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Modern Hyper- and High Inflations

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1. *Introduction*

IN HIS CLASSIC WORK, Phillip Cagan (1956) studied seven of the eight hyperinflations that took place between 1920 and 1946.[2] Cagan defined a hyperinflation as beginning in the month inflation first exceeds 50 percent (per month) and as ending in the month before the monthly inflation rate drops below 50 percent for at least a year. Although he did not specify a minimum span of time for an inflationary episode to qualify as a hyperinflation, none of the Cagan seven lasted less than ten months.

Hyperinflations are largely a modern phenomenon. While the data must be highly imperfect, the evidence (table 1) indicates that many of the famous pre-twentieth-century inflations were modest by present standards: the inflation associated with the Black Death was less than 50 percent per annum, and the Spanish inflation resulting from the discovery of the New World averaged less than 2 percent and probably never exceeded 15 percent per annum. Inflation in the Roman empire in the fourth century, following Diocletian,[3] may in some years have reached triple-digit levels measured in the prices of *denarius* (a small—and getting smaller—coin) but was very low measured in terms of the gold *solidus* (a larger coin).[4] The more recent inflations summarized in table 1, associated with wars and paper money, did on occasion reach triple-digit per-annum levels.

The first recorded inflation that meets Cagan's definition of a hyperinflation appears to be the *assignat* inflation of revolutionary France, during which there were at least five months in 1795–96 in which inflation exceeded 50 percent (see Forest Capie 1991; and Thomas Sargent and Francois Velde 1995). The link with the French Revolution supports the view that hyperinflations are a modern phenomenon related to the need to print paper money to finance large fiscal deficits caused by wars, revolutions, the end of empires, and the establishment of new states.

Between 1947 and 1984 there were no hyperinflations. Since 1984, there have been at least seven (in six countries) in the market economies—with the Nicaraguan hyperinflation the worst among the seven. By the same Cagan definition, there were also in

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[2] The seven hyperinflations were: Austria, Oct. 1921–Aug. 1922; Russia, Dec. 1921–Jan. 1924; Germany, Aug. 1922–Nov. 1923; Poland, Jan. 1923–Jan. 1924; Hungary I, March 1923–Feb. 1924; Greece, Nov. 1943–Nov. 1944; and Hungary II, Aug. 1945–July 1946. In addition, there was, by Cagan's definition, a hyperinflation in China from Oct. 1947 to March 1948 (Andrew Huang 1948).

[3] Inflation in the century leading up to Diocletian's price control edict in 301 AD appears to have averaged under 4 percent per annum (Don Paarlberg 1993).

[4] This appears to have been an early example of the adage that inflation is a regressive tax, for the solidus was reportedly too valuable to be held by the poor.

TABLE 1
HISTORICAL EPISODES OF HIGH INFLATION

Country/Episode	Dates of Episodes	Duration	Cumulative Inflation[1]	Geometric Annual Rate of Inflation	Max. Annual Inflation	Source(s)
Ancient Rome Diocletian	151–301	151 years	19,900.0	3.6	n.a.	Paarlberg (1993)
China/Sung Dynasty	1191–1240	50 years	2,092.6	6.4	18.0	Lui (1983)
Europe/Black Death[2]	1349–1351	3 years	138.5	33.6	56.3	Paarlberg (1993)
Spain	1502–1600	99 years	315.2	1.4	14.6	Hamilton (1965), Paarlberg (1993)
France/John Law [6]	Feb. 1717– Dec. 1720	47 months	55.2	11.9	1,431.3	Hamilton (1936), Paarlberg (1993)
American Revolution [3,6]	Feb. 1777– Jan. 1780	36 months	2,701.7	203.7	16,098.7	Fisher (1913), Paarlberg (1993)
French Revolution [4,6]	Feb. 1790– Feb. 1796	73 months	26,566.7	150.5	92,067.6	Capie (1991)
U.S. Civil War/ North	1862–1864	3 years	116.9	29.4	45.1	Paarlberg (1993),
Confederacy[6]	Feb. 1861– Apr. 1865	51 months	9,019.8	189.2	5,605.7	Lerner (1955)
Mexican Revolution [5,6]	Feb. 1913– Dec. 1916	47 months	10,715.4	230.6	7,716,100.0	Cardenas and Manns (1989), Kemmerer (1940)
China	1938–1947	10 years	2,617,681.0	176.6	612.5	Huang (1948)

[1] Inflation expressed in percentage terms.
[2] Price of wheat in England.
[3] Depreciation of the continental currency (in units per Spanish Dollar), based on prices of beef, Indian corn, wool, and sole leather.
[4] Value of assignat.
[5] Pesos per U.S. dollar.
[6] Maximum annual inflation based on annualized maximum monthly inflation rate.

the past decade hyperinflations in transition economies, particularly the countries of the former Soviet Union. Table 2 shows hyperinflations during 1956–96, as defined by Cagan, but excluding episodes that lasted less than two months.[5] The Serbian case stands out as the worst among recent hyperinflations, with a peak monthly inflation rate that exceeds those in all the Cagan seven except the post-World War 2 Hungarian hyperinflation.[6]

Interwar controversies over hyperinflation centered on the question of whether the process was driven by monetary expansion (for example Constantino Bresciani-Turroni 1937, and Frank Graham 1930) or the balance

[5] We exclude episodes lasting less than two months because many transition economies, especially those in the former Soviet Union, suffered at least one month of more than 50-percent inflation when price controls were lifted. Since these episodes were more in the nature of a price-level adjustment than an ongoing process of high inflation, we have changed the definition to exclude them.

[6] The peak monthly rate in the post-World War 2 Hungarian hyperinflation was 41.9×10^{15}.

of payments.[7] The latter view accorded a major role in the inflationary process to the assumed exogenous behavior of the exchange rate. According to Bresciani-Turroni, this view was held throughout the German hyperinflation by the Reichsbank, bankers, industrialists, much of the press, and most German economists. Cagan advanced the analysis within a monetary framework by including the role of expectations, asking whether the process of expectations formation itself might have caused hyperinflation, and concluding—assuming adaptive expectations—that underlying monetary growth was instead responsible.

Since 1956, the formal analysis of hyperinflations has advanced in a number of directions, each of which brought in its train a large literature.[8] First, with the development of the theory of rational expectations, the notion that expectations alone could have caused hyperinflation became more difficult to sustain, except if there were multiple equilibria, some of them hyperinflationary and others not. Such an outcome is possible, for instance, if the inflation tax is subject to the Laffer curve, as is implied by the demand for money function assumed by Cagan (Michael Bruno and Stanley Fischer 1990).[9] The introduction of rational expectations also led to a more sophisticated econometric treatment of the demand for money, and therefore to attempts to estimate money demand functions in hyperinflations under the constraint of rational expectations (for example, Thomas Sargent and Neil Wallace 1973).

Second, consideration of inflation as a tax, formalized for instance in Martin Bailey (1956), implied a change in emphasis from monetary to fiscal factors as the root cause of hyperinflations—with the complication that in the presence of the Keynes-Tanzi effect (whereby, due to lags in tax collection, higher inflation reduces the real value of government tax revenues), an initially money-driven inflation could generate a growing fiscal deficit in an unstable feedback process.[10]

Third, in a famous article, Sargent (1982) studied the process of ending hyperinflations, emphasizing that a credible change in policies, preferably embedded in legal and institutional changes, could bring a hyperinflation to an end at essentially zero cost. Along similar lines, the notion that higher inflation reduces the normal policy lags meant that there could be scope for heterodox policies, involving for instance temporary wage and price controls, that would make it possible to move from a high inflation to a low-inflation equilibrium very rapidly and at low output cost.

Fourth, and closely related to Sargent's approach, the development of the game-theoretic approach to policy made it possible to analyze the concept of *credibility* (Torsten

[7] It should be noted that, at the time, some analysts also emphasized the role of expectations; see David Laidler and George Stadler (1998).

[8] Of course, the verbal accounts of some of the inter-world war authors contain many of the mechanisms and subtleties developed more formally in the later literature.

[9] In the presence of multiple equilibria, the key question becomes whether "learning" (or any other convergence process) will lead the economy to the "good" (i.e., non-explosive) Laffer curve equilibrium. While, theoretically, learning does not rule out the possibility of convergence to sunspot equilibria (Michael Woodford 1990), experimental evidence suggests that the economy will tend to converge to a low inflationary steady-state (Ramon Marimon and Shyam Sunder 1993). Also, as pointed out by Woodford (1990), there are many different ways—all equally plausible and satisfying some weak criteria for rational decision-making—of specifying a learning process. For the case of linear rational expectations models, Albert Marcet and Thomas Sargent (1995) analyze the speed of convergence in a setting in which agents learn by fitting ARMA models to a subset of state variables. For details on learning and its relation to the rational expectations hypothesis, see the excellent review by George Evans and Seppo Honkapohja (2001).

[10] However, high inflation could actually reduce the fiscal deficit if the real value of government expenditure falls by more than real tax revenues. Eliana Cardoso (1998) points to the so-called Patinkin effect, the converse of the Tanzi effect, which could arise if, for instance, nominal government spending is fixed and its real value reduced by inflation—an equilibrating mechanism that was operative during Brazilian high inflations.

TABLE 2
HYPERINFLATIONS, 1956–96 (CAGAN DEFINITION)[1,2]

Countries	Dates of Episode	During Hyperinflation: Duration (in months)	During Hyperinflation: Cumulative Inflation
Angola[3]	Dec. 94–Jun. 96	19	62,445.9
Argentina	May 89–Mar. 90	11	15,167.0
Bolivia	Apr. 84–Sep. 85	18	97,282.4
Brazil	Dec. 89–Mar. 90	4	692.7
Nicaragua	Jun. 86–Mar. 91	58	11,895,866,143
Congo, Dem. Rep.	Oct. 91–Sep. 92	12	7,689.2
Congo, Dem. Rep.	Nov. 93–Sep. 94	11	69,502.4
Armenia	Oct. 93–Dec. 94	15	34,158.2
Azerbaijan	Dec. 92–Dec. 94	25	41,742.1
Georgia	Sep. 93–Sep. 94	13	76,218.7
Tajikistan	Apr. 93–Dec. 93	9	3,635.7
Tajikistan	Aug. 95–Dec. 95	5	839.2
Turkmenistan	Nov. 95–Jan. 96	3	291.4
Ukraine	Apr. 91–Nov. 94	44	1,864,714.5
Serbia	Feb. 93–Jan. 94	12	156,312,790.0

Sources: IMF, *International Financial Statistics;* national authorities, and IMF staff estimates.
[1] Cagan defines hyperinflation "as beginning in the month the rise in prices exceeds 50 percent and as ending in the month before the monthly rise in prices drops below that amount and stays below for at least a year. The definition does not rule out a rise in prices at a rate below 50 percent per month for the intervening months, and many of these months have rates below that figure."
[2] Excludes the following one- and two-month episodes. In the market economies, Chile (Oct. 1973) and Peru (Sep. 1988, July–Aug. 1990). In the transition economies, Estonia (Jan.–Feb. 1992), Latvia (Jan. 1992), Lithuania

Persson and Guido Tabellini 1990), thus providing analytic content for a concept frequently invoked by central bankers and other policy makers.

In addition to the deepening understanding of hyperinflation, the period since 1956 has also seen the introduction of the important concept of chronic inflation by Felipe Pazos (1972). Pazos emphasized that the inflationary problem in many countries, especially in Latin America, was not so much one of occasional outbursts of hyperinflation followed by stability, but rather that of an ongoing process of double-digit (per annum) inflation, rising occasionally to triple digits.[11]

[11] Marcet and Juan Pablo Nicolini (1998) study a model with learning that can explain sudden outbursts of high inflation in chronic inflation countries. In a similar vein, see Carlos Zarazaga (1993).

Institutional mechanisms created to protect against the effects of inflation make the problem more deep-seated and difficult to deal with. In particular, Pazos emphasized the difficulties for disinflationary policies caused by overlapping, often indexed, wage contracts. Devastating as hyperinflations are when they occur, the problem of moderate or chronic inflation better describes the form in which inflation confronts most countries that have suffered the effects of inflation in the last half-century.

Increasing evidence on the real effects of inflation-stabilization programs in chronic-inflation countries brought to the forefront the possibility that—contrary to conventional wisdom—disinflation may lead to an initial expansion in economic activity—particularly in GDP and consumption—as argued by

TABLE 2 *(Cont.)*

During Hyperinflation Monthly Inflation Rate			Twelve Months After Hyperinflation Monthly Inflation Rate		
Geometric Average	Median	Highest	Geometric Average	Median	Highest
40.3	36.0	84.1	9.5	5.3	38.1
58.0	61.6	196.6	12.0	11.2	27.0
46.6	51.8	182.8	5.7	2.7	33.0
67.8	70.2	80.8	14.8	14.4	21.5
37.8	31.4	261.2	1.8	0.8	20.3
43.8	35.2	114.2	15.9	12.6	40.9
81.3	65.0	250.0	12.9	12.8	26.2
47.6	44.5	437.8	2.4	2.0	7.8
27.3	23.1	64.4	5.2	3.3	27.8
66.6	66.3	211.2	0.4	0.9	13.0
49.5	36.4	176.9	0.1	3.3	6.6
56.5	63.0	78.1	2.9	2.1	19.6
57.6	55.7	62.5	11.2	9.7	25.0
25.0	14.9	285.3	10.9	7.7	28.4
228.2	54.2	175,092.8	1.0	–0.2	12.4

(Jan. 1992), Krygyz Republic (Jan. 1992), and Moldova (Jan.–Feb. 1992). In addition, we also excluded Belarus (April 1991, Jan.–Feb. 1992), Kazakstan (April 1991, Jan. 1992), Russia (April 1991, Jan. 1992), and Uzbekistan (April 1991, Jan.–Feb. 1992) even though by Cagan's definition these episodes lasted more than two months, as they appear related to two price jumps (April 1991, and Jan.–Feb. 1992).
[3] Period after hyperinflation is from July–Dec. 1996.

Miguel Kiguel and Nissan Liviatan (1992) and Carlos Végh (1992). The recession typically associated with disinflation appears to occur later in the programs. Interestingly, the initial expansion appears to be related to the use of the exchange rate as the main nominal anchor. Several types of models have been developed to explain these puzzling stylized facts, which emphasize the role of inflation inertia, lack of credibility, purchases of durable goods, and supply-side effects (see Guillermo Calvo and Végh 1999 for a critical review).

Cagan (1956, p. 25) justified treating hyperinflations separately on the grounds that they permit "relations between monetary factors . . . to . . . be studied . . . in what almost amounts to isolation from the real sector of the economy." In this paper, we follow Cagan's approach of studying inflationary episodes, but rather than confine ourselves to hyperinflations strictly defined—which are quite rare—we examine the still relatively rare episodes of very high inflation, defined as inflations in excess of 100 percent per annum (an exact definition is provided below).

We do this for four main reasons. First, inflations in this range are sufficiently disruptive that in practice virtually no country has been willing to live with them for more than a few years. Second, both popular usage—which often refers to triple digit inflation as hyperinflation—and the literature have tended to treat 100 percent as a distinguishing line between high and extraordinary inflations. Third, in studying episodes of extreme inflation, it is useful to have the extra statistical degrees of freedom offered by the larger sample of countries that have experienced very high inflation, rather than hyperinflations. Fourth, as it turns out, certain simple economic relationships stand out more clearly in high inflations than they do in normal conditions.

We start by characterizing in section 2 the dynamic behavior of inflation in different ranges, first by listing the frequency of inflationary episodes in different ranges, and then by using transition matrices to assess, in particular, whether inflationary dynamics are different at high inflation rates. For the remainder of the paper we concentrate on episodes of *very high inflation*. In our definition (formally stated in section 2), a "very high-inflation episode" takes place when the twelve-month inflation rates rises above 100 percent. Based on this formal definition, we identify 45 such episodes in 25 countries. In section 3, we proceed to examine several mechanisms that are basic to the analysis of inflation such as the relationship between money growth and inflation on the one hand and among fiscal deficits, seigniorage, and inflation on the other. We also examine the causal relation among money, inflation, and exchange rates, as well as the concept of inflation inertia. In section 4, we shift gears and focus on (i) the behavior of macroeconomic variables during high-inflation periods compared with low-inflation periods and (ii) the real effects of disinflation. Section 5 concludes by summarizing the results and, in the process, identifying ten key stylized facts associated with very high inflation.

2. *Characteristics of High Inflation*

2.1 *Inflationary Episodes and Dynamics*

Table 3a presents data for 133 market economies on the frequency of inflationary episodes for specified ranges of the inflation rate in the period 1960–96 (or, if data were not available, the longest available subsample). An inflationary episode is defined as taking place when the twelve-month inflation rate rises above the lower bound of the specified range. In that case, we take the start of the episode to be the first month of that twelve-month period, and the last month to be the first month before the twelve-month inflation rate falls below the lower bound and stays there for at least twelve months.[12] For example, take the 100-percent threshold, and imagine a country whose twelve-month inflation rate is above 100 percent only in, say, June 1970. Then, under our definition, this country experienced a 100-percent inflationary episode from July 1969 to June 1970. Notice that, under this definition, the minimum duration of an episode is twelve months.

