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The Communication Effects on Inflation Forecast Errors: Empirical Evidence from Colombia

Summary: The purpose of this article is to explore the central bank's ability to management inflation forecast errors in Colombia. We present empirical evidence based on the Colombian experience with data from the period of 2008 to 2020. The communication channel selected for analysis is the press releases. The empirical evidence is divided into three steps: (i) regression analysis using an EGARCH model; (ii) use of VAR models; and (iii) variance decomposition analysis. The communications effects are significant for several months and that close to half of the forecast error variance can be explained by innovations in central bank communication. The results obtained allow monetary policymakers to develop more efficient strategies for anchoring expectations and strengthening the central bank credibility.

Keywords: Central bank communication, Forecast errors, Monetary policy.

JEL: E52, E58, E63.

Inflation expectation management is fundamental for monetary policy credibility and macroeconomic performance (David Johnson 2003; Michael Ehrmann et al. 2011; Michael Scharnagl and Jelena Stapf 2015). In inflation targeting, the central bank has different tools to improve transparency and reduce asymmetric information in the financial market. As a result, market inflation forecasts are more accurate (Ben Bernanke et al. 1999; Petra Geraats 2002; Christopher Crowe 2010).

There is a need to broaden the research on the communication effects on controlling financial market expectations in emerging economies. This study helps to understand how the central bank communication affects inflation forecast errors and it contributes to the literature in several ways. First, in accordance with the methodology applied by Gregory Mankiw, Ricardo Reis, and Justin Wolfers (2004) and Michael Pederesen (2015), it demonstrates that monetary policy announcements have significant effects on forecast errors. Second, it analyzes the Colombian economy, an economy with a gap in the literature in terms of the possible effects of communication on controlling financial market inflation expectations. Third, it provides evidence that the bank's announcements have the potential to decrease inflation forecast errors.

We choose the Colombian economy because it is an emerging economy that adopted inflation targeting in the year 2000, and the Central Bank of Colombia has

perfected his communication channels with the public. In addition, it has investment grade, and the development of the capital market is based on the growth of the domestic public debt market. In short, it is worthwhile to analyze inflation forecast errors in the Colombian context.

The remainder of this article is structured as follows: Section 1 makes a brief presentation of the monetary history of Colombia; Section 2 makes a literature review; Section 3 defines the inflation forecast error and presents the methodology for measuring the effects of communication on forecast errors; Section 4 provides econometric estimates and a discussion of the results obtained; Section 5 concludes the article.

1. Background: Monetary Policy of Central Bank of Colombia

The Bank of the Republic, the central bank of Colombia, emerged in 1923 as an issue, transfer, deposit, and discount bank and is the highest monetary, exchange and credit authority in Colombia. The bank functioned as a development bank for the economic growth of Colombia between 1930 and 1980. In those years, coffee growers, industrialists, merchants, and other agents had representation on the board of directors. In this period, the Colombian economy presented average annual inflation rates of 20%.

The bank's institutional principles were modified in 1991, and since then, its main objective has been to maintain a low and stable inflation rate. For this, the board of directors was modified to be independent of the economic sectors¹. Since then, the bank's board of directors has been made up of seven members: the minister of finance and public credit; five permanent members, appointed for 4 years; and the general manager.

Since 2000, the Central Bank of Colombia adopted the inflation targeting regime and inflation rates have averaged 5% per year. For this, the bank has the commitment to announce an inflation target each year and the responsibility for its compliance. Furthermore, from 2003, the announcement of the target is accompanied by the announcement of tolerance intervals that allow monetary policy to adjust less severely to external shocks (Enrique López-Enciso, Hernando Vargas-Herrera, and Norberto Rodríguez-Niño 2016).

The bank pursues its policy objectives through open market operations, discounted loans, and reserve requirements. The main control variable is the monetary policy interest rate or intervention rate (López-Enciso, Vargas-Herrera, and Rodríguez-Niño 2016). However, the most widely used policy tool is open market operations, which consist of buying or selling public debt securities of the Colombian government.

The bank's objectives and their strategies, economic prospects, and future decisions are systematically announced since the late 1990s (Juan Camilo Anzoátegui Zapata and Juan Camilo Galvis Ciro 2019). Since 1997, the general manager presents two annual reports to the Congress of the Republic on the execution of monetary policy. Moreover, from 2000, decisions on the policy rate have been announced through press releases. In addition, since 2012, the policy decision is presented to the media at a press conference. From 2007, the minutes of the decisions on the policy rate have been

¹ The objectives of the central bank are enshrined in the 1991 Constitution of Colombia in article 371.

published. In the minutes, the inflationary situation and the prospects for the economy are discussed. In addition, these are presented with the details of the economic information that was used to make decisions about the interest rate. With regard to decision-making meetings, policy decisions between 2000 and 2017 were made monthly. As of 2018, eight meetings are held; this is to maintain synchrony with the monetary policy decisions made by the main central banks in the world.

