Disinflating from Moderate Inflation in Latin America and the Caribbean[1]

Marc Hofstetter[2]

Abstract

This paper studies the behavior of several macroeconomic variables during disinflationary episodes in Latin-America and the Caribbean (LAC). In particular, it focuses on disinflations from low and moderate peaks for the period 1973-2001. The methodology used for studying the average behavior of macroeconomic variables across disinflations overcomes the traditional problem of scarce long time series (of high frequency data) that has hindered the empirical research of monetary shocks in many LAC countries. Some of the important findings are as follows: i) while GDP growth slowed down during the disinflations of the 70s and 80s, there is no evidence of this for the 90s; ii) the trade balance significantly deteriorated during the disinflations; iii) the nominal devaluation rate slowed down during the episodes; and iv) the real exchange rate appreciated during the episodes.

Resumen

Este artículo estudia el comportamiento de algunas variables macroeconómicas durante procesos desinflacionarios en América Latina y el Caribe. En particular, el artículo se enfoca en las desinflaciones desde picos inflacionarios bajos y moderados para el período 1973-2001. Al estudiar el comportamiento de las variables a través de las desinflaciones, se supera la necesidad de largas series de tiempo de variables macro de alta frecuencia, que ha obstaculizado el análisis empírico de choques monetarios en la región. El artículo encuentra que: i) el crecimiento económico se desaceleró durante las desinflaciones de los 70s y 80s, pero no durante las caídas de la inflación de los 90s; ii) la balanza comercial se deterioró durante las desinflaciones; iii) la depreciación nominal se redujo durante los episodios estudiados y iv) la tasa de cambio real se apreció durante las desinflaciones.

Keywords: Inflation, Growth, Disinflation, Trade Balance, Exchange Rate.
Palabras clave: Inflación, Crecimiento, Desinflación, Balanza comercial, Tasa de cambio.
Clasificación JEL: E31, E32, E52, F43.

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[2] Department of Economics and CEDE Universidad de los Andes. E-mail: mahofste@uniandes.edu.co

I. INTRODUCTION

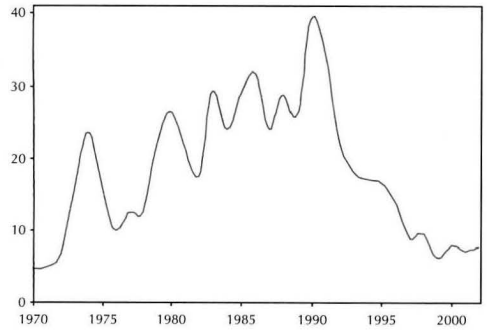
In response to the infamous inflation in Latin-America and the Caribbean (LAC) during the 70s, 80s and early 90s , economists studied exhaustively the region's attempts at stabilization from high inflation rates (*e.g.*, Calvo and Végh, 1999; Hamann, 2001). During the 1990s, LAC countries undertook what would turn out to be a very successful disinflationary process. Indeed, since 1997, more than half of the LAC countries have had annual inflation rates below 10% with the average being below 15%, a scenario that had not occurred since 1971. Given this new inflation scenario, it has become apparent that policymakers will face, in the present and in the near future, questions related to disinflations from moderate or low inflation rates and the sustainability of reasonable price stability. Given this fact, it is striking to observe how little attention has been devoted in the literature to the behavior of LAC economies during such disinflations.

The relevance of disinflations can hardly be overstated, as they significantly affect many aspects of the macroeconomic environment. Mankiw (2004, p. 523), for instance, argues that when "economies reduce their rate of inflation, they almost always experience a period of high unemployment and low output". Eichenbaum and Evans (1995, p. 1006) find that during disinflations, there are "significant, persistent appreciations in exchanges rates, both nominal and real". Finally, Lane (2000) shows that disinflations are associated with significant deteriorations in current accounts.

Unfortunately, those conclusions are mainly based on empirical results obtained using data from developed countries, and very little is known as to whether they hold for developing economies. This aspect is particularly important as, from a theoretical point-of-view, developing economies have characteristics that could alter the conclusions cited above. For instance, many developing countries have been plagued by repeated inflationary crises that might erode nominal rigidities, alter the expectations formation mechanisms and deteriorate the credibility of policymakers. Furthermore, many developing nations have generated indexation mechanisms that might also influence macroeconomic variables during disinflations (Fischer, 1988). Finally, it is also important to note that, generally speaking, these countries do not have unemployment insurance. The latter has been shown to be an important determinant of the long-run implications of monetary policy (Ball 1997, 1999). Given the relevance of these elements in models dealing with disinflation, many of the stylized facts supported by OECD data, do not necessarily extend to the case of developing countries. Obtaining a set of stylized facts related to what happens to several macroeconomic variables during disinflations in developing economies is important both for policymakers and academic researchers. The aim of this paper is precisely to provide such evidence.

There are several reasons explaining why the literature has not focused on this important topic for developing nations. The first obvious reason is that low inflation is a new phenomena in the region. Indeed, the LAC countries had a terrible inflation history during the 70s, 80s and early 90s. That dark inflation period peaked in 1990 when LAC's median inflation rate reached a staggering 39.4%, corresponding to an average annual rate across countries of 1152% (see Graph 1). With those statistics, it is not surprising that research in LAC -both theoretical and empirical- has focused on stabilization attempts from *high* inflation, neglecting the analysis of disinflations from moderate and low peaks. Additionally, the lack of proper data has also impeded systematic research in this area. Indeed, the use of VAR (and similar) estimation methods and the consequent examination of impulse response functions -common

Graph 1. THE MEDIAN INFLATION RATE FOR THE LAC COUNTRIES, 1970-2002



Source: Author's calculations based on International Monetary Fund, *International Financial Statistics*, various issues.

tools in the analysis of monetary shocks- has been very scarce in LAC samples. This is mainly because these techniques require long high-frequency time series of several macro variables, ideally over time spans during which the economy has been stable (in the sense of not experiencing, for instance, hyperinflation). The lack of such data has also hindered research on disinflations in many LAC countries.