Although a variety of adjectives have been used to categorize inflationary episodes, for instance moderate, high, extreme, and hyper- (Rudiger Dornbusch and Fischer 1993), there is as yet no agreed convention.[13] Seen in international perspective, the ranges in the table can be regarded as "moderate to high" (for the 25–50 percent range), and "high" (for the 50–100 percent range), with the remaining categories constituting at the least "very high" inflation rates—although 25 percent per annum would not be regarded as moderate in many countries.

Table 3a tells us that most countries, most of the time, experience inflation of less than 25 percent per annum.[14] However, over two-thirds (92) of the countries in the sample experienced an episode of more than 25-percent per-annum inflation. Over half (49) of those countries in turn suffered from an episode in excess of 50 percent per annum, while 25

[12] Although our definition is modeled on that of Cagan (1956) in his classic article, it differs in one important respect from his: namely, Cagan based his definition on *monthly* rates of inflation whereas ours is based on twelve-month inflation rates.

[13] The ranges used in this paper draw largely from previous work. One way to proceed would be to look for breaks in the transition probabilities. If any were found, this would suggest that inflation behaves differently in different ranges. We follow this approach only in examining some results of Michael Bruno and William Easterly (1995) discussed later in this section.

[14] The total number of country-months in the sample included in table 3a is 44,910. For 80.1 percent of those months, the monthly inflation rate is less than 1.9 percent (corresponding to an annual rate of 25 percent).

TABLE 3A
MARKET ECONOMIES: FREQUENCY OF EPISODES BY LEVEL OF INFLATION, 1960–96[1]
(monthly data)

Range of Annualized Inflation[2]	Number of Episodes[3]	Number of Countries	Duration (in months)		
			Average	Minimum	Maximum
25 and above	212	92	41.0	12	313
50 and above	87	49	43.4	12	216
100 and above	45	25	40.0	12	208
200 and above	17	13	47.2	15	106
400 and above	13	11	43.9	17	98

TABLE 3B
FREQUENCY OF EPISODES BY LEVEL OF INFLATION, 1987–96[1]
(monthly data)

Range of Annualized Inflation[2]	Number of Episodes[3]	Number of Countries	Duration (in months)		
			Average	Minimum	Maximum
25 and above	30	28	56.5	16	104
50 and above	25	25	53.0	14	103
100 and above	25	23	45.9	12	100
200 and above	24	22	40.6	13	59
400 and above	20	19	39.7	13	59

Sources: IMF, *International Financial Statistics,* national authorities, and IMF desk economists.
[1] The starting period for market economies (133 in total) was determined by data availability, while for transition economies (28 in total) by the period in which prices were freed on a large scale.
[2] 25% per annum = 1.9% per month; 50% per annum = 3.4% per month; 100% per annum = 5.9% per month; 200% per annum = 9.6% per month; 400% per annum = 14.4% per month.
[3] See text for definition of an inflationary episode.

experienced an inflationary episode of more than 100 percent and eleven countries suffered from at least one episode of more than 400-percent per-annum inflation. The average duration of the inflationary episodes is remarkably similar—and, at three–four years, surprisingly long—while the maximum duration declines as the inflation rate rises. Only one country (Argentina) that experienced an inflationary episode in excess of 400 percent per annum repeated the experience.

Data on inflationary episodes in 28 transition economies are presented in table 3b. All of these economies experienced an episode of inflation of more than 25 percent; indeed most of them (19 out of 28) suffered from an inflationary episode in excess of 400 percent per annum. Most of the extreme inflations in these countries were at the start of the transition process when, in light of large monetary overhangs, the price level jumped in response to price liberalization. For this group of countries, over the period since prices were freed,[15] monthly inflation was generally

[15] The starting dates selected depend on when prices were freed and on data availability. Thus, they tend to vary across the transition economies, being 1991 for most of Eastern Europe and Mongolia, 1992 for the former Soviet Union, 1988 for Poland, 1990 for the former Yugoslavian states and Vietnam, 1986 for China, and 1976 for Hungary.

TABLE 4
MARKET ECONOMIES: TRANSITION MATRIX[1]

Range of Inflation	Year T + 1						Probability		Number of Observations
	< 25	25–50	50–100	100–200	200–400	> 400	Will Rise	Will Fall	
Year T									
< 25	95.4	4.1	0.4	0.1	0.0	0.0	4.6	0.0	3343
25–50	46.5	38.4	13.3	1.4	0.4	0.0	15.1	46.5	279
50–100	10.6	23.0	47.5	14.8	1.6	2.5	18.9	33.6	122
100–200	10.1	11.9	18.6	42.4	15.3	1.7	17.0	40.6	59
200–400	11.7	5.9	5.9	11.8	17.6	47.1	47.1	35.3	17
> 400	2.7	0.0	8.1	13.5	8.1	67.6	0.0	32.4	37
Total									3857

Source: IMF, *International Financial Statistics.*
[1] Calculated as number of observations in year T + 1 in the corresponding column range as a percentage of numbers of observations in the corresponding row range in year T. (Rows add up to 100.) Based on pooled, cross-section annual data 1960–96, from 133 countries.

above 25 percent per annum,[16] although inflation in most of them is now into the low double- or even single-digit annual rates.

In table 4, we present related (to table 3a) information on the statistical properties of inflation in the market economies, in the form of a transition matrix. Categorized by the inflation rate in year T (rows), these matrices show the frequencies with which the inflation rate in the subsequent year ($T + 1$) is in different ranges.[17] For instance, if the inflation rate in year T is in the range of 25–50 percent, the probability that it will be less than 25 percent in the following year is 46.5 percent (corresponding to the entry in the second row, first column).

Three features of table 4 are noteworthy. First, when the inflation rate is less than 25 percent, it is very likely (95.4 percent probability) to be in that range in the following year. In contrast, for all higher inflation ranges (excluding the last range which has no upper bound), the probability that inflation will stay in its current range is less than 50 percent.[18] Second, consider the columns labeled “Probability will rise” and “Probability will fall.” The probability that inflation will rise to a higher range increases from 4.6 percent in the lowest range to 47.1 percent in the next-to-last range.[19] This captures the idea that higher inflation is more explosive. Third, until inflation reaches the 200-percent level, it is still more likely to fall than rise.

Finally, combining table 2 with information in table 3a, we see that of the eleven market economies that experienced episodes of inflation of more than 400 percent,[20] more than half (six) also had a hyperinflation as defined by Cagan. This certainly suggests that extreme inflations carry with them a high danger of hyperinflation.

[16] Of a total sample of 2,023 monthly inflation rates, only 37 percent were below 1.9 percent.

[17] We have also calculated a transition matrix for the corresponding monthly rates of inflation. For all but the 200–400 percent per-annum range, the probability of inflation remaining in a given range is smaller with monthly than with annual data. Further, the probability that the inflation rate will fall is uniformly higher for the monthly than the annual data. These results are due mainly to the greater variability in monthly inflation rates compared to annual rates.

[18] In discussing tables 4 and 5, we refer to frequencies and probabilities interchangeably.

[19] However, there are relatively few observations in the higher inflation ranges.

[20] The eleven countries are Angola, Argentina, Bolivia, Brazil, Chile, Democratic Republic of Congo, Israel, Lebanon, Nicaragua, Peru, and Suriname.

2.2 *Very High Inflations*

In the remainder of this paper, most of our attention will focus on episodes of very high inflation as defined in section 2. This definition does not require the monthly inflation rate to be within the range every month, nor does it imply that the average inflation rate within an episode necessarily exceeds 100 percent per annum.[21]

Detailed data on the 45 episodes of very high inflation in 25 countries are presented in table A1 (in the appendix). Twelve of the countries (eighteen episodes) are in South America or the Caribbean (Argentina, Bolivia, Brazil, Chile, Costa Rica, Jamaica, Mexico, Nicaragua, Peru, Suriname, Uruguay, and Venezuela), nine countries (nineteen episodes) are in Africa (Angola, Democratic Republic of the Congo, Ghana, Guinea-Bissau, Sierra Leone, Somalia, Sudan, Uganda, and Zambia) with Afghanistan (two episodes), Israel (one episode), Lebanon (three episodes) and Turkey (two episodes) completing the list. The longest episodes were in Argentina (over seventeen years) and Brazil (over fifteen years); the Democratic Republic of the Congo (formerly Zaire) suffered from six episodes totaling fifteen years. The surprise in these data is the number of very high-inflation episodes in African countries, whose inflationary experience has been studied much less than that of many other countries in the group, particularly a number of Latin American countries and Israel.[22]

Bruno and Easterly (1995) present data suggesting that 40 percent per annum is a critical inflation threshold, above which the probability of inflation rising to 100 percent per annum becomes much larger. Table 5, which uses more finely defined inflation ranges than table 4, shows that the probability of annual inflation rising increases as the inflation rate rises toward 100 percent. These data confirm the impression that inflation tends to become more unstable as it rises. Even so, there is no inflation range in table 5 for which inflation is more likely to rise than fall. Nor does there seem to be a significant discontinuity at 40-percent inflation.

Tables 2 through 5 present useful characterizations of different aspects of the inflationary process, with an emphasis on high inflations. In summary, most of the time, in most countries, inflation is low, and low inflation is stable. However, since 1960, most countries have suffered from at least one episode of inflation of more than 25 percent per annum, and as many as 25 (out of 133) market economies have experienced an episode of very high inflation (i.e., twelve-month inflation above 100 percent). Further, the data suggest that inflation is more likely to increase the higher it is or, equivalently, that higher inflation is relatively more unstable than lower inflation.

3. *Inflationary Mechanisms*

Having documented the dynamic behavior of inflation, the natural next step is to try to determine what are the key macroeconomic variables that underlie inflationary processes.[23] To that effect, this section first revisits and confirms a basic tenet of monetary economics: in the long run, money growth and inflation are highly correlated. In this (admittedly narrow) sense, therefore, "inflation is always and everywhere a monetary phenomenon," as famously argued by Milton Friedman (1963). While a useful starting point, the high correlation between money growth and inflation actually raises more questions than it answers. The first question is causation: does money cause inflation? Or is there reverse

[21] This is because of the end-point requirement in the definition; namely, that the twelve-month rate stay below 100 percent for at least twelve months for an episode to end. It can be seen from table A1 that in thirteen of the 45 episodes, the (geometric) average inflation rate within an episode is less than 100 percent per annum. Note also that the end of two episodes (in Congo and Venezuela) is dictated by the end of the sample period (December 1996).

[22] See Carmen Reinhart and Kenneth Rogoff (2002) for a recent analysis of high inflation in Africa.

[23] From this point onwards—and since we will be mostly looking at long-run relationships—we will restrict our attention to market economies.

TABLE 5
MARKET ECONOMIES: PROBABILITY OF INFLATION BEING ABOVE 100 PERCENT NEXT YEAR DEPENDING ON INFLATION IN THE CURRENT YEAR[1]

Range of Inflation	Probability that Inflation Next Year			Number of Observations
	Will Be Above 100 Percent	Will Rise	Will Fall	
Current Year				
< 20	0.1	6.0	0.0	3171
20–40	1.0	12.6	41.8	388
40–60	7.5	25.2	41.1	107
60–80	15.7	29.4	41.2	51
80–100	37.0	37.0	48.1	27
> 100	71.7	0.0	28.3	113
Total				3857

Source: IMF, *International Financial Statistics.*
[1] Calculated as number of observations in a given range followed by observations in the 100% and above range, next range, and range below, respectively, as percentage of observations in the initial range (pooled, cross-section annual data 1960–96, from 133 countries).

causation from inflation to money/exchange rate? Our basic finding is that, more often than not, causation (in the Granger sense) runs from exchange-rate changes and inflation to money growth. We interpret this result, however, as saying that once inflation has been triggered, monetary policy has typically been accommodative, thus allowing inflation to be driven by temporary shocks and by its own dynamics (i.e., inflation persistence). This leads to the next question: what triggers inflation to begin with? The standard explanation is fiscal imbalances. By and large, we find that fiscal deficits indeed explain high inflation using standard regression techniques. Finally, we tackle the issue of inflation persistence by providing two definitions based on autoregressive processes, which allow us to quantify persistence and examine how it varies with the level of inflation.

3.1 *Data and Methodology*

Since several of the econometric exercises in this section rely on a common data set and regression techniques, we first describe the sample and the common methodology behind them. We used as large a sample as possible with regard to both the number of countries and the time period covered. However, both the quality and availability of data on several macroeconomic variables varied widely across countries. To maintain consistency across all the panel regressions that were run and to maximize the number of countries included in the sample, we imposed the condition that a country be included in the sample only if there were at least ten annual observations during the 1960–95 period for each of the five variables—inflation, reserve money, broad money (including foreign currency deposits), fiscal balance, and nominal GDP—that were needed for running the regressions. Consequently, 94 countries were selected (all market economies), each with at least ten annual observations.

For each type of regression reported below, we allowed for different coefficients for high- and low-inflation countries, where the high-inflation countries were the 24 in this sample that experienced at least one episode of very high inflation (as described in the previous section).[24] In the panel regressions, we also allowed for lags of the independent variables to affect the dependent variable of

[24] The only high-inflation country not included (due to lack of data) is Afghanistan.

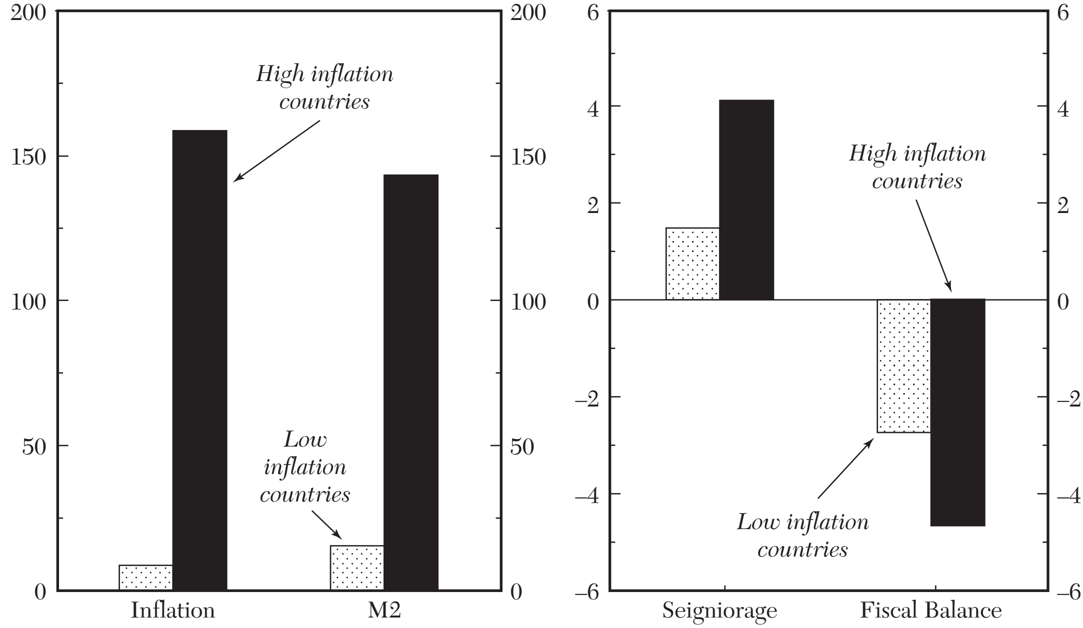

Figure 1. Inflation, Money Growth, Seigniorage, and Fiscal Balance[1]

[1] High-inflation countries as defined in text. Each bar is calculated by taking the average for all countries in that group for each year, and then averaged over all the years. 94 countries in total, each with ten or more observations.

interest. In addition, subsamples that included only the high-inflation countries were tested to see whether the coefficients during their high-inflation episodes differed from their low-inflation episodes. In all panel regressions we allowed for country and period-specific effects.

To set the stage, figure 1 shows the averages of inflation, money growth (M2), seigniorage (as percent of GDP), and fiscal balance (as percent of GDP) for high-inflation countries (24 countries) and low-inflation countries (70 countries). As is evident from figure 1, high-inflation countries also exhibit high levels of money growth, seigniorage, and fiscal deficit. The remainder of this section will formally examine these relationships.

3.2 *Money and Inflation*

Figure 2 and table 6 show the cross-sectional (long-run) relationship between inflation and money growth, with each observation representing the simple average over the sample period of the inflation and the money growth rates, each defined as $ln(1 + x/100)$ where x is the corresponding annual rate. As shown, the relationship between money growth and inflation is extremely strong and close to one-to-one.[25] The regression coefficient is in fact 1.115 and highly significant (table 6, column 1). Furthermore, the relationship holds even when the sample is broken up into high- and low-inflation countries (table 6, column 2). In the long run, therefore, the data show a very strong relationship between money growth and inflation.

