Anchoring of Inflation Expectations in Latin America

Rocío Gondo
James Yetman

Abstract

We use inflation survey data from Consensus Economics to assess how firmly inflation expectations are anchored in Latin America. Following the methodology proposed by Mehrotra and Yetman (2018), we model inflation forecasts using a decay function, where forecasts monotonically diverge from an estimated anchor towards recent actual inflation as the forecast horizon shortens. Our results suggest that most countries do have an inflation anchor, with the estimated weight of the anchor increasing through time, indicating more strongly anchored expectations. This is consistent with the improving credibility of central banks' monetary policy management over our sample period (1993-2016). For countries with formal inflation targets, our results indicate that inflation targeting regimes are generally credible, with estimated anchors lying within the inflation target range for all countries in the most recent sample that we consider.

Keywords: inflation expectations, inflation anchoring, decay function.
JEL classification: E31, E58.

R. Gondo <rocio.gondo@bcrp.gob.pe>, researcher at the Economic Research Department of the Banco Central de Reserva del Perú, and J. Yetman <james.yetman@bis.org>, principal economist at the BIS Representative Office for Asia and the Pacific. Julieta Contreras and Berenice Martínez provided excellent research assistance. This paper is part of CEMLA's joint research project on Inflation Expectations and their Degree of Anchoring. The authors thank, without implication, other project participants and especially our advisor for this paper, Olivier Coibion, for their comments. The views expressed here are those of the authors and are not necessarily shared by the Bank for International Settlements or the Banco Central de Reserva del Perú.

1. INTRODUCTION

Monetary policy effectiveness, and especially the achievement of price stability, can be greatly assisted when inflation expectations are well anchored. In many models of inflation, for example, volatile inflation expectations directly increase the volatility of inflation outcomes. In Latin America, with a history of repeated episodes of high inflation, many countries have adopted inflation targeting (IT) as a framework to support a move to low and stable inflation and provide for better anchoring of inflation expectations. Some of these countries have adopted a schedule of decreasing targets over time with a view to gradually reducing inflation.

Challenges of inflation control for central banks in the region remain. In 2015-2016, some countries experienced inflation rates above the top of their target ranges, mainly commodity exporters who experienced large currency depreciations. In the cases of Colombia and Peru inflation expectations appear to have become deanchored to some extent, with high inflation persisting (see Figure 1). Monetary policy tightening actions were taken in response to these developments, with their central banks raising policy rates by 3.25% and 1%, respectively.

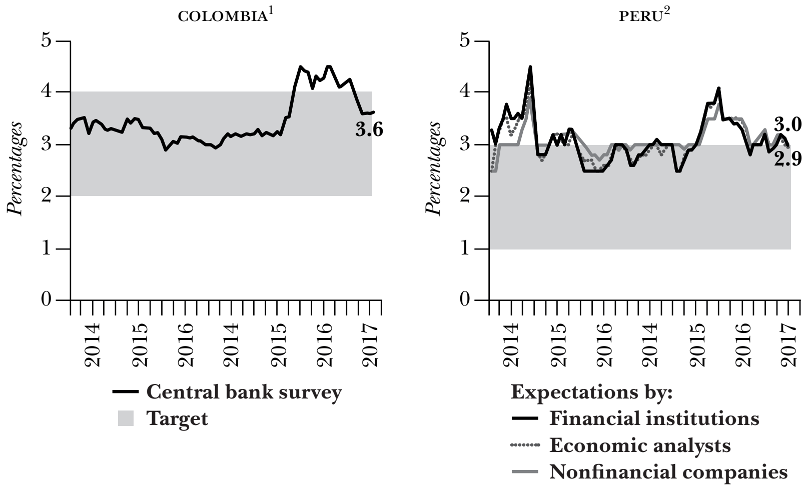
The goal of this paper is to assess whether or not countries have an inflation expectations anchor and, if they do, how strongly inflation expectations are anchored. For economies with formal IT frameworks, we also examine whether the anchor is consistent with the central bank's target. We define an inflation anchor as the expected level of inflation in the absence of any shocks to the economy. It should be noted that the inflation anchor is not necessarily equal to the inflation target for countries with an IT framework.

For each country, first, we evaluate whether there is an anchor for inflation expectations and, if so, how the anchor has evolved over time. Second, we analyze how well identified the inflation anchor is, using the standard deviation of the estimated anchor as an indicator of the degree of anchoring. Third, we compare the anchoring of inflation expectations between countries in the region that have inflation targets with such anchoring in those that do not.

We model inflation forecasts using a decay function, where forecasts monotonically diverge from the estimated anchor towards recent actual inflation as the forecast horizon shortens. We estimate

Figure 1

INFLATION EXPECTATIONS PUBLISHED BY CENTRAL BANKS



[1] Expectations for 12-month inflation. [2] Expectations of current year (December) 12-month inflation.
Sources: National data.

this relationship for each country over eight-year rolling samples using maximum likelihood, obtaining parameter estimates that define the decay function and the anchor.

Our results suggest that most countries do have an inflation anchor, although in some countries (including Argentina and Venezuela), the degree of anchoring declined in recent periods. For most countries, we observe a pattern of increasing anchoring of inflation expectations, consistent with the improved credibility of central banks' monetary policy management. This result stands in contrast with the results of Davis and Mack (2013), who found a low degree of anchoring of inflation expectations for Latin America compared with other regions, using a Phillips curve regression on core inflation.

In IT countries, inflation expectations appear to be well anchored. In addition, we find that the estimated anchors are generally consistent with their inflation targets; in the most recent sample that we examine, our estimated inflation anchors lie within the inflation target range for all countries with formal inflation targets. This result is consistent with the results in De Carvalho et al. (2006), where they find that the inflation anchor does not differ statistically from the inflation target for Brazil, Chile, and Mexico. For countries that adopted IT after 2009, the estimated anchor is slightly higher than the target, but this might be due to the rolling sample containing some years before the adoption of the regime.

We then consider some second-stage regressions based on these estimates, focusing on the estimated weight on the anchor at a two-year horizon, to explore what is driving our results. We show that IT and low levels of inflation persistence help explain strongly anchored inflation expectations.

Moreover, we find that inflation-targeting countries generally have more precisely estimated inflation expectations anchors. Capistran and Ramos-Francia (2010) report similar results: Countries with IT show a lower dispersion of long-run inflation expectations, especially in the case of emerging market countries. Similarly, for a sample of 15 advanced countries, Cecchetti and Hakkio (2009) find that the adoption of IT reduces the dispersion of inflation expectations.

In addition to the papers already cited, our work is related to models of inflation expectations extracted from financial data. For instance, Gurkaynak et al. (2007) find that ITers such as Canada and Chile have better anchored long-run inflation expectations than the United States (US), using break-even inflation rates from nominal and inflation-indexed bonds. For Latin America, De Pooter et al. (2014), using both survey-based and financial market-based data, find that inflation expectations have become better anchored over the past decade in Brazil, Chile, and Mexico. Focusing on Colombia, Espinosa-Torres et al. (2017) find that inflation expectations, obtained through break-even inflation measures, have remained anchored to values inside the inflation target range in the period following the Great Financial Crisis. Finally, for Brazil, Vicente and Guillen (2013) find that break-even inflation is an unbiased predictor of future inflation at short horizons, but is actually negatively correlated with inflation outcomes at 24- and 40-month horizons.

The paper is organized as follows. Section 2 provides a short description of the estimation methodology. Section 3 describes the data. Section 4 discusses the results. Section 5 then concludes.

2. METHODOLOGY

Following the methodology proposed by Mehrotra and Yetman (2018), we model inflation forecasts using a decay function, where forecasts diverge monotonically from an estimated anchor towards recent actual inflation as the forecast horizon shortens. This framework makes full use of the multiple-horizon dimension of the data to provide a measure of the level of the inflation anchor.

The functional form used to model inflation expectations is based on the cumulative density function of the Weibull distribution. This functional form assumes that, as the forecast horizon shortens, inflation expectations become increasingly sensitive to newly arriving information about inflation outcomes.

Given the observed behavior of inflation forecasts from the mean and median data from Latin American Consensus Forecasts, we model the expectations process for each country as follows:[1]

1 $$f(t,t-h)=\alpha(h)\pi^{*}+(1-\alpha(h))\pi(t-h)+\varepsilon(t,t-h),$$

where $f(t,t-h)$ is the forecast of inflation for year t at horizon h; h is the number of months before the end of year being forecasted; $\alpha(h)$ is the weight on the anchor (which follows a decay function); π^{*} is the inflation anchor; $\pi(t-h)$ is the observed inflation at the time that the forecast is made; and $\varepsilon(t,t-h)$ is a residual term.

We assume that the decay function $\alpha(h)$ follows a Weibull cumulative density function:[2]

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1 We parametrize the model to separately identify the anchor and the coefficients indicating the weight on the anchor. If there is a link between the two (for example, adopting an inflation target leads to a change in both the anchor and how strongly inflation is anchored), our estimation allows for this possibility but does not impose it. As such, it may be possible to improve the efficiency of the estimation approach taken here.

2 Our results are conditional on the decay function. Mehrotra and Yetman (2018) demonstrate that, provided inflation follows an autoregressive process, a monotonically decreasing decay function should fit inflation expectations.

2 $$\alpha(h) = 1 - \exp\left(-\left(\frac{h}{b}\right)^{c}\right).$$

The two parameters to estimate from the decay function are b and c. Higher values of b result in a smaller weight on the inflation anchor at short horizons, whereas higher values of c provide more curvature, and a more rapid decline the weight on the inflation anchor as the horizon shortens.