The goal of this paper is to study the behavior of LAC economies during disinflations from low and moderate inflation peaks. It focusses on a set of four important macroeconomic variables: inflation, output growth, trade balance and exchange rates. The main objective is to set the stylized facts straight and point out cases where we might need new theories or further empirical work to explain particular outcomes. In this paper we do not attempt to go beyond this description of the main macroeconomic stylized facts and some preliminary speculations explaining some outcomes we find. A few of the interesting questions that arise from the stylized facts identified along the paper, are more deeply explored in a couple of companion papers (Hofstetter, 2007a and 2007b). Other relevant questions are left for future research.

To overcome the lack of long time series of high frequency data, this paper emphasizes the *cross-section* evidence on disinflations, taking advantage of the existence of disinflation episodes in several LAC economies. In doing so, the data availability hurdle is avoided. At the same time, predictions on the paths followed by the variables after disinflationary shocks are obtained and their statistical significance made assessable.

Some of our most important findings are the following: i) there is a significant GDP growth slowdown during the disinflations of the 70s and 80s but no evidence of such a slowdown during the 90s; ii) there is a significant deterioration of the trade balance during disinflations; iii) the nominal devaluation rate slows down during the disinflations, mimicking the path followed by the inflation rate and iv) the real exchange rate appreciates during the episodes.

The remainder of the paper is organized as follows: Section II begins by describing the sample of disinflations in the LAC countries (for low and moderate peaks) for the period 1973-2001 and highlighting some relevant summary statistics. The average behavior across episodes of several macroeconomic variables is then analyzed. This strategy is applied to the current account in section III, the GDP growth in section IV, and the exchange rate in section V. In all cases the analysis is framed within a discussion of the possible hypotheses that might explain the results. Section VI concludes, discusses policy-implications and considers possible avenues for future research and limitations.

II. DISINFLATIONS IN LAC

The set of disinflations from low and moderate peaks in the LAC countries used here is borrowed from Hofstetter (2007a). Before proceeding any further, we

highlight the main characteristics of his methodology to identify disinflations from low and moderate trend inflation rates and describe a few summary statistics from the sample.[3] Readers interested in a more detailed discussion of the method and the related literature should refer to Hofstetter (2007a).

A. Disinflation

A disinflation starts at the inflation peak (labeled period , ends at the trough (period and requires that: i) the peak is 30% or less; ii) the inflation rate drop by at least 1.5% points between peak and trough; iii) inflation should fall 1/4 or more from its initial level (for example, if the peak is 16%, we require inflation to drop to at least 12%); iv) a revision of the historical records corroborate that economic policy was indeed disinflationary. Hofstetter (2007a) applied this rule to the LAC countries for the period 1973-2000, and identified 34 episodes. This is the sample of disinflations used throughout this paper. Table A in the appendix reproduces the list of episodes included and their main characteristics.

Table 1. SUMMARY STATISTICS OF DISINFLATIONS

	LAC 1973: 2000	
	Inflation Peaks Below 20%	**Inflation Peaks 20% - 30%**
Number of episodes	18	16
In the 70's and 80's	11	11
In the 90's	7	5
Average Length of Episodes (in years)	2.9	2.8
In the 70's and 80's	2.7	2.5
In the 90's	3.3	3.4
Maximum Peak	19.6	29.6
Average Peak	16.1	25.4
In the 70's and 80's	16.0	25.4
In the 90's	16.3	25.5
Average Drop in Inflation	8.8	13.8
In the 70's and 80's	8.3	13.1
In the 90's	9.8	15.1
Percentage Average Drop in Inflation	55.2	53.8
In the 70's and 80's	51.7	51.1
In the 90's	60.6	59.6
Average Speed	3.4	5.6
In the 70's and 80's	3.6	5.6
In the 90's	3.1	5.5

Source: Hofstetter, (2007a).

B. Stylized facts

Table 1 presents summary statistics condensing relevant aspects of average disinflations. It presents separate statistics for the episodes from the 90s. The reason for this is that during that decade, most LAC countries pursued structural reforms, inclusive of a sharp move towards independent Central Banks (*e.g.*, Lora, 2001). By looking at the 90s separately, we take a first look at the potential impact these reforms had on our variables of interest during disinflations. Table 1 shows that LAC disinflations last roughly three years and usually cut the inflation rate by half. Moreover, disinflations during the 90s were longer and stronger. Indeed, episodes during the earlier decades lasted 10 quarters, whereas during the 90s, the average jumped to 13. During the 90s, disinflations were also more pronounced. This manifested itself both in points dropped during average episodes and in relative terms with respect to the initial peak.

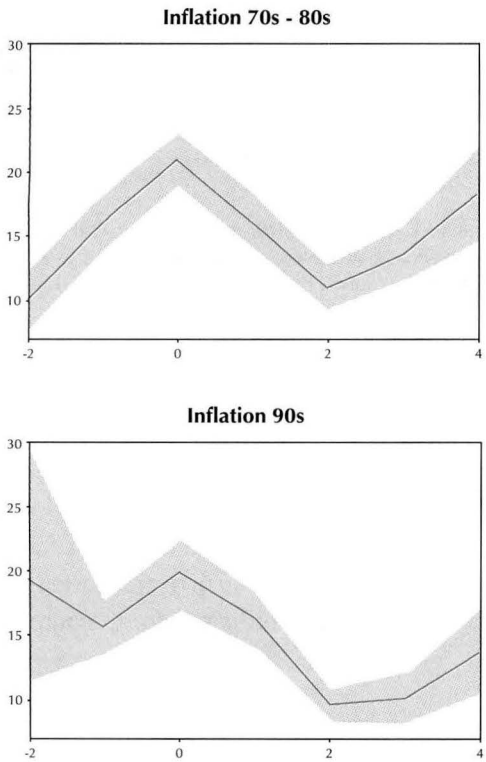
Complementing the results in Table 1, Figure takes an alternative look at the data by plotting the average inflation across episodes for the periods (-2,4), where again period 0 corresponds to the inflation peak. Thus, for instance, the inflation rate for period 1 of the Figure is obtained by averaging the inflation rates for that period across episodes. Furthermore,

[3] Trend inflation corresponds to an eight-quarter moving average of the quarterly CPI inflation rate, as in Ball (1994).

the graph is built using only episodes lasting two to three years. This allows to focus on the 'representative disinflation' -almost 3/4 of all LAC episodes last between 2 to 3 years-.