Does the money-inflation link remain valid in the short run? To answer this question, we ran a panel regression with annual data in which, in addition to allowing for different coefficients on money growth in the low- and high-inflation countries, we also allow for two lags of money growth. We then

[25] The outlier in figure 1 is Nicaragua (the furthermost from the regression line).

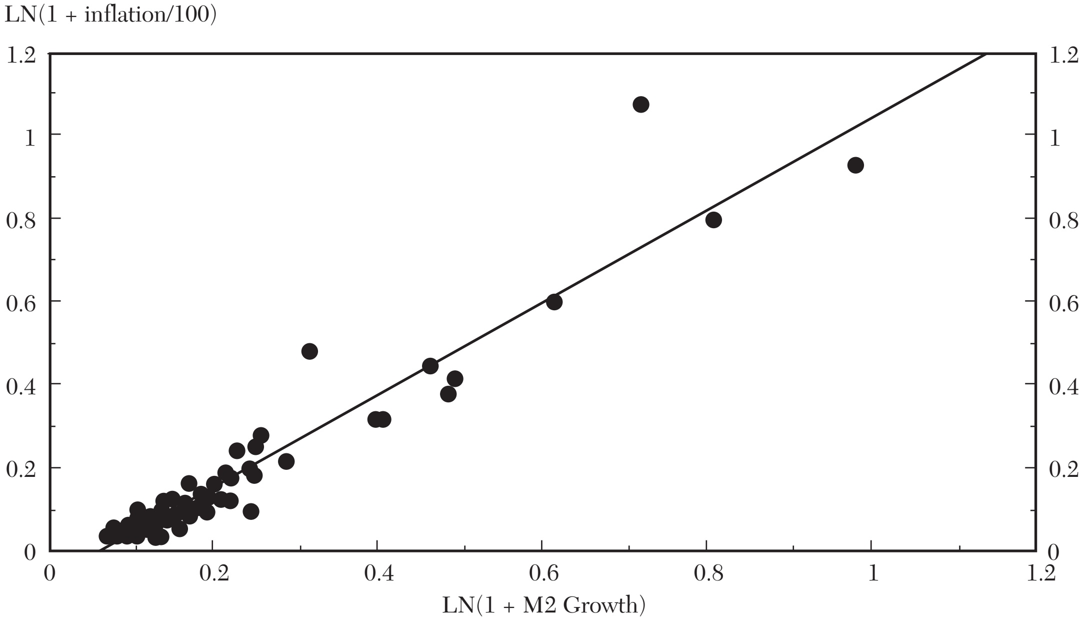

Figure 2. Inflation and Money (M2) Growth[1]
1960–95 averages

[1] Slope of regression line is 1.115 with a t-statistic of 12.13; 94 countries in total, each with 10 or more observations.

take a subsample that includes only high-inflation countries and test for different coefficients on high- and low-inflation episodes.

We find that while the relationship between money and inflation remains highly significant (table 6, columns 4 and 5) for both groups of countries, the coefficient for low-inflation countries is much lower, a result that is perhaps not surprising given that we are looking at a short-run relationship and the fact that GDP growth is not taken into account in the regressions. When two lags on money growth are included in the panel regression (table 6, column 5), the coefficients on both contemporaneous and lagged money growth are significant and different across high- and low-inflation countries. The contrast between high- and low-inflation countries in the speed with which the effects of money growth are transmitted is quite dramatic: the bulk of the inflationary effects of money growth occurs remarkably early in the high-inflation countries; in contrast, in low-inflation countries the effects are distributed evenly across the current and previous periods. In the panel subsample with only high-inflation countries (table 6, columns 6 and 7), the previous results of a strong effect of money growth on inflation carry through. We also find a differential effect during high- and low-inflation episodes within high-inflation countries, which is likely to be due to (i) GDP growth being more important relative to the inflation rate during low-inflation years, and (ii) the negative impact of high inflation on the demand for money.[26] In line with our previous findings, adding lags shows that the bulk of the effects takes place contemporaneously (table 6, column 6).

In sum, the data show that the inflation-money growth link is exceptionally strong, both in the long and short run. While the relationship may not necessarily be instantaneous nor precisely one-for-one, there can

[26] We could not reject the OLS model in favor of a fixed-effects one, indicating the overwhelming effect of money growth on inflation that is common across the high-inflation countries.

TABLE 6
INFLATION AND MONEY GROWTH
DEPENDENT VARIABLE: INFLATION RATE[1,2] (T-STATISTICS IN PARENTHESES)

Independent Variables	Cross-Section		Annual Panel			Annual Panel High Inflation Countries	
	OLS (1)	OLS (2)	OLS (3)	Fixed[4] (4)	Fixed[4] (5)	OLS[6] (6)	Fixed[4,7] (7)
Intercept	–0.069***		–0.047***				
	(–4.96)		(–8.19)				
Intercept/hi[3]		–0.041				0.100**	
		(–0.87)				(2.10)	
Intercept/low[3]		– 0.028***				0.059***	
		(–3.13)				(4.26)	
M2[1]	1.115***		0.972***				
	(12.13)		(30.64)				
M2/hi[1,3]		1.091***		1.011***	0.886***	0.978***	0.881***
		(8.160)		(109.70)	(74.75)	(21.86)	(17.30)
M2/low[1,3]		0.804***		0.219***	0.165***	0.513***	0.421***
		(11.92)		(7.50)	(5.57)	(9.97)	(6.37)
M2/hi(–1)[1,3,5]					0.242***		0.228**
					(16.33)		(3.89)
M2/low(–1)[1,3,5]					0.190***		0.152***
					(6.40)		(2.57)
M2/hi(–2)[1,3,5]					–0.078***		–0.085
					(–6.54)		(–1.17)
M2/low(–2)[1,3,5]					0.111***		–0.022)
					(3.78)		(–0.98)
R-squared	0.917	0.925	0.855	0.902	0.922	0.919	0.937
Adj. R-squared	0.916	0.923	0.855	0.897	0.917	0.918	0.933
Observations	94	94	2318	2318	2130	410	380

Sources: IMF, *International Financial Statistics;* authors' estimations.
Note: Significance at the 10-, 5-, and 1-percent level is indicated by one, two, and three stars, respectively.
[1] Inflation rate if defined as ln(1 + inflation/100), money growth as ln(1 + M2 growth). Minimum of 10 observations per country.
[2] All results corrected for heteroskedasticity if it existed.
[3] Hi and low refer to coefficients for high- and low-inflation countries or high- and low-inflation episodes.
[4] Fixed refers to a fixed-effects model with both country and time dummies, both of which are significant unless otherwise indicated.
[5] The number in parentheses next to the independent variables refers to the number of lags.
[6] Fixed effects model of this regression was not significant.
[7] Time dummies not significant.

be no doubt that inflation can be ended if the monetary taps are turned off.[27,28] In this sense, therefore, our evidence overwhelmingly confirms what every schoolchild knows: inflation is always and everywhere a monetary phenomenon. This, however, is only the beginning of wisdom.

[27] We are aware that in talking about causation we have taken a step that goes beyond the inflation-money growth correlations. But it is a short step, since money growth is always potentially controllable—if necessary with a change in monetary operating practices.

[28] Naturally, for the government to be able to turn off the monetary taps permanently, the underlying fiscal problems must be addressed. Otherwise, low inflation will only be purchased at the cost of future high inflation (i.e., Sargent and Wallace's 1981 celebrated unpleasant monetarist arithmetic).

3.3 *Money, Exchange Rates, and Inflation*

With the money-inflation link established, there remains the question: What drives money growth? The question is relevant because high inflations are not popular, and it is reasonable to believe that it is rare for governments to take a deliberate policy decision to have a high inflation—even if a set or sequence of policy decisions produces a high inflation.[29] The usual answer to the question of what drives money growth is fiscal deficits: in this view, inflation is a fiscal phenomenon. We shall turn to this view shortly.

An alternative answer to what drives money growth is that rapid money growth, and hence high inflation, is the unintended consequence of inappropriate monetary policies, for instance policies directed at producing real outcomes that are inconsistent with the real equilibrium of the economy, be it for unemployment, the real exchange rate, real wages, or the real interest rate.[30] For instance, as noted in the introduction, there was an active controversy during and after the German hyperinflation over whether inflation was caused by money growth or the balance of payments. The latter view can be made consistent with the evidence that inflation is a monetary phenomenon by thinking of monetary policy as seeking to maintain a constant real exchange rate in circumstances where the nominal exchange rate is being moved by exogenous forces (e.g., speculation, access to external loans, terms of trade shocks, reparation payments, and so forth).

An examination of the short-run dynamics of money, inflation, and the exchange rate should shed light on the issue of whether monetary policy reacts to or leads inflation and the exchange rate. To try to disentangle the dynamic relationships—in particular to see whether money growth leads or lags inflation—we conducted Granger-causality tests by running vector autoregressions (VARs) in a three-variable system containing the inflation rate, nominal exchange rate (percentage change), and money growth. The results are based on data from only eight of the 24 market economies. The data consisted of quarterly series for the longest sample period for which data were available for each country (see table 7 for details).[31] An analysis of the remaining seventeen very high-inflation countries was not conducted because of large gaps in the availability of time-series data.

For each country, we first ran an unrestricted VAR. We then ran a series of restricted VARs by excluding each variable, one at a time, from the equations for the other two variables (still in the three-variable system) and conducted chi-squared tests to see whether the exclusion of these variables is rejected. Table 7 presents the results of the three-way Granger causality tests. Seasonal dummies were used only if they were jointly significant at the 5-percent level in the unrestricted VAR regression. The most appropriate lag length was chosen on the basis of statistical significance.[32]

The last three columns in table 7 report whether a chi-squared test rejects the exclusion of the variable of interest from the VAR regressions at the 5-percent level (two stars), the 10-percent level (one star), or does not reject the exclusion (a dash). For example, in the case of Argentina, the results indicate that exchange-rate movements Granger-cause money growth and inflation, while inflation and money growth do not Granger-cause each other or changes in the exchange rate. The overall picture that emerges is that

[29] It is sometimes argued that the Soviet inflation of the early-1920s was a deliberate act of policy; it has also been argued that the German hyperinflation was an attempt to demonstrate that reparations could not be paid.

[30] This is the so-called "shocks and accommodation" view of monetary policy in chronic inflation countries; see, among others, Charles Adams and Daniel Gros (1986), Bruno and Fischer (1986), Bruno and R. Melnick (1994), and Calvo, Reinhart, and Végh (1995).

[31] The sample period is not confined to very high-inflation episodes.

[32] We also ran the VARs imposing a uniform three-quarter lag length. The results on the statistical significance of the exclusion restrictions were unchanged, except in the case of Somalia.

TABLE 7
VAR-BASED GRANGER CAUSALITY TESTS IN SELECTED HIGH-INFLATION COUNTRIES

Country	Years and Quarters	Annualized Average Inflation	Seasonal Dummies[1]	Appropriate Lag Length (in quarters)[2]	Money Growth[3]	Inflation[3]	Exchange Rate Change[3]
Argentina	1967:1–1991:1	191.8	No	1	—	—	°°
Ghana	1966:1–1996:4	32.6	Yes	3	°	°°	°
Jamaica	1970:3–1996:4	20.7	Yes	1	—	—	°°
Peru	1967:1–1996:4	99.1	Yes	5	°°	°°	°°
Somalia	1967:1–1989:3	26.2	Yes	2	—	°°	—
Sudan	1966:1–1994:2	32.6	Yes	3	°°	°°	°°
Turkey	1970:1–1996:4	46.0	Yes	1	°°	—	—
Uruguay	1967:1–1996:4	59.3	Yes	2	—	°°	°°

Sources: International Finance Statistics, International Monetary Fund; and authors' calculations.
[1] Seasonal dummies were used in the VAR regressions when they were jointly significant at the 5-percent level.
[2] Lag length determined by the one that was most significant.
[3] °° = significant at 5-percent level.
° = significant at 10-percent level.
— = not significant at 5-percent or 10-percent levels.

Granger causality appears to run more often from exchange-rate changes or inflation to money growth than vice versa.[33]

These regression results should not be interpreted as implying that, in some circumstances, inflation is not caused by money growth, or that inflation could not be stopped if monetary policy changed and money growth was reduced to a very low level.[34] One explanation for the creation and persistence of very high inflation which we find plausible is that inflation initially emerges as an undesired result of other policy decisions (the obvious candidate being fiscal imbalances), and continues because policymakers often tend to accommodate shocks (the shocks-and-accommodation view mentioned above)—thus allowing inflation to be driven by exogenous shocks and its own dynamics—and/or are reluctant to incur the costs needed to get rid of chronic inflation. There may be several reasons for such reluctance. First, once the public expects high inflation to continue, it may become too costly for the government not to validate the public's expectations (see, for instance, Calvo 1988a). Second, even if the mechanisms were found to credibly commit to low inflation, political battles over the distribution of the required fiscal adjustment may lead to a period of inaction that will erode the political support to proceed further (Alberto Alesina and Allan Drazen 1991). As a result, things often need to get worse (in the form of outbursts of extremely high inflation as in Argentina and Brazil in the late 1980s) before they get better (Drazen and Vittorio Grilli 1993).

3.4 *Fiscal Deficits, Inflation, and Seigniorage*

As mentioned above, the most commonly held view about the ultimate origins of

[33] Our results are thus broadly consistent with the conclusions of Montiel (1989) and Dornbusch, Federico Sturzenegger, and Holger Wolf (1990). They are also consistent with earlier analysis of the classical hyperinflations by Frenkel (1977, 1979) and Sargent and Wallace (1973). In particular, Sargent and Wallace (1973) conclude, based on Cagan's seven hyperinflations, that the causality from inflation to money is typically stronger than from money to inflation. (See also Beatrix Paal 2000.)

[34] In fact, as shown by Sargent and Wallace (1973), causality from inflation to money is entirely consistent with a model in which inflation is driven by the need to finance a fixed real amount of government spending. In such a model, the "causality" from inflation to money growth emerges because the public's expected rate of inflation influences future money growth through the government budget constraint.

inflation is that it results from fiscal imbalances. But does the data bear this out? To answer this question, we turn to an empirical analysis of the relationship between fiscal deficits, seigniorage, and inflation. These links derive from the flow fiscal identity:

$$\textit{fiscal deficit} = \textit{seigniorage} + \textit{borrowing} \quad (1)$$

with the inflation-deficit link emerging from the link between seigniorage and inflation. In addition, there is an associated intertemporal fiscal constraint which requires that the present discounted value of primary deficits (i.e., deficits net of interest payments) plus the government's initial debt be equal to the present discounted value of seigniorage.[35] As a result of the restrictions imposed by this intertemporal constraint, there may be complicated dynamic relationships among the terms within the fiscal budget identity (1). For instance, for a given present discounted value of primary deficits, less use of seigniorage today will necessarily require the use of more seigniorage tomorrow, as shown by Sargent and Wallace's (1981) monetarist arithmetic.[36]

Fiscal Deficits and Seigniorage. We start by exploring the relationship between seigniorage and fiscal deficits. Even though in the short run, higher fiscal deficits may be financed by borrowing, the intertemporal budget constraint and optimal tax arguments suggest a positive association between seigniorage (as a financing source) and the deficit. Hence, we expect a negative relationship between seigniorage and the fiscal balance (which is the variable used in the econometric analysis).[37]

Figure 3 shows the cross-sectional relationship between seigniorage and the fiscal balance, each expressed as a share of GDP, for 94 market economies. Seigniorage was computed as the increase in the nominal stock of high-powered money in a given year, divided by nominal GDP in that year. A negative relationship is visible (figure 3 and table 8, column 1): a ten-percentage-point reduction in the fiscal balance leads on average to a 1.5-percent increase in seigniorage revenues (both as a share of GDP), with the highest levels of seigniorage (more than six percent of GDP) recorded for Israel, Chile, Argentina, Malta, and Nicaragua.

When panel regressions with annual data are run, the coefficient on the fiscal balance becomes even more significant but remains unchanged quantitatively as compared to the results obtained in the cross-section regressions (compare columns 1 and 2, table 8). When different coefficients are allowed for the high- and low-inflation countries (table 8, column 3), the coefficient for high-inflation countries rises sharply while that for the low-inflation countries falls and becomes insignificant. The difference between the coefficients of the high- and low-inflation countries is statistically significant. A ten-percentage-point reduction in the fiscal balance in the high-inflation countries leads, on average, to a 4.2-percentage-point increase in seigniorage (both as a share of GDP). Allowing for separate coefficients (and constant terms) raises the adjusted R-squared from 0.048 to 0.334 (table 8, column 3).

