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Article

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Latin American Journal of Central Banking (LAJCB)

Provided in Cooperation with:

Center for Latin American Monetary Studies, Mexico City

Suggested Citation: Carotta, Gianni; Mello Costa, Miguel; Ponce, Jorge (2023) : Monetary policy communication and inflation expectations: New evidence about tone and readability, Latin American Journal of Central Banking (LAJCB), ISSN 2666-1438, Elsevier, Amsterdam, Vol. 4, Iss. 3, pp. 1-17,
<https://doi.org/10.1016/j.latcb.2023.100088>

This Version is available at:

<https://hdl.handle.net/10419/336375>

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Contents lists available at ScienceDirect

Latin American Journal of Central Banking

journal homepage: www.elsevier.com/locate/latab

Monetary policy communication and inflation expectations: New evidence about tone and readability[☆]

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ARTICLE INFO

JEL classification:

C23
E52
E58

Keywords:

Inflation expectations
Monetary policy communication
Tone
Readability

ABSTRACT

We contribute new empirical evidence on monetary policy communication and inflation expectations by firms. First, we construct a new indicator of the *perceived tone* of monetary policy communication that complements traditional indicators of the *effective tone*. Both have the expected negative sign and are statistically significant in panel data regressions with firms' inflation expectations as the dependent variable, suggesting that communication has an important effect over inflation expectations. We also compute readability and perspicuity indicators of the communications. Better readability of monetary policy communication reinforces the effect of the tone. Impact is larger when combined with the indicator of effective tone, suggesting that readability is an important component in monetary policy communication.

1. Introduction

Inflation expectations play a crucial role in modern monetary policy. Economic agents update their expectations continuously based on new information. In turn, these expectations regarding the future affect present behavior and macroeconomic outcomes. Monetary authorities aim to anchor inflation expectations to the values that are targeted to ensure price stability. Toward this goal, monetary authorities use communication as a key instrument in their toolkit.

How important is the tone of monetary policy communication to anchor inflation expectations to the target? Are there any differences between the effective tone of monetary policy communication and the perceived by economic agents tone? How do readability and perspicuity of monetary policy communication interacts with the communication tone? In this paper, we provide empirical evidence to answer these questions.

We use micro-data on inflation expectations by firms in Uruguay. This unique data set contains systematic and quantitative data on firms' macroeconomic expectations. The period under analysis ranges from October 2009 to March 2020. We also construct an indicator of the perceived tone of monetary policy communication through a survey. We randomly assigned passages of the monetary policy communications to respondents, and asked them to classify the perceived tone. The survey collects a total of 1310 responses that covers all the texts of the monetary policy communications during the period under analysis. The indicator of the perceived tone is computed as the average of the answers, and complements indicators of the effective tone of monetary policy communication.¹

[☆] The views and opinions therein are those of the authors and do not necessarily represent that of the institutions to which they are affiliated. The authors would like to thank Fernando Borraz, Aldo Lema, José Antonio Licandro, Viviane Torinelli and anonymous referees for their comments and suggestions. We would like to thank CEMLA for granting this work the Central Bank Award Rodrigo Gómez in 2022.

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¹ In particular, we compare it with the indicator built in [Mello and Ponce \(2020\)](#).

<https://doi.org/10.1016/j.latab.2023.100088>

Received 24 October 2022; Received in revised form 7 January 2023; Accepted 26 January 2023

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We also compute indicators on the readability and the perspicuity of monetary policy communication. While there is a large body of academic evidence suggesting that central bank communication plays a crucial role, most studies focus primarily on the effects of central bank communications on expectations derived from asset prices and professional forecasters. However, according to [Haldane and McMahon \(2018\)](#) there is far less evidence that monetary policy communication has had any impact on the expectations and behavior of the general public. We aim to fill that gap.

We focus on inflation expectations by price setters, a group that is closer to the general public than to experts on monetary policy. Central banks have often not made their communications accessible to a sufficiently wide audience because their linguistic complexity would make them inaccessible to a large part of the general public. Hence, we start by computing indicators of the linguistic complexity of monetary policy communications, analyzing whether they have become more accessible to the general public through time, and finally assessing if they have any relation with firms' inflation expectations.