The most prominent fact that emerges from Graph 2 is that the inflation rate following episodes does pick up considerably in the 70s and 80s, whereas during the 90s, the post-episode inflation rate appears to stabilize below the starting point. This signals that, during the 90s, countries were able to lock-in the gains made by disinflations but were unable to do so during the earlier decades. In Hofstetter (2007b), I show that this fact also occurs in disinflations of the G7 nations and study the determinants of the sustainability of disinflations.

Graph 2. INFLATION IN 2-3 YEAR LONG EPISODES WITH 90% INTERVALS (Shaded areas)



Source: Hofstetter, (2007a).

In what follows, we study the behavior of the current account, GDP growth and the exchange rate, each in a separate section. In each case, we first discuss the expected path of each variable according to economic theory and the empirical results of other studies (usually with OECD data). We then provide graphical evidence on the average behavior of each variable in our sample of LAC disinflations and finally perform some statistical tests to verify the robustness of the results emerging from the plots.

III. THE CURRENT ACCOUNT DURING DISINFLATIONS

How does the current account react to disinflationary shocks? From a theoretical standpoint, the traditional results pioneered by the Mundell-Fleming model predict that the current account should worsen following a contractionary monetary shock. Using a more modern and sophisticated framework, Obstfeld-Rogoff (1995) support this implication. Nevertheless, this view has not gone unchallenged. For instance, Lane (2000), building on the Redux framework by adding a non-tradable sector, shows that the effect of monetary shocks on the current account is ambiguous; it depends on the relative size of the intertemporal elasticity of substitution vis a vis the intratemporal elasticity between traded and non-traded goods.[4]

[4] A contractionary monetary shock appreciates the exchange rate (that is, the prices of tradable goods fall) and reduces the production and consumption of non-tradables. As the consumption of non-tradables decreases, so does the consumption of tradables if the elasticity of substitution between the goods is low (relative to the intertemporal elasticity). Such a scenario leads to an improvement of the current account. If the elasticity of substitution between the goods is higher, then the short-run real appreciation effect dominates, and the contractionary shock sends the current account into deficit.

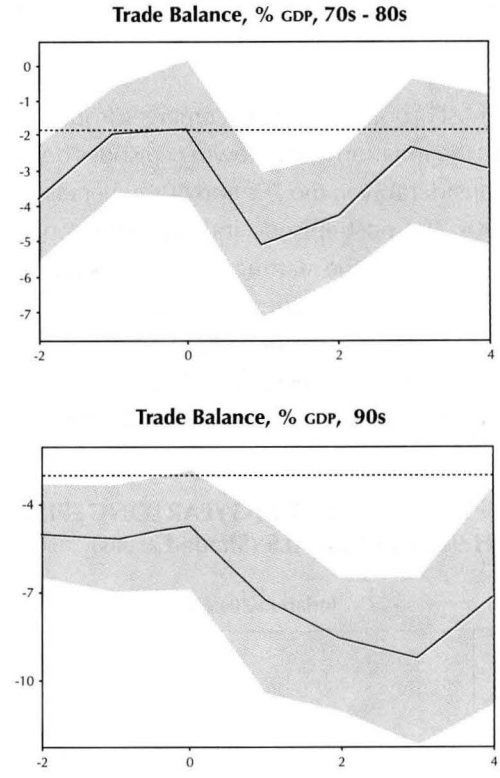
From an empirical standpoint, Lane (2000), shows that, in the US, the current account responds *positively to expansionary* monetary shocks. That effect is significant and occurs following a short period during which the current account actually goes into deficit. In other words, the current account follows a *J-curve* type of path after a positive monetary shock.

A. Current Account I: the impulse response

For the empirical tests in this section, we use the trade balance as a proxy of the current account. The reason for this is that the trade balance data has a better coverage of our sample than the data on the current account. Graph 3 depicts the average reaction of the trade balance across episodes following a disinflationary shock. Again, period 0 is where inflation reached its peak, and the plots include only two- and three-year long episodes. We also include a line representing the average trade balance in LAC during period 0.[5] The line allows for a comparison of the variable's evolution against a regional threshold. Finally, 90% confidence intervals are included (the shaded areas).

The trajectory of the trade balance -both during the 70s and 80s and during the 90s-, exhibits a peak in period 0 and a sharp deterioration during disinflation. Nevertheless, there are important quantitative differences across the decades. The worsening of the trade balance during the 90s begins from a much larger initial deficit, such that by the time the deterioration process reaches its trough, the mean trade balance deficit is almost twice as large as that of the earlier decades. Of course, what fuels those level differences, are the huge capital inflows that flooded the region during the first half of the 90s; these allowed the financing of overall larger current account deficits.[6] Nevertheless, for the purposes of

Graph 3. TRADE BALANCE AS A PERCENTAGE OF GDP DURING DISINFLATIONS



Note: Shaded regions are 90% confidence intervals. The straight lines represent the weighted median trade balance (as a percentage of GDP) of LAC during period 0 for the respective decades.
Source: Hofstetter, (2007a).

[5] The measure is actually a weighted average of LAC's median trade balance as a percentage of GDP, for period 0. The weights are the number of episodes for each year. Put in another way, if we suppose n_1 episodes starting at t_1 and n_2 episodes starting at t_2 and set g_t as the average trade balance of LAC at t, the dashed line becomes:

$$\frac{(n_1 * gt_1) + (n_2 * gt_2)}{n_1 + n_2}$$

[6] For a good discussion on the capital inflow dynamics to the LAC countries during the 90s, see Calvo, Reinhart and Leiderman's trilogy, (1993, 1994 & 1996).

this paper, what matters most is the reaction of the current account following disinflationary shocks, rather than the initial (deficit) level. Under that optic, the crucial point is that -in line with Lane's empirical findings for the US (2000)- the plots suggest that LAC disinflationary shocks are indeed followed by a significant trade balance deterioration.