When panel regressions for the subsample of high-inflation economies are run, the simple OLS yields, as expected, a much higher coefficient than that obtained for all market economies (compare column 4 to column 2, table 8). The largest effects of the fiscal balance on seigniorage revenues are obtained during the high-inflation periods: a ten-percentage-point reduction in the fiscal balance leads to a 6.27-percentage-point increase in seigniorage revenues, both as a share of GDP (table 8, column 5). On the other hand,

[35] Naturally, this formulation presupposes that the fiscal authority is solvent in an intertemporal sense.

[36] In a similar vein, Drazen and Elhanan Helpman (1990) show how the anticipation of future policies may trigger inflation today.

[37] The public finance perspective that treats seigniorage as another form of taxation may suggest that seigniorage revenue should be more closely associated with the level of government spending rather than with the deficit (see, for example, Végh 1989).

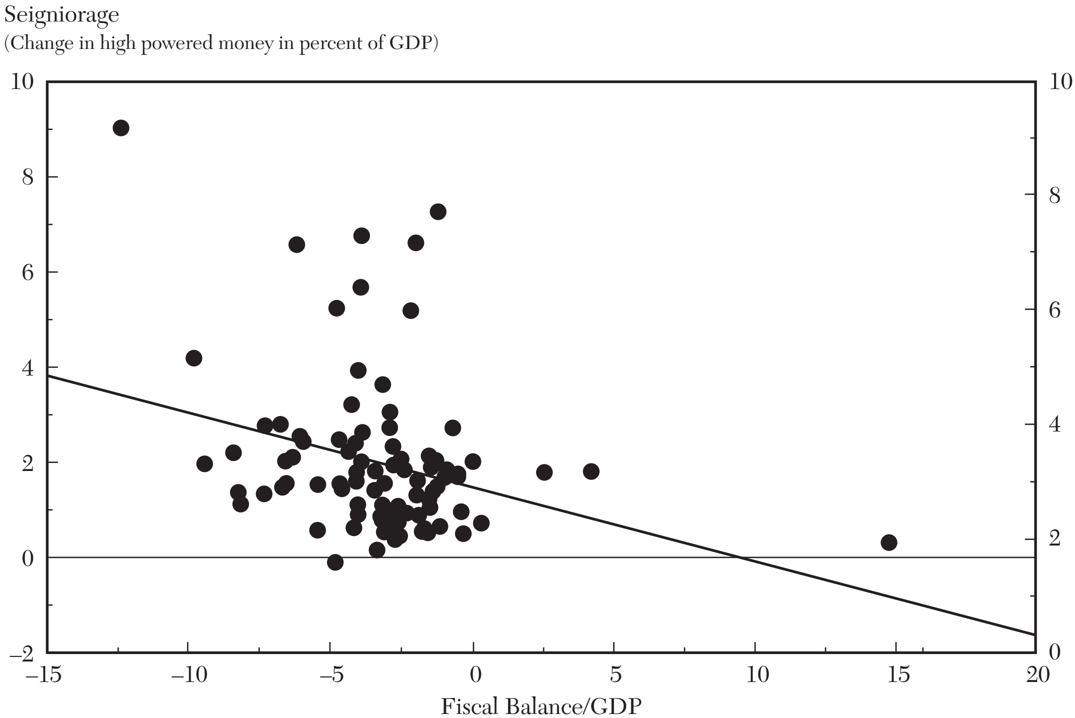

Figure 3. Seigniorage and Fiscal Balance[1]
1960–95 averages

[1] Slope of regression line is –0.152 with a t-statistic of –2.30; 94 countries in total, each with 10 or more observations.

the effect of the fiscal balance on seigniorage revenues during the low-inflation years is small and statistically insignificant.

The data thus show that the relationship between the fiscal deficit and seigniorage is strong only in the high-inflation countries. Moreover, even in these countries, the fiscal deficit-seigniorage relationship is strengthened during periods of high inflation compared to low-inflation years.

Inflation and Seigniorage. Even though in the high-inflation countries seigniorage rises as a share of GDP as the deficit increases, the relationship between inflation and seigniorage is likely to be more complicated because seigniorage revenues may eventually decline as inflation rises; that is, there may be a Laffer curve effect as inflation continues to rise. The reason for the fall in seigniorage revenue at high rates of inflation is that the tax base—real money balances—may fall more, in proportional terms, than the growth rate of the money base, thus leading to a fall in seigniorage.[38]

Working with the same samples as those used for seigniorage and fiscal deficits, we estimate a nonlinear relationship between seigniorage and inflation of the following form:

$$\textit{Seigniorage} = \alpha + \beta\, \textit{inflation} + \gamma\, (\textit{inflation})^2,$$

where we expect β to be positive and γ to be negative, that is, seigniorage revenues rise as inflation rises, reaching a maximum and then declining with further increases in the inflation rate. The cross-sectional plot is presented in figure 4 (table 9, column 2), which

[38] The Laffer curve shape emerges from the steady state relationship between the inflation rate and seigniorage. If, for instance, expectations lag behind actual inflation, it may be possible for a time to increase seigniorage by accelerating inflation even beyond the steady state revenue maximizing rate.

TABLE 8
SEIGNIORAGE AND FISCAL BALANCE
DEPENDENT VARIABLE: SEIGNIORAGE[1,2] (T-STATISTICS IN PARENTHESES)

Independent Variables	Cross-Section	Annual Panel		Annual Panel High Inflation Countries	
	OLS (1)	OLS (2)	Fixed[4] (3)	OLS (4)	Fixed[4] (5)
Intercept	1.455***	1.626***		2.77***	
	(6.48)	(17.27)		(8.13)	
Fiscal[1]	−0.152**	−0.152***		−0.376***	
	(−2.30)	(−5.33)		(−4.72)	
Fiscal/hi[1,3]			−0.420***		−0.627***
			(−14.52)		(−5.84)
Fiscal/low[1,3]			0.007		−0.041
			(0.36)		(−0.52)
R-squared	0.085	0.048	0.371	0.137	0.416
Adj. R-squared	0.075	0.048	0.334	0.135	0.392
Observations	94	2318	2318	410	410

Sources: IMF, *International Financial Statistics;* authors' estimations.
Note: Significance at the 10-, 5-, and 1-percent level is indicated by one, two, and three stars, respectively.
[1] Seigniorage is defined as [RM-RM(−1)]/GDP, where RM is reserve money in current period, RM(−1) is reserve money in last period and GDP is output in current period, and fiscal is defined as the fiscal balance in percent of GDP.
[2] All results corrected for heteroskedasticity if it existed.
[3] Hi and low refer to coefficients for high- and low-inflation countries or high- and low-inflation episodes.
[4] Fixed refers to a fixed-effects model with both country and time dummies, both of which are significant.

shows the estimated nonlinear relationship.[39] Seigniorage revenues are maximized when inflation reaches 174 percent.

The main message to emerge from table 9 is that a Laffer curve is visible and significant in high-inflation countries (table 9, column 4) and in high-inflation episodes for the subsample with the high-inflation countries only (table 9, column 6). These findings are consistent with the notion that a Laffer curve is more likely to emerge the higher is the level of inflation.

In terms of the linear regressions, table 9 indicates that, as expected, the coefficient on the inflation rate is significant for both high- and low-inflation countries (table 9, column 3) and for both high- and low-inflation episodes for the subsample of high-inflation countries (table 9, column 5).

[39] As before, the inflation rate is defined as $ln(1 + inflation/100)$ and seigniorage as the change in high-powered money as a share of GDP.

Fiscal Deficits and Inflation. Figure 5 shows the deficit-inflation link for the whole sample. As shown in table 10, column 1, the relationship is significant in the cross-section regression. This relationship, however, becomes insignificant when different constant terms and coefficients are allowed for in the high- and low-inflation market economies (table 10, column 2).

When annual panels are considered, the relationship between the fiscal balance and inflation becomes significant for the high-inflation countries but does not for the low-inflation countries (table 10, column 3). A reduction in the fiscal balance by 1 percent of GDP in the high-inflation countries leads to an increase in the inflation rate by 4.2 percent. The introduction of lags (table 10, column 4) improves the fit substantially, with all the lags being significant for high-inflation countries but not low-inflation countries.

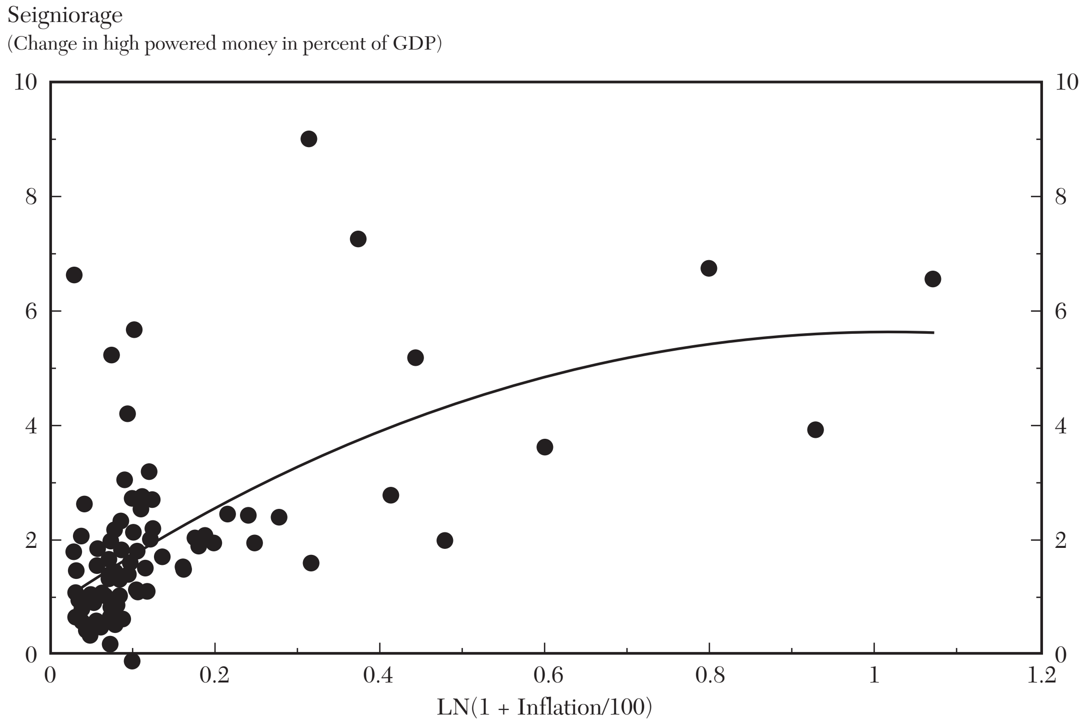

Figure 4. Seigniorage and Inflation[1]
1960–95 averages

[1] Regression line is 0.806 + 9.563*LN(1 + inflation/100) –4.691*(LN(1 + inflation/100)^2; t-statistics on the coefficients are 2.65 and –1.31 respectively; 94 countries in total, each with ten or more observations.

The basic results from the annual panels carry through in the subsample of high-inflation countries in the sense that the relationship between inflation and the fiscal balance is significant for high-inflation episodes but not for low-inflation episodes (table 10, column 5). In high-inflation periods, a 1-percentage-point reduction in the fiscal balance leads to a 6.3-percent increase in the inflation rate. It is also the case that the introduction of lags improves the fit substantially with the second lag for high-inflation episodes being statistically significant (table 10, column 6).[40]

In sum, no obvious long- or short-run relationship between inflation and fiscal balance is found for the low-inflation countries or during the low-inflation episodes in the high-inflation countries. The relationship, however, is quite strong in the high-inflation countries during the high-inflation episodes.[41] Lags in the fiscal balance are important in explaining inflation in the high-inflation countries and episodes.

3.5 *Inflationary Persistence*

As argued above (and consistent with our findings so far), we believe that inflation is typically caused by fiscal imbalances and is perpetuated by monetary accommodation to real shocks and by its own dynamics. We

[40] Notice that since the relevant variable for determining inflationary finance is the present discounted value of primary deficits, *a priori* one would indeed expect additional lags to improve the fit.

[41] Catão and Terrones (2001), however, find a statistically significant positive long-run relationship between fiscal deficits and inflation for a panel of 23 emerging market countries during 1970–2000, using an estimator that distinguishes between short-run dynamics and equilibrium relationships in heterogeneous panels.

TABLE 9
INFLATION AND SEIGNIORAGE
DEPENDENT VARIABLE: SEIGNIORAGE[1,2] (T-STATISTICS IN PARENTHESES)

Independent Variables	Cross-Section		Annual Panel		Annual Panel High Inflation Countries	
	OLS (1)	OLS (2)	Fixed[4] (3)	Fixed[4] (4)	Fixed[4] (5)	Fixed[4,5] (6)
Intercept	1.157***	0.806**				
	(7.15)	(2.51)				
Inflation[1]	5.44***	9.563***				
	(5.81)	(2.65)				
Inflation/hi[1,3]			4.246***	9.775***	3.950***	9.938***
			(17.55)	(15.52)	(8.00)	(5.19)
Inflation/low[1,3]			3.342***	2.013	4.474**	10.85*
			(2.83)	(0.74)	(2.13)	(1.89)
Infsq[1]		–4.691				
		(–1.31)				
Infsq/hi[1,3]				–1.586***		–1.628***
				(–9.47)		(–2.94)
Infsq/low[1,3]				5.006		–1.655
				(0.73)		(–0.17)
R-squared	0.339	0.361	0.397	0.421	0.425	0.398
Adj. R-squared	0.332	0.347	0.361	0.386	0.343	0.370
Observations	94	94	2318	2318	410	410

Sources: International Financial Statistics; authors' estimations.
Note: Significance at the 10-, 5-, and 1-percent level is indicated by one, two, and three stars, respectively.
[1] Seigniorage is defined as [RM-RM(–1)]/GDP, where RM is reserve money in current period, RM(–1) is reserve money in last period and GDP is output in current period, inflation is defined as ln(1 + inflation/100) and infsq is the square of the ln(1 + inflation/100).
[2] All results corrected for heteroskedasticity if it existed.
[3] Hi and low refer to coefficients for high- and low-inflation countries or high- and low-inflation espisodes.
[4] Fixed refers to a fixed-effects model with both country and time dummies. These results indicate the significance of both unless otherwise specified.
[5] Period effects not significant.

now explore the issue of inflation's own dynamics, which we will refer to as inflation persistence. Our aim is twofold: first, to come up with a quantitative measure of persistence and, second, to test if inflation persistence falls as the level of inflation rises. The latter point is relevant because, according to conventional wisdom, the inflationary inertia that is present at low inflation rates is responsible for the Phillips curve-related output costs of reducing inflation. Sargent (1982), however, argued that several hyperinflations have been eliminated at no cost by a credible change in policy. A common interpretation of Sargent's views is that the shortening of contracts that takes place in high-inflation episodes reduces inflationary inertia, thereby making it less costly to stabilize from high than from moderate inflation.

In an attempt to examine this argument empirically, let the inflationary process take the following autoregressive (AR) form:[42]

[42] Using univariate autoregressive processes to measure inflation persistence has a long tradition in the literature; see, in particular, Bruno and Fischer (1986), Bruno (1993), and James Stock (2001).

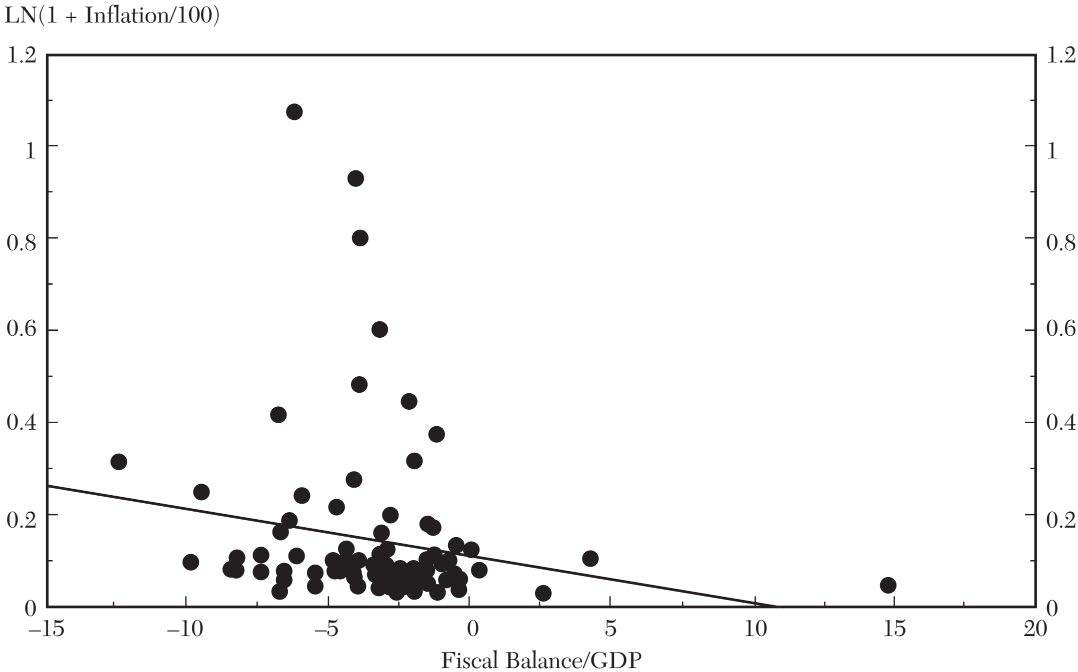

Figure 5. Fiscal Balance and Inflation[1]
1960–95 averages

[1] Slope of regression line is –0.010 with a t-statistic of –2.45; 94 countries in total, each with ten or more observations.

$$\pi_t = \sum_{i=1}^{n} \alpha_i \pi_{t-i} + u_t \qquad (2)$$

where π_t is the inflation rate at time t, i is the lag length, n is the maximum lag length, and u_t is an error term which is i.i.d. We then define two indices of inflation inertia, the mean lag and the median lag. The mean lag is defined as follows:

$$Mean\ lag = \frac{\sum_{i=1}^{n} i \mid \alpha_i \mid}{\sum_{i=1}^{n} \mid \alpha_i \mid} \qquad (3)$$

This index is an average of the n lags, weighted by the coefficient, α_i, associated with each lag, i. If n equals zero, the mean lag is simply defined to be zero. Otherwise, the index has a lower bound of unity, which occurs for the case in which $n = 1$.

