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On the Credibility of Inflation-Targeting Regimes in Latin America

ABSTRACT Inflation targeting has become popular in emerging economies. Eight countries in Latin America adopted this regime and were successful in bringing inflation down. However, continuing success depends on the credibility of the target. We interpret credibility as how tightly inflation expectations are anchored and develop a methodology to test the response to shocks. Inflation targets gained credibility over time, but when inflation rises above target, credibility suffers. Moreover, at the end of the sample, there is evidence of de-anchoring.

JEL Codes: E31, E52, E58

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Inflation-targeting regimes have become popular around the world. Pioneers included New Zealand, which adopted inflation targeting in 1990, and Chile, which started to introduce the regime alongside an exchange rate band as early as 1991. Inflation targeting has been adopted by many economies such as Canada (1991), Israel (1992), the United Kingdom (1992), Sweden (1993), and Finland (1993). Several other emerging economies have also adopted inflation-targeting regimes, including Korea, South Africa, the Philippines, and Thailand, and in Latin America, apart from Chile, Brazil, Colombia, Guatemala, Mexico, Paraguay, Peru, and Uruguay.

A collection of papers argues that the macroeconomic performance of inflation-targeting countries is superior to that of countries that have adopted

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alternative monetary regimes.¹ In particular, Corbo, Landerretche, and Schmidt-Hebbel compare the implementation and performance of inflation targeters around the world, including five countries in Latin America, namely, Brazil, Chile, Colombia, Mexico, and Peru.² They suggest that Latin American inflation targeters succeeded in bringing inflation down around the year of adoption of the regime, were successful in attaining their target levels, and had sacrifice ratios (and output volatility) that were lower after the regime was implemented and comparable to those observed in developed countries. Schmidt-Hebbel and others also argued that inflation and sacrifice ratios were lower in Brazil, Mexico, and Chile relative to a control group of other countries without inflation-targeting schemes.³

It has been argued that the benefits of inflation targeting not only apply to levels but also to second moments. Vega and Winkelried use the adoption of inflation targeting by country as a treatment, and the results indicate that, relative to a control group, it helped reduce the level and volatility of inflation.⁴

However, some papers find more nuanced results. Cecchetti and Ehrmann suggest that inflation targeting makes central banks more averse to inflation shocks relative to output shocks so the change in performance is more related to a change in preferences.⁵ Mishkin and Schmidt-Hebbel and Ball and Sheridan find that there is not enough evidence to conclude that inflation-targeting schemes were instrumental in helping countries reduce inflation and inflation volatility below the levels they would have attained otherwise.⁶ On the other hand, Gonçalves and Salles extend Ball and Sheridan's analysis for a set of thirty-six emerging market economies and find that compared to non-targeters, developing countries adopting an inflation-targeting regime experienced lower inflation and greater reductions in growth volatility.⁷ Capistrán and Ramos-Francia find that in inflation-targeting regimes, the dispersion of long-run inflation expectations is smaller after controlling for country-specific effects.⁸ The benefits of inflation targeting are not limited to reducing inflation and economic volatility. Bernanke and others argue that the adoption of inflation targeting typically also comes with improvements in how central

1. Bernanke and others (1999); Corbo and Schmidt-Hebbel (2001); Corbo, Landerretche, and Schmidt-Hebbel (2001).

2. Corbo, Landerretche, and Schmidt-Hebbel (2001).

3. Schmidt-Hebbel and others (2002).

4. Vega and Winkelried (2005).

5. Cecchetti and Ehrmann (2002).

6. Mishkin and Schmidt-Hebbel (2001); Ball and Sheridan (2004).

7. Gonçalves and Salles (2008).

8. Capistrán and Ramos-Francia (2010).

banks communicate with private markets and the public, together with greater transparency.⁹

Several papers argue that adopting inflation-targeting regimes has had an impact on inflation expectations. According to Bernanke and others, inflation targeting assists in anchoring expectations at or close to the target.¹⁰ Johnson finds evidence that the level of expected inflation in inflation-targeting countries falls after the announcement of inflation targets, although there is no subsequent reduction in absolute forecast errors.¹¹ Levin and others find evidence that the adoption of inflation targeting may change the way agents form expectations regarding inflation and on the persistence of inflation.¹² They find that for inflation targeters, inflation expectations and lagged inflation are uncorrelated, in contrast to the case of nontargeters such as the United States. Gurkaynak and others find that long-run inflation expectations respond to economic news in the United States, while this is not the case in Sweden or in the United Kingdom since the central bank gained operational independence.¹³ Fraga, Goldfajn, and Minella contrast inflation targeting in advanced versus emerging economies and argue that emerging inflation targeters are no less committed to targets, but rather are subject to higher economic volatility and weaker credibility, which implies harsher trade-offs and may explain why inflation appears to be higher in these economies and why inflation may be allowed to breach target levels.¹⁴

In Figure 1 we plot information on the distribution of inflation rates for a selection of countries in the region. In the 1980s and early 1990s, several countries in Latin America suffered from extremely high inflation rates. Monetary policy was largely dominated by fiscal needs, in several cases related to the fiscal consequences of the resolution of the 1980s financial crises and the lost decade in terms of growth that affected fiscal revenues. After several attempts at stabilization, inflation was eventually brought down. In some cases, this was achieved through the use of a fixed exchange rate regime. Inflation targeting was seen as an alternative to establish a nominal anchor without the potentially negative effects of a fixed exchange rate, maintaining flexibility and the potential use of a safety valve if abnormal conditions dictated straying from the target. However, perhaps the main question was

9. Bernanke and others (1999).

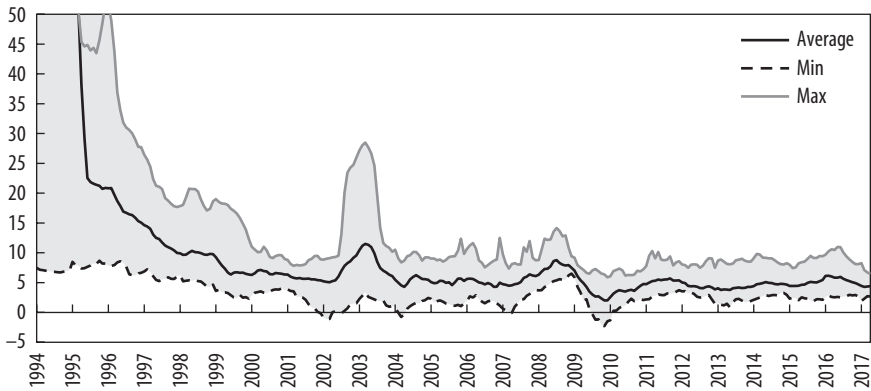
10. Bernanke and others (1999).