B. Current Account II: the whole sample

The results in Figure focused on two and three year long episodes. Here we provide further evidence concerning the behavior of the trade balance *during* disinflations using the whole sample of episodes. The main hypothesis we test is whether the trade balance during disinflations is smaller than those *before* and *after* the episodes. The graphical evidence suggested that the deterioration of the trade balance should start in period 1. Building on that finding, the '*during* group' is defined as periods [1,T] with '*before*' and '*after*' constituting the three adjacent years preceding and following the during sample respectively. We then test whether there are statistically significant *differences* between the means of each of these three groups. The results are presented in Table 2 for the 70s and 80s, and in Table 3 for the 90s.

The first result that stands out is that the current account does indeed worsen during disinflations relative to the trade balance *prior* to them. This results holds across the decades and is statistically significant in the baseline test.

Interestingly, the trade balances *after* and *during* disinflations are not statistically different. This result implies that the current account does not recuperate rapidly, *i.e.*, monetary shocks seem to have long-lasting effects on the trade balance. For the 90s, that result is even more emphatic: during that decade, the trade balance *before* the disinflation is larger than after and that difference is significant, though only at the 10% level. In other words, the deterioration of the trade balance did not stop with the end of disinflations.

1. Robustness

The last four columns of Tables 2 and 3 perform some robustness tests. Column (1) controls for exogenous

Table 2. TRADE BALANCE AS A PERCENTAGE OF GDP, 1970s & 1980s

1970s & 1980s	Number of Observations	Mean Trade Balance % GDP	Robustness (1)	(2)	(3)	(4)
Before Peak [-2, 0]	66	-2.66	-0.91	-2.51	-2.67	-0.68
During Episode [1, T]	57	-4.19	-1.71	-4.19	-4.15	-1.52
After Trough [T + 1, T + 3]	66	-3.36	-1.68	-3.29	-3.36	-1.71
H_0: Before = During, t-stat		1.81 **	0.94	1.74 **	1.70 **	0.85
H_0: After = During, t-stat		0.98	0.37	0.99	0.90	0.20
H_0: Before = After, t-stat		0.86	0.94	0.79	0.85	1.04

* Significant at 10% level; ** Significant at 5% level; *** Significant at 2.5% level.
(1) Annual Trade Balance deficit measured in deviations w.r.t LAC annual median.
(2) Trade Balance Deficit. Sample excluding observation if: inflation surpasses 40% or they hit a neighboring episode.
(3) Trade Balance Deficit. "During" sample restricted to [1, 4] length.
(4) Trade Balance Deficit. All restrictions (1) - (3) simultaneously in place.

Table 3. TRADE BALANCE AS A PERCENTAGE OF GDP, 1990s

1990s	Number of Observations	Mean Trade Balance % GDP	Robustness (1)	(2)	(3)	(4)
Before Peak [-2,0]	36	-5.20	-2.19	-4.30	-2.67	-1.56
During Episode [1, T]	40	-8.30	-4.00	-8.28	-4.15	-3.91
After Trough [T + 1, T + 3]	29	-7.30	-3.42	-7.19	-3.36	-3.54
H_0: Before = During, t-stat		2.43 ***	1.45 *	2.7 ***	2.28 ***	1.58 *
H_0: After = During, t-stat		0.75	0.45	0.75	0.67	0.25
H_0: Before = After, t-stat		1.5 *	1.23	1.74 **	1.49 *	1.21

* Significant at 10% level; ** Significant at 5% level; *** Significant at 2.5% level.
(1) Annual Trade Balance deficit measured in deviations w.r.t LAC annual median.
(2) Trade Balance Deficit. Sample excluding observation if: inflation surpasses 40% or they hit a neighboring episode.
(3) Trade Balance Deficit. "During" sample restricted to [1, 4] length.
(4) Trade Balance Deficit. All restrictions (1) - (3) simultaneously in place.

shocks that might affect the regional trade balance (for instance, the debt crisis of the early 80s) and are independent of the disinflationary shocks. To control for these exogenous shocks, we obtain for each country and year in the sample the deviations of trade balance from the LAC annual median and repeat the tests of the baseline case using the transformed data. Column (2) verifies the impact of excluding observations (in the *after* and *before* groups) when the economies hit inflation crisis levels (40%), or when they coincide with the *during* part of an adjacent disinflation. Column (3) controls for the episode's length *i.e.* it only includes observations in the *during* group up to year 3, and drops those between 4 and T. The strategy adopted up to this point was to include in the *during* group any observation between 1 and T but this biases the sample against short episodes. Finally, (4) considers all the robustness controls -*i.e.*, (1) through (3)- simultaneously.

Taken as a whole, the conclusions are not altered by the robustness tests. There is a deterioration of the trade balance following the disinflationary shock, a result similar to Lane's findings discussed above. Moreover, the trade balance does not recuperate after the episodes are over, suggesting that there are long-lived consequences of disinflations.

IV. GDP GROWTH DURING DISINFLATIONS

Do disinflations cause output contractions in LAC? The evidence from OECD nations points to a robust pattern showing that disinflations cause recessions (see Ball 1994, Zhang 2005).[7] Most research with

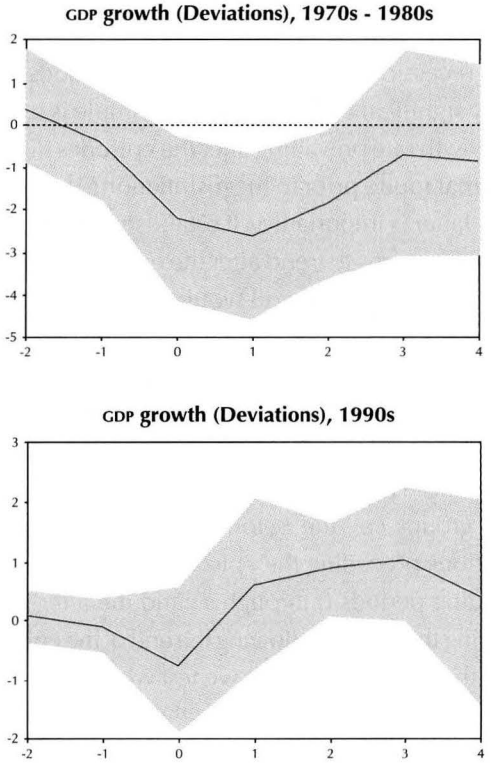
[7] Economists have proposed multiple theoretical models to explain this fact. At the aggregate level, the theoretical underpinnings of the idea are closely related to those found in the Phillips curve literature, where an explicit (usually short-run) trade-off between inflation and unemployment is established. Some early attempts to rationalize the trade-off include Fischer (1977) and Taylor (1980), who based their result on the notion of staggered contracts. Fischer (1986) extended the lessons to an open economy whereas, more recently Mankiw and Reis (2002) built a model where the driving force of the result is the slow dissemination of information.

