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The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

CORRIGENDUM

The attached corrections to WP/02/197 (November 2002) have been provided by the staff:

Pages 2 and 3: to reflect changes in page numbering due to inadvertent omission of tables and figure and minor editorial changes. Subsequent pagination renumbered accordingly.

Page 35, first para., line 6: for “Table 12” read “Appendix Table 14”

Page 46, Table 12: inadvertently omitted

Page 51, Table 13: inadvertently omitted

Page 52, Figure 9: inadvertently omitted

Page 56 (now page 59), table title: for “Appendix Table 12” read “Appendix Table 14”

Corrected pages are attached.

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Modern Hyper- and High Inflations

Prepared by Stanley Fischer, Ratna Sahay, and Carlos Végh¹

November 2002

Abstract

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Since 1947, hyperinflations (by Cagan's definition) in market economies have been rare. Much more common have been longer inflationary processes with inflation rates above 100 percent per annum. Based on a sample of 133 countries, and using the 100 percent threshold as the basis for a definition of *very high inflation* episodes, this paper examines the main characteristics of such inflations. Among other things, we find that (i) close to 20 percent of countries have experienced inflation above 100 percent per annum; (ii) higher inflation tends to be more unstable; (iii) in high-inflation countries, the relationship between the fiscal balance and seigniorage is strong both in the short and longrun's; (iv) inflation inertia decreases as average inflation rises; (v) high-inflation is associated with poor macroeconomic performance; and (vi) stabilizations from high inflation that rely on the exchange rate as the nominal anchor are expansionary.

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I. 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 10 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-20th 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 A.D., 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 Capie (1991), and Sargent and 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 have also been in this decade hyperinflations in transition economies, particularly the countries of the former Soviet Union.

² The seven hyperinflations were: Austria, October 1921–August 1922; Russia, December 1921–January 1924; Germany, August 1922–November 1923; Poland, January 1923–January 1924; Hungary I, March 1923–February 1924; Greece, November 1943–November 1944; and Hungary II, August 1945–July 1946. In addition, there was, by Cagan's definition, a hyperinflation in China from October 1947 to March 1948 (Huang, 1948).

³ Inflation in the century leading up to Diocletian's price control edict in 301 A.D. appears to have averaged under 4 percent per annum (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.

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 II.B 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 Appendix Table 14 (as in Democratic Republic of Congo, Ghana, Mexico, Sierra Leone, Uganda, and Uruguay) when subsequent episodes were adequately close (less than 10 quarters). The sample of countries was thus reduced to 16, 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. Since unit roots were present in several episodes, the regressions were run in first differences, following Hamilton (1994, pp. 528). Specifically, equation (2) can be rewritten as:

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

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 β s in equation (5) were estimated and the α s 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, either in the high or in the low inflation episodes. In three other countries—Chile, Nicaragua and Sierra Leone—the degree of inertia

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.