11. Johnson (2002).

12. Levin and others (2004).

13. Gurkaynak and others (2007).

14. Fraga, Goldfajn, and Minella (2004).

FIGURE 1. Declining Inflation Rates in Latin America^a

a. The sample includes Brazil, Chile, Colombia, Guatemala, Mexico, Paraguay, Peru, and Uruguay. Inflation is calculated as the percentage change of the consumer price index (CPI) from a year ago.

whether such an anchor could gain credibility, given the region's previous poor inflation performance, and, if so, how long that would take.

At times inflation has also risen and breached the established targets in several countries. In one or two cases, these breaches have been quite persistent. The recent experience can be rationalized as follows. Countries suffered significant negative shocks, including from the global financial crisis and, for commodity exporters, the steep falls in commodity prices. Exchange rates depreciated rapidly as a result, and moderate pass-through led to higher inflation. Central banks were caught between allowing such depreciations to help stabilize output in the face of negative shocks and the dangers of allowing inflation to creep above target levels. Powell describes this experience and employs a monetary model to analyze central banks' policy choices.¹⁵ However, this experience also raises the question as to whether allowing inflation to drift above targets implies a loss in credibility that may then affect future economic performance and, if so, how important a consideration this should be. To our knowledge this is the first paper that presents evidence regarding this issue.

Central banks have developed a variety of means of communicating with the private sector. In this paper we exploit one such device, namely, a survey regarding inflation expectations conducted regularly with private sector

15. Powell (2017).

analysts that is published on a regular basis. We consider the degree of sensitivity of changes in medium-term inflation expectations to shocks in actual inflation. If the inflation-targeting regime is highly credible, then inflation expectations should be well anchored, and medium-term inflation expectations should not be very sensitive to such shocks.

In the first few years of an inflation-targeting regime, it might be considered likely that there would be reactions to inflation shocks, but over time, as credibility is gained, this sensitivity would be expected to decline. However, if inflation then drifts above the target, perhaps due to negative shocks and exchange rate movements as described above, then credibility may be put at risk. The aim in this paper is to investigate the changing credibility of inflation-targeting regimes in Latin America over this fascinating recent period. More specifically, we consider whether allowing inflation to drift above target implies a loss in credibility of the regime that may affect future economic performance.

The paper is organized as follows. In the next section, we discuss the relationship between inflation and inflation expectations in inflation-targeting regimes and in Latin America in particular. We then discuss in more detail the data we employ in the empirical analysis, and we investigate whether the inflation expectations revealed in surveys are biased. We describe the econometric methodology employed to consider if inflation expectations are well anchored in Latin America. Then we consider how the effect of inflation being above the target might affect expectations. Finally, we examine whether the nature of the persistence has changed over time and present our conclusions.

Inflation Targeting and Inflation Expectations

Given indeterminacy in monetary models, expectations play a critical role. Questions such as whether expectations are rational or adaptive, and how quickly they react to policy measures, have created much debate in economics. But expectations are not directly observable, and indirect means of observation must be used. Long-run expectations, for example, can be derived from the difference in yields between nominal and inflation-indexed bonds. An alternative method employed by central banks to obtain inflation expectation estimates, particularly for the medium-term and shorter horizons, is through surveys of inflation expectations. Typically these surveys draw on the opinions of a targeted group of experts, including academics, consultants, or private sector institutions (banks and other financial institutions), on a monthly basis.

The success of an inflation-targeting scheme is in large part dependent on that regime maintaining a high degree of credibility. This, in turn, implies that inflation expectations must remain anchored and not move excessively with each and every shock that may affect the economy and particular prices. One way to think about high credibility is that there must be an expectation that when shocks arrive, the authorities will take appropriate countervailing actions, for example, to keep inflation within the published targets. Interestingly, Gurkaynak and others find that while long-term forward nominal interest rates and inflation move “excessively” in response to releases of macroeconomic data in nontargeters, this is not the case in Canada and Chile, which maintain explicit inflation targets.¹⁶ This is consistent with the hypothesis that inflation targeting may help to assist in anchoring expectations.¹⁷

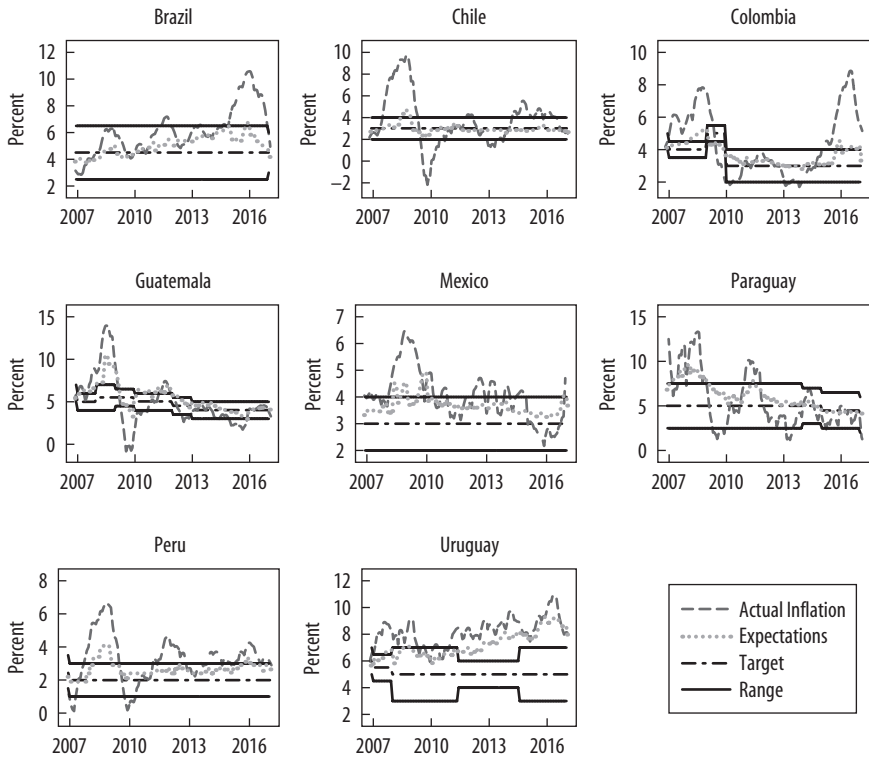
Most countries in Latin America with inflation-targeting regimes have been relatively successful in keeping inflation expectations close to published targets even when actual inflation has been higher. Figure 2 plots monthly inflation expectations for the annual inflation rate of December of the following year, monthly interannual inflation, and the inflation target. In Chile, while interannual inflation reached 8.3 percent in April 2008, inflation expectations remained relatively stable at around 3.5 percent, indicating the expectation that inflation would come back to within the target. The same is true for most of the countries analyzed in this paper for the period considered. Exceptions include the case of Guatemala, where inflation expectations rose to levels somewhat higher than the target’s upper band, and Uruguay, where actual inflation and inflation expectations have also risen above the target.