The variance of the residual is $\varepsilon(t,t-h)$ modeled as a function of the forecast horizon h:

3 $$V\left(\varepsilon(t,t-h)\right) = \exp\left(\delta_0 + \delta_1 h + \delta_2 h^2\right).$$

The use of the exponential function here ensures that the fitted values of the variance are positive for any values of the parameters defining the variance (δ_0, δ_1 and δ_2). Note that, aside from this restriction, our modeling assumptions for the variance are very flexible: It can be increasing or decreasing in the forecast horizon, or even follow a u-shaped (or inverse u-shaped) pattern across horizons.

Forecasts made at different horizons for the inflation outcome in a given year t are likely to be correlated, and more strongly so the closer the two horizons are. Therefore, the correlation between the residual at two different horizons h and k is modeled as:

4 $$corr\left(\varepsilon(t,t-h), \varepsilon(t,t-k)\right) = \phi_0 + \phi_1 |h-k|.$$

We estimate the set of parameters $\{\pi^*, b, c, \delta_0, \delta_1, \delta_2, \phi_0, \phi_1\}$ by maximum likelihood, economy by economy, based on eight-year rolling samples. Given the high degree of non-linearity of the model, we use 100 different sets of starting values in each case to ensure convergence to a global maximum. We then choose the estimates with the highest log-likelihood function value for which the parameters of the decay function are identified.

3. DATA

We use data on mean or median inflation forecasts from Latin American Consensus Forecasts. Our preference is median forecasts, constructed based on the full panel of inflation forecasts available from Consensus Economics at a monthly frequency. Medians are less affected by outlier forecasts than means, and may, therefore, be less vulnerable to data errors, for example. However, for some countries, forecaster-level data only becomes available partway through our sample. For other countries, only average forecasts are available for the full sample. Where we cannot construct median forecasts, we use mean forecasts instead.

Our sample covers 18 countries in the region, as listed in Table 1. The economies in our sample account for more than 95% of GDP for Latin America and the Caribbean in 2015 at market exchange rates. This sample includes countries with and without IT regimes, those that achieved low and stable inflation rates, and others where inflation has stayed relatively high and volatile.

Table 1

LIST OF COUNTRIES AND SAMPLE

	Data available from	*Inflation target adopted*		*Data available from*	*Inflation target adopted*
Argentina	1993		Guatemala	2009	2005
Bolivia	1993		Honduras	2009	
Brazil	1990	1999	Mexico	1990	2001
Chile	1993	1999	Nicaragua	2009	
Colombia	1993	1999	Panama	1993	
Costa Rica	1993	2005[a]	Paraguay	1993	2011
Dominican Republic	1993	2012	Peru	1993	2002
Ecuador	1993		Uruguay	1993	2007
El Salvador	2009		Venezuela	1993	

[a] Transition to an explicit IT regime started in 2005 with the announcement of an annual inflation target.

Arguably, there may be better inflation forecast datasets that could be used to answer this question, at least for some of the economies in our sample. For example, Consensus Economics' inflation forecasts are typically based on the annual average inflation rate, whereas most inflation targets are defined in terms of year-on-year inflation. Hence, central bankers are likely to care more strongly about anchoring in terms of year-on-year inflation, rather than annual average inflation. Offsetting this, we expect that measures of anchoring are likely to be highly correlated across the two measures. Further, using Consensus data, we are able to focus on a larger cross-section of countries, covering a longer period for many economies than would be possible with forecasts from other sources. The forecast surveys are also constructed using consistent methodology (in terms of variable definition and the timing of the forecasts, for example), so the results are likely to be comparable across countries.

Table 1 shows the availability of data for each country, including the starting date and the year of adoption of an IT regime, where applicable. Note that data availability is limited to bi-monthly for some economies in the early part of the sample, with monthly forecasts only published beginning in 2002. In these cases, we ensure that the contribution of the missing observations to the likelihood function is set to zero.

Figure A.1 in the Annex shows the evolution of inflation forecasts for each country in the sample. For countries that have had IT regimes for an extended period (displayed in Figure A.1, Section A: Brazil, Chile, Colombia, Mexico, and Peru), longer-horizon forecasts are more strongly anchored than for other countries in the sample. In particular, two-year-ahead inflation forecasts are close to the inflation target and the dispersion between the inflation forecasts for different years is quite small. In this set of countries, inflation forecasts only start to deviate from the target around 12 months ahead of the date being forecast, when observed inflation outcomes become more informative about the path of inflation.

The second group of countries (displayed in Figure A.1, Section B: Costa Rica, the Dominican Republic, Guatemala, Paraguay, and Uruguay) adopted IT more recently. For longer-horizon forecasts, e.g., 24 months ahead, we observe a wide dispersion in inflation forecasts across time, but a declining trend in the initial forecast point after the adoption of IT.

The last subset of countries is those without an explicit inflation target throughout our sample (see Figure A.1, Section C). These countries tend to show the largest dispersion between inflation forecasts at both short and long horizons.

4. RESULTS

We estimate our non-linear model by maximum likelihood using eight-year rolling samples. For each sample, we consider a large set of different starting values to ensure convergence to the global maximum. We consider that an inflation anchor exists if the estimated weight on the anchor at 24 months is higher than 0.10. Below this threshold, the estimated anchor tends to be very volatile and highly dependent on starting values, which we interpret as indicating that there is no inflation anchor.

4.1 Decay Function

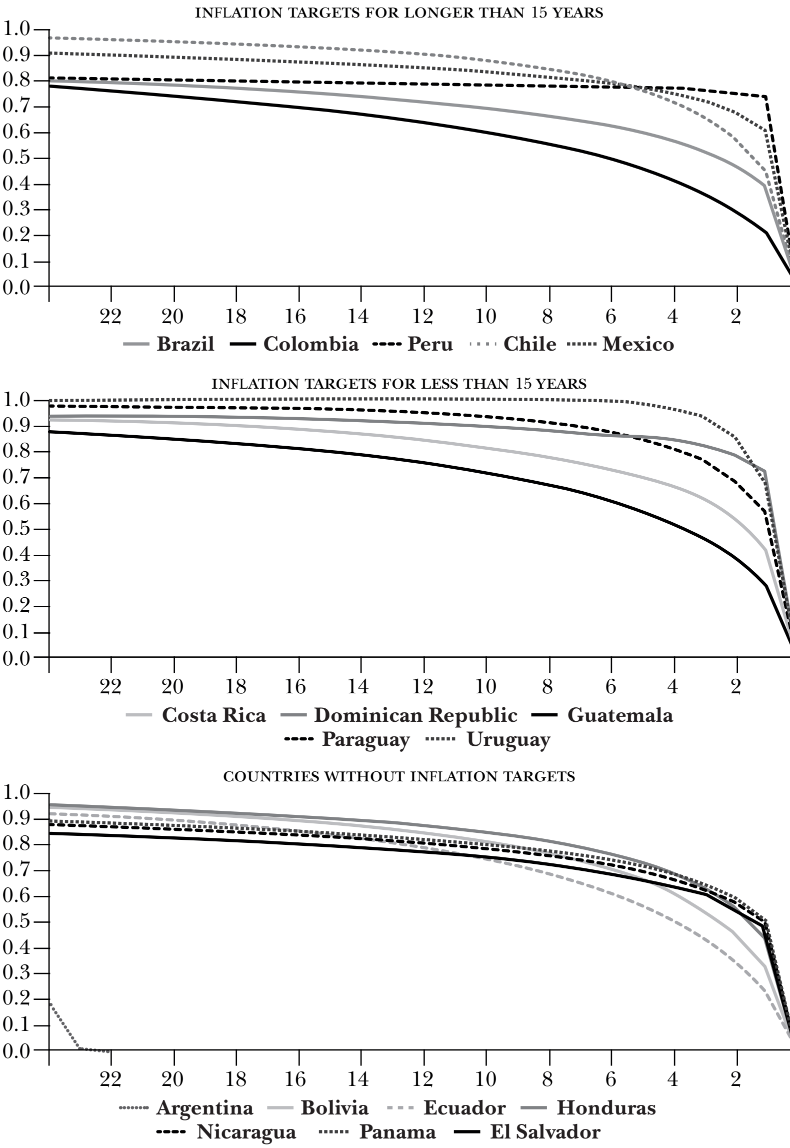
Figure 2 shows the estimated decay functions for all the countries in the sample, using the most recent rolling sample of 2009-2016. The figures show that the weight on the anchor is high–generally above 0.7–for all horizons longer than 12 months for all countries in our sample, with the exception of Argentina (which is barely visible in the bottom left corner of the right-hand panel). We generally observe a sharp decline in the weight assigned to the inflation anchor in horizons shorter than six months, when forecasters have more information about realized inflationary shocks that are likely to continue to influence inflation through to the inflation outcome being forecast. Qualitatively, there does not seem to be a large difference between countries with IT in our sample and other Latin American countries in terms of the estimated decay functions.

With respect to the evolution through time, Figure 3 shows the estimated weight on the anchor at a horizon of two years (i.e., $\alpha(24)$), the longest horizon for which we use the Consensus Forecast data.[3] We include all countries for which there are multiple rolling samples (i.e., forecasts are available before 2009). These results suggest

[3] Consensus Forecasts also publishes average forecasts at longer horizons, of up to ten years, for some economies in our sample, but these are only available twice per year.