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 inflation	Calculated Coefficients of Lags								Appropriate	Mean	Median	R-squared
			a ₁	a ₂	a ₃	a ₄	a ₅	A ₆	a ₇	a ₈				
Argentina	1959:2-1974:2	28.0	0.46	0.06	-0.07	0.34	0.05	-0.37			6	3.4	4.0	0.369
	1974:3-1991:3	310.6	0.47								1	1.0	1.0	0.220
	1991:4-1997:1	6.2	0.30	0.12	0.11	-0.22	0.10	-0.02	-0.03	0.06	8	3.2	3.0	0.916
Bolivia	1959:2-1981:2	12.5	0.49	0.14	-0.29	0.24	0.27	-0.26			6	3.3	3.0	0.412
	1981:3-1986:3	789.3	0.58								1	1.0	1.0	0.337
	1986:4-1997:1	12.3	0.28	-0.13	-0.30	0.27	0.04	-0.08			6	2.9	3.0	0.346
Brazil 2/	1959:2-1980:2	38.0	0.85	-0.19	0.13	0.39	-0.28				5	2.5	2.0	0.753
	1980:3-1997:2	357.6	0.81								1	1.0	1.0	0.652
Chile	1959:2-1971:3	24.7	0.34	0.05	0.04	0.29	0.11	-0.33			6	3.7	4.0	0.324
	1971:4-1977:2	229.9	0.56								1	1.0	1.0	0.333
	1977:3-1997:2	19.4	0.50								1	1.0	1.0	0.610
Congo, Dem. Republic. Of	1968:2-1977:4	26.1	0.07	0.04	0.00	0.19	-0.12	-0.31	0.47		7	5.6	6.0	0.783
	1978:1-1997:3	281.8	0.94	-0.66	0.80	-0.67	0.56	-0.47	0.36		7	3.5	3.0	0.656
Ghana	1963:3-1976:1	13.3	0.14	-0.10	0.29	0.16	0.13	-0.49			6	4.2	4.0	0.524
	1976:2-1984:1	72.2									0	0.0	0.0	0.00
	1984:2-1997:1	27.7	0.76	-0.54	0.33	0.18	-0.33				5	2.4	2.0	0.664
Israel	1959:2-1978:3	14.3	0.51	-0.16	0.26	0.18	-0.08	0.31			6	3.1	3.0	0.738
	1978:4-1986:3	139.9	0.22	0.34	0.04	0.10	-0.90	0.05	0.05	0.90	8	5.3	5.0	0.773
	1986:4-1997:2	14.1									0	0.0	0.0	0.00
Mexico	1959:1-1981:4	10.1	0.30								1	1.0	1.0	0.647
	1982:1-1988:3	90.6	0.69								1	1.0	1.0	0.555
	1988:4-1997:4	20.6	0.53								1	1.0	1.0	0.278

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

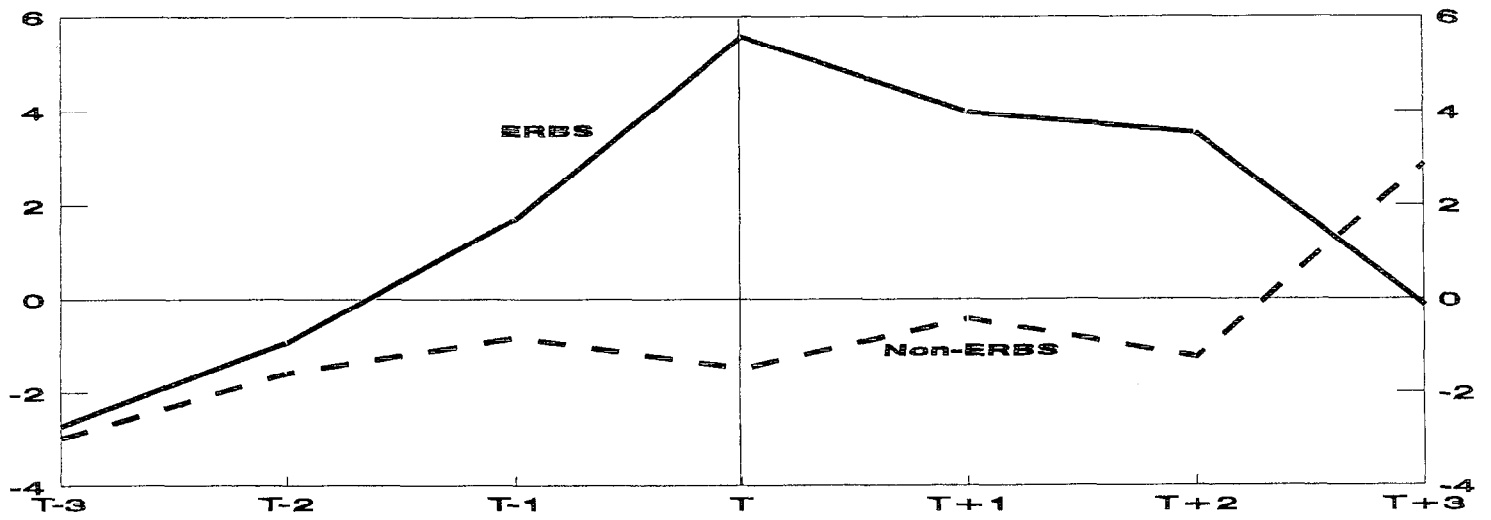
Table 13. Exchange-Rate Based Versus Non-Exchange Rate Based Stabilization