Data on Inflation and Inflation Expectations

The data on inflation expectations employed in this paper come from REVELA, an Inter-American Development Bank (IDB) database that compiles data on inflation and growth expectations from the central banks of Latin American countries that have inflation-targeting schemes; the database is available at www.iadb.org/revela. The data are monthly and cover the period 2006–17. The countries covered are Brazil, Chile, Colombia, Guatemala,

16. Gurkaynak and others (2007).

17. See also Gurkaynak, Levin, and Swanson (2010), van der Cruysen and Demerizis (2011), and Pierdzioch and Rülke (2013).

FIGURE 2. Current Inflation, Expectations, and Inflation Targets in Latin America, 2006–2017^a

a. Actual inflation is calculated as the percentage change of the CPI index from a year ago. Inflation expectations refer to the expected value of the actual inflation in two years from the quoted date.

Mexico, Paraguay, Peru, and Uruguay. The data are downloaded on the third week of each month from the web pages of countries' central banks. REVELA collects mean inflation and mean growth expectations for all the countries for which that information is available.

Most of these surveys are monthly, with the exceptions of Brazil and Colombia. Brazil maintains a daily database of expectations; in this case REVELA compiles the data for the 20th of each month, or the closest day when the data are available. Colombia's inflation survey is available monthly, but growth expectations (not used in this paper) are reported on a quarterly basis. Reported statistics differ among countries, but most of the central banks include means of the individual forecasters, which are typically compiled in

REVELA. Chile and Peru only report medians, so this is the statistic reported in those cases.

Inflation figures are obtained from the relevant statistical agencies or central banks, and we match the inflation statistics with the expectations data. We also collect data on other variables that we use as controls, such as exchange rates and sovereign spreads, employing Emerging Market Bond Indices from JP Morgan as published by Bloomberg.

Testing for Bias in Inflation Expectations

As the surveys on inflation expectations are under the control of the central banks that also maintain the very same inflation-targeting regimes, there may be concern that there is a conflict of interest, although, as mentioned above, these surveys have at times indicated expectations outside the target bands. However, to consider whether the inflation surveys are reliable in a preliminary analysis, we consider whether there is any bias in the surveys. Specifically, we estimate a regression of forecast errors, using actual inflation data and inflation expectations data from REVELA, on a constant. We use the inflation forecasts of March of every year for December of that same year (nine-month forecasts) for the period 2007–17, and the forecast error is defined as the difference between the inflation expectation in March and inflation for that year, that is, $E_{\text{March}}\pi_t - \pi_t$. Table 1 provides the results for the pooled regression across all countries across time. The constant is not statistically significant. This provides some evidence that there is no overall or systematic bias in the expectations. Of course, this does not mean that the expectations are necessarily good predictors of inflation. Indeed, there still could be significant errors in the forecasts for some countries or for some periods of time.¹⁸

In a second exercise, we regress the forecast errors on a country fixed effect in a panel format. Only one country fixed effect is significant, the case of Paraguay, and that only at the 5 percent level. The coefficient is positive, which means that the mean of the survey in general indicates inflation somewhat higher than out-turn levels. There is then no evidence of a downward bias in surveys and only this one case of marginally significant upward bias.

18. Certainly the graphs plotted in figure 2 suggest that inflation expectations appeared to underestimate inflation in virtually all countries in 2007–08. The food price shock, which was most likely unanticipated, pushed inflation higher in most countries during this period.

TABLE 1. Investigating the Bias in Inflation Expectations^a

	<i>Pool</i> (1)	<i>Country FE</i> (2)
Brazil		-0.3734 (0.4388)
Chile		-0.3621 (0.4388)
Colombia		-0.3129 (0.4388)
Guatemala		0.6093 (0.4388)
Mexico		-0.1308 (0.4388)
Paraguay		0.9780** (0.4388)
Peru		-0.2466 (0.4388)
Uruguay		-0.6485 (0.4388)
Constant	-0.0609 (0.1593)	
Adj. R^2	0.0000	0.0407
N	80	80

* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. Regression of the forecast errors on a constant, and one with constant country effect. Standard errors are in parentheses.

Estimating the Credibility of Inflation Targeting

In a credible inflation-targeting regime, private analysts will anticipate the policy actions of central banks in attempting to address shocks to inflation that might threaten an inflation target. If inflation expectations are well anchored, changes in the actual inflation rate should have a low impact on medium-term inflation expectations, and the system might be considered to have high credibility. This is the idea we follow in this paper to attempt to shed light on the credibility of inflation-targeting regimes in Latin America and on whether such regimes have gained credibility over time.

In terms of developing the econometric methodology, we are helped by Huang and Trehan, who consider whether inflation expectations are well anchored in the United States.¹⁹ We adapt their methodology to the data we have available for several inflation-targeting countries in the region.

19. Huang and Trehan (2008).

Following their approach, we consider whether shocks to current inflation affect medium-term inflation expectations. Specifically, we employ inflation expectations two years out, as we wish to avoid the automatic effect of a shock to inflation on the inflation rate for the current twelve months. We then estimate the following regression:

$$(1) \quad E_t \pi_{t+h} = \alpha + \beta \pi_t + \gamma E_{t-1} \pi_{t+h} + \phi X_t + \varepsilon_t,$$

where π_t is the actual inflation rate in time period t and $E_t \pi_{t+h}$ is the t period expectation of inflation for time period $t+h$. X_t is a set of additional covariates that are considered—such as the sovereign (EMBI) spread and the change in the (bilateral) nominal exchange rate. The idea is then to consider whether, controlling for the previous period's medium-term inflation expectation, the new (current) inflation rate affects those expectations in the current time period. If inflation expectations are well anchored, then we would not expect to find a strong effect of current inflation on today's medium-term inflation expectations, so the beta coefficient should not be quantitatively large or statistically significant. As discussed above, we use inflation expectations from the surveys conducted by central banks and employ expectations for inflation two years out.