Figure 2

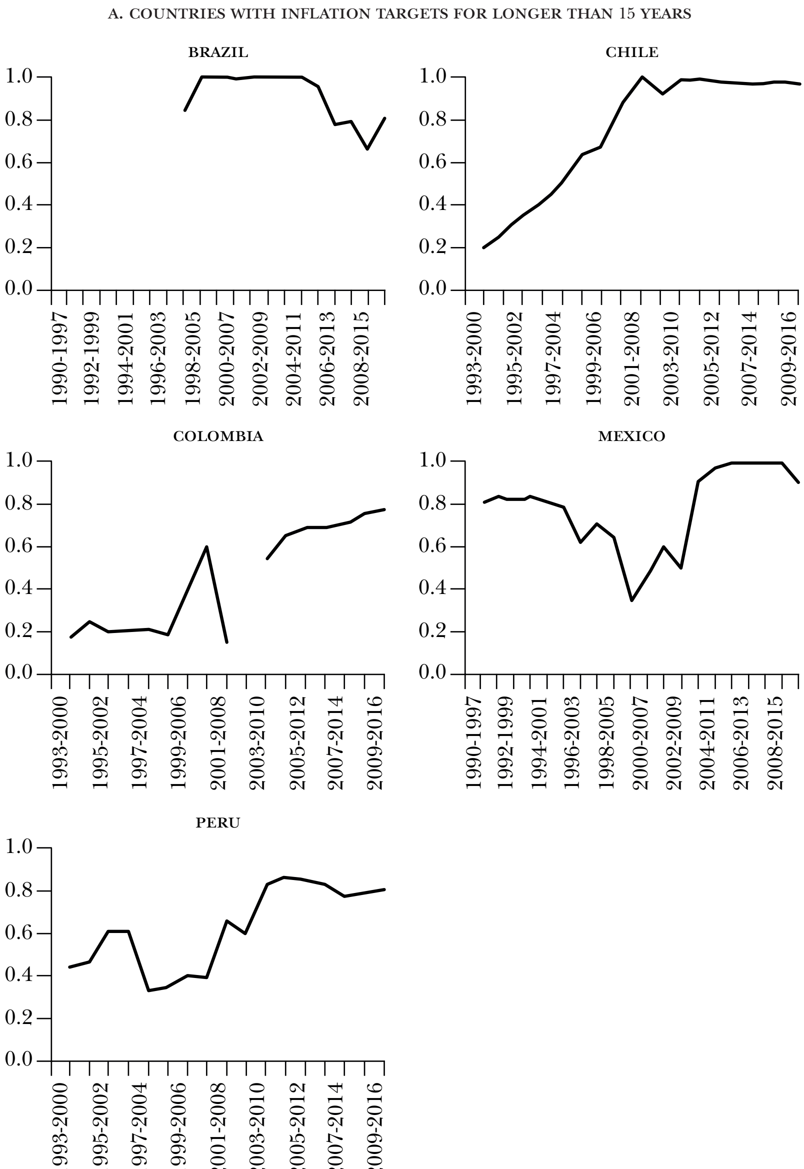
DECAY FUNCTIONS 2009-2016



Notes: The horizontal axis represents the forecast horizon, defined as the number of months before the end of the calendar year being forecasted.
The graph does not include the decay function for Venezuela because the last available rolling sample is 2008–2015.
Sources: Authors' calculations.

Figure 3

ESTIMATED WEIGHT ON INFLATION ANCHOR (*h* = 24)

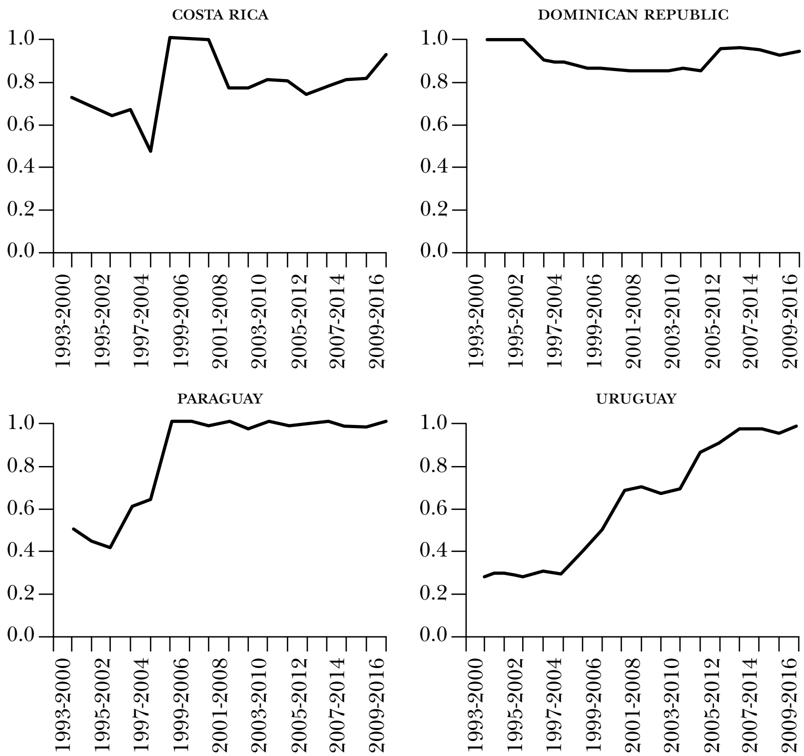


Notes: Horizontal axis displays the eight-year rolling sample. Periods where no line is displayed correspond to rolling samples for which no anchor can be identified.
Source: Authors' calculations.

Figure 3 (cont.)

ESTIMATED WEIGHT ON INFLATION ANCHOR (*h* = 24)

B. COUNTRIES WITH INFLATION TARGETS FOR LESS THAN 15 YEARS

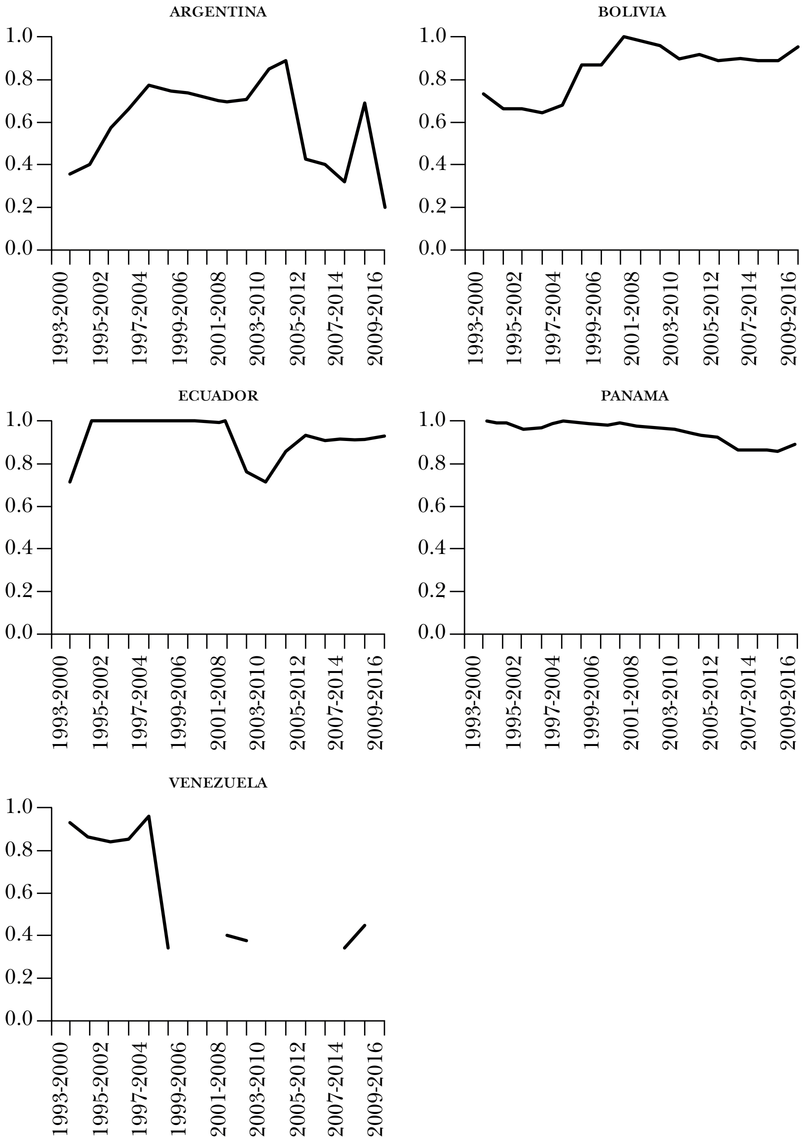


Notes: Horizontal axis displays the eight-year rolling sample. Periods where no line is displayed correspond to rolling samples for which no anchor can be identified.
Source: Authors' calculations.

Figure 3 (cont.)

ESTIMATED WEIGHT ON INFLATION ANCHOR (h = 24)

C. COUNTRIES WITHOUT INFLATION TARGETS



Notes: Horizontal axis displays the eight-year rolling sample. Periods where no line is displayed correspond to rolling samples for which no anchor can be identified.
Source: Authors' calculations.

that the degree of anchoring of long-run inflation expectations has generally increased over the sample, most notably for some of the economies with inflation targets (Chile, Colombia, Peru in Panel A, and Paraguay and Uruguay in Panel B).[4] In the most recent rolling sample, the weight on the anchor exceeds 0.7 for all economies except Argentina and Venezuela. Similar results are observed at other horizons too (see Figure A.2 in the Annex for anchoring at a 12-month horizon, for example).

Table 2 displays the key estimated parameters for the most recent rolling sample, 2009-2016. We report an estimated inflation anchor for all economies, including those for which this is poorly identified in the data. There is a wide variety of parameter estimates across countries. We note that Venezuela has a much higher estimated anchor than any of the other economies (at over 28%), and Argentina and Venezuela have much less precisely estimated anchors than the other countries in the sample, consistent with relatively weakly anchored inflation expectations for these countries.