LAC data has focused on stabilizations from high inflation rates. Part of that literature questions the view that disinflations (now from high inflation rates) cause recessions. Kiguel and Leviatan (1992) and Végh (1992), claim that the output's path during Exchange Rate Based Stabilizations (ERBS) follows a boom-recession cycle that is, in the initial phases of the stabilization the economy booms, and it is only later that a recession occurs.[8] Nevertheless, subsequent papers by Bruno and Easterly (1998) and Hamann (2001) suggest that once the sample is extended outside the Southern Cone, the stabilizations from high inflation rates generate output expansions independently of the anchor used.[9]

A. GDP growth I: the impulse response

We take a first look at the behavior of GDP in Graph 4, which depicts the average real GDP growth rate during disinflations. In particular, the plots show the average growth rate across two - and three-year long episodes, with period 0 corresponding to the year when the inflation peak occurred. The left panel focuses on the 70s and 80s, while the right one deals with the 90s. The growth rates in the Graph are "deviations" *i.e.*, they are constructed by substracting from each episode (periods -2 to 4) its average growth rate during periods -1 and -2 This allows us to control for differences in the initial growth rates across episodes. The plot also includes confidence intervals. A dashed line going through 0 facilitates interpretation of the confidence intervals.

Graph 4. GDP GROWTH RATES WITH 90% CONFIDENCE INTERVALS



Source: Hofstetter, (2007a).

As Figure shows, for the 70s and the 80s, there is an important reduction in the GDP growth rate during disinflations, corroborating the conventional wisdom that disinflations are contractionary. As for the size of the recession, the gap between the dashed line and the average growth rate at the trough is just short of 3%. Another important feature is that the GDP growth rates peak prior to inflation. In contrast to the GDP slowdown of the 70s and 80s, the story during the 90s suggests that there is no evidence of a slowdown during those episodes. During the 90s, LAC countries seem to have escaped the recession that accompanied disinflations during the earlier decades.

[8] Succesive follow-ups on that literature, using the same hypothesis as the original 1992 papers include Calvo and Végh (1994, 1999), De Gregorio, Guidotti and Végh (1998), and Fischer, Sahay and Végh (2002), among others.

[9] The debate is not settled yet. Fischer *et al.* (2002) argue once more that expansionary stabilizations are a phenomena mainly attached to ERBS.

B. GDP growth II: the whole sample

1. The 70s and 80s

Is the recession observed during the episodes statistically significant when the whole sample is used? Is the growth rate prevailing after the episodes different from that found prior to the disinflation? The answer to the latter is important as it establishes whether the GDP *level* returns to trend after the episode. Failure to find a catching-up period would be consistent with long-lived effects on output, which has important consequences for the literature measuring disinflation costs (*e.g.*, Zhang, 2005; Hofstetter, 2007a).

To test these hypotheses, we again split the data into three groups *i.e.*, the *before group*, covering 3 observations preceding the episode; the *during* group, including periods 0 through *T*; and the *after group*, covering the 3 years following the end of the episodes. As in the previous section, we test whether there are differences in the means of the three groups. The results for the 70s and 80s are presented in Table 4.

The first important finding for the 70s and 80s is that the growth rate *during* the episodes is smaller than *after* and *before*, and that these differences are significant. As suggested in the plot, output growth did indeed slow down during the disinflations of the 70s and 80s. This finding is consistent with the evidence from OECD disinflations (*e.g.*, Ball, 1994).

On the other hand, we do not observe a statistically significant difference between the growth rate *after* and *prior* to the peaks. Hence, there is no catching-up period *i.e.*, where the growth rate following the episode picks up and brings the output level back to trend. The implication is that, for the 70s and 80s, the GDP growth path is consistent with long-lived effects on the output level, a fact also present in OECD disinflations (see Zhang, 2005).[10]

Table 5 performs a similar exercise for the 90s. In line with the implications derived from the impulse responses, there is no evidence that the growth rate during the episodes is significantly different from that prior or after them. More specifically, there is

Table 4. OUTPUT GROWTH DURING DISINFLATIONS IN LAC, 1970s & 1980s

1970s & 1980s	Number of Observations	Mean GDP % Growth	Robustness (1)	(2)	(3)	(4)
Before Peak [-3, -1]	66	4.82	0.50	5.29	4.82	0.96
During Episode [0, T]	79	2.71	-0.53	2.71	2.73	-0.66
After Trough [T + 1, T + 3]	66	4.33	0.81	4.85	4.33	1.35
H_0: Before = During, t-stat		2.69 ***	1.46 *	2.83 ***	2.58 ***	1.93 **
H_0: After = During, t-stat		2.06 ***	1.89 **	2.50 ***	1.97 ***	2.54 ***
H_0: Before = After, t-stat		0.60	0.41	0.44	0.60	0.43

* Significant at 10% level; ** Significant at 5% level; *** Significant at 2.5% level.
(1) Annual Output growth rate measured in deviations w.r.t LAC annual median.
(2) Y growth. Sample excluding observation if: inflation surpasses 40% or they hit a neighboring episode.
(3) Y growth. "During" sample restricted to [0, 3] length.
(4) Y growth. All restrictions (1) - (3) simultaneously in place.