2. Short Review of Literature

The literature presents results linking the central bank's communication with the performance of monetary policy, term structure of interest rates, and managing inflation expectations (Michael Woodford 2005; Alan Blinder et al. 2008; Ehrmann and David Sonderman 2012). Thus far, the findings denote that different communication channels of the central banks (Press Releases, Statements, Inflation Reports, Minutes, Interviews, Records, Financial Reports, etc.) contains fundamental information affecting the financial markets' performance and economic outlook.

Several studies have evaluated the communication effect on market expectations. Between these, Carlo Rosa and Giovanni Verga (2007) found that the surprise component of the Statements of the European Central Bank affects future contracts, and the European Central Bank is effective in its communication to the public because influences market expectations on the short-term interest rate path. Also, Rachel Reeves and Michael Sawicki (2007), Ehrmann and Sonderman (2012) found that interest rate expectations respond to the surprise component contained in the Inflation Reports and Minutes. In the case of emerging economics, Gabriel Montes et al. (2016) shows that the monetary policy signaling and the minutes of the COPOM-Brazil reduces heterogeneity in inflation expectations.

Regarding the specialized literature on the effects of communication on forecast errors, studies are divided into two streams. Part of the literature focuses on the disagreements between different agents about the inflation forecast (see, for example, Mankiw, Reis, and Wolfers 2004; Carlos Capistrán and Allan Timmermann 2009; Jonas Dovern, Ulrich Fritsche, and Jiri Slacalek 2009; Andrew Patton and Timmermann 2010; Ehrmann, Sylvester Eijffinger, and Marcel Fratzscher 2012). Another strand of this literature analyzes the inflation surveys and their forecasting capacity (Johnson 2003; Mordecai Kurz 2005; Pierre Siklos 2008; Lena Dräger and Michael Lamla 2012; Pedersen 2015; Nicholas Apergis 2017; Joao Tovar 2017).

In this study, we defined the forecast error as the difference between the market inflation forecast and the central bank's inflation target. Thus, the forecast error is a measurement associated with the credibility of monetary policy. To our knowledge, no studies have been done to research the effects of communication on forecast errors based on the inflation expectations implicit in government bonds in emerging economies. This article aims to fill this gap in the literature.

3. Methodology and Data

A well-anchored inflation expectation in the inflation targets is fundamental to the central bank because it indicates the public confidence on monetary policy (Refet Gürkaynak, Andrew Levin, and Eric Swanson 2010; Levin 2014). Inflation forecast errors reflect disagreements among agents with regard to the monetary policy management. Consequently, a reduction in market forecast errors contributes to inflation control and financial system stability (Mankiw, Reis, and Wolfers 2004).

Transparency and communication are important central bank tools for reducing bias and anchoring inflation expectations into target (Ehrmann, Eijffinger, and Fratzscher 2012). In emerging economies, there are several sources of uncertainty and external shock that make it difficult to control expectations (Michiel De Pooter et al. 2014). Specifically, it is difficult for markets to anticipate the decisions of the central bank, and these include surprise elements (Tore Ellingsen and Ulf Söderström 2001). The main objective of this study is to analyze the effect of monetary policy announcements on the anchoring of inflation expectations in the Colombian economy. The results obtained allow monetary policymakers to develop more efficient strategies for anchoring expectations and strengthening the credibility of the central bank.

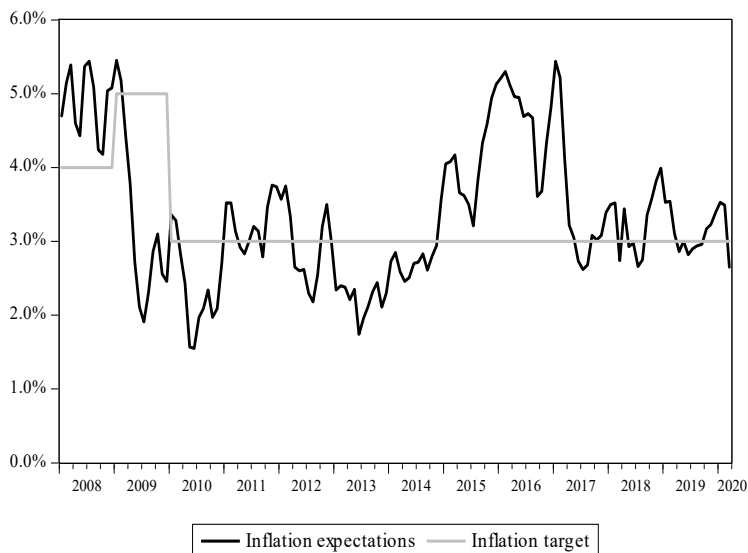
To calculate the behavior of agents' expectations, we use market-based estimates, which have proved better predictors than estimates based on surveys. The measures derived from the assets prices are available daily and reveal an accurate projection of the investors' expectations for inflation (Ian Christensen, Frédéric Dion, and Christopher Reid 2004; Gürkaynak, Brian Sack, and Swanson 2005; Paul Söderlind 2011).