The median lag, m, is chosen such that it divides the sum of the coefficients, $\sum_{i=1}^{n} \alpha_i$, (the total frequency) equally before and after this lag. That is, we chose the smallest integer m such that:

$$\frac{\sum_{i=1}^{m-1} \mid \alpha_i \mid}{\sum_{i=1}^{n} \mid \alpha_i \mid} \leq 0.5 \leq \frac{\sum_{i=1}^{m} \mid \alpha_i \mid}{\sum_{i=1}^{n} \mid \alpha_i \mid} \qquad (4)$$

If m equals zero, the median lag is also defined to be zero.

The hypothesis that the mean and the median lag lengths are higher in low-inflation episodes than in high-inflation episodes is now examined in the high-inflation countries that were identified in section 2.2 using quarterly data. Unfortunately, the duration of several very high-inflation episodes was far too short to lend itself to econometric estimation. To increase the number of countries in our sample, however, we combined some of the episodes identified in table A1 (as in Democratic Republic of Congo, Ghana, Mexico, Sierra Leone, Uganda, and

TABLE 10
INFLATION AND FISCAL BALANCE
DEPENDENT VARIABLE: INFLATION RATE[1,2] (T-STATISTICS IN PARENTHESES)

Independent Variables	Cross-Section		Annual Panel		Annual Panel High Inflation Countries	
	OLS (1)	OLS (2)	Fixed[4] (3)	Fixed[4] (4)	Fixed[4] (5)	Fixed[4] (6)
Intercept	0.113*** (7.26)					
Intercept/hi[3]		0.447*** (4.16)				
Intercept/low[3]		0.083*** (13.16)				
Fiscal[1]	–0.010** (–2.45)					
Fiscal/hi[1,3]		–0.00001 (–0.001)	–0.042*** (–17.49)	–0.016*** (–5.63)	–0.063*** (–11.23)	–0.024*** (–3.38)
Fiscal/low[1,3]		–0.001 (–1.43)	0.000 (–0.19)	–0.001 (–0.54)	–0.005 (–0.77)	–0.012 (–1.32)
Fiscal/hi (–1)[1,3,5]				–0.028*** (–8.51)		–0.014 (–1.27)
Fiscal/low (–1)[1,3,5]				–0.001 (–0.54)		–0.012 (–1.34)
Fiscal/hi (–2)[1,3,5]				–0.032*** (–11.08)		–0.057*** (–5.52)
Fiscal/low (–2)[1,3,5]				0.002 (0.76)		–0.007 (–1.07)
R-squared	0.032	0.556	0.442	0.542	0.543	0.644
Adj. R-squared	0.021	0.541	0.408	0.512	0.478	0.586
Observations	94	94	2318	2130	410	380

Sources: IMF, *International Financial Statistics;* authors' estimations.
Note: Significance at the 10-, 5-, and 1-percent level is indicated by one, two, and three stars, respectively.
[1] Inflation rate is defined as ln(1 + inflation/100) and fiscal is defined as the fiscal balance in percent of GDP.
[2] All results corrected for heteroskedasticity if it existed.
[3] Hi and low refer to coefficients for high- and low-inflation countries or high- and low-inflation episodes.
[4] Fixed refers to a fixed-effects model with both country and time dummies. These results indicate the significance of both unless otherwise specified.
[5] The number in parentheses next to the independent variables refers to the number of lags.

Uruguay) when subsequent episodes were adequately close (less than ten quarters). The sample of countries was thus reduced to sixteen, with the revised high- and low-inflation episodes reported in table 11.[43]

The empirical procedure employed in computing the lag lengths was as follows.

[43] While the high-inflation episodes in Angola and Suriname were not short in themselves, they were preceded and followed by low-inflation episodes of limited length due to lack of data.

Since unit roots were present in several episodes, the regressions were run in first differences, following Hamilton (1994, p. 528). Specifically, equation (2) can be rewritten as:

$$\pi_t = \rho\pi_{t-1} + \sum_{i=1}^{n-1} \beta_i \Delta\pi_{t-1} + u_t, \qquad (5)$$

where the coefficients in (5) are related to those in equation (2) as follows:

$$\alpha_1 = \rho + \beta_1,$$
$$\alpha_2 = \beta_2 - \beta_1,$$
$$\alpha_n = -\ \beta_{n-1}.$$

Following the determination of the appropriate model,[44] the βs in equation (5) were estimated and the αs in equation (2) were calculated. Finally, using equations (3) and (4), the mean and the median lag lengths were calculated for each episode in each country. These results are reported in table 11. By and large, inflation persistence seems to be important. With some exceptions, the hypothesis that inertia is lower during high-inflation episodes than during low-inflation episodes is confirmed by the results for the mean lag length. The four exceptions are Israel, Mexico, Suriname, and Zambia. In Israel and Suriname, the indices of inertia appear to have increased during the high-inflation episodes, while in Mexico and Zambia, there was virtually no evidence of inertia in either the high- or the low-inflation episodes. In three other countries—Chile, Nicaragua, and Sierra Leone—the degree of inertia in the economy appears not to have increased during their last post-stabilization period. By and large, similar conclusions can be drawn from the median lag length.

To formally test for the relationship between inflation inertia and the level of inflation, we pooled the sample of 42 episodes for the sixteen countries and ran an OLS regression. Since institutional arrangements regarding indexation often differ markedly across countries, country dummies were introduced in the regression. The results were:

$$\underset{}{mean\ lag} = \underset{(-2.21)}{-0.54 \log(\pi)} \quad \text{Adj. } R^2 = 0.63,$$

$$\underset{}{median\ lag} = \underset{(-2.43)}{-0.58 \log(\pi)} \quad \text{Adj. } R^2 = 0.60,$$

where the t-statistic is reported below the regression coefficient. All country dummies, with the exception of Zambia's, were significant at the 5-percent level. The regression results support the view that inflation inertia falls as the level of inflation rises.

What do we make of these results? Several remarks are in order. First, while the measures of inflation persistence defined above have the virtue of simplicity, it is not entirely clear that measures based on univariate autoregressive processes will indeed be capturing "inertia." To the extent that some underlying policy variable (i.e., the money supply in Cagan's model) is highly persistent, inflation will be equally "persistent" (in an autoregressive sense) even in a model that completely abstracts from expectational and/or nominal frictions. Hence, as argued by Leonardo Leiderman (1993), testing for inflation inertia would require estimating a structural model that embodies it in a falsifiable manner. In spite of this obvious shortcoming, we still believe that AR-based measures of persistence are useful, since, in addition to the persistence of fundamentals, they will also capture indexation and institutional practices that tend to give inflation a life of its own.

Second, our result that, on average, higher inflation exhibits less persistence is consistent with our priors. The main reason is that, as inflation increases, the length of contracts becomes shorter and/or more contracts and prices are denominated in foreign currency. In the extreme case (a full-blown hyperinflation à la Cagan), all prices are expressed in foreign currency which, by construction, should completely eliminate inflation inertia. In fact, it is the disappearance of inflation inertia in full-blown hyperinflations that makes the exchange rate so effective in stopping inflation in its tracks.

Finally, to put the issue of inflation persistence into perspective, it is useful to relate our findings to an ongoing debate on U.S. inflation persistence. The conventional wisdom within the Federal Reserve is that inflation

[44] We estimated equation (5) with a maximum of seven lags, seasonal dummies, and a trend for each episode. Using the F-test, the model was reduced to determine the appropriate lag length and to see whether seasonal dummies and the trend belonged to the model. If the seventh lag was significant, we included more lags in the model.

TABLE 11
INFLATION INERTIA IN HIGH-INFLATION COUNTRIES

Country	Episodes	Average Annual Inflation	Calculated Coefficients of Lags			
			α_1	α_2	α_3	α_4
Argentina	1959:2–1974:2	28.0	0.46	0.06	–0.07	0.34
	1974:3–1991:3	310.6	0.47			
	1991:4–1997:1	6.2	0.30	0.12	0.11	–0.22
Bolivia	1959:2–1981:2	12.5	0.49	0.14	–0.29	0.24
	1981:3–1986:3	789.3	0.58			
	1986:4–1997:1	12.3	0.28	–0.13	–0.30	0.27
Brazil[2]	1959:2–1980:2	38.0	0.85	–0.19	0.13	0.39
	1980:3–1997:2	357.6	0.81			
Chile	1959:2–1971:3	24.7	0.34	0.05	0.04	0.29
	1971:4–1977:2	229.9	0.56			
	1977:3–1997:2	19.4	0.50			
Congo, Dem.	1968:2–1977:4	26.1	0.07	0.04	0.00	0.19
Republic. of	1978:1–1997:3	281.8	0.94	–0.66	0.80	–0.67
Ghana	1963:3–1976:1	13.3	0.14	–0.10	0.29	0.16
	1976:2–1984:1	72.2				
	1984:2–1997:1	27.7	0.76	–0.54	0.33	0.18
Israel	1959:2–1978:3	14.3	0.51	–0.16	0.26	0.18
	1978:4–1986:3	139.9	0.22	0.34	0.04	0.10
	1986:4–1997:2	14.1				
Mexico	1959:1–1981:4	10.1	0.30			
	1982:1–1988:3	90.6	0.69			
	1988:4–1997:4	20.6	0.53			
Nicaragua	1959:2–1984:1	15.3	0.75	0.11	–0.01	–0.07
	1984:2–1992:1	54.3	0.89			
	1992:2–1997:2	19.2	0.58			
Peru	1959:2–1982:2	22.2	0.34	0.13	–1.08	0.30
	1982:3–1992:1	413.0	0.54	0.14	–0.11	–0.05
	1992:1–1997:4	19.4	0.88	–0.36	0.30	
Sierra Leone	1961:1–1986:3	17.9	0.13	–0.01	0.09	0.43
	1986:4–1991:4	90.0				
	1992:1–1997:1	23.0				
Sudan	1959:2–1989:4	16.7	0.04	–0.18	0.04	–0.02
	1990:1–1997:1	102.7				
Suriname	1959:2–1991:4	9.3	0.05	0.22		
	1992:1–1995:4	177.4	0.66	0.76	0.14	1.03
	1996:1–1998:2	8.0				
Uganda[3]	1981:2–1988:4	99.0				
	1989:1–1997:4	19.5	0.53	–0.16	–0.11	–0.16
Uruguay[3]	1959:2–1974:4	49.2	0.39	0.37		
	1975:1–1997:2	56.0	0.50	0.22		
Zambia	1988:3–1994:1	127.8				
	1994:2–1997:4	31.4				

Source: IFS; authors' calculations.
[1] Model reduction by F-tests (successively dropping lags and stopping when dropping the last is significant compared to the next to last).

TABLE 11 *(Cont.)*

Calculated Coefficients of Lags							
α_5	α_6	α_7	α_8	Appropriate Lag Length[1]	Mean Lag	Median Lag	R-squared
0.05	–0.37			6	3.4	4.0	0.369
				1	1.0	1.0	0.220
0.10	–0.02	–0.03	0.06	8	3.2	3.0	0.916
0.27	–0.26			6	3.3	3.0	0.412
				1	1.0	1.0	0.337
0.04	–0.08			6	2.9	3.0	0.346
–0.28				5	2.5	2.0	0.753
				1	1.0	1.0	0.652
0.11	–0.33			6	3.7	4.0	0.324
				1	1.0	1.0	0.333
				1	1.0	1.0	0.610
–0.12	–0.31	0.47		7	5.6	6.0	0.783
0.56	–0.47	0.36		7	3.5	3.0	0.656
0.13	–0.49			6	4.2	4.0	0.524
				0	0.0	0.0	0.00
–0.33				5	2.4	2.0	0.664
–0.08	0.31			6	3.1	3.0	0.738
–0.90	0.05	0.05	–0.90	8	5.3	5.0	0.773
				0	0.0	0.0	0.00
				1	1.0	1.0	0.647
				1	1.0	1.0	0.555
				1	1.0	1.0	0.278
–0.03	0.06	0.00	0.36	8	3.4	1.0	0.847
				1	1.0	1.0	0.771
				1	1.0	1.0	0.335
–0.56	0.31			6	3.6	3.0	0.739
0.08	–0.05	–0.05		7	2.4	1.0	0.458
				3	1.6	1.0	0.925
0.34				5	3.8	4.0	0.478
				0	0.0	0.0	0.000
				0	0.0	0.0	0.000
–0.06	0.05	–0.21		7	4.5	5.0	0.582
				0	0.0	0.0	0.000
				2	1.8	2.0	0.129
–0.54	–1.98			6	4.2	4.0	0.892
				0	0.0	0.0	0.000
				0	0.0	0.0	0.000
0.11	0.20	–0.30		7	3.6	3.0	0.720
				2	1.5	1.0	0.436
				2	1.3	1.0	0.457
				0	0.0	0.0	0.000
				0	0.0	0.0	0.000

[2] Last period ignored because sample size is too small.
[3] Some high- and low-inflation periods have been combined to allow sufficient sample period.

persistence increased with the rise in inflation in the 1970s and has been falling ever since (see John Taylor 1998). This belief receives support from a sophisticated multivariate procedure carried out in Timothy Cogley and Sargent (2001). In this view, therefore, the relation between the level and persistence of U.S. inflation would be positive. In his discussion of Cogley and Sargent, however, Stock (2001) argues—based on an univariate AR representation—that inflation persistence in the United States has not changed over the past forty years.[45,46] Stock attributes the Cogley and Sargent finding to the fact that, in his view, their specification tends to confuse volatility with persistence. Whatever the merits of the argument, the fact that AR-based measures of persistence are not unduly influenced by inflation volatility is a particularly important feature when it comes to analyzing this phenomenon in developing countries. All in all, our reading of this debate is that there is much to be learned from simple AR representations, as more sophisticated techniques do not seem to necessarily translate into a cleaner measure of inflation persistence.

4. *Real Effects of Inflation and Stabilization*

This section focuses on the very high-inflation countries identified above and examines the behavior of key macroeconomic variables during high inflation and disinflation. Two main exercises are carried out. The first one compares the average behavior of the main macroeconomic variables during periods of very high inflation—as defined in previous sections—with periods of low inflation. This exercise is thus related to the effects of high inflation on macroeconomic performance. The second exercise deals with the real effects of disinflation from high inflation by looking at the behavior of the main macroeconomic variables just before and after a disinflation process is under way. The main issue related to this exercise is whether stabilization from high inflation may be expansionary and whether the nominal anchor matters; that is, whether exchange rate-based stabilizations are more likely to be expansionary than money-based stabilizations.

4.1 *Very High- versus Low-Inflation Periods*

Figure 6 summarizes the differences in behavior of the main macroeconomic variables during episodes of very high inflation using annual data for eighteen of the 25 market economies identified in the previous sections.[47,48] Specifically, figure 6 presents the averages for the different variables for very high-inflation years and low-inflation years. Average inflation was 739 percent during years of very high inflation and 22.4 percent during low-inflation years. (For scaling purposes, figure 6 shows the figure for $log\,(1 + x/100)$, where x is either the inflation rate or the devaluation rate in percentage terms.) The average rate of devaluation/depreciation is 984 percent during high-inflation periods and 16.7 during periods of low inflation.

There are few surprises. Real GDP per capita fell on average by 1.6 percent per annum during the very high-inflation episodes, and rose by 1.4 percent during years of low inflation. The same pattern holds for private consumption per capita, which fell on average

[45] Stock (2001) measures persistence by the largest root of an AR representation of inflation.

[46] See also Christopher Sims' (2001) comments on Cogley and Sargent.

[47] If a high inflation episode begins in the second half of the year, or ends in the first half of the year, that year is taken as a low-inflation year.