Individual Country versus Panel Estimates

A first question is whether we can conduct a panel-type analysis or whether we should conduct a set of separate country-by-country regressions as specified above. In table 2, we show the results of a set of tests regarding the poolability across countries of the relevant slope coefficients, including β , our parameter of interest. The conclusion is that in this first specification we can reject that the slope coefficients are equal to each other and specifically that beta is the same across countries (see column 1).²⁰ It appears that we should consider in the first instance country-by-country regressions. These results are invariant to the introduction of different controls discussed below.

The results of country-by-country regressions for the whole sample are presented in table 3. The beta coefficient is positive and significant for all countries except Brazil and Mexico, where it is positive but not significant. For most countries, the coefficient is relatively small and, in most cases, an order of magnitude lower than the effect of lagged inflation expectations.

20. Column 2 includes a term comparing actual inflation to the level of the target. We discuss this and the other columns of this table below.

TABLE 2. Poolability Tests^a

Explanatory variable	Full sample	
	(1)	(2)
Lag. inflation exp.	2.89** (0.0085)	2.28* (0.0348)
Actual inflation	2.12* (0.0495)	1.48 (0.1807)
Breaching target		0.30 (0.9362)
All slopes	2.19* (0.0106)	1.56 (0.0656)

* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. Roy-Zellner test, where the null hypothesis is poolability. *F* test with *p* values in parentheses. Test excludes Uruguay.

These results do not change if we include controls available at a monthly frequency, such as the exchange rate or the country sovereign (EMBI) spread. Even with these controls added we find the coefficient on current inflation to be significant in all countries except Mexico (see tables 4 and 5). Moreover, for most countries we do not find the controls significant; an exception is Chile, where the exchange rate and the EMBI spread are significant. The lack of significance in most cases may come as something of a surprise, as EMBI spreads are quite volatile and, as discussed above, exchange rates have been very flexible in some time periods. The results suggest that while there is considerable variation in these controls, they have not systematically affected the relationship between inflation and inflation expectations in the region.

Returning to the original regression without controls in table 3, the lowest coefficient, significant at the 5 percent level or higher, is found for Chile (0.03) and the highest, for Guatemala (0.13). Chile is the oldest inflation targeter in the region and hence has had a relatively long period to establish credibility, while Guatemala is the most recent convert to this regime, of the countries considered.

It is likely that credibility has changed over time. In particular, several of the regimes in Latin America are relatively new, and it is possible that a track record of consistent communication and policy actions is required to build credibility and to anchor expectations. This would imply that the coefficients above may not be stable over time. To investigate this possibility, we estimate the same regressions on a rolling window. In figure 3, we plot the beta coefficients for the rolling regressions, estimated with a 2.5-year rolling

TABLE 3. Country-by-Country Regressions of the Effect of Inflation Shocks on Expectations^a

<i>Explanatory variable</i>	<i>Brazil</i>	<i>Chile</i>	<i>Colombia</i>	<i>Guatemala</i>	<i>Mexico</i>	<i>Paraguay</i>	<i>Peru</i>	<i>Uruguay</i>
Lag.inflation exp.	0.9168*** (0.0457)	0.7712*** (0.0877)	0.8850*** (0.0365)	0.7475*** (0.0587)	0.6894*** (0.1741)	0.8990*** (0.0357)	0.7651*** (0.0697)	0.8945*** (0.0286)
Current inflation	0.0150 (0.0211)	0.0271** (0.0111)	0.0349*** (0.0100)	0.1291*** (0.0359)	0.0486 (0.0320)	0.0514** (0.0209)	0.0658*** (0.0191)	0.0951*** (0.0222)
Constant	0.3416 (0.2149)	0.6156** (0.2492)	0.2808** (0.1132)	0.7638*** (0.2295)	0.9644* (0.5524)	0.3398* (0.1751)	0.4336*** (0.1499)	0.0123 (0.1489)
LR current inflation	0.1808 (0.2391)	0.1186** (0.0476)	0.3035*** (0.0887)	0.5114*** (0.0962)	0.1566** (0.0733)	0.5093*** (0.1857)	0.2801*** (0.0638)	0.9016*** (0.1724)
LR constant	4.1055*** (1.3393)	2.6904*** (0.1467)	2.4425*** (0.3169)	3.0246*** (0.4535)	3.1048*** (0.2581)	3.3642*** (0.8323)	1.8462*** (0.1805)	0.1171 (1.3957)
Adj. R^2	0.8990	0.8085	0.9360	0.9209	0.6024	0.9369	0.8780	0.9529
N	121	121	121	121	121	121	121	121

* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. LR: long-run estimation of the coefficients. Standard errors are in parentheses.

TABLE 4. Country-by-Country Regressions of the Effect of Inflation Shocks on Expectations, with EMBI Spreads^a

