77%	-2.7%
	1975	1994		8%	1.7%
Bolivia	1960	1981	13%	1.6%	-0.8%
	1982	1986	X	781%	-4.9%
	1987	1994		14%	0.8%
Brazil	1950	1961	21%	3.6%	1.2%
	1961	1966	X	58%	1.6%
	1967	1975		23%	6.8%
	1976	1994	X	329%	0.7%
Chile	1960	1971	25%	2.4%	-0.4%
	1972	1977	X	240%	-2.8%
	1978	1994		21%	2.8%
Costa Rica	1960	1980	7%	2.8%	0.3%
	1981	1982	X	73%	-7.0%
	1983	1994		17%	1.9%
Dominican Republic	1960	1987	8%	2.5%	0.6%

Table 7 (Continued)

Country	Period		Crisis period	Inflation rate (Geometric average)	Per capita growth rate (log)	Per capita growth rate, deviation from world average (log)
	1988	1990	X	65%	- 2.1%	- 3.1%
	1991	1994		7%	1.0%	1.0%
Ecuador	1960	1987		13%	2.5%	0.8%
	1988	1992	X	59%	2.1%	1.6%
	1993	1994		28%	0.8%	0.7%
Ghana	1960	1974		11%	0.4%	- 2.4%
	1975	1983	X	71%	- 4.7%	- 5.8%
	1984	1994		24%	1.4%	0.8%
Guinea-Bissau	1973	1983		8%	- 1.9%	- 3.3%
	1984	1992	X	64%	1.3%	0.6%
	1993	1994		24%	2.5%	2.4%
Indonesia	1951	1960		21%	1.2%	- 1.1%
	1961	1968	X	189%	0.9%	- 1.7%
	1969	1994		12%	4.0%	2.7%
Iceland	1961	1973		13%	3.9%	1.2%
	1974	1975	X	47%	2.1%	0.9%
	1976	1977		31%	1.9%	0.9%
	1978	1983	X	57%	2.5%	1.8%
	1984	1994		14%	1.0%	0.4%
Israel	1960	1976		13%	4.4%	1.8%
	1977	1985	X	135%	1.5%	0.7%
	1986	1994		16%	2.0%	1.4%
Jamaica	1960	1990		13%	0.5%	- 1.4%
	1991	1992	X	59%	0.5%	0.6%
	1993	1994		28%	0.1%	- 0.1%
Mexico	1960	1981		10%	3.6%	1.3%
	1982	1988	X	86%	- 1.9%	- 2.5%
	1989	1994		16%	1.1%	0.8%
Nigeria	1961	1987		11%	- 0.2%	- 2.1%
	1988	1989	X	54%	5.0%	3.7%
	1990	1991		13%	2.3%	2.3%
Nicaragua	1992	1994	X	62%	- 0.2%	- 0.4%
	1960	1983		11%	0.2%	- 1.9%
	1984	1991	X	1842%	- 6.0%	- 6.7%
	1992	1994		17%	- 1.5%	- 1.7%
Peru	1960	1975		10%	2.2%	- 0.3%
	1976	1992	X	205%	- 2.2%	- 3.2%
	1993	1994		27%	7.5%	7.3%
Poland	1971	1987		14%	0.1%	- 0.2%
	1988	1992	X	149%	- 3.4%	- 3.9%
	1993	1994		34%	1.9%	1.7%

Table 7 (Continued)

Country	Period		Crisis period	Inflation rate (Geometric average)	Per capita growth rate (log)	Per capita growth rate, deviation from world average (log)
Romania	1971	1990		2%	2.1%	0.9%
	1991	1994	X	180%	-7.4%	-7.5%
Sudan	1960	1987		15%	-0.5%	-2.5%
	1988	1993	X	97%	-2.3%	-3.0%
Sierra Leone	1960	1982		9%	1.6%	-0.6%
	1983	1991	X	85%	-1.5%	-2.2%
Somalia	1992	1994		26%	-2.4%	-2.6%
	1961	1978		6%	0.4%	-2.2%
	1979	1980	X	56%	-6.9%	-8.3%
	1981	1982		27%	2.6%	2.8%
Suriname	1983	1984	X	65%	-6.2%	-6.3%
	1985	1986		31%	2.5%	1.4%
	1987	1988	X	72%	-1.0%	-2.0%
Turkey	1960	1991		9%	-1.3%	-2.6%
	1992	1993	X	126%	-6.2%	-6.3%
Uganda	1960	1976		9%	3.7%	1.1%
	1977	1980	X	61%	-0.5%	-2.4%
	1981	1983		34%	1.7%	2.0%
	1984	1994	X	63%	2.3%	1.7%
Uruguay	1967	1973		8%	-0.8%	-3.6%
	1974	1981	X	75%	-1.1%	-2.9%
	1982	1983		28%	-6.2%	-5.6%
	1984	1989	X	131%	-1.4%	-2.4%
	1990	1994		21%	3.5%	3.3%
Venezuela	1961	1962		11%	-0.8%	-3.2%
	1963	1968	X	67%	-0.2%	-2.8%
	1969	1971		23%	2.1%	-1.4%
	1972	1980	X	67%	2.9%	0.8%
	1981	1982		25%	-4.8%	-4.6%
Yugoslavia	1983	1994	X	70%	1.1%	0.6%
	1960	1992		12%	0.0%	-1.7%
Zaire	1993	1994	X	58%	-1.8%	-2.0%
	1960	1982		17%	4.5%	2.2%
	1983	1991	X	191%	-1.6%	-2.3%
Zambia	1964	1975		20%	0.1%	-2.5%
	1976	1983	X	63%	-3.8%	-5.2%
	1984	1986		30%	0.3%	-0.7%
	1987	1994	X	956%	-6.5%	-7.1%
Zambia	1961	1984		10%	-0.6%	-2.7%
	1985	1993	X	96%	-2.7%	-3.3%

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