[48] Due to lack of data, we excluded Afghanistan, Angola, Guinea-Bissau, Jamaica, Lebanon, Nicaragua, and Somalia. The sample consists of annual data, 1960–1995 (or longest available sub-period). Note that the total number of observations varies according to the variable considered. There are 647 observations for the nominal exchange rate, 590 observations for inflation, 533 for real per capita GDP growth, 355 for real per capita consumption growth, 365 for real per capita investment growth, 285 for the change in the real exchange rate, 407 for the current account, and 499 for the fiscal balance.

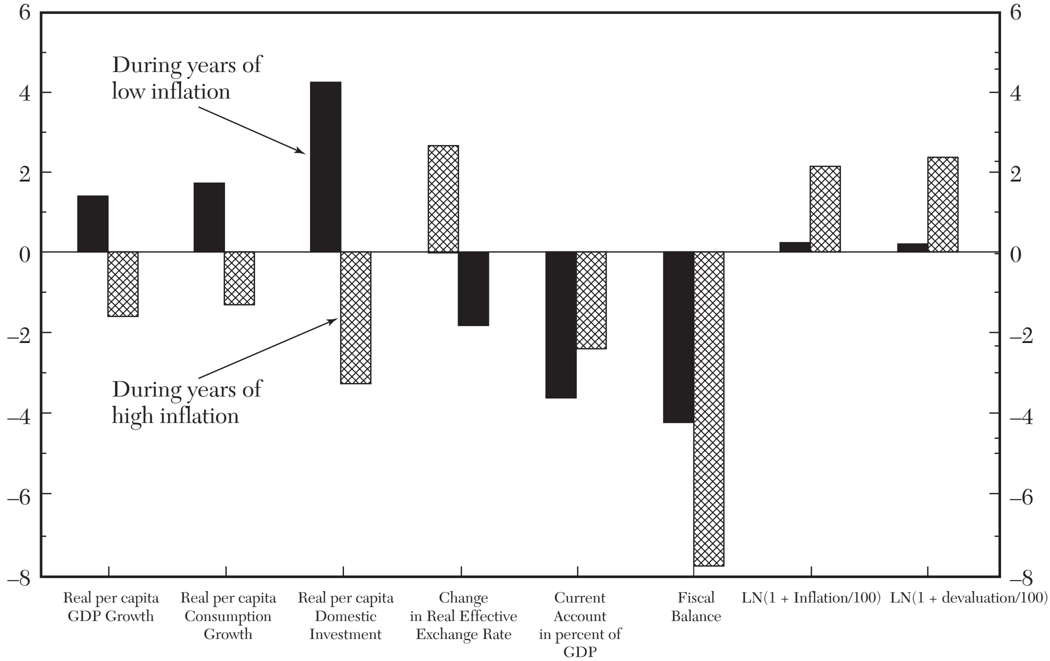

Figure 6. Macroeconomic Performance in High-Inflation Countries

by 1.3 percent during very high-inflation episodes, and rose by 1.7 percent during low-inflation years. Investment growth per capita fell by 3.3 percent during high-inflation years, while it increased by 4.2 percent during low-inflation periods. The domestic currency appreciated, in real terms, at a rate of 2.7 percent during high-inflation years and depreciated at a rate of 1.8 percent during low-inflation years. The current account deficit, as a proportion of GDP, is higher in low-inflation years (3.6 percent) than in high-inflation years (2.4 percent). The average fiscal deficit is higher during high-inflation years (7.8 percent of GDP) than during low-inflation years (4.2 percent). In sum, on average, periods of high inflation are characterized by a contraction in the levels of GDP, consumption, and investment per capita, an appreciating currency (in real terms), and higher fiscal deficits. High inflation is thus associated with bad macroeconomic performance.[49]

In particular, figure 6 is consistent with the view that inflation is bad for growth (see Fischer 1996 for a brief survey). The literature on this topic is unanimous in finding that very high inflation is bad for growth.[50] There is, however, controversy over the nature of the relationship at low inflation rates. Bruno and Easterly (1995) point to 40 percent as a danger point, beyond which increases in inflation are very likely to lead to a growth crisis. In the case of the transition economies, Fischer, Sahay, and Végh (1996) find that this cutoff point occurs at about 50 percent. Michael Sarel (1996) searches for a break-point in the relationship between inflation and growth, and locates it at an annual rate of 8 percent. A more recent paper (Mohsin Khan and Abdelhak Senhadji 2000) analyzes this relationship separately for industrial countries and developing countries and finds that

[49] Benedikt Braumann (2001) also documents a sharp decline in real wages during periods of high inflation, based on an analysis of 23 episodes.

[50] See, for example, Fischer (1993), De Gregorio (1993), and Bruno and Easterly (1995).

"the threshold level of inflation above which inflation significantly slows growth is estimated at 1–3 percent for industrial countries and 7–11 percent for developing countries." Above that rate, inflation and growth are negatively related; below it, the relationship is not statistically significant. In summary, the literature finds that high inflation is bad for growth; the relationship is weaker or nonexistent at low rates of inflation; but there is no evidence that inflation is good for growth.[51]

Figure 6 also suggests that high inflation is bad for consumption and for investment, with changes in consumption growth of roughly the same order of magnitude as those in GDP growth and changes in investment of about twice that magnitude. If one accepts the notion that inflation is bad for growth, the behavior of investment is hardly surprising. Based on the business-cycle literature, the higher volatility of investment growth is also to be expected.

What are the specific mechanisms that could be at work in explaining the stylized fact that inflation is bad for growth? Any model in which the inflation rate adversely affects the allocation of resources is bound to generate a negative correlation between inflation and growth. Consider, for instance, a model in the spirit of Alan Stockman (1981) in which the inflation rate acts as a tax on investment (through a cash-in-advance on the purchase of capital goods). In this context, periods of high inflation will lead to lower investment and, hence, a lower capital stock. This reduces the demand for labor and leads to lower employment, output, and real wages. On the demand side—and assuming a cash-in-advance for the purchase of consumption goods—higher nominal interest rates will lower consumption by making consumption more expensive during high-inflation periods. These results are general to the extent that any model in which the inflation rate distorts both investment and consumption will generate a negative correlation between inflation on the one hand, and investment, output, and consumption on the other.[52]

Finally, while the behavior of the current account captured in figure 6 is consistent with the theoretical predictions, the behavior of the real exchange rate appears to be at odds. Specifically, in an open-economy version of the simple model just described, the lower demand for non-tradables that would result from higher inflation should lead to a fall in the relative price of non-tradables (i.e., a real depreciation of the currency) since the supply response is relatively inelastic in the short run. On the other hand, the lower demand for tradable goods would translate into a lower current-account deficit. We thus conjecture that the behavior of the real exchange rate, which in our sample appreciates during high-inflation years, might be explained by numerous episodes in which nominal exchange rates have been kept more or less fixed in spite of ongoing inflation.[53,54]

4.2 *Real Variables in Disinflation*

Conventional wisdom—based on the experience of industrial countries—holds that

[51] We find it quite plausible to believe that deflation is bad for growth, and thus would not be surprised if further research showed that inflation and growth are positively related for extremely low and negative inflation rates, for example up to 2 percent per annum.

[52] Steve Ambler and Emanuela Cardia (1998) calibrate a richer model along these lines. They conclude that the model does indeed predict a negative correlation between inflation and growth (both for time series and, in the long-run, for a cross section). Since both variables are endogenous, the size of this correlation will depend on the size of the underlying exogenous shocks. The authors also offer an insightful analysis of the pitfalls associated with interpreting standard inflation and growth regressions.

[53] Notice that the real exchange rate appreciates during high inflation periods even though the average nominal depreciation (984 percent) is higher than the average rate of inflation (739 percent). This is related to the fact that the samples are not the same; that is, the number of observations for the real exchange rate is much lower than that for the nominal devaluation/depreciation and the inflation rate.

[54] With a smaller sample (23 episodes), Braumann finds the expected results: during high inflation periods, a real depreciation goes hand in hand with an improvement in the external trade accounts.

disinflation is costly in terms of output forgone. In fact, the notion that disinflation is contractionary is so entrenched in the literature that the question has typically been not *if* but by *how much* output would fall in response to an inflation stabilization program. To answer this question, a large literature has computed the so-called "sacrifice ratio" associated with disinflation, defined as the cumulative percent output loss per percentage reduction in inflation (see, for instance, Arthur Okun 1978; Robert Gordon 1982; and Fischer 1986). Laurence Ball (1994) examined 28 disinflation episodes in nine OECD countries using quarterly data and found that, with one exception, disinflation is always contractionary, with the sacrifice ratio ranging from 2.9 for Germany to 0.8 in France and the United Kingdom. While Ball's (1994) estimates are somewhat lower than those in the earlier literature, they continue to support the notion that disinflation in industrial countries is costly in terms of output. This stylized fact is, of course, consistent with closed-economy, staggered-contracts models à la Fischer (1977) and Taylor (1979, 1980) and other models that generate a short-run Phillips-curve (Robert Lucas 1972).

The Phillips-curve-based conventional wisdom has not gone unchallenged. In an influential paper, Sargent (1982) examined the behavior of output in four classical hyperinflations and argued that stabilization was achieved at small or no output cost.[55] More recently, and for the case of much more mundane inflationary processes, Kiguel and Liviatan (1992) and Végh (1992) have argued that stabilization programs in chronic-inflation countries based on the nominal exchange rate (exchange rate-based stabilization) have actually led to an initial expansion in output and consumption, with the conventional contraction occurring only later in the programs.[56] Fischer, Sahay, and Végh (1996, 1997) also find evidence for the transition economies in favor of expansionary stabilizations, with the expansions being more pronounced for the case of exchange rate-based stabilizations. Easterly (1996), however, has argued that expansionary stabilization is a more general feature of stabilization from high-inflation countries, and occurs irrespective of whether the nominal anchor is the exchange rate or not.[57] We now proceed to revisit these important issues.

4.2.1 *Stabilization Time Profiles*

We first compute the time profiles for the main macroeconomic variables in "stabilization time."[58] Stabilization time is denoted by $T + j$, where T is the year in which an episode of very high inflation ends, and j $(= -3, \ldots, 3)$ is the number of years preceding or following the year of

[55] Sargent's (1982) analysis has itself been challenged; most notably by Peter Garber (1982) and Elmus Wicker (1986); see also Végh (1992) and Bruno (1993).

[56] For econometric evidence in favor of this hypothesis, see Reinhart and Végh (1994, 1995a), De Gregorio, Guidotti, and Végh (1998) and Calvo and Végh (1999). David Gould (1996) and Federico Echenique and Alvaro Forteza (1997) take issue with some of the econometric findings. At a more fundamental level, Finn Kydland and Zarazaga (1997) argue against the view that stabilizations necessarily have important real effects in high inflation countries.

[57] It should be noted that none of this evidence on the relationship between inflation and growth bears on the optimal speed of disinflation. David Burton and Fischer (1998) discuss several cases of extremely rapid and successful (growth-increasing) disinflation from triple digit rates; they also show that in other cases, starting at moderate rates of inflation, disinflation has been very slow, for fear that more rapid disinflation would slow output growth.

[58] In selecting the stabilization episodes, we take as our starting point the episodes of very high inflation defined above (45 episodes in 25 countries, as listed in table A1). In our definition, when a very high inflation episodes ends, a stabilization starts. Due to (i) lack of data, (ii) instances in which very high inflation episodes separated by less than 12 months were consolidated into one, and (iii) instances in which the very high inflation episode is ongoing as of 1995 (the end of our sample for stabilization purposes), we end up with 27 stabilization episodes in 18 countries: (Argentina (1), Bolivia (1), Brazil (1), Chile (1), Congo (3), Costa Rica (1), Ghana (2), Israel (1), Mexico (2), Peru (1), Sierra Leone (2), Sudan (1), Suriname (1), Turkey (2), Uganda (2), Uruguay (3), Venezuela (1), and Zambia (1).

stabilization.[59] The average paths of variables are then calculated relative to year T.[60]

Consider first figure 7. Inflation falls sharply in the year before stabilization and continues to fall in the year of stabilization, but then stabilizes at around 25 percent. Real GDP per-capita growth is basically zero in the year before stabilization and turns positive (at around 1 percent) in the year of stabilization, peaking at more than 3 percent in year $T + 2$. A similar profile holds for per-capita consumption growth: it is essentially zero in the year before stabilization and jumps to around 2 percent in the year of stabilization, peaking at 2.6 percent in year $T + 2$. While exhibiting more variability, the behavior of real per-capita domestic-investment growth fits the same pattern. It jumps from −1.2 percent in the year before stabilization to more than 9 percent in the year of stabilization, to end with a rate of growth above 10 percent in year $T + 3$. This preliminary evidence is therefore consistent with the idea that, contrary to what happens in low-inflation countries, stabilization from high inflation appears to be associated with an expansion in output, consumption, and investment.[61]

Figure 8 shows the behavior of other macroeconomic variables. As expected, the rate of growth of the nominal exchange rate exhibits a similar pattern to the inflation rate. The real exchange rate, which is appreciating until year $T - 2$, begins to depreciate in the year before stabilization and continues to do so throughout the stabilization. The current account balance worsens throughout the stabilization, reaching a trough of 4 percent of GDP in year $T + 2$. Finally, the fiscal deficit falls from more than 8 percent of GDP in year $T - 3$ to close to 2 percent in $T + 3$.

While figure 7 is consistent with the idea that stabilization from high inflation may be expansionary, it offers no sense of the statistical significance, if any, of the time profile, nor does it address the question of whether factors other than the disinflation process itself may be causing such behavior. To address these questions, table 12 presents regressions of the main macroeconomic variables on the stabilization time dummies, controlling for three externals factors: OECD growth, terms of trade shocks, and LIBOR (in real terms).[62]

Consider the first three columns, which show the results for GDP, consumption, and investment. Note that the control variables appear to play an important role in explaining these variables. In the case of GDP, for instance, all three control variables are highly significant and, at least for OECD growth and real LIBOR, with the expected sign.[63] Consumption growth is affected positively by terms of trade and negatively by real LIBOR, whereas investment growth is only affected significantly by changes in real LIBOR.

With respect to the stabilization time dummies, the results are somewhat mixed. There is evidence of an expansionary response in output growth, as shown by the significance of the coefficients on $T + 1$ and $T + 2$. There is, however, no evidence of any significant response in consumption growth. In the case of investment growth, the coefficient on

[59] If the episode of very high inflation ends in the second half of the year, we take T to be the following year.

[60] Notice that the number of observations for each year in stabilization time may differ. The number of observations for a given $T + j$ may also differ across variables.

[61] See Peter Henry (2002) for an analysis of the effects of stabilizations on the stock market. Based on a sample of 81 episodes, he finds that, when stabilizing from inflation rates higher than 40 percent per year, the domestic stock market appreciates on average by 24 percent in real dollar terms.

[62] The variable terms of trade is defined in such a way that a rise in the index denotes a terms of trade improvement.

[63] The sign on the terms of trade is somewhat unexpected as it implies that a positive terms of trade shock leads to lower output. Interestingly enough, the same shock does lead to a significant increase in consumption and an improvement in the current account, as one would expect.

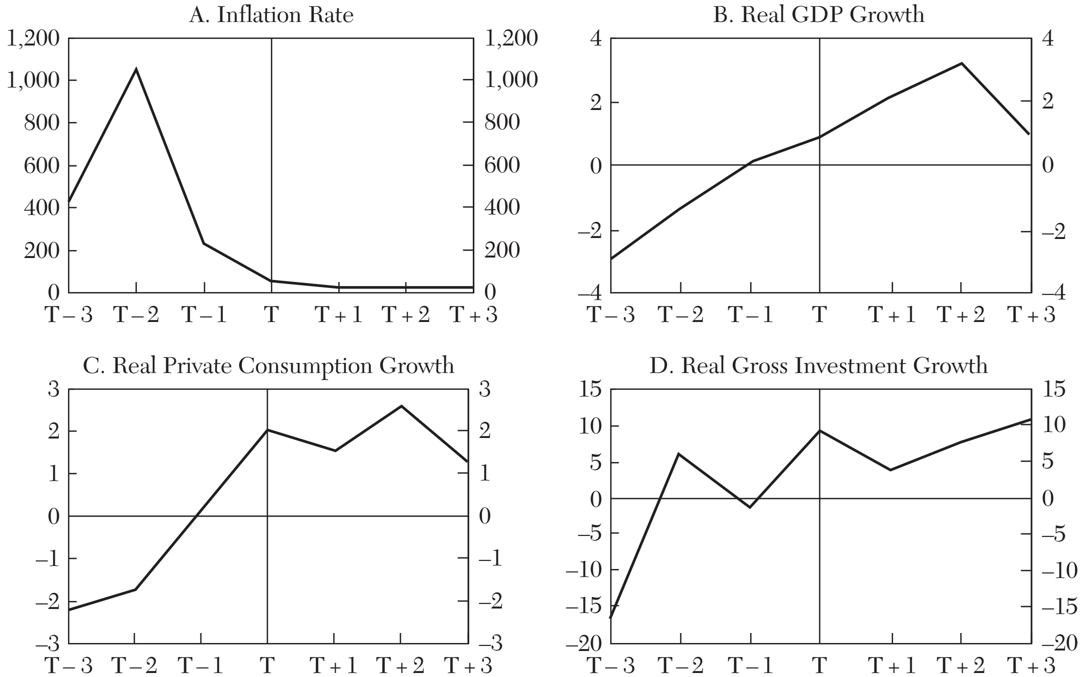

Figure 7. Inflation, GDP, Consumption, and Investment

T is significant. As to the other two variables—current account and the real exchange rate—the stabilization time dummies are, by and large, not significant.