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

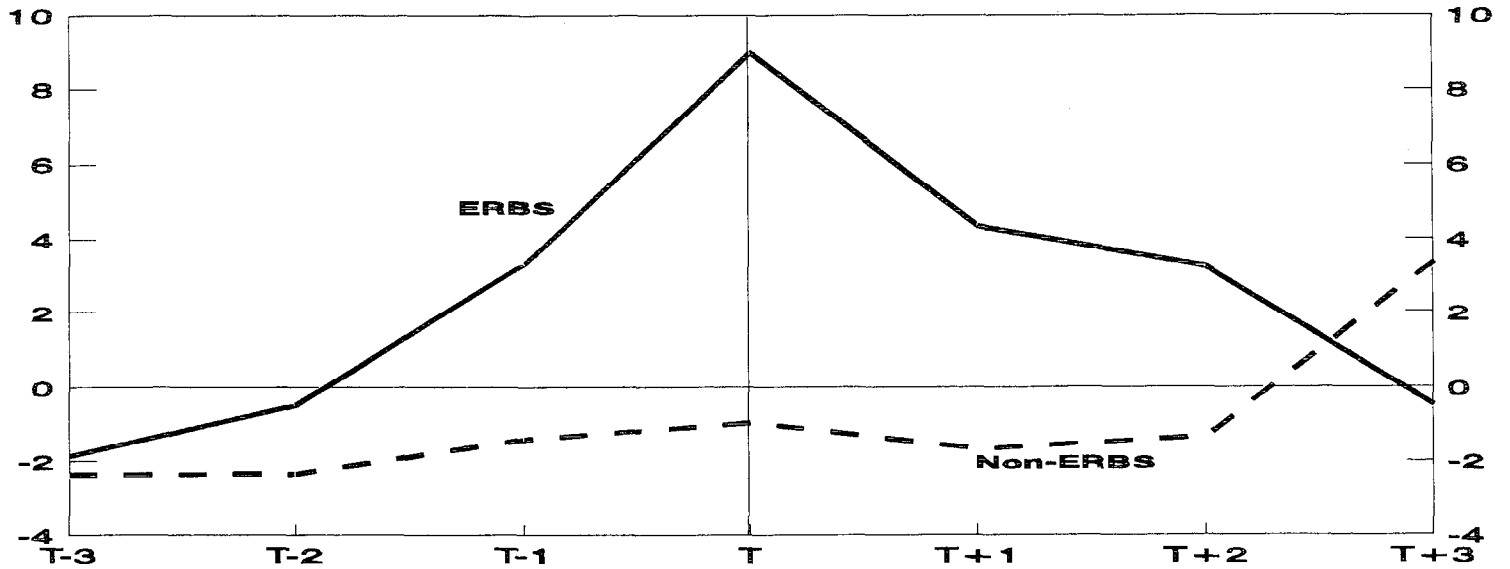
Note: T-statistics in parenthesis. All dependent variables are expressed in per capita terms. Method of estimation was OLS. Significance at the 10, 5, and 1 percent level is indicated by one, two, and three stars, respectively.