The most popular market measurement used to estimate inflation expectations is Break-Even Inflation (*BEI*), also known as inflation compensation (Gürkaynak, Levin, and Swanson 2010 and Söderlind 2011). The *BEI* captures the compensation that investors demand both for expected inflation and for the risks or uncertainty associated. Therefore, *BEI* is a measurement of inflation expectations and is calculated as the inflation rate at which investors will have no preference between nominal and inflation-indexed bonds. That is:

$$\pi_t^e = f_{t,nom}^m - f_{t,real}^m, \quad (1)$$

where π_t^e is the inflation expectations or *BEI*, $f_{t,nom}^m$ is the nominal bond yields, $f_{t,real}^m$ is the index-linked bond yields and m is the maturity period of the bond.

Based on monthly data, the behavior of inflation expectations over time (*BEI*) and the inflation target are presented in Figure 1. In general, it is observed that market expectations closely follow the target set by the Central Bank of Colombia. It is possible to identify deviations above the goal, which indicate a de-anchoring of expectations in 2008 related to the uncertainty and great slowdown generated by the subprime crisis and between 2015 and 2017 caused by the fall in oil prices. In turn, there are deviations below the goal, which occurred between 2009-2010 and 2012-2014, which indicate an important control of expectations. In short, the inflation target has the ability to guide the expectations of the financial market.



Source: Devised by the authors based on data from the Central Bank of Colombia.

Figure 1 Inflation Expectations and Inflation Target

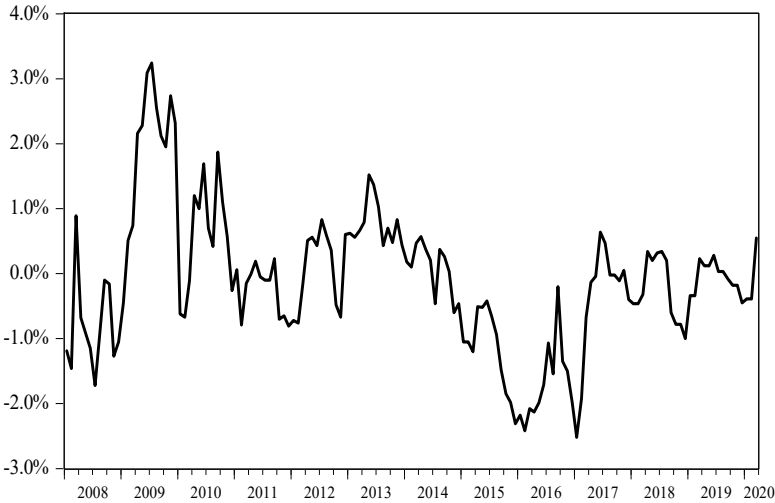
The *BEI* has proved efficient in measuring short-term inflation expectations for Colombian economy (Luis Melo and Joan Granados 2010). As such, we used bonds with a maturity period of one year in this study to calculate inflation expectations. Both positive and negative deviations from the target are considered to be errors (Johnson 2003; Mankiw, Reis, and Wolfers 2004). Thus, the forecast error is constructed as the difference between the inflation target and inflation expectations, thus:

$$\varepsilon_t = \pi^* - \pi_t^e, \quad (2)$$

where ε_t is the forecast error, π^* is the inflation target and π_t^e are the inflation expectations. The error can take positive values $\pi^* > \pi_t^e$ that indicate anchoring of expectations and can take negative values $\pi^* < \pi_t^e$ that signal loss of control of expectations by the bank. Therefore, the sign of the deviations is important because it allows us to identify the monetary policy reaction, for example, when the error takes negative values. The behavior of forecast errors for the Colombian economy during the period of 2008 to 2020 are presented below (see Figure 2)².

On average, the forecast error in Colombia was -0.084% (see Figure 2). In general, the forecast error is positive in a large part of the analyzed sample. This means that inflation expectations converged to the central inflation target when it was set at 3% (from 2010 onward). However, the error remains on the downside significantly from 2015 to the end of 2017 resulting in an average forecast error of -1.061% when inflation expectations accelerated.

² The choice of initial period is due to the data availability on indexed bonds in Colombia.



Variable	Mean	Min.	Max.	SD	Kurtosis
ε_t	-0.0840	-2.5200	3.2400	1.1268	3.4968

Source: Devised by the authors based on data from the Central Bank of Colombia.