4.3 *Does the Nominal Anchor Matter?*

The results so far provide only weak evidence in favor of the hypothesis that stabilization may be expansionary. Since, as mentioned above, it has been argued that the real effects of disinflation may depend on the nominal anchor, it is worth examining this issue with the sample at hand. To that effect, we selected nine out of the 27 episodes of stabilization in our sample, which can be classified as exchange rate-based stabilizations (ERBS).[64] The rest of the episodes are classified as non-exchange rate based stabilizations and include an assorted combination of other types of stabilization.[65] This two-way classification is sufficient for our purposes.

[64] These include (initial year of the stabilization episode according to our criteria in parenthesis) Turkey (1995), Argentina (1992), Brazil (1995), Chile (1977), Mexico (1989), Peru (1986), Uruguay (1969 and 1992), and Israel (1986).

[65] We purposely choose to refer to the remaining episodes as "non-exchange rate based stabilizations" (as opposed to "money-based stabilizations") because they include not only episodes which can be characterized as money-based stabilization (i.e., stabilizations carried out under floating or dirty floating exchange rates) as, for example, Uruguay (1975), but also other episodes which defy a clear classification. An example of the latter is Turkey (1981) which relied on a PPP-type rule that aimed at keeping the real exchange rate more or less constant (see Rodrik 1991). It should also be noted that most stabilization episodes in Africa were carried out under dual exchange rates (official and unofficial). With few exceptions, however, the important characteristic of these non-exchange-rate based stabilizations is that, to at least some extent, the money supply was under the control of the monetary authorities (as is the case under dirty floating or dual exchange rates). As argued by Calvo and Végh (1999), *some* control over the money supply is enough to make these episodes formally resemble a "pure" money-based stabilization.

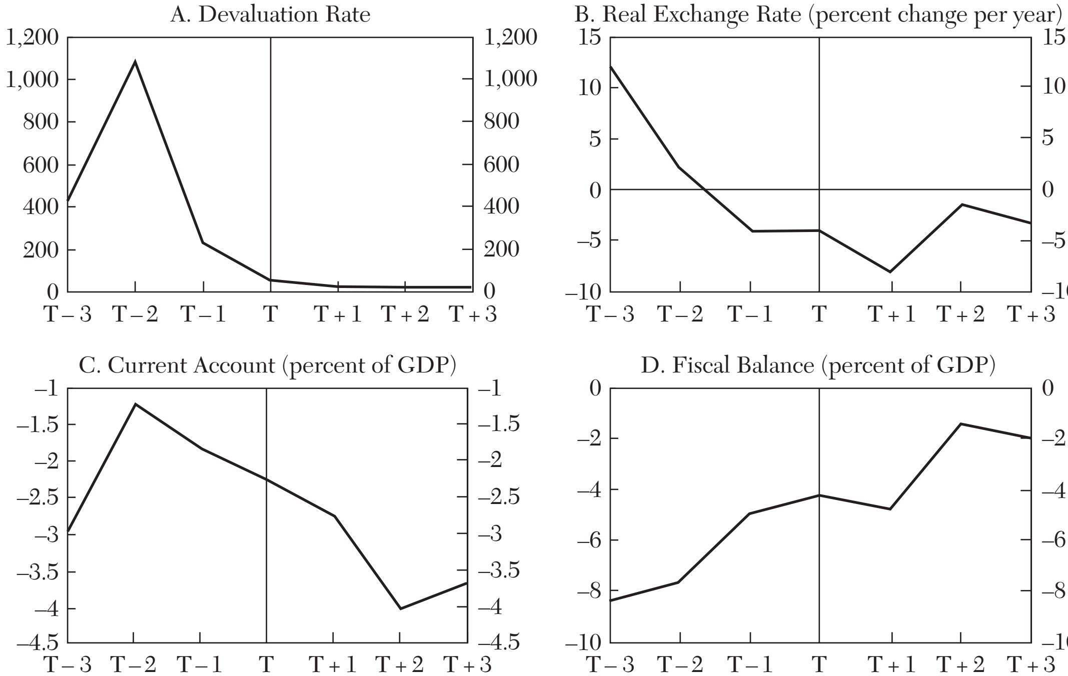

Figure 8. Devaluation, Real Exchange Rate, Current Account, and Fiscal Balance

We focus on GDP growth, consumption, and investment, since we are mainly interested in the expansionary effects of stabilizations. Figure 9 shows the stabilization time profiles for these three variables for both exchange rate-based episodes (nine) and non-exchange rate-based episodes (eighteen). For ERBS, GDP growth rises very sharply upon stabilization—from an already positive value in the year before stabilization—and then stays high until $T + 2$ only to fall sharply in year $T + 3$. This finding is in line with other studies (see Calvo and Végh 1999). In sharp contrast, the stabilization time profile for non-ERBS stabilizations shows no discernible pattern. The profiles for consumption growth fit exactly the same pattern. With respect to investment growth, the stabilization time profiles for ERBS and non-ERBS look qualitatively similar, in that they both show a jump in investment at time T but, quantitatively, the change for ERBS is much stronger. This evidence thus seems to indicate that the profiles for the whole sample shown in figure 7 are basically driven by these nine episodes of exchange rate-based stabilization.

To look further into this issue, table 13 presents the same type of regressions as before for the two subsamples: ERBS and non-ERBS stabilizations. As column (1) shows, in ERBS real GDP growth in the two years before stabilization ($T-2$ and $T-1$) is not significantly different from average growth in the sample. In the first two years of the stabilization, however, growth is indeed significantly different. In contrast, as shown in column (2), in non-ERBS growth after the stabilization is never significant. As before, the three controls variables are

TABLE 12
REAL VARIABLES DURING STABILIZATION

	Dependent Variables				
	Growth in Real GDP (1)	Growth in Real Private Consumption (2)	Growth in Real Gross Investment (3)	Current Account (as % of GDP) (4)	Change in Real Exchange Rate (5)
T – 3	–2.80	–2.48	–17.06***	0.14	11.03**
	(–2.67)	(–1.85)	(–3.14)	(0.11)	(2.02)
T – 2	–1.05	–1.97	5.96	2.21	–1.88
	(–1.01)	(–1.25)	(1.10)	(1.70)	(–0.35)
T – 1	0.24	0.03	–1.17	0.93	–4.39
	(0.24)	(0.02)	(–0.22)	(0.74)	(–0.87)
T	0.71	1.85	9.45*	0.55	–3.42
	(0.68)	(1.18)	(1.71)	(0.44)	(–0.69)
T + 1	2.07*	1.20	3.64	0.02	–8.75
	(1.75)	(0.71)	(0.61)	(0.01)	(–1.62)
T + 2	2.92**	2.07	7.24	–1.48	–1.52
	(2.28)	(1.13)	(1.11)	(–1.01)	(–0.24)
T + 3	0.77	0.67	9.99	–1.18	–4.07
	(0.59)	(0.34)	(1.37)	(–0.74)	(–0.65)
OECD	0.60***	0.26	0.31	–0.04	–1.00
Growth	(5.45)	(1.18)	(0.42)	(–0.25)	(–1.05)
Terms of Trade	–0.004***	0.011*	0.024	0.015***	0.070***
	(–4.00)	(1.83)	(1.20)	(3.75)	(3.68)
Real LIBOR	–0.40***	–0.49***	–1.06*	–0.29**	–1.17*
	(–4.00)	(–3.27)	(–2.00)	(–2.42)	(–1.92)
Number of observations	428	355	365	395	285

Note: T-statistics in parenthesis. The first three dependent variables are expressed in per capita terms. Method of estimation was OLS. Significance at the 10-, 5-, and 1-percent level is indicated by one, two, and three stars, respectively.

highly significant. A similar story holds for consumption growth (columns 3 and 4). For ERBS, consumption growth in the year of stabilization is highly significant, whereas for non-ERBS no coefficient is significant after the stabilization. For investment growth (columns 5 and 6), there is no difference between the ERBS and non-ERBS sample. It should be said, however, that the coefficient on *T* for the ERBS sample is significant at the 11-percent level, whereas that for non-ERBS is highly insignificant. Hence, whatever effects we found for investment growth in the full sample are also coming from the ERBS sample.

In sum, the evidence shown here suggests that the expansionary effects of stabilization—which are mostly evident in GDP and consumption—are due essentially to the ERBS present in our sample. This is consistent with the idea that the nominal anchor

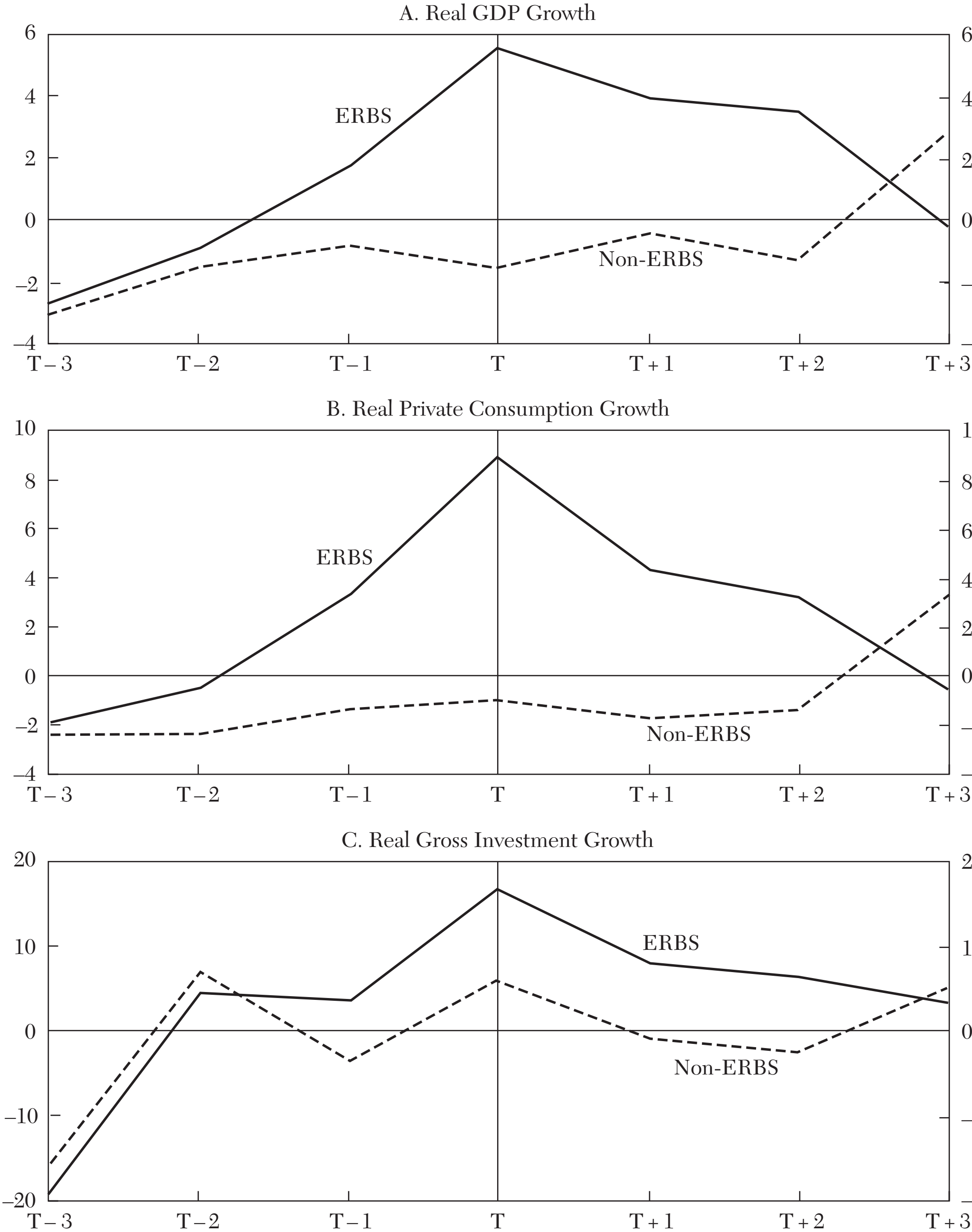

Figure 9. ERBS and Non-ERBS Stabilizations

TABLE 13
EXCHANGE-RATE-BASED VERSUS NON-EXCHANGE-RATE-BASED STABILIZATION

	Dependent Variables					
	Growth in Real GDP		Growth in Real Private Consumption		Growth in Real Gross Investment	
	ERBS (1)	Non-ERBS (2)	ERBS (3)	Non-ERBS (4)	ERBS (5)	Non-ERBS (6)
T–3	–2.94*	–2.93**	–1.51	–3.22	–18.87**	–16.97**
	(–1.70)	(–2.25)	(–0.59)	(–1.74)	(–2.04)	(–2.56)
T–2	–0.79	–1.37	–0.49	–3.02	4.26	6.08
	(–0.46)	(–1.06)	(–0.19)	(–1.58)	(0.46)	(0.92)
T–1	1.56	–0.60	3.28	–1.83	2.85	–3.86
	(0.90)	(–0.48)	(1.29)	(–0.99)	(0.31)	(–0.59)
T	5.34***	–1.55	8.98***	–1.48	16.14	5.81
	(2.90)	(–1.23)	(3.28)	(–0.80)	(1.63)	(0.88)
T + 1	3.60*	-0.07	3.62	-2.00	6.54	-0.74
	(1.65)	(–0.03)	(1.20)	(–0.63)	(0.60)	(–0.06)
T + 2	3.02	–1.04	2.65	–1.08	5.35	–1.87
	(1.52)	(–0.62)	(0.97)	(–0.46)	(0.54)	(–0.22)
T + 3	–0.09	2.37	–0.90	2.98	2.14	4.35
	(–0.04)	(1.35)	(–0.27)	(1.15)	(0.02)	(0.43)
OECD growth	0.59***	0.64***	0.26	0.28	0.38	0.46
	(5.36)	(5.82)	(0.85)	(1.27)	(0.50)	(0.62)
Terms of trade	–0.005***	–0.004***	0.009	0.012**	0.023	0.026
	(–5.00)	(–4.00)	(1.50)	(2.00)	(1.15)	(1.30)
Real LIBOR	–0.39***	–0.36***	–0.52***	–0.44***	–1.00*	–1.04*
	(–3.90)	(–3.60)	(–3.47)	(–2.93)	(–0.52)	(–1.96)
No. of observations	428	428	355	355	365	365

Note: T-statistics in parenthesis. All dependent variables are expressed in per capita terms. Method of estimation was OLS. Significance at the 10-, 5-, and 1-percent level is indicated by one, two, or three stars, respectively.

matters for the real effects of disinflations, with ERBS leading to an initial boom in output and consumption.[66,67]

4.4 *In Search of an Explanation*

The evidence reviewed above suggests that inflation stabilization is expansionary in the short run, particularly when based on the use of the exchange rate as the nominal anchor. Why would that be the case?

To early observers of many of these programs, the most conspicuous feature was the sharp increase in private consumption,

[66] This contrasts with Easterly's (1996) results which suggest, based on a sample of 28 stabilization episodes, that there is no difference between the behavior of ERBS and non-ERBS. In the same spirit, see Javier Hamann (2001).

[67] Note that figure 9 is also suggestive of the late contraction in ERBS discussed in the literature. This feature, however, does not show as significant in the regressions shown in table 13. In this study, we do not make an attempt to focus on these late real effects, for which more observations after the stabilization and perhaps a slightly different methodology would be called for (see Calvo and Végh 1999, and Braumann 2001).

particularly of durable goods.[68] We thus view demand-side considerations as the most plausible explanation for the observed short-run expansions. The most popular demand-side explanation (often referred to as the "temporariness hypothesis") is predicated on the idea that, in light of a rich history of failed stabilization attempts, most stabilization programs in chronic inflation countries are bound to suffer from lack of credibility.[69] Following Calvo (1986), lack of credibility has typically been formalized by positing that agents expect the program to be temporary. In the typical model, cash is needed to purchase goods (via a cash-in-advance constraint) so that a lower nominal interest rate reduces the "effective price" of consumption.[70] Then, a non-credible (i.e., temporary) stabilization induces consumers to switch future consumption toward the present, thus resulting in a consumption boom. If, in addition, prices were sticky, this consumption boom cannot take place under a money-based stabilization because the nominal money supply cannot increase endogenously to accommodate the higher consumption expenditures.