Figure 9. ERBS and Non-ERBS Stabilizations

A. Real GDP Growth



B. Real Private Consumption Growth



C. Real Gross Investment Growth

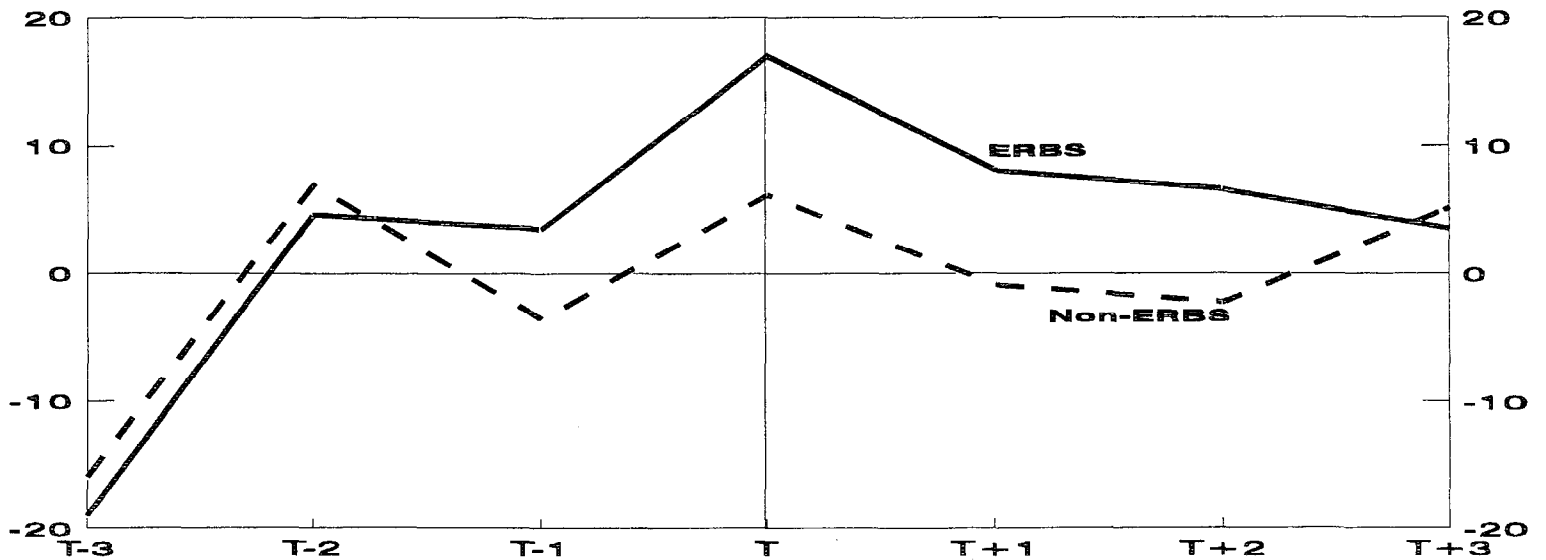


Table 14. Inflationary Episodes in High-Inflation Market Economies

Country	Date of Episode		During High Inflation					Twelve Months After High Inflation	
			Duration (In months)	Cumulative Inflation	Monthly Inflation Rate			Monthly Inflation Rate	
	Start	End			Geometric Average	Arithmetic Average	Highest	Geometric Average	Highest
Afghanistan	July 1988	June 1989	12	109	6.3	6.5	25.6	2.9	19.8
Afghanistan	Feb. 1985	Oct. 1986	21	109	3.6	N.A.	3.9	1.4	6.4
Angola	Jan. 1991	June 1997	78	287,726,172	21.0	22.3	84.1	1.8	3.0
Argentina	July 1974	Oct. 1991	208	3,809,187,961,396	12.4	13.5	196.6	1.4	3.0
Bolivia	Aug. 1981	Aug. 1986	61	5,220,261	19.5	22.1	182.8	0.7	2.4
Brazil	Apr. 1980	May 1995	182	20,759,903,275,651	15.4	16.1	80.7	1.7	4.4
Chile	Oct. 1971	May 1977	68	127,958	11.1	11.6	87.5	3.0	4.2
Congo, Dem. Rep. of	Dec. 1989	Dec. 1996	85	88,510,051,965	27.4	32.0	250.0	N.A.	N.A.
Congo, Dem. Rep. of	Feb. 1988	July 1989	18	202	6.3	6.4	20.4	3.1	5.9
Congo, Dem. Rep. of	July 1986	Dec. 1987	18	146	5.1	5.2	16.6	5.5	20.4
Congo, Dem. Rep. of	Oct. 1982	Jan. 1984	16	146	5.8	5.9	25.1	0.8	3.8
Congo, Dem. Rep. of	Feb. 1978	Aug. 1980	31	317	4.7	5.8	76.5	2.8	8.4
Congo, Dem. Rep. of	Mar. 1967	Feb. 1968	12	101	6.0	6.1	18.2	-0.1	5.7
Costa Rica	Sept. 1981	Oct. 1982	14	120	5.8	5.8	10.7	1.0	2.6
Ghana	May 1982	Feb. 1984	22	243	5.8	6.0	23.4	0.3	4.9
Ghana	Feb. 1980	Dec. 1981	23	257	5.7	5.7	13.2	1.3	7.9
Ghana	May 1976	Feb. 1979	34	567	5.7	5.9	22.8	1.1	8.9
Guinea-Bissau	Sept. 1986	Feb. 1988	18	146	5.1	5.5	25.0	4.6	12.6