Figure 2 Forecast Error Evolution in Colombia

Overall, central bank decisions involve both expected and unexpected components. The expected component has already been incorporated into agents' expectations and does not have significant effects on markets (Blinder et al. 2008). As such, to analyze the effects of communication special attention must be paid to the unexpected component (David-Jan Jansen and Jakob De Haan 2007; Gürkaynak, Levin, and Swanson 2010; Ehrmann et al. 2011).

The surprise element in monetary policy is the unexpected component in central bank communication and appears when agents do not anticipate the behavior of the interest rate because they do not understand the monetary policy posture. Unexpected changes are linked to information asymmetry, where the central bank possessed information not known by the public. Consequently, surprises cause some disruption in the financial market and affect the anchoring of inflation expectations to the inflation target; therefore, communication has an impact on forecast errors (Andre Filardo and Diwa Guinigundo 2008 and Montes et al. 2016).

In accordance with the methodology proposed by Kenneth Kuttner (2001) and Ellis Connolly and Marion Kohler (2004), the unexpected component is defined as the change in the 30-day interest rate on the day of central bank announcement. The 30-day interest rate reflect market expectations on monetary policy decisions. Therefore, these rates vary according to the extent that agents are caught off guard in terms of the expected monetary policy position (see, for example, Kuttner 2001). In Colombia, according to and Galvis Ciro and Anzoátegui Zapata (2018) methodology, we calculated the

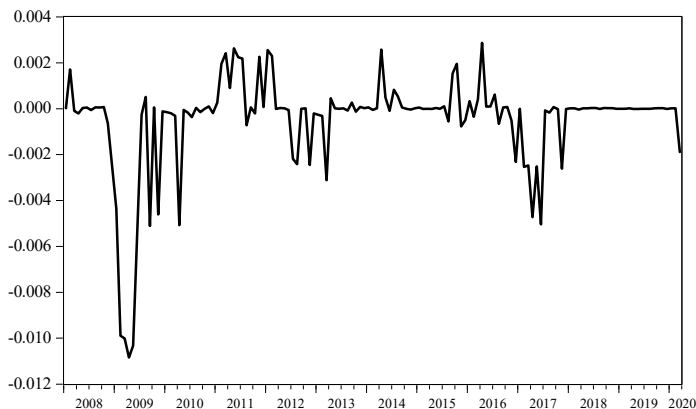
unexpected component of monetary policy with the changes in the Reference Banking Indicator rate (IBR).

The IBR reflects the short-term liquidity position that the banks expect and is a result of stock market negotiation in the Colombian financial system³. Thus, to calculate the surprises in the Central Bank of Colombia announcements, we calculated the changes in IBR rate:

$$MPS_t = IBR_t - IBR_{t-1}, \quad (3)$$

where MPS_t is the unexpected component of monetary policy announcements and ΔIBR_t is the IBR change between t and $t-1$, and t is the announcement day. To calculate the unexpected component, we focus on press releases which are published monthly immediately after a meeting of the board of directors. This channel receives much attention from financial markets and enable quick identification of changes in monetary policy stance. The press releases provide to the public is concrete information, and the main objective is to briefly report the basic reasons behind each decision of monetary policy intervention rate.

The changes in the IBR rate on the press releases days are presented in Figure 3. The dates on which the central bank communicates its decisions were set according to the calendar provided by the board of directors of the Central Bank of Colombia⁴. Whenever a press release came out after the closing of the Colombian stock market, the day of the press release was recorded as the next business day. In Figure 3, the changes in the IBR rate shows that the market reacts to the press releases, which suggests that each decision made by the central bank has unexpected components and effects on the financial market.



Source: Devised by the authors based on data from the Central Bank of Colombia.

Figure 3 Unexpected Component of Monetary Policy for Colombia

³ The IBR is the mean of the rates set by the eight major banks in the Colombian financial system and is the rate at which each bank is willing to provide or receive resources.

⁴ See Table A1 (Appendix) for sources of data and description of all variables used in the study.

The changes in the IBR rate imply divergences in market expectations and affect forecasts for future intentions with regard to monetary policy stance. In turn, unexpected variations in the policy rate lead investors to revalue expected returns on nominal and indexed bonds. Thus, when the financial market reacts to monetary policy decisions, it is expected a rearrangement of inflation expectations in relation to the central bank's targets. According to Mankiw, Reis, and Wolfers (2004), it is also important to point out that the forecast error demonstrates significant inertia over time. Therefore, we used the following basic model:

$$\varepsilon_t = \alpha_0 + \alpha_1 \varepsilon_{t-1} + \alpha_2 MPS_t + \alpha_3 \sum_{i=1}^n X_i + u_t, \quad (4)$$

where ε_t is the forecast error and ε_{t-1} is the forecast error in the past period and captures the inertia in the forecast error. The term *MPS* is the unanticipated component of monetary policy, and X_i is a vector of control variables.