Table 5. OUTPUT GROWTH RATES DURING DISINFLATIONS IN LAC, 1990s

1990s	Number of Observations	Mean GDP % Growth	Robustness (1)	(2)	(3)	(4)	(5)
Before Peak [-3, -1]	36	3.92	0.17	3.96	3.92	0.22	3.68
During Episode [0, T]	52	3.69	-0.07	3.69	3.81	-0.07	3.77
After Trough [T + 1, T + 3]	29	2.80	-0.50	2.34	2.80	-0.82	2.80
H_0: Before = During, t-stat		0.42	0.45	0.42	0.20	0.43	0.15
H_0: After = During, t-stat		1.53	0.75	2.18 **	1.66 *	1.15	1.58
H_0: Before = After, t-stat		1.79 *	1.09	2.2 **	1.77 *	1.38	1.30

* Significant at 10% level; ** Significant at 5% level; *** Significant at 2.5% level.
(1) Annual Output growth rate measured in deviations w.r.t LAC annual median.
(2) Y growth. Sample excluding observation if: inflation surpasses 40% or they hit a neighboring episode.
(3) Y growth. "During" sample restricted to [0, 3] length.
(4) Y growth. All restrictions (1) - (3) simultaneously in place.
(5) During defined as [1, T] and before as [-2, 0].

no growth slowdown during the episodes of the 90s; at the same time it is not possible to characterize the behavior as a statistically significant boom.[11] The finding that disinflations of the 90s were not contractionary is certainly a striking result. For policymakers, it poses the question of whether they can count on such behavior in the future *i.e.*, if the conditions that allowed costless disinflations are the new *status quo*. Again, answering this question goes beyond the scope of this paper, but we take steps towards answering it in Hofstetter 2007a. Our answer in that companion paper is emphatic: the conditions that allowed costless disinflations are not the new *status quo*; policymakers should not expect a free lunch when attempting to disinflate form low and moderate inflation rates in the future.

2. Robustness

For the 70s and 80s, the results in Table 4 under columns (1), (2), (3) and (4) for the additional tests, indicate that all the conclusions reached sofar are remarkably robust. The *during* group remains on average significantly smaller than the *before* and *after* groups; moreover, there is no statistically significant difference between the before and the after groups.

We perform the same robustness tests for the 90s in Table 5, though adding one test under column (5). The latter verifies whether or not shifting the definition of *before* and *during* one period ahead, alters the conclusions. This test makes sure that the results are not driven by the trough in period 0, that we identified in the impulse response. All the robustness tests for the 90s corroborate that there is no evidence of a recession during the disinflations. If anything, there is some weak evidence that the

[10] Nevertheless, some caution should be used in interpreting this result. Indeed, the conclusion hinges on the growth rate prior to disinflation being the 'normal' growth rate. It is conceivable though that the presence of rising inflation might be a symptom of a reheated economy. If that were the case, the growth rate prior to disinflation would be above average.

[11] Given that the direction in which growth moves across groups for the 90s is unclear, the statistical tests are two-tailed.

output *during* the episodes is higher than the output *after* them.

V. EXCHANGE RATES DURING DISINFLATIONS

In a disinflationary context, the *nominal* exchange rate can be affected by at least two different policy-related shocks. i) It is possible for monetary authorities to use the exchange rate itself as the principal tool for disinflating, in what would constitute an exchange rate based disinflation. If that is the case, the exchange rate devaluation rate during the episode should be reduced or, in the extreme case, where the policy involves fixing the currency, become zero. ii) It is also conceivable, that monetary authorities disinflate with traditional monetary contractions and/or interest rate hikes. If that is the case, following a contractionary monetary shock, almost any model of exchange rate determination based on the fundamentals of the economy would predict a reduction in the nominal devaluation rate.[12]

As for the *real* exchange rate, several models with sticky prices do also predict its appreciation in response to monetary contractions. The early contributions of the Mundell-Fleming-Dornbusch models, and more recent treatments like Beaudry and Devereux (1995), Obstfeld (1985) and Corsetti and Pesenti (2001), are good examples of this results.

From an empirical standpoint, Obstfeld and Rogoff (1996, p. 621) argue that "[c]ountries that adopt dramatic monetary tightening almost invariably appear to experience real currency appreciation". This conclusion is formally reached, for example, in Eichenbaum and Evans (1995). They point-out that contractionary monetary policy shocks yield to persistent and significant appreciations of both nominal and real exchange rates (for US data). Furthermore, these findings do not only hold in disinflations from low or moderate peaks. Indeed, using a stabilization sample from high inflation rates, Calvo and Végh (1999) argue that the real exchange rates appreciate, irrespective of the nominal anchor used to disinflate.

A. Exchange rate I: the impulse response

Since parallel rates are more likely to reflect the path followed by a market-determined exchange rate, we use parallel bilateral exchange rates against the US dollar for the empirical exercises in this section.[13] Exchange rates are defined such that increases in the variable represent depreciations. The data is taken from Reinhart and Rogoff's (2004) database (see the Appendix for details).

Although the main goal of this section is to track the evolution of the *real* exchange rate during disinflations, for the sake of completeness, we plot in Graph 5 the average impulse response of the nominal exchange rate across episodes. The plots show that the nominal devaluation rate follows a path resembling the one described for inflation *i.e.*, i) it peaks in period 0 and falls thereafter in a similar fashion; and

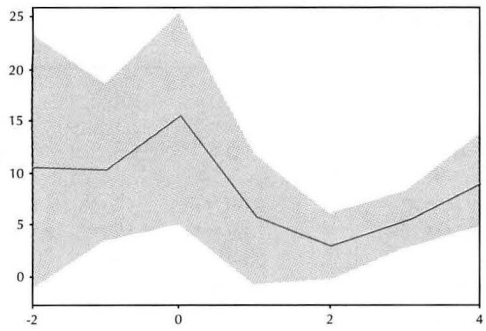
[12] For a good survey on exchange rate determination, see Frankel and Rose (1995) or Taylor (1995).

[13] Effective rates built by the IFS, which would also be a good choice, are only available since the early 80s and only for a handful of countries in the region. Furthermore, official exchange rates are inadequate for our purposes. Indeed, many LAC countries had fixed official nominal exchange rates throughout the 70s, and also though less widespread during the 80s and 90s. Those that did not have fixed exchange rate regimes often opted for crawling pegs, where the exchange rate was still determined by the government. For both scenarios, the official rates were not likely to reflect market oriented exchange rates, and differences between parallel and official rates could be substantial, as Reinhart and Rogoff (2004) report.