Israel	Dec. 1978	Mar. 1986	88	109,187	8.3	8.4	27.5	1.7	3.3
Jamaica	Apr. 1991	May 1992	14	124	5.9	5.9	10.2	1.1	2.5
Lebanon	Aug. 1991	Dec. 1992	17	118	4.7	5.0	22.6	-0.1	1.9
Lebanon	Mar. 1990	Feb. 1991	12	100	5.9	6.2	17.7	1.3	10.3
Lebanon	Aug. 1985	Aug. 1988	37	2,345	9.0	9.6	50.1	4.4	14.2
Mexico	Dec. 1985	Aug. 1988	33	724	6.6	6.6	15.5	1.3	2.5
Mexico	Feb. 1982	July 1983	18	180	5.9	5.9	11.2	4.2	6.4
Nicaragua	May 1984	Feb. 1992	94	288,735,412,719	26.1	30.3	261.1	1.6	9.3
Peru	Dec. 1986	Mar. 1992	64	25,392,223	21.5	25.9	397.0	3.5	4.8
Peru	June 1982	Apr. 1986	47	1,953	6.6	6.7	13.9	4.6	6.6
Sierra Leone	Feb. 1989	Dec. 1991	35	689	6.1	6.2	19.9	2.5	5.9
Sierra Leone	Nov. 1986	Dec. 1987	14	144	6.6	6.9	24.1	2.7	16.1
Somalia	Oct. 1987	Nov. 1989	26	388	6.3	6.4	16.8	N.A.	N.A.
Somalia	Mar. 1983	June 1984	16	140	5.6	5.8	19.6	2.7	9.0
Sudan	Feb. 1990	June 1994	53	2,715	6.5	6.7	28.3	N.A.	N.A.
Suriname	Apr. 1992	Oct. 1995	43	4,559	9.3	9.7	40.7	-0.3	3.3
Turkey	May 1993	Mar. 1995	23	269	5.8	5.9	24.7	5.0	8.3
Turkey	Mar. 1979	Sept. 1980	19	199	5.9	6.0	21.5	2.4	8.1
Uganda	Feb. 1984	Dec. 1988	59	9,071	8.0	8.3	37.9	3.8	6.9
Uganda	Feb. 1981	Apr. 1982	15	160	6.6	7.0	43.8	1.5	5.3
Uruguay	June 1989	Aug. 1991	27	414	6.2	6.3	14.7	4.4	6.5
Uruguay	Jan. 1974	Dec. 1974	12	107	6.3	6.3	16.8	4.4	11.4
Uruguay	Dec. 1971	Sept. 1973	22	256	5.9	6.1	20.3	4.5	16.8
Uruguay	Oct. 1966	Oct. 1968	25	336	6.1	6.2	17.9	1.2	2.7
Venezuela	July 1995	Dec. 1996	18	161	5.5	5.5	12.6	N.A.	N.A.
Venezuela	June 1988	May 1989	12	103	6.1	6.2	21.3	2.4	3.3
Zambia	Aug. 1988	Mar. 1994	68	11,713	7.3	7.4	29.5	2.4	7.7

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