The residual term is $u_t = v_t h_t \sim (0, h_t^2)$, with $v_t = \frac{u_t}{h_t} \sim iid(0,1)$. We assumed that the residual term has a conditional variance with the following process:

$$\log(h_t^2) = \varpi + \sum_{j=1}^q \beta_j \log(h_{t-j}^2) + \sum_{i=1}^p \alpha_i \left| \frac{u_{t-i}}{h_{t-i}} \right| + \sum_{k=1}^r \gamma_k \frac{u_{t-k}}{h_{t-k}}. \quad (5)$$

To improve the efficiency in Equation (4), we assume that the residuals can be modelled as an EGARCH (2, 2). According to Robert Engle (1982), GARCH conditional variance models are useful because they consider the features of the series derived from the financial market, which usually have non-normal distribution and show a high kurtosis. Specifically, the EGARCH or exponential GARCH model was proposed by Daniel Nelson (1991) and is advantageous because it differentiates between the asymmetrical effects of the changes on inflation forecast errors from positive or negative shocks.

According to Mankiw, Reis, and Wolfers (2004) and Apergis (2017), forecast errors are also affected by other variables not related to monetary policy decisions. There are evidences that exchange rate variations affect inflation expectations in the Colombian economy (Hernán Rincón and Norberto Rodríguez 2017). Therefore, as a first control variable, we used nominal exchange rate variations (Δe).

The global financial uncertainty is an important factor in capital flows to emerging economies because the changes in international market contribute to asset prices volatility and as a result, affect inflation compensation (Joseph Byrne and Norbert Fiess 2016). One indicator that measures investors' appetite for risk is the S&P 500 Market Index or VIX Index, which signals the global risk of capital flows. Thus, the second control variable is the VIX Index variation (ΔVIX).

The interest rate for US bonds reflects global economic conditions and functions as a proxy for the risk-free interest rate. In addition, global liquidity is a standard variable for any investor and the interest rate for US Treasury bonds reflects the international cost of capital and affects returns on the sovereign bonds of domestic economies (Martin González-Rozada and Eduardo Levy-Yeyati 2008). Consequently, the third variable is the interest rate for US Treasury bonds (Δi^*).

In emerging economies, there is a significant pass-through of oil prices to domestic prices. In addition, the price of oil greatly influences the macroeconomic stability of

the Colombian economy. Specifically, the oil price volatility also influences returns on nominal and indexed public bonds and as such, on inflation compensation (Diego Martínez, José Moreno, and Juan Rojas 2015). Thus, we used the oil prices changes (ΔOIL) as the fourth control variable.

To sum up, together with unanticipated component of monetary policy, four control variables are considered (Δe , ΔVIX , Δi^* , ΔOIL). To standardize the measurement units for the different control variables, we used standard deviation and this is calculated on the press release days (see, for example, Gürkaynak, Levin, and Swanson 2010; Ehrmann et al. 2011; De Pooter et al. 2014).

We used data from January 2008 to March 2020. The source and descriptive statistics of all variables can be found in the Appendix (Tables A1 and A2). The first procedure to be carried in time series is verifying the existence of unit roots. Therefore, before estimating of the models, the following tests were performed: the augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. The results denote that all series are $I(0)$ (see Table A3, Appendix).

4. Empirical Evidence

We present baseline empirical results in Table 1. First, the basic model that evaluates the effect of communication on inflation forecast errors is estimated, and then the base model is expanded, and all control variables are added at once.

An initial inspection of the coefficients associated with communication show that the sign is in line with the expected theoretical perspective, and the estimated parameters are significant. The central bank has more and better information about the economic performance. Consequently, when the central bank makes announcements, it reduces the level of uncertainty in the financial system, and the market adjusts its forecast according to the newly outlined prospects (Pedersen 2015). The results show that the coefficient associated with monetary policy announcements has, in statistical terms, opposite and significant effects on forecast errors in all estimated models. Overall, the evidence suggests that announcements decrease the forecast error, and as such, it can be inferred that the central bank has the capacity to cause inflation expectations to converge to the target. Similar results have been reached by Johnson (2003), Dräger and Lamla (2012) and Pedersen (2015),

The financial variables also affect the market forecast errors. In general, the signs of the variables' coefficients are in line with the expectations, and the coefficients are significant in the estimated models. The forecast error shows persistence because in the market, agents take some time to understand the business cycle (Mankiw, Reis, and Wolfers 2004). According to the results, the estimates show that the lag in the forecast error (ε_{t-1}) is positive with a significance level of 1% in all models. Thus, the lag is important and help to explain financial market forecast errors. A similar result is reported by Mankiw, Reis, and Wolfers (2004) and Jan Babecký and Jiri Podpiera (2011).