Graph 5. NOMINAL DEVALUATION RATE

Nominal Devaluation, Parallel rate, 70s - 80s

Nominal Devaluation, Parallel rate, 90s



Note: Shaded regions are 90% confidence intervals. An increase in the variable represents a depreciation.
Source: Hofstetter, (2007a).

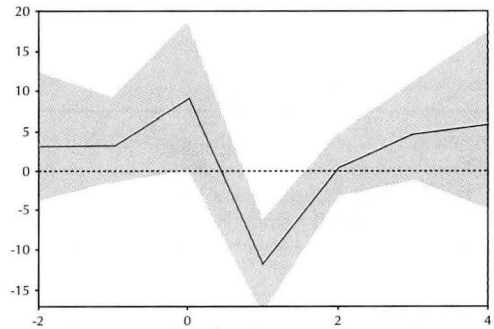
ii) during the 90s, depreciation remains low after the episodes are over, whereas for the earlier decades it increases and almost reaches the starting point by period 4. Indeed, notice that in period 4, depreciation during the 70s and 80s is already above 20%, while during the 90s, it remains below the 10% mark.

Graph 6 depicts the changes in the *real* exchange rate calculated against the US dollar *i.e.*, $RER = EP^*/P$, where E is the nominal exchange rate, and P^*, P are consumer price indices in the US and the respective LAC country. A dashed line going through zero is included. Numbers below the line represent appreciations of the RER.

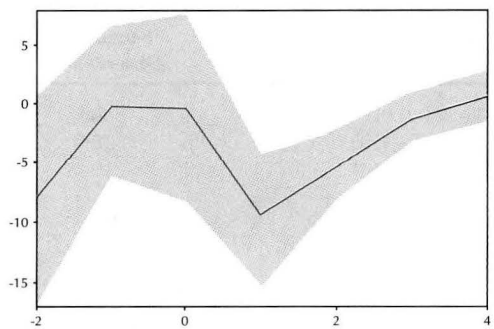
In both panels, the real exchange rate appreciates during disinflations. For the 70s and 80s, the appreciation occurs during the first year and in a statistically significant manner. For the 90s, the real appreciation lasts longer -for 3 years- with the first two years being statistically significant. Of course, part of the difference between the 90s and the earlier decades is that during the 90s many countries experienced periods of real appreciation fueled by capital inflows. This was particularly true during the first part of the decade. What the plots suggest is that disinflations make the appreciation more acute, independent of the starting point of the real exchange rate.

Graph 6. REAL DEVALUATION RATE DURING DISINFLATIONS

Real Devaluation, Parallel rate, 70s - 80s



Real Devaluation, Parallel rate, 90s



Note: Increase in the variable reflect depreciation. Shaded regions are 90% confidence intervals.
Source: Hofstetter, (2007a).

B. Real Exchange Rate II: the whole sample

As with the current account and GDP growth, we now test whether the trends in Graph 6 hold true once we take into account the whole sample. In particular, we test if the mean for the RER for the groups *before*, *during* and *after* disinflations are statistically different. Again, the *during* group includes periods [1, T] while the *before* and *after* groups cover three adjacent years before and after the *during* group, respectively. Table 6 presents the results for the changes in the real exchange rate during the 70s and 80s, while Table 7 reports them for the 90s.

As predicted by the theories outlined above and suggested by the evidence in the plots, an average appreciation of the real exchange rate does indeed occur *during* the episodes. The annual revaluation

Table 6. TESTS FOR THE REAL EXCHANGE RATE, 1970s & 1980s

1970s & 1980s (3)	Number of Observations	Change in Real Exchane Rate (%)	Robustness		
				(1)	(2)
Before Peak [-2, 0]	47	5.4	3.8	5.4	3.8
During Episode [1, T]	47	-2.5	-2.5	-2.3	-2.3
After Trough [T + 1, T + 3]	60	5.0	7.0	5.0	7.0
H_0: Before = During, t-stat		2.22***	1.65 **	2.13 ***	1.57 *
H_0: After = During, t-stat		2.25***	2.68 ***	2.15 ***	2.57 ***
H_0: Before = After, t-stat		0.10	0.84	0.10	0.83

* Significant at 10% level; ** Significant at 5% level; *** Significant at 2.5% level.
(1) Real Depreciation. Sample excluding observation if: inflation surpasses 40% or they hit a neighboring episode.
(2) Real Depreciation. "During" sample restricted to [1, 4] length.
(3) Real Depreciation. All restrictions (1) - (2) simultaneously in place.

Table 7. TESTS FOR THE REAL EXCHANGE RATE, 1990s

1970s & 1980s (3)	Number of Observations	Change in Real Exchane Rate (%)	Robustness		
				(1)	(2)
Before Peak [-2, 0]	36	-2.8	-0.5	-2.8	-0.5
During Episode [1, T]	38	-6.1	-6.1	-6.3	-6.3
After Trough [T + 1, T + 3]	19	1.7	4.1	1.7	4.1
H_0: Before = During, t-stat		1.39*	2.27 ***	1.43 *	2.33 ***
H_0: After = During, t-stat		2.69***	3.45 ***	2.72 ***	3.47 ***
H_0: Before = After, t-stat		0.52*	0.43 *	1.51 *	1.41 *

* Significant at 10% level; ** Significant at 5% level; *** Significant at 2.5% level.
(1) Real Depreciation. Sample excluding observation if: inflation surpasses 40% or they hit a neighboring episode.
(2) Real Depreciation. "During" sample restricted to [1, 4] length.
(3) Real Depreciation. All restrictions (1) - (2) simultaneously in place.

during disinflations of the 70s and 80s is 2.5% whereas for the disinflations of the 90s it reaches 6%. In both cases, the behavior of the exchange rate during the episodes is statistically different from that for the groups prior and after, a result that remains firm throughout the robustness tests. As Eichenbaum and Evans (1995) find for the US, disinflations in LAC are associated with RER appreciations.