There are two potential problems with the temporariness hypothesis. First, by construction, it can only explain consumption booms in episodes in which the program was non-credible in its early stages. However, since no program in chronic inflation countries is likely to be viewed as fully credible, this is perhaps not a very damaging criticism. More important is the fact that, at a quantitative level, this hypothesis relies critically on a large intertemporal elasticity of substitution. Since estimates of this parameter are typically low, the quantitative explanatory power of this hypothesis is rather limited (Reinhart and Végh 1995b). It should be noted, however, that the formal introduction of durable goods should improve the quantitative performance of this hypothesis for two reasons. First, there is some evidence to suggest that, if durable goods consumption is taken into account, estimates of the intertemporal elasticity of substitution become higher (see Yvon Fauvel and Lucie Samson 1991). Second, in the presence of durable goods, households will also engage in intertemporal *price* speculation (Calvo 1988b). Unfortunately, the additional quantitative power brought about by these additional considerations has not yet been established.

A related, demand-side explanation has been offered by Jose De Gregorio, Pablo Guidotti, and Végh (1998). In their model, consumers follow inventory-type rules (i.e., (S,s) rules) for the purchase of durable goods. While purchases of durable goods are "lumpy" at an individual level (since any given individual consumer only buys/replaces his/her durable good every once in a while), they are initially smooth in the aggregate (as consumers buy/replace durables at different times). Consider now a stabilization that generates some sort of wealth/income effect. In response, some consumers that were not planning to buy/replace their durable good today will decide to bring forward their purchases and perhaps even upgrade (i.e., next year's Toyota becomes today's Mercedes Benz). The resulting "bunching" produces a boom in durable-goods consumption. This boom is necessarily followed by a slowdown because all the consumers that brought forward their purchases of durable goods will not want to replace them for a while. In the

[68] This is supported by data provided in De Gregorio, Guidotti, and Végh (1998) for a small group of countries. For instance, in the 1978 Chilean ERBS, durable goods consumption more than doubled from the beginning of the program to the year in which consumption peaked, while total private consumption increased by only 26 percent. During the 1985 Israeli stabilization (and for the analogous period), durable goods consumption rose by 70 percent compared to 25 percent for total consumption. In the first four years of the Argentine 1991 Convertibility plan, car sales (a good proxy for durable goods consumption) rose by a staggering 400 percent, compared to 30 percent for total private consumption.

[69] See Calvo (1986), Calvo and Végh (1993, 1994a,b), Enrique Mendoza and Martin Uribe (1999), and Francisco Venegas-Martinez (2001), among others.

[70] In a cash-in-advance setting, the "effective price of consumption" is an increasing function of the nominal interest rate.

presence of idiosyncratic shocks, consumers would "de-bunch" over time until a new steady state is reached in which aggregate purchases are constant over time. This mechanism is thus capable of generating a consumption boom-bust cycle without having to resort to lack of credibility.[71]

Yet another and early demand-based explanation of the boom-bust cycle in consumption, originally due to Carlos Rodriguez (1982), was based on backward-looking inflation expectations, in the spirit of Cagan.[72] Specifically, Rodriguez (1982) presents a model in which, due to the interest parity condition, the nominal interest rate falls one-to-one with the rate of devaluation. Since expected inflation is backward-looking, the real interest rate falls, thus expanding aggregate demand on impact. The excess demand for home goods leads to a real appreciation of the domestic currency, which eventually throws the economy into a recession. This model thus provides a coherent and plausible explanation for episodes in which there is an early fall in the domestic real interest rate (as happened in the Argentine 1978 program, which inspired Rodriguez's contribution). It cannot, however, explain programs in which the real interest rate increased on impact, as in many heterodox programs in the mid-1980s (see Calvo and Végh 1999).

Finally, another strand of the literature has focused on the supply-side responses that may be unleashed by stabilization.[73] The main idea is that inflation acts as a "tax" either on labor supply (by distorting the consumption-leisure choice) or on investment (by making it more expensive to hold readily-available working capital). Hence, the removal of such a distortion would lead to a higher labor supply and more investment, resulting in a permanently higher level of output. While such supply-side responses are likely to be a major factor in the long-run (in line with the inflation and growth literature examined above), we remain skeptical about their ability to explain *short-run* expansionary effects. The main problem with this hypothesis is that, empirically, the short-run response of investment seems to be, at best, weak.[74] Also, if true, one should see a short-run expansion in any stabilization, regardless of the nominal anchor.

Which of the above models does better when confronted with the data? Sergio Rebelo and Végh (1995) nest most of the above explanations into a single model and compare their qualitative and quantitative power. In line with the simple models described above, they conclude that only the temporariness and sticky wages models are capable of replicating the key empirical regularities. Quantitatively, however, supply-side effects are key in helping the model account for any sizable fraction of the observed magnitudes. Still, the model has problems in accounting for the large real appreciation observed in most of these programs. Further progress on this quantitative front has been recently made by Ariel Burnstein, Joao Neves, and Rebelo (2000), who show how, by introducing distribution costs into the picture, the model can explain

[71] Again, if some liquid assets were needed to purchase durable goods, this boom could not happen under a money-based stabilization.

[72] See also Dornbusch (1982), Fernandez (1985), Calvo and Végh (1994c) and Ghezzi (2001). Notice that, as shown in Calvo and Végh (1994c), Rodriguez's story can be reinterpreted as applying to a model with rational expectations and sticky wages (reflecting backward looking wage indexation).

[73] See Amartya Lahiri (2000, 2001), Rebelo (1997), Rebelo and Végh (1995), Jorge Roldos (1995, 1997), and Uribe (1997).

[74] Also, at a theoretical level, a somewhat unsatisfactory aspect of some of these models is that they rely on a number of features—gestation lags, adjustment costs, and particularly the assumption that the investment good is a "cash good"—which do not have a clear economic interpretation. In particular, there is no evidence that would seem to tie investment to the level of cash transactions. While, from a qualitatively point of view, the assumption that investment be a "cash good" is not necessary to generate the desired results (as made clear by Lahiri 2001), such an assumption is essential from a quantitative point of view if this type of models is to have any chance of replicating the actual orders of magnitudes observed in the data (see Rebelo and Végh 1995).

TABLE A1
INFLATIONARY EPISODES IN HIGH-INFLATION MARKET ECONOMIES

	Date of Episode		During High Inflation	
Country	Start	End	Duration (in months)	Cumulative Inflation
Afghanistan	July 1988–	June 1989	12	109
Afghanistan	Feb. 1985–	Oct. 1986	21	109
Angola	Jan. 1991–	June 1997	78	287,726,172
Argentina	July 1974–	Oct. 1991	208	3,809,187,961,396
Bolivia	Aug. 1981–	Aug. 1986	61	5,220,261
Brazil	Apr. 1980–	May 1995	182	20,759,903,275,651
Chile	Oct. 1971–	May 1977	68	127,958
Congo, Dem. Rep.	Dec. 1989–	Dec. 1996	85	88,510,051,965
Congo, Dem. Rep.	Feb. 1988–	July 1989	18	202
Congo, Dem. Rep.	July 1986–	Dec. 1987	18	146
Congo, Dem. Rep.	Oct. 1982–	Jan. 1984	16	146
Congo, Dem. Rep.	Feb. 1978–	Aug. 1980	31	317
Congo, Dem. Rep.	Mar. 1967–	Feb. 1968	12	101
Costa Rica	Sept. 1981–	Oct. 1982	14	120
Ghana	May 1982–	Feb. 1984	22	243
Ghana	Feb. 1980–	Dec. 1981	23	257
Ghana	May 1976–	Feb. 1979	34	567
Guinea-Bissau	Sept. 1986–	Feb. 1988	18	146
Israel	Dec. 1978–	Mar. 1986	88	109,187
Jamaica	Apr. 1991–	May 1992	14	124
Lebanon	Aug. 1991–	Dec. 1992	17	118
Lebanon	Mar. 1990–	Feb. 1991	12	100
Lebanon	Aug. 1985–	Aug. 1988	37	2,345
Mexico	Dec. 1985–	Aug. 1988	33	724
Mexico	Feb. 1982–	July 1983	18	180
Nicaragua	May 1984–	Feb. 1992	94	288,735,412,719
Peru	Dec. 1986–	Mar. 1992	64	25,392,223
Peru	June 1982–	Apr. 1986	47	1,953
Sierra Leone	Feb. 1989–	Dec. 1991	35	689
Sierra Leone	Nov. 1986–	Dec. 1987	14	144
Somalia	Oct. 1987–	Nov. 1989	26	388
Somalia	Mar. 1983–	June 1984	16	140
Sudan	Feb. 1990–	June 1994	53	2,715
Suriname	Apr. 1992–	Oct. 1995	43	4,559
Turkey	May 1993–	Mar. 1995	23	269
Turkey	Mar. 1979–	Sept. 1980	19	199
Uganda	Feb. 1984–	Dec. 1988	59	9,071
Uganda	Feb. 1981–	Apr. 1982	15	160
Uruguay	June 1989–	Aug. 1991	27	414
Uruguay	Jan. 1974–	Dec. 1974	12	107
Uruguay	Dec. 1971–	Sept. 1973	22	256
Uruguay	Oct. 1966–	Oct. 1968	25	336
Venezuela	July 1995–	Dec. 1996	18	161
Venezuela	June 1988–	May 1989	12	103
Zambia	Aug. 1988–	Mar. 1994	68	11.713

Sources: IMF, *International Financial Statistics,* national authorities, and IMF desk economists.

TABLE A1 *(Cont.)*

During High Inflation			Twelve Months After High Inflation	
Monthly Inflation Rate			Monthly Inflation Rate	
Geometric Average	Arithmetic Average	Highest	Geometric Average	Highest
6.3	6.5	25.6	2.9	19.8
3.6	n.a.	3.9	1.4	6.4
21.0	22.3	84.1	1.8	3.0
12.4	13.5	196.6	1.4	3.0
19.5	22.1	182.8	0.7	2.4
15.4	16.1	80.7	1.7	4.4
11.1	11.6	87.5	3.0	4.2
27.4	32.0	250.0	n.a.	n.a.
6.3	6.4	20.4	3.1	5.9
5.1	5.2	16.6	5.5	20.4
5.8	5.9	25.1	0.8	3.8
4.7	5.8	76.5	2.8	8.4
6.0	6.1	18.2	–0.1	5.7
5.8	5.8	10.7	1.0	2.6
5.8	6.0	23.4	0.3	4.9
5.7	5.7	13.2	1.3	7.9
5.7	5.9	22.8	1.1	8.9
5.1	5.5	25.0	4.6	12.6
8.3	8.4	27.5	1.7	3.3
5.9	5.9	10.2	1.1	2.5
4.7	5.0	22.6	–0.1	1.9
5.9	6.2	17.7	1.3	10.3
9.0	9.6	50.1	4.4	14.2
6.6	6.6	15.5	1.3	2.5
5.9	5.9	11.2	4.2	6.4
26.1	30.3	261.1	1.6	9.3
21.5	25.9	397.0	3.5	4.8
6.6	6.7	13.9	4.6	6.6
6.1	6.2	19.9	2.5	5.9
6.6	6.9	24.1	2.7	16.1
6.3	6.4	16.8	n.a.	n.a.
5.6	5.8	19.6	2.7	9.0
6.5	6.7	28.3	n.a.	n.a.
9.3	9.7	40.7	–0.3	3.3
5.8	5.9	24.7	5.0	8.3
5.9	6.0	21.5	2.4	8.1
8.0	8,3	37.9	3.8	6.9
6.6	7.0	43.8	1.5	5.3
6.2	6.3	14.7	4.4	6.5
6.3	6.3	16.8	4.4	11.4
5.9	6.1	20.3	4.5	16.8
6.1	6.2	17.9	1.2	2.7
5.5	5.5	12.6	n.a.	n.a.
6.1	6.2	21.3	2.4	3.3
7.3	7.4	29.5	2.4	7.7

a much more sizable fraction of the observed real exchange rate appreciation.

4.5 *In Sum*

There is by now abundant evidence that high inflation is bad for growth. While the debate over the mechanisms and causality are far from being resolved, the negative correlation between high inflation and macroeconomic performance is clearly there. So, at the very least, the old idea that in some sense inflation may be good for growth or is perhaps an inevitable part of the growth process should remain buried in the cemetery of harmful policy ideas.

There is also increasing evidence that stabilization from high inflation is expansionary. While not everybody would accept this notion, different researchers with different methodologies seem to be arriving at similar conclusions. It is at least safe to say that the idea is to be taken seriously and that it is no longer a heresy to think of an expansionary inflationary stabilization program.

We also believe that the evidence supports the idea that the nominal anchor matters and that, other things being equal, exchange-rate-based stabilizations are more likely to be expansionary. This idea also makes sense theoretically: unlike a money-based stabilization which—by its very nature—reduces inflation by inducing a liquidity crunch, in exchange-rate-based stabilizations the money supply is endogenous and will accommodate whatever increase in money demand results from real channels. This why exchange-rate-based stabilizations are so attractive as a means of reducing inflation from very high levels—even though the issue of how to exit from a peg before the advent of a potential crisis remains unresolved.

5. *In Conclusion: Top Ten List on High Inflation*

What have we learned after our long journey through the world of high inflation and stabilization? While the sample of 161 countries (133 market economies and 28 transition economies) offers very rich and diverse experiences, some general conclusions can still be drawn. Here, in our judgment, are the ten most important stylized facts related to high inflation and stabilization:

1. Since 1957, inflation has been commonplace throughout the world. Based on a sample of 133 countries (for a total of close to 45,000 observations), we find that more than two-thirds of the countries have experienced an episode of more than 25-percent per-annum inflation; more than one-third has experienced episodes in excess of 50 percent per annum; close to 20 percent of countries have experienced inflation in excess of 100 percent; and around 8 percent have experienced episodes of more than 400-percent per-annum inflation. The average duration of high-inflation episodes at different levels of inflation is remarkably similar and, at 3–4 years, surprisingly long.

2. In contrast to the market economies, all 28 transition economies experienced at least one episode of inflation above 25 percent per annum. Indeed, almost 80 percent suffered inflation in excess of 400 percent. Most of the extreme inflations in these economies were related to price liberalization.

3. Higher inflation tends to be more unstable. By constructing transition matrices, we find that, as inflation rises, the probability of inflation staying in the same range decreases and the probability that inflation will rise above its current level increases.

4. Since 1947, hyperinflations (meeting Cagan's definition) in market economies have been rare (a total of seven). Much more common have been longer inflationary processes with inflation rates above 100 percent per annum. We define an episode of "very high inflation" as taking place when the twelve-month inflation rate rises above 100 percent. In that case, we take the start of the episode to be the first month of that twelve-month period and the last month to be the first month before the twelve-month inflation rate falls below the lower bound and

stays there for at least twelve months. We identified 45 such episodes in 25 countries. Thirty-seven of these very high-inflation episodes took place in either Latin America or Africa. The duration of these episodes ranges from the minimum possible (twelve months) to 208 months (Argentina 1974–91). Monthly average inflation rates during these episodes vary from 3.6 percent to 27.4 (Democratic Republic of Congo 1989–96).

5. As expected, the long-run (cross-section) relationship between money growth and inflation is very strong. When the sample is divided between low- and high-inflation countries, the relationship is found to be stronger for high-inflation than for low-inflation countries. In the pooled, cross-section time-series panels, we find that the money-inflation link remains strong for the sample as a whole. When the sample is divided, however, the relationship for high-inflation countries is basically unchanged compared to the long run, whereas that for the low-inflation countries becomes much weaker.

6. The long-run relationship (based on cross-section data) between fiscal balance and seigniorage is significant and negative. In the short run, the relationship is strong for high inflation countries but insignificant for low inflation countries.

7. The expected positive relationship between fiscal deficits and inflation cannot always be detected in the data. We find no significant long-run (cross-section) relationship between fiscal deficits and inflation. In the annual cross-section time series panels, the relationship is significant for the high inflation countries but not for the low inflation countries.

8. Inflation inertia—defined either as the mean lag length or the median lag length of an autoregressive inflation process—falls as the level of inflation rises. This evidence supports the notion that nominal rigidities are weakened as inflation reaches higher levels.

9. Periods of high inflation are associated with bad macroeconomic performance. In particular, high inflation is bad for growth. The evidence is based on a sample of eighteen countries that have experienced very high inflation episodes. During such periods, real GDP per capita fell on average by 1.6 percent per annum (compared to positive growth of 1.4 percent in low inflation years); private consumption per capita fell by 1.3 percent (compared to 1.7 percent growth in low inflation years) and investment growth fell by 3.3 percent (compared to positive growth of 4.2 percent in low inflation years).

10. Exchange rate-based stabilizations appear to lead to an initial expansion in real GDP and real private consumption. Stabilizations which were not based on the exchange rate do not appear on average to have had a significant effect on output, consumption, or investment.

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