The parameter associated with the exchange rate (Δe) is positive and significant. The exchange rate increases have a significant pass-through to domestic prices in Colombia (Rincón and Rodríguez 2017). As a result, the exchange rate puts pressure on

inflation expectations, thereby affecting forecast errors. Similar results are found by Siklos (2008), Pedersen (2015) and Apergis (2017).

Estimates resulting from oil price changes (ΔOIL) show that the coefficient is positive with a significance level of 1% and is reinforced by empirical literature, which suggests oil price effects on inflation forecast errors (see Pedersen 2015; Frédérique Bec and Annabelle De Gaye 2016). In addition, the parameter associated with the external interest rate (Δi^*) is positive and significant in statistical terms. Thus, an increase in the external interest rate leads to a rise in forecast errors because of the potential effects on the movement of capital and the exchange rate. Finally, with regard to the (ΔVIX) coefficient, the results are in line with the literature. The coefficient is positive, which shows that the global risk – measured by the VIX index - moves the financial markets of emerging economies, affects expectations, and influences the forecast error (see De Pooter et al. 2014).

Table 1 Effects of Communication on Forecast Errors (EGARCH [2, 2])

Regressors	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	-0.0011*** (0.0002) [-4.5288]	-0.0011** (0.0002) [-3.8493]	-0.0004 (0.0003) [-1.5542]	-0.0012*** (0.0004) [-2.8352]	-0.0007** (0.0002) [-2.5640]	-0.0007*** (0.0001) [3.8466]
ε_{t-1}	0.7851*** (0.0267) [29.3442]	0.9233*** (1.59E-05) [58004.42]	0.8956*** (1.69E-05) [53069.97]	0.8766*** (0.0412) [21.2265]	0.8125*** (0.0054) [148.2311]	0.7806*** (0.0194) [40.1180]
MPS	-0.6465*** (0.2143) [-3.0163]	-0.9277*** (0.0885) [-10.4827]	-0.7605*** (0.1625) [-4.6796]	-0.7085*** (0.2556) [-2.7714]	-0.7160*** (0.0594) [-12.1333]	-0.5391*** (0.0713) [-7.5544]
Δe		5.97E-05*** (2.06E-05) [2.8922]				-0.0001*** (1.58E-05) [-9.7105]
ΔOil			6.89E-05*** (2.77E-05) [2.4874]			0.0001*** (2.73E-05) [4.2237]
Δi^*				0.0635* (0.0383) [1.6593]		0.0665*** (0.0083) [7.9646]
ΔVIX					0.0001*** (0.0003) [4.1381]	0.0009*** (0.0002) [3.8457]
Variance equation						
C1	-0.7922***	-1.7490***	-6.1707***	-0.4017***	-2.6142***	-10.731***
C2	-0.9564***	-0.1107***	0.7182***	-0.2144***	-0.3724*	0.9439***
C3	0.6567***	0.6080***	-0.8249***	-0.0801**	0.9744***	-0.8742***
C4	-0.0719*	-0.2339***	-0.5499***	0.9465***	0.4199***	0.8109***
C5	0.5899***	-0.1401***	0.2192***	0.3385***	-0.6358***	1.1477***
C6	0.3125***	0.9301***	0.1290***	-0.3090***	0.5167***	0.5878***
R ² adj.	0.71	0.72	0.72	0.71	0.71	0.71
Log likelihood	525.28	537.11	535.87	527.72	526.53	543.13
Obs.	138	138	138	138	138	138

Notes: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. Standard errors are in parentheses.

Source: Devised by the authors.

4.1 Asymmetric Effects of Central Bank Communication

This section verifies the existence of asymmetric effects in the central bank's communication. In general, central banks increase their efforts to improve their communication in situations of great uncertainty that desanchoring inflation expectations.

Table 2 Asymmetric Effects of Communication on Forecast Errors (EGARCH [2, 2])

Regressors	Model with negative errors ($\pi^+ < \pi_t^e$)	Model with positive errors ($\pi^+ > \pi_t^e$)
Constant	-0.0012* (0.0006) [-1.8739]	0.0015** (0.0006) [2.4866]
ε_{t-1}	0.8265*** (0.0579) [14.2740]	0.8200*** (0.0448) [18.2989]
MPS	-0.7490* (0.3635) [-2.0604]	-0.4716*** (0.1532) [-3.0775]
Variance equation		
C1	-12.4049***	-6.7638*
C2	0.3043	-0.3269
C3	0.5992**	1.7382***
C4	0.6982*	0.6846***
C5	-0.1639	-0.5256***
C6	1.1155*	0.7075***
R ² adj.	0.60	0.66
Log likelihood	310.42	256.45
Obs.	76	62

Notes: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. Standard errors are in parentheses.

Source: Devised by the authors.