VI. CONCLUSIONS

The successful disinflationary process of most LAC countries since the early 90s is certainly one of the most notable economic achievements of the region in recent times. Indeed, after enduring more than two decades of continuous inflation disasters, the region's median inflation has remained in single digits for almost a decade. The evidence suggests that most near-future disinflations in LAC will start from low and moderate peaks. Nevertheless, very little is known about the stylized facts of LAC disinflations in that peak range. This paper fills part of that gap with the hope of guiding future theoretical research. It also highlights several consequences of which policymakers should be aware.

The strategy of this paper consists of using a sample of policy-induced disinflations across countries, and then evaluating the average behavior of several macroeconomic variables during these disinflations. The approach overcomes the traditional problems faced by methods requiring long and stable quarterly or monthly time series, while at the same time, permitting a similar analysis of the impact of disinflationary shocks on macroeconomic variables.

It is shown that GDP growth slowed down during the disinflations of the 70s and 80s. Moreover, we find evidence consistent with the view that disinflations have long-lived effects on output level and that the growth slowdown precedes the fall in inflation by about a year. For the 90s, there is no evidence of a slowdown in the GDP growth rate during disinflations.

We also provide evidence of a significant trade balance deterioration during disinflations, and point at possible long-lived effects on that variable. The quantitative impact is by no means negligible, as the deterioration of the trade balance reaches almost 3 three percentage points (with respect to GDP) during disinflations of the 90s. The finding that the current account deteriorates during disinflations is an important result. The theoretical literature suggests that there are forces that could push the trade balance in either direction following a disinflationary shock; therefore, it is up to the empirical literature to determine which forces are quantitatively dominant.

Closely linked to the finding regarding the current account, it is shown that the nominal devaluation rate slows down during the disinflations, mimicking the path followed by the inflation rate. Furthermore, there is a significant average real exchange rate appreciation during the episodes. Both results are in line with the evidence from the OECD nations.

We should qualify the results. The method used to identify disinflations is based on the actual behavior of inflation *i.e.*, a disinflation is identified if the inflation rate actually falls by a sufficiently large amount. Some authors (*e.g.* Calvo and Végh, 1999) identify episodes based on the announcement by monetary authorities of an intention to disinflate. Note that the latter strategy for identifying episodes does not actually require inflation to fall. For our purposes, it is important to note that our results show the consequences of actually bringing the inflation down, rather than the consequences of announcing the intentions to bring it down.

Finally, our paper has only looked at the evolution of a few macroeconomic variables during disinflations. Several interesting questions remain to be explored. For instance, future research could be aimed at exploring the micro dynamics behind disinflations. For instance, studying the productivity, firm entry and exit, and the behavior of tradable and non-tradable sectors during disinflations, are areas were our knowledge still appears limited, particularly with respect to disinflations in the LAC countries.

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Appendix

Data: Most of the variables come from the International Financial Statistics (IMF, various issues). GDP growth rates and trade balances were complemented with data from the World Development Indicators (World Bank, various issues). The exchange rate is built using the data from Reinhart and Rogoff (2004). The database has a few blanks. It ends in 1998, which means that for a few disinflations during the 90s, there is no post episodes data. There is also no data for 3 early episodes (Jamaica, Honduras and Guatemala). Finally, Venezuela's episode during the early 80s has been discarded, as the exchange rate in 1983 depreciated by almost 200%, constituting a very large outlier that distorts results.

Table A. DISINFLATIONARY EPISODES IN LAC

Country	Initial Year	Final Year	Length	Initial Inflation	Drop of Inflation	% drop of Inflation	Speed
Honduras	1973	1975	2	9.7	4.3	4.05	2.2
Paraguay	1973	1975	2	19.6	14.6	74.5	7.3
Dominican Republic	1974	1978	4	13.3	9.6	72.2	2.4
Ecuador	1974	1976	2	19.4	9.2	47.7	4.6
El Salvador	1974	1976	2	17.3	8.4	48.6	4.2
Guatemala	1974	1976	2	14.7	4.1	28.2	2.1
Mexico	1974	1976	1	19.1	5.4	28.5	5.4
Honduras	1979	1987	8	14.5	11.4	78.8	1.4
Dominian Republic	1980	1982	2	14.3	8.1	56.6	4.0
El Salvador	1980	1982	2	15.9	5.1	32.2	2.6
Venezuela	1980	1983	3	18.6	10.6	56.8	3.5
El Salvador	1989	1991	2	19.5	9.6	49.0	4.8
Bolivia	1990	1993	3	19.3	11.7	60.7	3.9
El Salvador	1993	1999	6	15.7	14.9	94.6	2.5
Paraguay	1993	1996	3	18.9	10.1	53.5	3.4
Bolivia	1995	1999	4	11.2	8.1	72.3	2.0
Costa Rica	1995	1998	3	19.5	9.4	48.3	3.1
Guatemala	1996	1998	2	10.0	4.6	45.8	2.3
Jamaica	1974	1976	2	21.6	11.6	54.0	5.8
Colombia	1976	1978	2	25.2	7.1	28.4	3.6
Mexico	1977	1978	1	22.6	5.9	26.3	5.9
Jamaica	1978	1982	4	29.0	21.2	73.0	5.3
Paraguay	1979	1982	3	24.1	15.9	66.2	5.3
Colombia	1989	1983	3	24.9	7.7	31.0	2.6
Donimican Republic	1984	1986	2	29.6	20.4	69.0	10.2
Jamaica	1984	1987	3	24.9	18.0	72.1	6.0
Chile	1985	1988	3	24.1	9.6	39.7	3.2
El Salvador	1986	1988	2	27.3	11.2	41.1	5.6
Guatemala	1986	1988	2	25.6	15.7	61.4	7.9
Colombia	1990	1996	6	27.0	9.4	34.7	1.6
Honduras	1990	1992	2	26.7	17.8	66.7	8.9
Mexico	1990	1993	3	22.8	14.6	64.1	4.9
Costa Rica	1991	1993	2	24.8	14.7	59.4	7.4
Jamaica	1994	1998	4	26.2	19.2	73.3	4.8

Source: Hofstetter, (2007a).