Regarding the parameters that govern the shape of the decay function, most countries show a very low degree of curvature (i.e., low estimates of c), which means that the weight on the anchor remains high even as the forecast horizon shortens, as shown in Figure 2.

4.2 Estimated Inflation Anchors

Figure 4 shows the evolution of the estimated inflation expectations anchors, for the same set of countries displayed in Figure 3. Solid lines correspond to the point estimate of the anchor, while dashed lines represent the 95% confidence interval. Gray regions illustrate inflation target ranges where applicable.

Section A of the figure presents the results for countries that have had IT for more than 15 years. Since the adoption of IT, all these countries show a reduction in their anchor towards the inflation target.

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4 In our modeling of inflation expectations, we are implicitly assuming that changes in inflation persistence reflect changes in the anchoring of inflation expectations. To the extent that declining inflation persistence reflects changed price-setting mechanisms that results from greater anchoring of inflation expectations, this assumption is warranted (see Section 4.3). But there may be other, more mechanical sources of changes in inflation persistence–such as changes in the sectoral composition of the economy–that could bias our results.

Table 2

ESTIMATION RESULTS, 2009-2016

	b	c	π^*	$s.e.(\pi^*)$
Argentina	24.60	59.56	5.39	0.411
Bolivia	4.20	0.62	6.00	0.027
Brazil	6.37	0.38	4.88	0.028
Chile	2.58	0.55	2.98	0.004
Colombia	11.84	0.58	3.45	0.012
Costa Rica	3.39	0.49	6.09	0.043
Dominican Republic	0.35	0.25	5.84	0.044
Ecuador	6.25	0.72	4.17	0.015
El Salvador	3.47	0.33	3.06	0.014
Guatemala	6.62	0.59	7.83	0.032
Honduras	2.85	0.53	6.97	0.034
Mexico	1.29	0.29	3.54	0.006
Nicaragua	2.90	0.36	7.21	0.025
Panama	2.53	0.36	3.81	0.022
Paraguay	0.89	0.86	5.10	0.027
Peru	0.02	0.06	2.55	0.016
Uruguay	1.45	0.52	6.67	0.026
Venezuela[1]	29.64	2.39	28.35	0.328

[1] For Venezuela, results are for 2008-2015, since data are not available for 2016.

Moreover, for all countries except Brazil, estimates of the anchor are quite stable from one rolling sample to the next towards the latter end of the rolling samples.

The confidence bands (constructed from the standard deviation of the estimated anchor) indicate that the estimated anchors are generally tightly estimated.[5] Chile displays the most tightly estimated anchor across the rolling samples, whereas Colombia shows an increasing degree of tightness after the adoption of the inflation target, consistent with improving credibility.

Figure 4, Section B, shows the results for the more recent ITers. These countries, except for Uruguay, show a decreasing trend in their anchors. In the case of Costa Rica, this is consistent with their decreasing inflation target. In the case of Uruguay, the inflation target has remained at 5% since its adoption, but estimated inflation appears to be diverging from it towards the upper bound of the target range of 7%, at the same time as actual inflation has been close to 7%. This group of countries also shows a tightly estimated anchor for most countries and rolling samples; for Uruguay, the confidence band visibly narrows as time goes by.

For countries that are not ITers, displayed in Figure 4, Section C, there is generally more dispersion in both the estimated anchors and their trends. Ecuador has a stable estimated anchor of 4%, whereas Venezuela has many rolling samples without an identifiable anchor. The degree of tightness of the inflation anchor is, in general, lower for this group of countries too.

The degree of tightness of the inflation anchor exploits information from dispersion across the time series and horizons. We could also complement the estimation by further exploiting information on the standard deviation across forecasters for each country, although the availability of data would reduce the sample of countries. Thus, we leave this to future work.

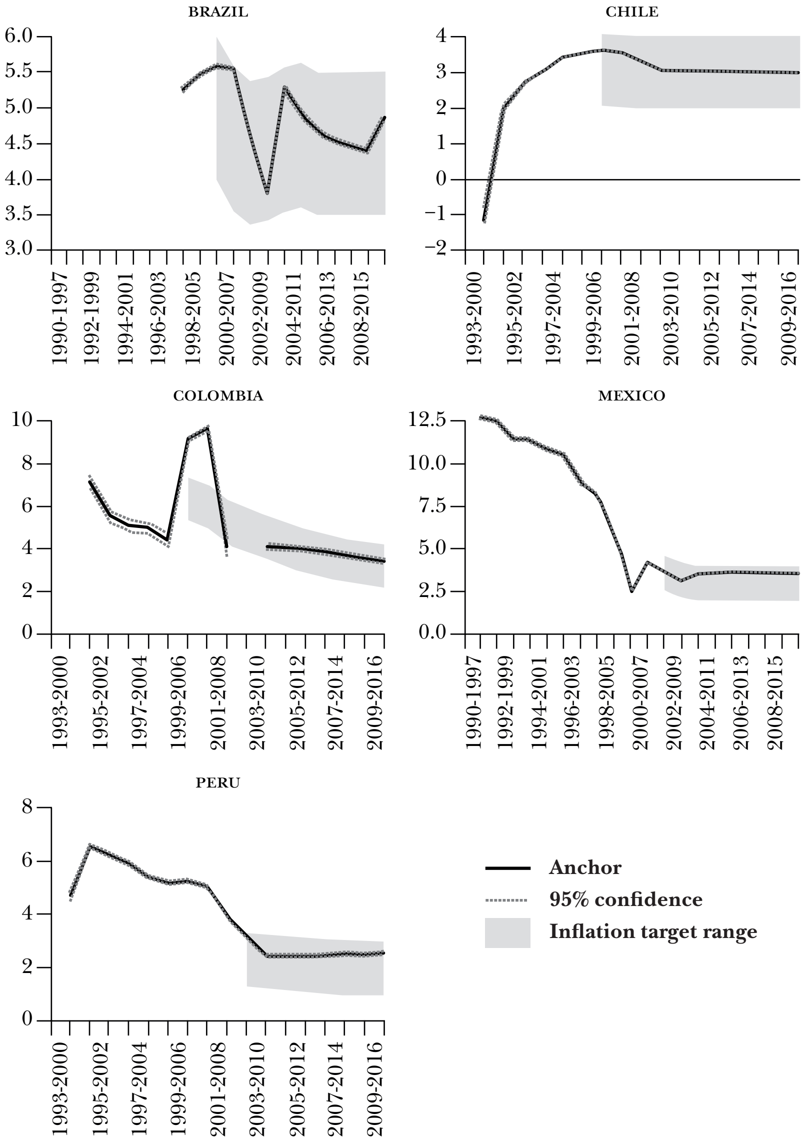
One caveat with the data used in the analysis is that inflation forecasts have a maximum horizon of two years, which might not be

[5] The estimated confidence intervals for the inflation anchor depend on the functional form of the decay function. However, for a sample of advanced and emerging countries, Mehrotra and Yetman (2018) find that the Weibull-based decay function fits the data better than more restrictive forms, and more general forms do not increase explanatory power markedly.

Figure 4

EVOLUTION OF ESTIMATED INFLATION ANCHOR[1]

A. COUNTRIES WITH INFLATION TARGETS FOR MORE THAN 15 YEARS

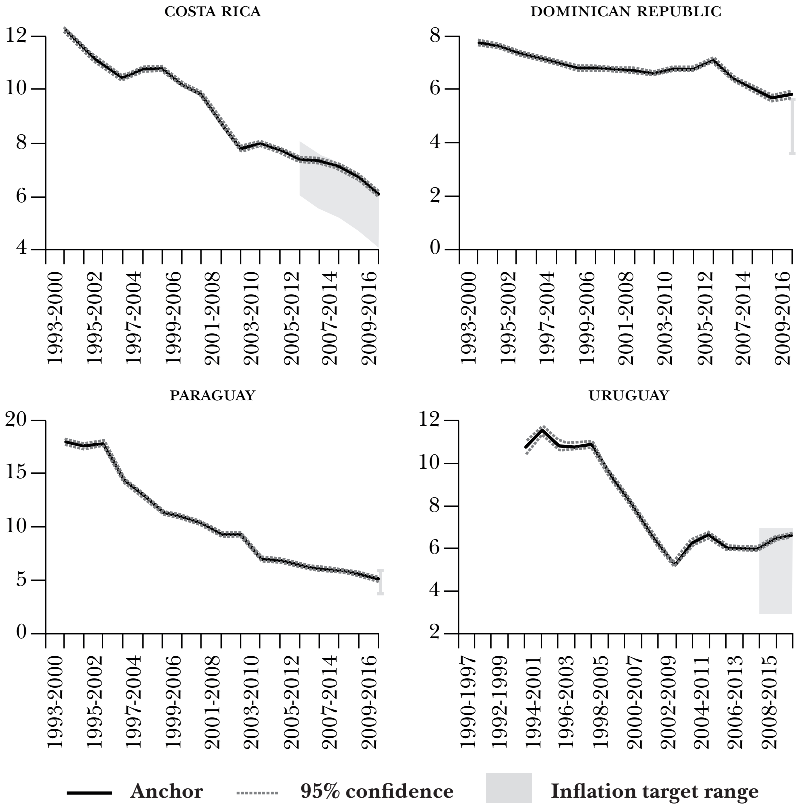


[1] Horizontal axis displays the eight-year rolling sample. Periods where no line is displayed correspond to rolling samples for which no anchor can be identified.
Source: Authors' calculations.

Figure 4 (cont.)