<i>Explanatory variable</i>	<i>Brazil</i>	<i>Chile</i>	<i>Colombia</i>	<i>Guatemala</i>	<i>Mexico</i>	<i>Paraguay</i>	<i>Peru</i>	<i>Uruguay</i>
Lag. inflation exp.	0.8876*** (0.0530)	0.8256*** (0.0717)	0.8948*** (0.0316)	0.7475*** (0.0589)	0.6892*** (0.1748)	0.8980*** (0.0368)	0.8002*** (0.0657)	0.8928*** (0.0283)
Current inflation	0.0483** (0.0207)	0.0329*** (0.0111)	0.0382*** (0.0106)	0.1291*** (0.0360)	0.0482 (0.0320)	0.0516** (0.0210)	0.0679*** (0.0196)	0.0955*** (0.0214)
EMBI spread	-0.0705 (0.0430)	-0.1199*** (0.0456)	-0.0211 (0.0266)	0.0657 (0.0824)	0.0028 (0.0255)	-0.0275 (0.0698)	-0.0345 (0.0349)	-0.0239* (0.0130)
Constant	0.4691* (0.2585)	0.6200*** (0.2139)	0.2748** (0.1071)	0.5972** (0.2941)	0.9608* (0.5563)	0.4210 (0.3213)	0.3983*** (0.1398)	0.0809 (0.1523)
LR current inflation	0.4299*** (0.1427)	0.1885** (0.0749)	0.3634*** (0.0775)	0.5115*** (0.0967)	0.1551** (0.0727)	0.5061*** (0.1866)	0.3396*** (0.0890)	0.8910*** (0.1680)
LR constant	4.1736*** (1.0201)	3.5554*** (0.4781)	2.6121*** (0.4947)	2.3653** (0.9266)	3.0914*** (0.3061)	4.1288* (2.2293)	1.9933*** (0.2852)	0.7547 (1.3244)
LR EMBI spread	-0.6275* (0.3285)	-0.6879* (0.3798)	-0.2009 (0.2473)	0.2603 (0.3268)	0.0089 (0.0821)	-0.2701 (0.6499)	-0.1727 (0.1915)	-0.2231* (0.1306)
Adj. <i>R</i> ²	0.9031	0.8315	0.9360	0.9204	0.5991	0.9364	0.8787	0.9534
<i>N</i>	121	121	121	121	121	121	121	121

* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. LR: long-run estimation of the coefficients. The EMBI spread and all other variables are measured in percentage points. Standard errors are in parentheses.

TABLE 5. Country-by-Country Regressions of the Effect of Inflation Shocks on Expectations, with the Exchange Rate^a

<i>Explanatory variable</i>	<i>Brazil</i>	<i>Chile</i>	<i>Colombia</i>	<i>Guatemala</i>	<i>Mexico</i>	<i>Paraguay</i>	<i>Peru</i>	<i>Uruguay</i>
Lag. inflation exp.	0.9147*** (0.0481)	0.7619*** (0.0801)	0.8732*** (0.0515)	0.7352*** (0.0687)	0.6818*** (0.1795)	0.8947*** (0.0378)	0.7806*** (0.0669)	0.8858*** (0.0307)
Current inflation	0.0138 (0.0185)	0.0359*** (0.0118)	0.0391*** (0.0109)	0.1408*** (0.0441)	0.0502 (0.0327)	0.0482** (0.0236)	0.0653*** (0.0184)	0.0908*** (0.0221)
Exchange rate growth	0.0003 (0.0012)	-0.0051*** (0.0018)	-0.0006 (0.0015)	0.0133 (0.0200)	-0.0007 (0.0016)	-0.0018 (0.0034)	-0.0032 (0.0024)	0.0016 (0.0019)
Constant	0.3583 (0.2173)	0.6275*** (0.2258)	0.3100** (0.1543)	0.7749*** (0.2358)	0.9909* (0.5711)	0.3849* (0.2206)	0.3946*** (0.1456)	0.1062 (0.1692)
LR current inflation	0.1619 (0.1999)	0.1509*** (0.0489)	0.3085*** (0.0736)	0.5317*** (0.0926)	0.1578** (0.0712)	0.4578* (0.2318)	0.2978*** (0.0711)	0.7953*** (0.1714)
LR constant	4.2006*** (1.1346)	2.6360*** (0.1379)	2.4445*** (0.2874)	2.9263*** (0.4124)	3.1140*** (0.2516)	3.6565*** (1.1508)	1.7981*** (0.2002)	0.9300 (1.3464)
LR exchange rate growth	0.0031 (0.0138)	-0.0212*** (0.0080)	-0.0049 (0.0107)	0.0502 (0.0679)	-0.0023 (0.0047)	-0.0170 (0.0303)	-0.0144 (0.0116)	0.0143 (0.0155)
Adj. R^2	0.8981	0.8295	0.9356	0.9208	0.5998	0.9365	0.8793	0.9528
N	121	121	121	121	121	121	121	121

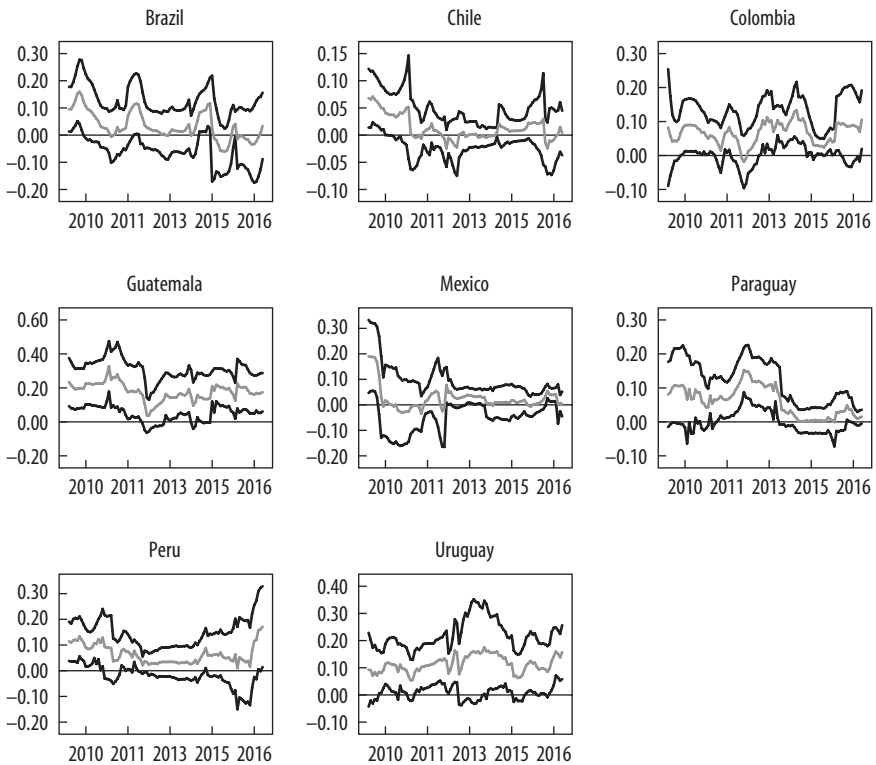
* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. LR: the long-run estimation of the coefficients. Standard errors are in parentheses.

FIGURE 3 . The Effect of Inflation on Medium-Term Inflation Expectations, by Country: Beta Coefficients



window, for each country over time. The beta coefficient tends to decline in most countries, although not always monotonically.