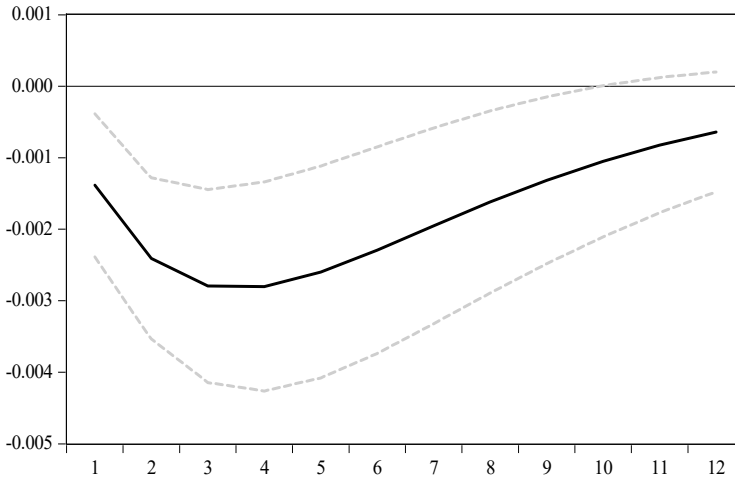
Table 2 shows the results of the regressions carried out to identify the effects of communication when errors are positive and negative. The results found allow identifying the existence of asymmetric effects in communication. We found evidence that the coefficient associated with communication (MPS) is higher when the error is negative, that is, when there is a de-anchoring of expectations.

The empirical literature suggests that the uncertainty associated with unexpected changes in macroeconomic fundamentals increases the risk for investors. In particular, the drops in expectations below the inflation target suggest economic recessions, when errors tend to be negative. In this situation, two reactions coincide: (i) agents pay more attention to monetary policy decisions to reduce uncertainty; and (ii) central banks are concerned with providing more information, and this amplifies the effects of communication on the financial market.

4.2 Impulse Response and Variance Decomposition

With the aim of increasing the evidence that central bank announcements influence inflation forecast errors, we extend our analysis through a vector autoregressive (VAR) model. As usual, the dynamics analysis is carried out using impulse-response functions

because they offer the possibility of observing the effect of an impulse in the communication caused by shocks or innovations. In accordance with Gary Koop, M. Hashem Pesaran, and Simon Potter (1996) and Pesaran and Yongcheol Shin (1998), we used a generalized impulse-response function as it is invariant to the order of the variables considered in the VAR.



Notes: Accumulated response to a generalized s.d. innovation ± 2 S.E.

Source: Devised by the authors based on data from the Central Bank of Colombia.

Figure 4 Accumulated Response of the Forecast Error to Central Bank Announcements

The impulse-response analysis is performed for the variables, ε_t and MPS_t . The order of the VAR lag is chosen based on the Hannan-Quinn information criterion (HQC), which is consistent for small samples (see Table A4 in the Appendix).

Figure 4 shows the results of the generalized impulse-response function for a period of 12 months. The graphic suggests that an unexpected positive shock caused by an announcement provokes a significant reduction in forecast errors starting in the second month. In addition, the impact is significant up until month 10. In brief, Central Bank of Colombia announcements aid in reducing bias in financial market expectations.

To complement the impulse-response analysis, a variance decomposition is carried out below. The variance decomposition of forecast errors in the event of an innovation in communication and an innovation in forecast errors is presented in Table 3. As shown, an innovation in the central bank's communication accounts for nearly 2.6% of the forecast errors variation in the second period. The impact of the announcement increases monotonously, and at the end of month 12 explains 19.6% of the forecast errors variance. In short, the evidence suggests that communication must be considered when analyzing inflation forecast errors in the financial market.

Table 3 Variance Decomposition of Forecast Errors

Period	Standard error	Forecast error	Central bank communication
1	0.005940	100.0000	0.0000
2	0.007845	97.3100	2.6899
3	0.009032	93.5312	6.4688
4	0.009825	89.9538	10.0461
5	0.010360	87.0209	12.9790
6	0.010715	87.7929	15.2070
7	0.010948	83.1835	16.8164
8	0.011096	82.0656	17.9343
9	0.011189	81.3147	18.6852
10	0.011245	80.8254	19.1745
11	0.011279	80.5156	19.4843
12	0.011299	80.3245	19.6754

Notes: Devised by the authors.

5. Concluding Remarks

In this article, we study the impact of Central Bank of Colombia announcements on inflation forecast errors for the Colombian economy. Inflation expectations were extracted from government bonds, and the forecast error was calculated based on the difference between inflation expectations and the inflation target. In addition, the effects of the central bank's announcements on the forecast error were captured through the unexpected components of monetary policy decisions. Following the construction of the variables, econometric estimates were carried out.

The results allow three observations. First, communication from the Central Bank of Colombia is a monetary policy tool that promotes convergence between financial market expectations and the inflation targets. Consequently, communication proves effective in managing expectations.