EVOLUTION OF ESTIMATED INFLATION ANCHOR[1]

B. COUNTRIES WITH INFLATION TARGETS FOR LESS THAN 15 YEARS

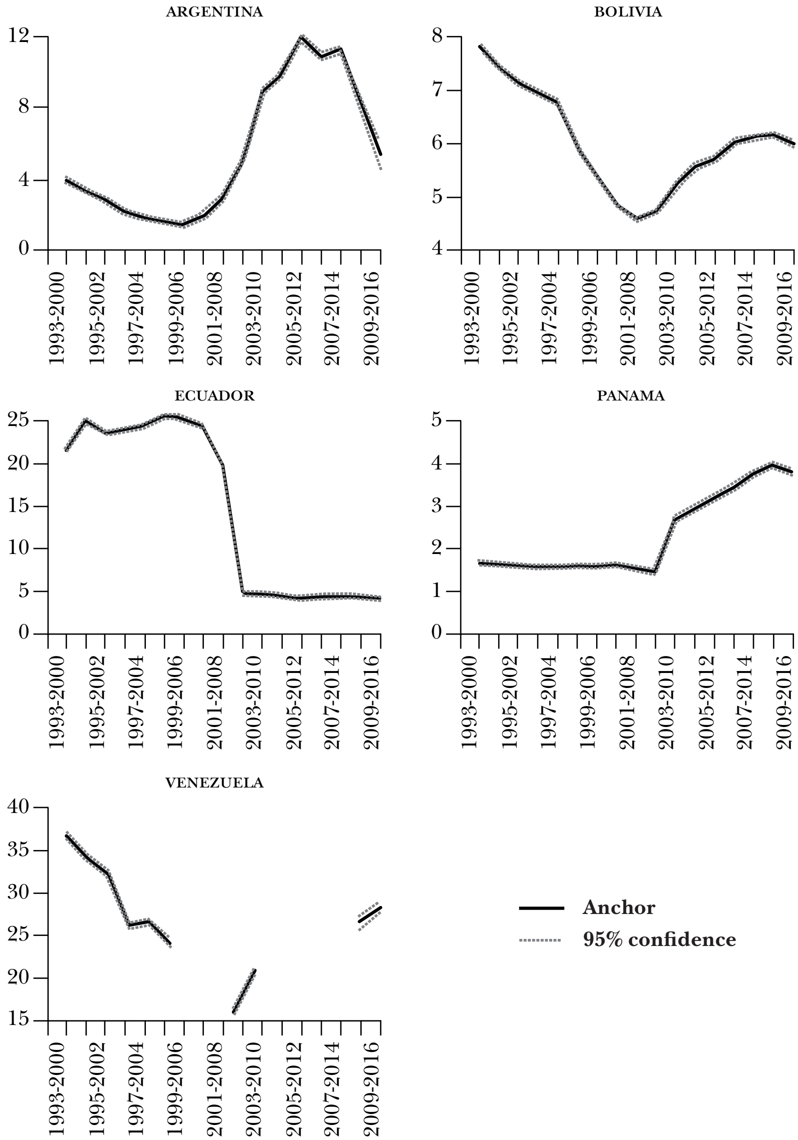


[1] Horizontal axis displays the eight-year rolling sample. Periods where no line is displayed correspond to rolling samples for which no anchor can be identified.
Source: Authors' calculations.

Figure 4 (cont.)

EVOLUTION OF ESTIMATED INFLATION ANCHOR[1]

C. COUNTRIES WITHOUT INFLATION TARGETS



[1] Horizontal axis displays the eight-year rolling sample. Periods where no line is displayed correspond to rolling samples for which no anchor can be identified.
Source: Authors' calculations.

long enough to capture long-run inflation expectations.[6] We test this by plotting the longer-term Consensus inflation forecasts for six-to-ten years ahead, for the countries for which these are available, against the estimated anchors. Figure 5 shows that six-to-ten year ahead forecasts are highly correlated with the estimated anchor, with Venezuela being the main outlier, regardless of whether we take a particular sample period or the average. This is consistent with the results displayed in Mehrotra and Yetman (2018) for a larger sample of countries.

4.3 Effect of IT

Next, we focus on the sample of countries with IT and analyze whether or not the estimated anchor is consistent with the inflation target. By doing so, we are assessing whether our results are consistent with these countries building credibility for their IT monetary policy frameworks.[7] We focus on the average across all rolling samples where a country has an IT framework. Table 3 shows that the estimated

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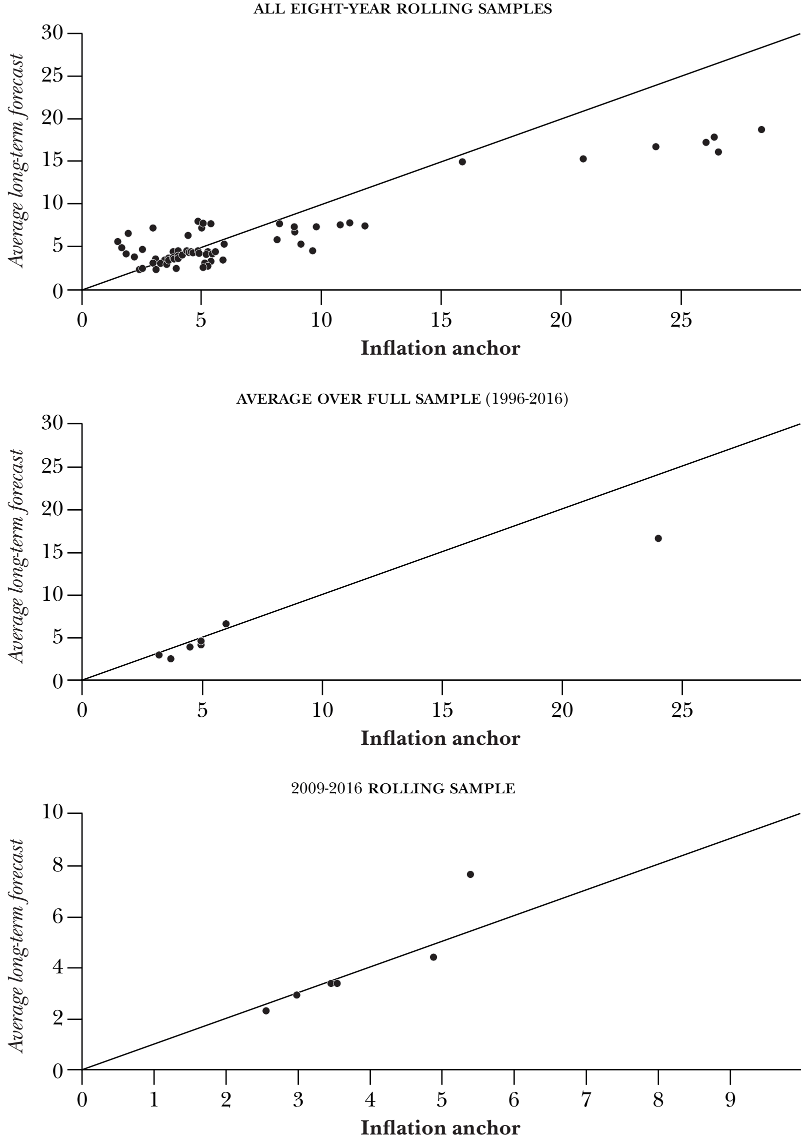
6 On the other hand, long-horizon forecasts (e.g., six-to-ten years ahead) might relate to outcomes too far into the future to be useful for monetary policy purposes. For monetary policy setting, the most relevant horizon is related to the frequency with which most prices and wages are adjusted, and hence has the greatest impact on inflation dynamics. Thus, one could imagine wage and price-setting decisions being influenced by inflation expectations that are anchored by a level of expected inflation that differs from expectations of long-run inflation (if, for example, forecasters anticipated that the monetary policy framework might be adjusted in a few years). In that case, six-to-ten year ahead inflation expectations might not be relevant for explaining inflation dynamics, but they could still be important for other economic decisions such as deciding to invest in fixed assets or determining long-term savings goals.

7 The anchor of inflation expectations could become more consistent with the inflation target, even if the central bank is not building credibility, e.g., if inflation moves towards the target for reasons unrelated to monetary policy or the inflation target is adjusted endogenously to track inflation. In the former case, these effects are likely to be transitory (so are mitigated against in part by our use of rolling samples). With respect to the latter case, we see limited evidence of inflation targets being adjusted strategically in response to deviations of inflation from target in the inflation targeters that we examine: Inflation targets are either constant over most of the 2009-2016 period (Brazil, Chile, Colombia, Guatemala, Mexico, Peru, and Uruguay) or follow a consistent declining path as inflation targets become more established over time (Costa Rica, the Dominican Republic, and Paraguay).

Figure 5

RELATION BETWEEN ESTIMATED INFLATION ANCHOR AND LONG-TERM FORECAST FROM CONSENSUS ECONOMICS



Note: Sample of countries with long-term forecasts from Consensus Economics includes Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela.
Sources: Consensus Economics©; authors' calculations.

Table 3

ESTIMATED ANCHOR AND INFLATION TARGET, 2009-2016

	Estimated anchor	*Inflation target*[1]		*Estimated anchor*	*Inflation target*[1]
Brazil	4.88	4.5	Guatemala	7.83	4.5
Chile	2.98	3.0	Mexico	3.54	3.0
Colombia	3.45	3.3	Paraguay[2]	5.10	4.8
Costa Rica	6.09	5.1	Peru	2.55	2.0
Dominican Republic[2]	5.84	4.6	Uruguay	6.67	5.0

[1] The inflation target is the simple average of the annual inflation target for each country in the given sample. [2] For countries that adopted IT later than 2009 such as the Dominican Republic and Paraguay, the sample starts in 2012 and 2011, respectively.

anchor is quite close to the average midpoint value of the inflation target in each country, and inside the range of +/− 1 percentage point for most countries. The gap between the two is wider in the case of the most recent ITers (such as Guatemala and the Dominican Republic) but, in those cases, the rolling sample includes years before the adoption of IT, so a wider deviation does not necessarily indicate a lack of central bank credibility.