For example, in the cases of Colombia, Brazil, and Paraguay, there is some evidence (admittedly not always significant) that over some periods the beta coefficient actually rose. Uruguay is an exceptional case where the beta coefficient does not appear to decline over time. In figure 2, which plots actual inflation and inflation targets, the relevant periods appear to coincide with periods in which inflation shocks were significant (for example, in Paraguay) or inflation breached or appeared to be in danger of breaching the relevant inflation target (for example, in Brazil and Colombia). In the cases of Chile and Mexico, the beta coefficient was at the edge of significance for the first window, but was strictly not significantly different from zero for virtually all

subsequent windows. It is also notable that the error bands on the beta coefficient for these two countries appear tighter than for the other cases.

At the end of the period, error bounds appear to widen and beta coefficients appear to rise again in several cases, although they are only significant in Colombia, Guatemala, Peru, and Uruguay. These results indicate that in general inflation-targeting regimes became more credible in Latin America, and inflation expectations appear to have been well anchored in virtually all countries analyzed in these regressions.²¹ Toward the end of the sample, however, there does appear to be some evidence of a weakening in the anchoring of inflation expectations. Moreover, there appear to have been some periods, especially in the middle of the sample, when medium-term inflation expectations also responded to inflation shocks. Considering the graphs of individual countries, there seems to be some relation between when the coefficient on inflation shocks is significant in the rolling regressions and when the level of inflation is around or exceeds the target. This raises the interesting question of whether inflation-targeting credibility suffers, in the sense that inflation expectations become less anchored, when the level of inflation rises and breaches the target. We investigate this possibility in the following section.

Inflation Credibility and the Inflation Target

In this section we consider the effect of inflation being above the target on the degree to which inflation expectations are anchored.²² Specifically, we estimate the following equation:

$$(2) \quad E_{t,k}\pi_{t+h,k} = \alpha_k + \beta\pi_{t,k} + \gamma E_{t-1,k}\pi_{t+h,k} + \delta \text{Max}[\pi_{t-1,k} - T_{t-1,k}, 1] + \varepsilon_{t,k}.$$

In this regression we add a further term in which $T_{t,k}$ is the inflation target for country k . This extra term then takes the value of inflation minus the target when inflation is at least 1 percent above the target and one otherwise. This allows us to exploit the information available on the targets and actual inflation rates. This term may be positive or negative. If inflation expectations move higher when inflation is above target, we would expect a positive coefficient. This would suggest that there has been a reduction in credibility. On the other hand, if actual inflation has moved higher but expectations remain

21. Again Uruguay is an exception, as the beta coefficient is significant for many periods.

22. The target is either the actual target, when that is defined, or the midpoint of the band.

low, suggesting the target retains high credibility, then a negative coefficient would result. If the coefficient is not significant, then we can conclude that there was no significant change in the relationship between inflation and inflation expectations as inflation moved above the target. We choose 1 percent to avoid cases where inflation is just decimals over the target. Although we only include inflation more than 1 percent above the target, there have also been cases where inflation has been lower than 1 percent below targets. In most specifications below, we add dummies for these relatively infrequent events.

Before we proceed, we test again whether we can pool across countries. The results from table 2 (column 2) suggest that when we include the breaching term, pooling is not rejected. It is not rejected for the individual coefficients on current inflation, on the breaching term itself, and, most important, for the overall test for pooling on all slope coefficients. This suggests that with this breaching term included, we can proceed to consider panel regressions with common slope coefficients. The breaching term then appears to control for the cross-country heterogeneity in our analysis. The results of the full sample panel regressions are detailed in table 6 (column 2). For completeness and to compare the coefficients, we add a specification without the breaching term in column 1, although pooling was rejected in that case.

The results are consistent with the previous country-by-country regressions. Two points stand out. First, inflation expectations appear to be highly persistent, with a coefficient on the previous period's medium-term inflation expectation of over 0.8.²³ Second, the current inflation rate does indeed appear to have a statistically significant impact on medium-term inflation expectations. The coefficient is fairly small, however, at about 0.06, and thus an order of magnitude less than the effect of lagged inflation expectations, implying a relatively small but statistically significant effect. Finally, the breaching term is not statistically different from zero: we do not find an overall additional impact on expectations when inflation breaches the relevant target across the whole sample.²⁴ In other words, for the whole sample, while we do find an impact of current inflation on medium-term inflation expectations, we do not find that inflation exceeding the band has an additional impact on how well expectations have been anchored, at least over the whole sample period when Uruguay is included.

23. In a separate analysis not reported here, we established that inflation and inflation expectations are $I(0)$ over the sample period.

24. As mentioned above, Uruguay is something of a special case; still, these results are robust to including or excluding Uruguay.

TABLE 6. The Effect of Inflation Shocks on Inflation Expectations^a

<i>Explanatory variable</i>	<i>Without breaching term</i>	<i>With breaching term</i>
Lag. inflation exp.	0.8810*** (0.0279)	0.8800*** (0.0304)
Current inflation	0.0478** (0.0170)	0.0563*** (0.0205)
Breaching target		-0.0083 (0.0111)
Low inflation dummies		0.0430 (0.0419)
Constant	0.3224*** (0.0683)	0.2865*** (0.0601)
LR current inflation	0.4018*** (0.0727)	0.4694*** (0.0805)
LR constant	2.7092*** (0.3588)	2.3870*** (0.3942)
Adj. R^2	0.9768	0.9770
N	968	968

* Statistically significant at the 10 percent level.