Second, the impulse-response analysis shows that communication reduces the forecast error and that its effects are significant for several months. In addition, the variance decomposition analysis confirms that close to half of the forecast error variance can be explained by innovations in central bank communication. Thus, the evidence that has been presented shows that there is a channel of expectations, given that the central bank has the capacity to make expectations converge toward the inflation target.

Third, and finally, there are other variables not related to communication that affect the inflation expectations management. One such variable is the forecast error persistence. Other factors include the exchange market volatility, global uncertainty, and the monetary policy of the US Federal Reserve. These factors are shown to have effects on forecast error and have the potential to deviate market expectations from the inflation target.

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Appendix

Table A1 Sources of Data and Description of the Variables

Variable	Description	Source
<i>MPS</i>	Unanticipated monetary policy component. Calculated with IBR rate 30-day.	Central Bank of Colombia http://www.banrep.gov.co/es/ibr
$f_{nominal}$	Nominal bond yields.	Central Bank of Colombia http://www.banrep.gov.co/es/tes
f_{index}	Index-linked bond yields.	Central Bank of Colombia http://www.banrep.gov.co/es/tes
e	Nominal exchange rate. Colombian peso / dollar.	Central Bank of Colombia http://www.banrep.gov.co/es/trm
<i>Oil</i>	Oil price changes - West Texas Intermediate (WTI).	Federal Reserve Bank of St. Louis (http://research.stlouisfed.org/)
<i>VIX</i>	Volatility of the stock market index S&P 500.	Federal Reserve Bank of St. Louis (http://research.stlouisfed.org/)
i^*	US treasury rate (1 month).	Federal Reserve Bank of St. Louis (http://research.stlouisfed.org/)

Source: Devised by the authors.

Table A2 Descriptive Statistics

Variable	Mean	Min.	Max.	St. deviation	Kurtosis
<i>mps</i>	-0.0005	-0.0108	0.0028	0.0022	11.5156
ε_t	-0.0010	-0.0252	0.0324	0.0112	3.4968
Δe	10.7390	0.0000	74.7910	11.5549	9.7323
ΔOil	1.6945	0.0070	52.4602	5.8375	52.7631
Δi^*	0.0146	0.0000	0.4647	0.0504	64.4564
ΔVIX	0.8378	0.0000	8.9873	1.2036	21.2608

Source: Devised by the authors.

Table A3 Unit Root and Stationarity Tests

Series	ADF				PP				KPSS			
	Lags	Esp.	Test	C.V. (1%)	Band	Esp.	Test	C.V. (1%)	Band	Esp.	Test	C.V. (1%)
<i>mps</i>	0	N	-3.63	-2.58	4	N	-4.91	-2.58	8	C,T	0.10	0.21
ε_t	0	N	-3.50	-2.58	3	N	-3.47	-2.58	8	C,T	0.09	0.21
Δe	1	C,T	-8.75	-4.02	7	C,T	-9.63	-4.02	8	C,T	0.12	0.21
ΔOil	1	N	-10.95	-2.58	5	N	-11.08	-3.49	0	C	0.12	0.73
Δi^*	1	C	-8.60	-3.47	7	C	-9.30	-3.47	7	C	0.40	0.73
ΔVIX	1	C	-9.92	-3.47	1	C	-9.93	-3.47	0	C	0.04	0.73

Notes: C.V. = critical value. Trend (T), and / or constant (C), or neither trend nor constant (N) are included based on the Schwarz Information Criteria. The KPSS Test was used with the Newey-West band.

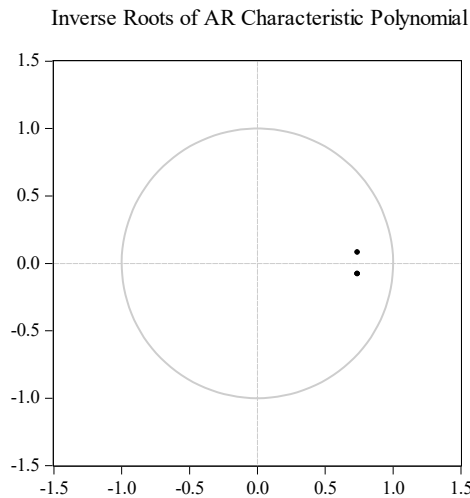
Source: Devised by the authors.

Table A4 Selection of VAR Lag Order (Dependent: ε_t)

Lag	With constant	Without constant
	HQC	HQC
1	-17.41 ^a	-17.45 ^a
2	-17.37	-17.41
3	-17.28	-17.32
4	-17.23	-17.28
5	-17.16	-17.21

Notes: HQC: Hannan-Quinn information criterion. ^a Indicates lag order chosen by criterion.

Source: Devised by the authors.



Source: Created by the authors.

Figure A1 VAR Stability

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