We also estimate a modified version of our model only for countries with IT. Instead of estimating the anchor, we consider the midpoint value of the inflation target $\pi^T(t)$ and add a parameter d to capture deviations from the target.

$$f(t,t-h) = \alpha(h)(\pi^T(t) + d) + (1-\alpha(h))\pi(t-h) + \varepsilon(t,t-h).$$

A simple test with a null hypothesis of $d=0$ is then a test of whether the inflation target was credible or not. Note that, in cases where central banks have time-varying inflation targeting, we capture this with our $\pi^T(t)$, as we then use different values of the target for different years.

Table 4

ESTIMATION RESULTS WITH INFLATION TARGET, 2009-2016

	b	*c*	*d*	*s.e.(d)*
Brazil	6.37	0.38	0.38	0.028
Chile	2.58	0.56	–0.02	0.004
Colombia	11.27	0.74	0.35	0.014
Costa Rica	3.31	0.56	0.97	0.030
Dominican Republic	5.86	0.46	0.12	0.014
Guatemala	9.01	0.45	1.46	0.027
Mexico	1.29	0.29	0.54	0.005
Paraguay	1.34	1.17	0.10	0.017
Peru	0.32	0.12	0.55	0.016
Uruguay	1.45	0.52	1.67	0.025

Note: Uruguay has a target range of +/–2 percentage points; all other countries have a target range of +/–1 percentage point.

Table 4 shows the results of these estimations, for the most recent eight-year rolling sample. These confirm that the anchors of inflation expectations are in line with the inflation target range in all countries: within a +/–1 percentage point range in all cases except for Guatemala and Uruguay, the latter of which has an inflation target range of +/–2 percentage points. That is, we cannot reject the hypothesis that inflation expectations are anchored by the inflation targets for most countries.

In order to complement the comparison between countries with and without inflation targets, we further examine whether IT improves the anchoring of expectations. To do this, we perform a second step panel estimation. We regress the weight of the anchor $(\alpha(h))$ for each country for each eight-year rolling sample on a set of country characteristics. The set of regressors includes: *1)* a dummy variable that takes the value of 1 for countries with IT for the full rolling sample during the rolling sample; *2)* the number of years since the adoption of the IT regime; *3)* mean inflation; *4)* inflation variability, measured by the standard deviation of inflation; *5)* inflation persistence, based on an estimated AR(1) coefficient in a regression on annual inflation that includes a constant; and *6)* real GDP per capita.

The results, shown in Table 5, indicate that, aside from an intercept, only the coefficients for inflation persistence and the IT dummy are statistically significant. IT is associated with an increase in the degree of anchoring of inflation expectations by 0.25, whereas countries with less inflation persistence are associated with an increase in the degree of anchoring (the coefficient of −0.768 indicates that a decrease in inflation persistence from 0.9 to 0.8 corresponds to an increase in anchoring of 0.08). We obtain similar results when we repeat the regression with weights at shorter horizons, such as one year.[8] One way to interpret these results is that, even when we control for inflation persistence, which is negatively correlated with the IT dummy and anchoring, we still find that IT is associated with a significant increase in the anchoring of inflation expectations.

Table 6 displays second step estimation results where the dependent variable is the estimated standard error of the anchor. Here, the number of years since the adoption of IT and the persistence of inflation are marginally statistically significant, but the IT dummy is insignificant.

5. CONCLUSIONS

In this paper, we modeled inflation expectations from Consensus Forecasts to assess inflation expectations anchoring in Latin America. Our results suggest that most countries do have an inflation anchor, and that expectations have become more tightly anchored through time, consistent with the improving credibility of central banks' monetary policy management.

For countries with IT, we find that inflation targets are generally credible, in the sense that the estimated anchors lie within the inflation target range for all countries in the most recent sample that we estimate. Also, the adoption of IT is generally associated with an improvement in the degree of anchoring of expectations, both

[8] At a forecast horizon of 12 months, being under an it regime is associated with an increase in the degree of anchoring of inflation expectations by 0.25, and a 0.1 drop in inflation persistence is associated with an increase in the degree of anchoring by 0.09.

Table 5

SECOND STEP ESTIMATION RESULTS
Dependent variable: inflation anchor weight ($h = 24$)

	Coefficient	*Standard error*
IT dummy	0.245[c]	0.0617
Years under IT	0.00682	0.01385
Inflation mean	4.39e-04	6.41e-04
Inflation standard deviation	4.55e-03	4.34e-03
Inflation AR(1) coefficient	–0.768[b]	0.343
GDP per capita	4.18e-06	7.30e-06
Constant	1.37[c]	0.322
R squared within	0.280	
Between	0.002	
Overall	0.107	
F-statistic	4.20	

Note: [a], [b], [c] indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6

SECOND STEP ESTIMATION RESULTS
Dependent variable: standard error of the inflation anchor

	Coefficient	*Standard error*
IT dummy	–1.67e-03	13.2e-03
Years under IT	–6.03e-03[a]	2.92e-03
Inflation mean	2.97e-04	1.95e-04
Inflation standard deviation	5.42e-04	6.25e-04
Inflation AR(1) coefficient	0.0971[a]	0.0522
GDP per capita	3.68e-06	2.22e-06
Constant	–0.0733	0.0551
R squared within	0.176	
between	0.0007	
overall	0.004	
F-statistic	2.58	

Note: [a], [b], [c] indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

in terms of the weight on the anchor increasing and the anchor being more precisely identified by the data.

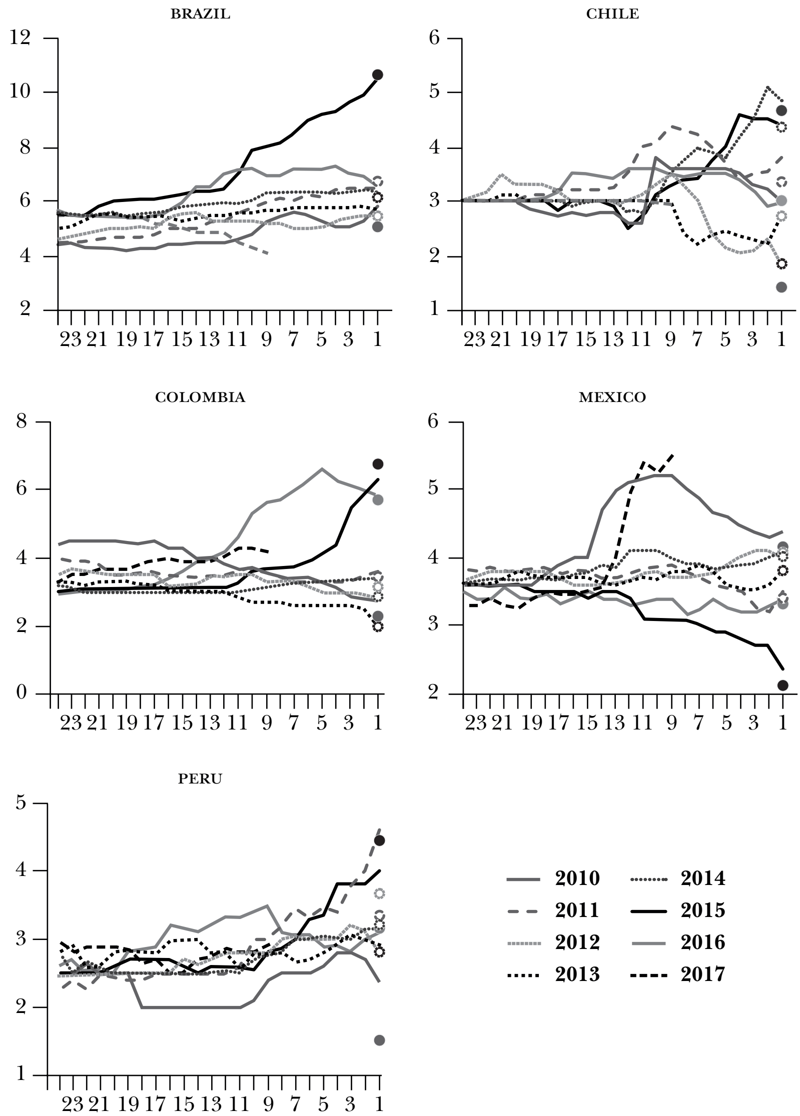
In future work, it would be possible to investigate inflation expectations anchoring further by focusing on the cross-sectional dispersion of forecasts. For example, Yetman (2017) focuses on forecaster-level data for Canada and the USA, while Hattori and Yetman (2017) conduct a similar exercise for Japan. However, for Latin America, similar data are only available from Consensus Economics for a limited subset (seven) of the countries that we study, and the number of forecasters for most of those countries is limited relative to those other studies.