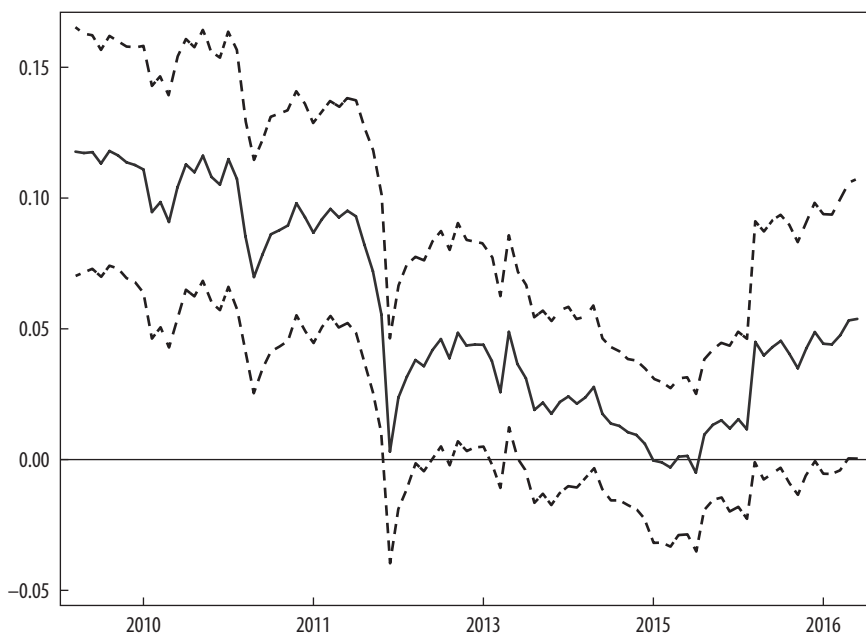
** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. Regressions on inflation expectations. LR: the long-run estimation of the coefficients. The EMBI spread and all other variables are measured in percentage points. Standard errors are in parentheses.

However, if we run a rolling panel regression, we find that at times during the sample the breaching term is indeed significant. Figures 4 and 5 show the rolling estimates of the coefficient on current inflation, when the breaching term is included in the regression and on the breaching term itself. As can be seen from the first figure, the effect of inflation shocks on inflation expectations diminished over time and became insignificantly different from zero, indicating that expectations became well anchored and suggesting a rise in credibility. However, toward the end of the sample it appears that there has been a loss of credibility, and expectations are in danger of becoming less strongly anchored again. According to figure 5, and the rolling coefficient on the breaching term, this was not significant initially but then became significant in the middle of the sample, from 2012 to the middle of 2015. This coincided with the sharp commodity price shock, large exchange rate depreciations, and pass-through to inflation. At the end of the sample, this coefficient becomes insignificantly different from zero again.

These results, together with the result that poolability cannot be rejected with this term added, suggest that this breaching term is picking up heterogeneity across countries, particularly during the middle of the sample. This suggests

FIGURE 4. Rolling Regression of the Effect of Current Inflation on Expectations: Beta Coefficient

that the heterogeneity is cyclical rather than structural. At this time, countries in the region were hit by shocks of quite different relative magnitudes. Commodities are particularly important for Chile, Colombia, and Peru, for example, while Mexico is more exposed to shocks from the United States. Brazil was arguably more exposed to financial and domestic shocks of a more political nature. Exchange rates reacted in different ways during this specific period, with different implications for inflationary processes. Our interpretation, therefore, is that this term, while significant in subsamples in the middle of our full sample, is mopping up this country heterogeneity over this period. We come back to discuss the implications of these findings in the conclusions below.

On the Persistence of the Inflation Process

One potential objection to our results is that the nature of the inflation process itself has changed, and this might be affecting our results. In particular, if the persistence of inflation shocks has fallen, then inflation shocks would be

FIGURE 5. The Changing Effect of Inflation in Relation to Target on Expectations: Delta Coefficient



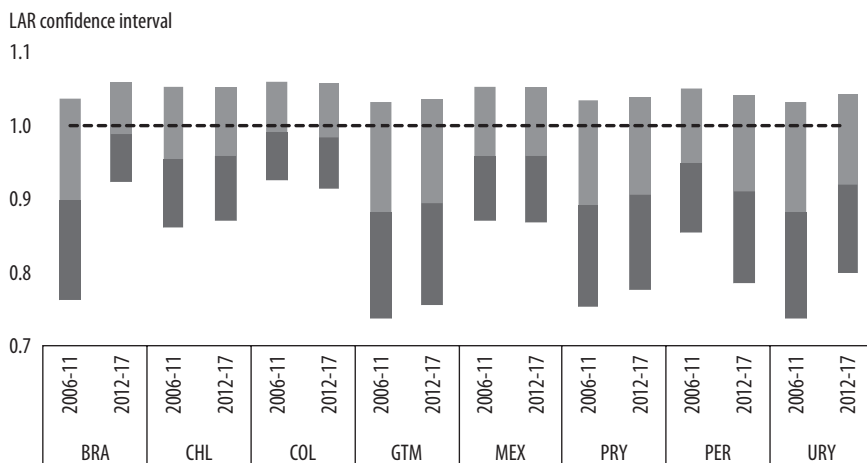
expected to have a lower impact on medium-term inflation expectations, even if credibility had not increased.²⁵ In this section, we therefore conduct an analysis to see if the underlying persistence of the inflation process has changed.

To test the persistence of inflation, we use a procedure proposed by Stock, who shows how to employ asymptotic theory to generate the distribution of a unit root test statistic such as the Dickey-Fuller test.²⁶ We construct these confidence intervals using this procedure and the estimates from the Dickey-Fuller test.

The advantages of this procedure are twofold. First, the method provides a measurement of persistence, while a unit root test would only provide a “rejection” or a “nonrejection” of the null hypothesis. Second, this approach explicitly recognizes that the distribution of the estimated coefficient (of the largest autoregressive root) is not normal. Moreover, the distribution becomes

25. Of course, if the persistence of shocks has changed, that could be endogenous to the regime in place. If we found that persistence has fallen, then this might be one interpretation.

26. Stock (1991); Dickey and Fuller (1979).

FIGURE 6. Inflation Persistence over Time^a

a. The graph shows the 90 percent confidence interval of the largest autoregressive root (LAR) in two time periods (Stock, 1991). The change in gray scale shows the median estimate. Inflation is calculated as the monthly percentage change of the CPI index.

increasingly nonnormal the closer it comes to unity. A caveat, however, is that the procedure may fail to deliver unbiased and robust confidence intervals when the process is highly stationary.²⁷

In this case, we split our sample in two and use annualized monthly inflation to calculate the largest autoregressive root (LAR). Figure 6 shows the results. The persistence of inflation shocks does appear to have decreased in some countries, but in the vast majority of cases, the confidence intervals overlap. We therefore conclude that there is not strong evidence that inflation shocks themselves have substantially changed.