ANNEX

Figure A.1

INFLATION FORECASTS AT DIFFERENT HORIZONS

A. COUNTRIES WITH INFLATION TARGETS FOR MORE THAN 15 YEARS

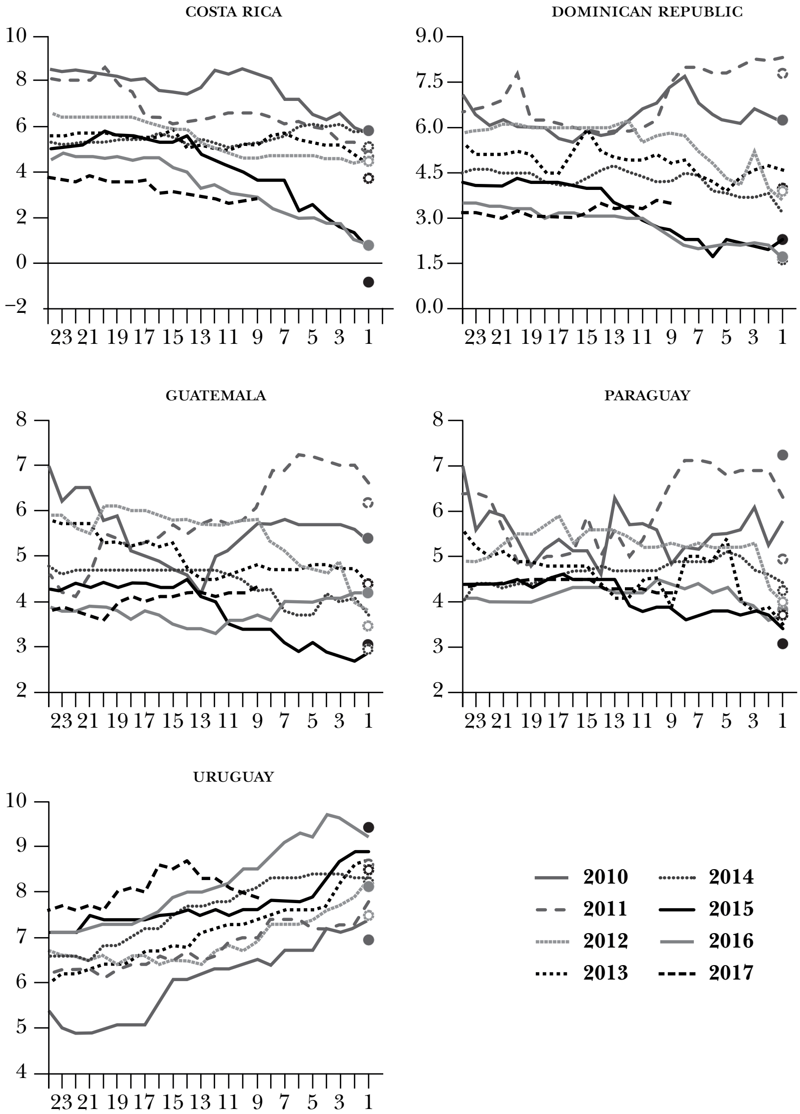


Notes: Horizontal axis represents the forecast horizon, defined as the number of months before the end of the calendar year being forecast. Dots represent the realized inflation at the end of year t.
Source: Consensus Economics ©; national data.

Figure A.1 (cont.)

INFLATION FORECASTS AT DIFFERENT HORIZONS

B. COUNTRIES WITH INFLATION TARGETS FOR LESS THAN 15 YEARS

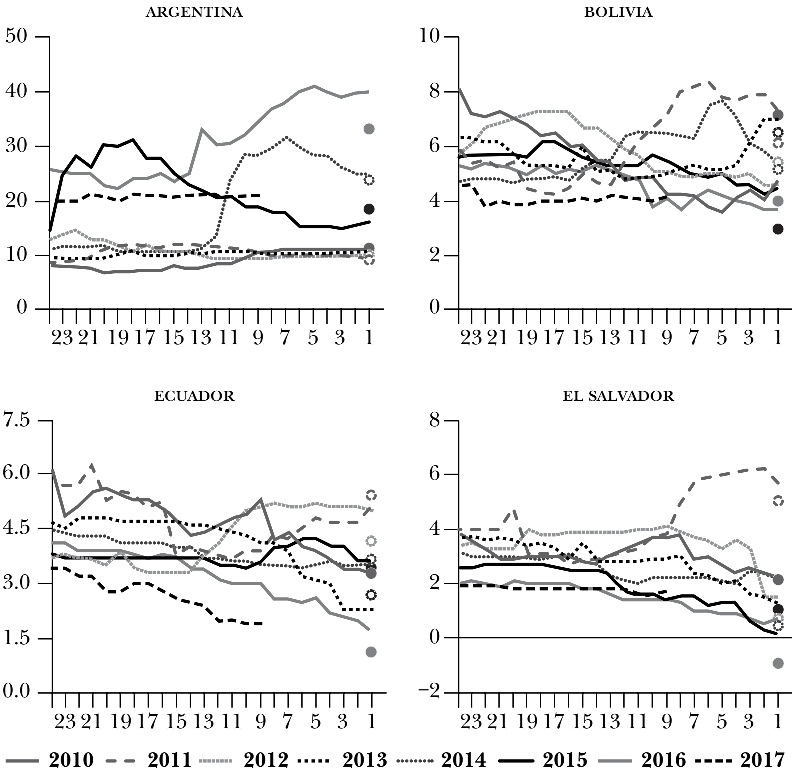


Notes: Horizontal axis represents the forecast horizon, defined as the number of months before the end of the calendar year being forecast. Dots represent the realized inflation at the end of year t.
Source: Consensus Economics ©; national data.

Figure A.1 (cont.)

INFLATION FORECASTS AT DIFFERENT HORIZONS

C. COUNTRIES WITHOUT INFLATION TARGETS

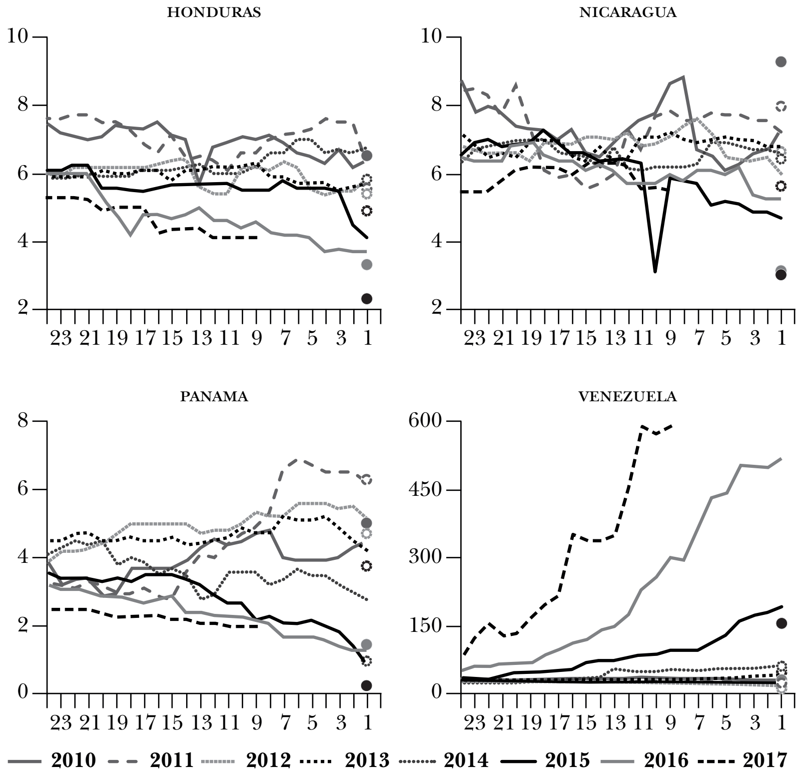


Notes: Horizontal axis represents the forecast horizon, defined as the number of months before the end of the calendar year being forecast. Dots represent the realized inflation at the end of year t.
Source: Consensus Economics ©; national data.

Figure A.1 (cont.)

INFLATION FORECASTS AT DIFFERENT HORIZONS

C. COUNTRIES WITHOUT INFLATION TARGETS (CONT.)

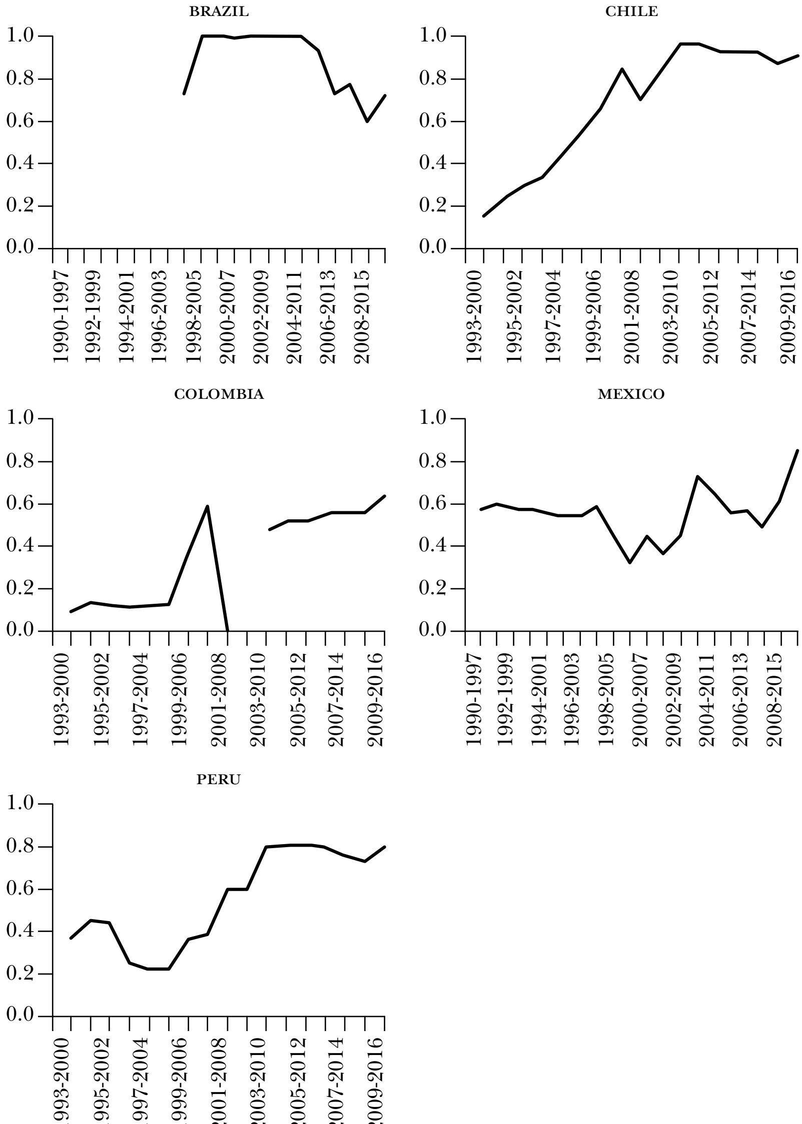


Notes: Horizontal axis represents the forecast horizon, defined as the number of months before the end of the calendar year being forecast. Dots represent the realized inflation at the end of year t.
Source: Consensus Economics ©; national data.