Conclusions

Several countries in Latin America have adopted inflation-targeting regimes. To a large degree, the success of such regimes depends on the credibility of the target. Given the region's experiences with high inflation in the past, an important question is whether such targets can become highly credible in

27. Phillips (2012).

such circumstances. In this paper, we consider how medium-term inflation expectations respond to current inflation shocks as a measure of credibility, and we develop an econometric methodology to consider how credibility has developed over time. We also take advantage of a publicly available database on inflation expectations.

The results indicate that over the whole sample period, inflation expectations were not fully anchored and did indeed respond to inflation shocks, although in most cases the magnitude of the effects appears relatively small. Moreover, we found that at the start of the sample, virtually all of the regimes gained credibility according to our measures. This is consistent with the view that the credibility of the inflation-targeting regimes in Latin America deepened over time, and after the middle of the sample, inflation shocks had no significant impact on medium-term inflation expectations in our pooled regressions. That said, there is also evidence in the middle of the sample that when inflation in the previous period exceeds the stated target, there is an impact of inflation on inflation expectations. This suggests that while overall credibility may have been enhanced in Latin America, there is a cost to deviating from the stated inflation target. Moreover, there is some evidence toward the end of the sample that inflation expectations do respond to inflation shocks, with the relevant coefficient on the verge of significance.

There is much discussion at present regarding the future of inflation targeting and whether central banks should have other objectives as well as stable prices, and we hope that this analysis might be a useful contribution to the debate. Inflation expectations did become more anchored in Latin America, and the credibility of the targets increased. On the other hand, if inflation is allowed to persist above targets, this may threaten the future success of this regime.

References

- Ball, Laurence M., and Niamh Sheridan. 2004. "Does Inflation Targeting Matter?" In *The Inflation-Targeting Debate*, edited by Ben S. Bernanke and Michael Woodford, pp. 249–82. University of Chicago Press.
- Bernanke, Ben S., and others. 1999. *Inflation Targeting: Lessons from International Experience*. Princeton University Press.
- Capistrán, Carlos, and Manuel Ramos-Francia. 2010. "Does Inflation Targeting Affect the Dispersion of Inflation Expectations?" *Journal of Money, Credit, and Banking* 42(1): 113–34.
- Cecchetti, Stephen G., and Michael Ehrmann. 2002. "Does Inflation Targeting Increase Output Volatility?: An International Comparison of Policymakers' Preferences and Outcomes." In *Monetary Policy: Rules and Transmission Mechanisms*, edited by Norman Loayza and Klaus Schmidt-Hebbel, pp. 247–74. Santiago: Central Bank of Chile.
- Corbo, Vittorio, Oscar Landerretche, and Klaus Schmidt-Hebbel. 2001. "Assessing Inflation Targeting after a Decade of World Experience." *International Journal of Finance and Economics* 6(4): 343–68.
- Corbo, Vittorio, and Klaus Schmidt-Hebbel. 2001. "Inflation Targeting in Latin America." Working Paper 105. Santiago: Central Bank of Chile.
- Demir, Banu, and Taner M. Yigit. 2008. "Announcements and Credibility under Inflation Targeting." *Economic Letters* 100(2): 249–253.
- Dickey, David A., and Wayne A. Fuller. 1979. "Distribution of the Estimators for Autoregressive Time Series with a Unit Root." *Journal of the American Statistical Association* 74(366): 427–31.
- Fraga, Arminio, Ilan Goldfajn, and André Minella. 2004. "Inflation Targeting in Emerging Market Economies." *NBER Macroeconomics Annual 2003*, vol. 18, edited by Mark Gertler and Kenneth Rogoff, pp. 365–415. MIT Press.
- Gonçalves, Carlos E. S., and João M. Salles. 2008. "Inflation Targeting in Emerging Economies: What Do the Data Say?" *Journal of Development Economics* 85(1): 312–18.
- Gurkaynak, Refet S., Andrew T. Levin, and Eric T. Swanson. 2010. "Does Inflation Targeting Anchor Long-Run Inflation Expectations? Evidence from the U.S., UK, and Sweden." *Journal of the European Economic Association* 8(6): 1208–42.
- Gurkaynak, Refet S., and others. 2007. "Inflation Targeting and the Anchoring of Inflation Expectations in the Western Hemisphere." *Economic Review* 2007: 25–47.
- Huang, Wayne, and Bharat Trehan. 2008. "Unanchored Expectations? Interpreting the Evidence from Inflation Surveys." *Economic Letter* 2008-23. Federal Reserve Bank of San Francisco.
- Johnson, David R. 2002. "The Effect of Inflation Targeting on the Behavior of Expected Inflation: Evidence from an 11 Country Panel." *Journal of Monetary Economics* 49(8): 1521–1538.

- Levin, Andrew T., and others. 2004. "The Macroeconomic Effects of Inflation Targeting." *Federal Reserve Bank of St. Louis Review* 86(4): 51–8.
- Mishkin, Frederic S., and Klaus Schmidt-Hebbel. 2001. "One Decade of Inflation Targeting in the World: What Do We Know and What Do We Need to Know?" Working Paper 101. Santiago: Central Bank of Chile.
- Phillips, Peter C. 2012. "On Confidence Intervals for Autoregressive Roots and Predictive Regression." Discussion Paper 1879. Yale University, Cowles Foundation for Research in Economics.
- Pierdzioch, Christian, and Jan-Christoph Rülke. 2013. "Do Inflation Targets Anchor Inflation Expectations?" *Economic Modelling* 35(1): 214–223.
- Powell, Andrew. 2017. "Routes to Growth in a New Trade World." 2017 Latin American and Caribbean Macroeconomic Report. Washington: Inter-American Development Bank.
- Schmidt-Hebbel, Klaus, and Alejandro M. Werner. 2002. "Inflation Targeting in Brazil, Chile, and Mexico: Performance, Credibility, and the Exchange Rate [with Comments by Ricardo Hausmann and Roberto Chang]." *Economía* 2(2): 31–89.
- Stock, James H. 1991. "Confidence Intervals for the Largest Autoregressive Root in U.S. Macroeconomic Time Series." *Journal of Monetary Economics* 28(3): 435–59.
- Van der Cruysen, Carin, and Maria Demerizis. 2011. "How Anchored Are Inflation Expectations in EMU Countries?" *Economic Modelling* 28(1): 281–98.
- Vega, Marco, and Diego Winkelried. 2005. "Inflation Targeting and Inflation Behavior: A Successful Story?" *International Journal of Central Banking* 1(3): 153–75.