Figure A.2

ESTIMATED WEIGHT ON INFLATION ANCHOR (*h* = 12)

A. COUNTRIES WITH INFLATION TARGETS FOR MORE THAN 15 YEARS

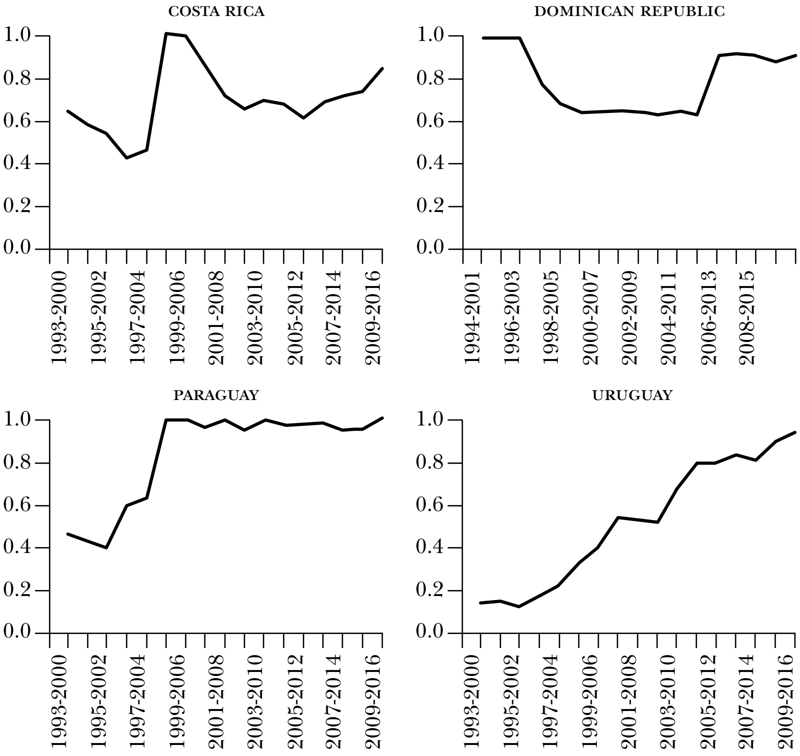


Notes: Horizontal axis displays the eight-year rolling sample. Periods where no line is displayed correspond to rolling samples for which no anchor can be identified.
Source: Authors' calculations.

Figure A.2 (cont.)

ESTIMATED WEIGHT ON INFLATION ANCHOR (*h* = 12)

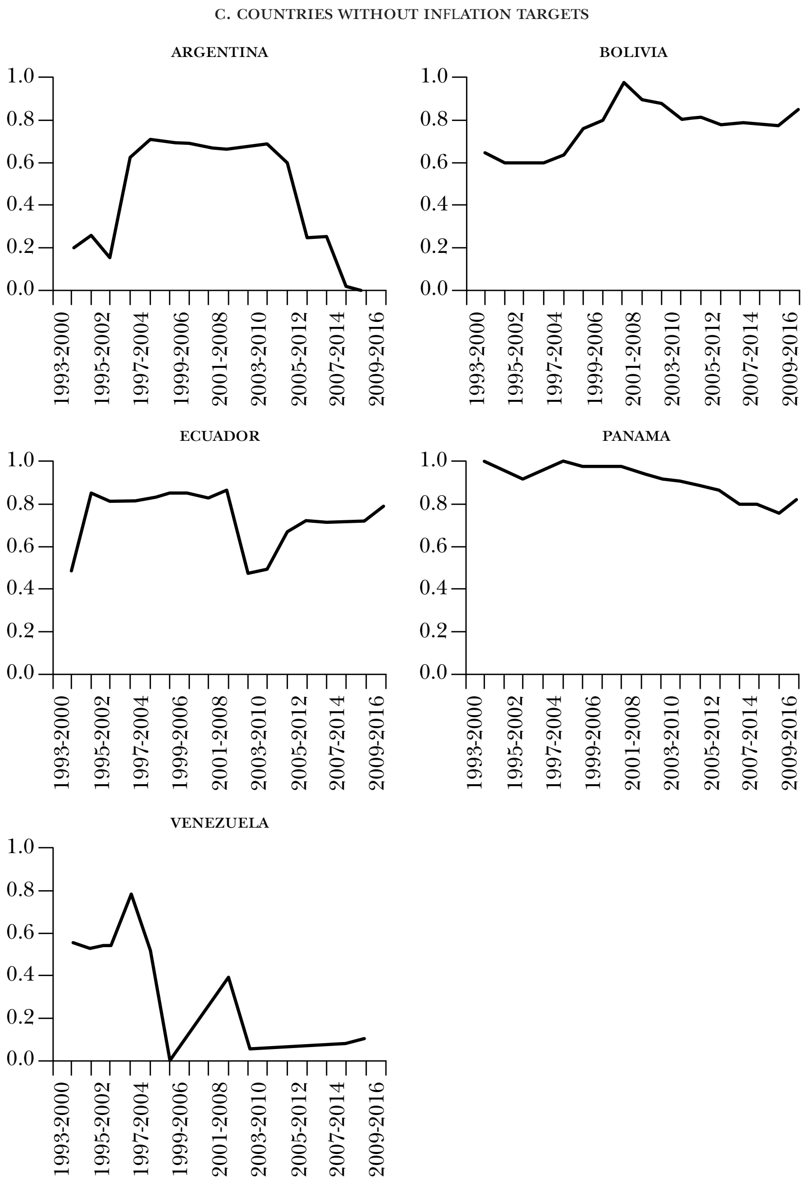
B. COUNTRIES WITH INFLATION TARGETS FOR LESS THAN 15 YEARS



Notes: Horizontal axis displays the eight-year rolling sample. Periods where no line is displayed correspond to rolling samples for which no anchor can be identified.
Source: Authors' calculations.

Figure A.2 (cont.)

ESTIMATED WEIGHT ON INFLATION ANCHOR (h = 12)



Notes: Horizontal axis displays the eight-year rolling sample. Periods where no line is displayed correspond to rolling samples for which no anchor can be identified.
Source: Authors' calculations.

References

Capistrán, Carlos, and Manuel Ramos-Francia (2010), "Does Inflation Targeting Affect the Dispersion of Inflation Expectations?," *Journal of Money, Credit, and Banking*, Vol. 42, No. 1, pp. 113-134.

Cecchetti, Stephen G., and Craig Hakkio (2009), *Inflation Targeting and Private Sector Forecasts*, No. W15424, National Bureau of Economic Research.

Davis, Scott, and Adrienne Mack (2013), *Cross-country Variation in the Anchoring of Inflation Expectations*, Staff Papers, No. 21, Federal Reserve Bank of Dallas, October.

De Carvalho, Fabia A., and Maurício Soares Bugarin (2006), "Inflation Expectations in Latin America," *Economía,* Vol. 6, No. 2, pp. 101-145.

De Pooter, Michel, et al. (2014), "Are Long-term Inflation Expectations Well Anchored in Brazil, Chile, and Mexico?," *International Journal of Central Banking*, Vol. 10, No. 2, pp. 337-400.

Espinosa-Torres, Juan Andrés, Luis Fernando Melo-Velandia, and José Fernando Moreno-Gutiérrez (2017), "Expectativas de inflación, prima de riesgo inflacionario y prima de liquidez: una descomposición del break-even inflation para los bonos del Gobierno colombiano," *Revista Desarrollo y Sociedad*, Vol. 78, pp. 315-365.

Gürkaynak, Refet S., et al. (2007), "Inflation Targeting and the Anchoring of Inflation Expectations in the Western Hemisphere," *Economic Review-Federal Reserve Bank of San Francisco*, pp. 25-47.

Hattori, Masazumi, and James Yetman (2017), "The Evolution of Inflation Expectations in Japan," *Journal of the Japanese and International Economies,* Vol. 46, pp. 53-68.

Mehrotra, Aaron, and James Yetman (2018), "Decaying Expectations: What Inflation Forecasts Tell Us about the Anchoring of Inflation Expectations," *International Journal of Central Banking,* Vol. 14, No. 5, December, pp. 55-101.

Vicente, José Valentim Machado, and Osmani Teixeira de Carvalho Guillen (2013), "Do Inflation-linked Bonds Contain Information about Future Inflation?," *Revista Brasileira de Economia,* Vol. 67, No. 2, pp. 251-260.

Yetman, James (2017), "The Evolution of Inflation Expectations in Canada and the US," *Canadian Journal of Economics/Revue canadienne d'économique*, Vol. 50, No. 3, pp. 711-737.