Empirical evidence shows a negative and statistically significant relationship between the tone of monetary policy communication and inflation expectations. This relationship is robust to a series of controls and robustness checks. Moreover, coefficients are similar when we use either the indicator of the perceived tone or the effective one. During the analyzed period the inflation rate and inflation expectations were at the top or above the inflation target range, so this empirical evidence suggests that monetary policy communication is a powerful lever of monetary policy.

More interestingly, empirical results indicate that, in addition to the tone, the readability of monetary policy communication has a statistically significant marginal contribution. More precisely, a easy linguistically communication reinforces the negative relation of the tone with the inflation expectations of firms. This result provides empirical evidence that suggests that central bank communication has an impact on the expectations of non-professional forecasters, and that efforts of central banks to make monetary policy communication more accessible to the general public may be worthy.

The rest of the paper is organized as follows. The next section revises related literature. [Section 3](#) describes and shows the results of computing the tone indicators. [Section 4](#) describes and computes the readability indicators. [Section 5](#) describes the empirical strategy, and presents the results and robustness checks. Finally, [Section 6](#) contains final remarks. Further information and results are in the Appendix.

2. Related literature

Communication has become a central piece in the monetary policy toolkit, especially since the development and implementation of inflation-targeting regimes. Today, it is widely accepted that a central bank's ability to affect economic performance critically depends on its ability to influence agents' expectations. As central banks moved towards transparency, the academic literature quickly provided new theoretical and empirical results. [Blinder et al. \(2008\)](#) gives a detailed compilation of the literature, both theoretical and empirical, on monetary policy communication. Our article contributes new empirical evidence about the impact of monetary policy communication on inflation expectations.

Recent studies have highlighted the importance of firms' inflation expectations to explain actual inflation ([Coibion and Gorodnichenko, 2015](#)). In spite of potential bias arising from surveys, [Borraz and Zacheo \(2018\)](#) and [Frache and Lluberas \(2019\)](#) show that the firms' inflation expectations that are used in this paper are a better predictor of inflation than those of professional forecasters. Inflation expectations in Uruguay are anchored consistently above the inflation target. A recent paper by [Shapiro and Wilson \(2021\)](#) suggests that this may also be the case in the US, although the inflation target is not explicit as in the case of Uruguay. Similarly, [Coibion et al. \(2022\)](#) show that US household inflation expectations are also consistently above target.

[Coibion et al. \(2022\)](#) is closely related to this paper. They conduct a random control trial to quantify the effect of different communication strategies on inflation expectations by households in the US. They find that communication is effective, although the effect depends on the precise form of communication. For another group of non-professional forecasters, such as firms in Uruguay, we contribute evidence about the importance of the readiness and perspicuity of the monetary policy communication to transmit its tone and affect inflation expectations.

[Haldane et al. \(2020\)](#) provide empirical evidence that suggests that non-professional forecasters, in particular households, may never engage with central bank communication because it is written in a way that they cannot understand. [Haldane and McMahon \(2018\)](#) argue that one reason for central banks to communicate better for the general public is for establishing trust and credibility about central banks and their policies. In turn, trust helps manage expectations. They also claim that there is little empirical evidence that monetary policy communication has had any impact on the expectations and the economic agents behavior. We contribute to filling that gap. More precisely, we compute readability and perspicuity indicators of monetary policy communication and include them as explanatory variables for the inflation expectations of firms. Hence, we provide new evidence that suggests that less linguistically complex communication reinforces the impact of monetary policy communication on the inflation expectations of non-professional forecasters.

Our article relates with the literature that develops sentiment indicators from monetary policy statements, in particular on their expansive or contractive tone. A significant number of articles use text analysis techniques to extract the tone of the announcements: for example [Hansen and McMahon \(2016\)](#), [Hansen et al. \(2019\)](#) and [Park et al. \(2019\)](#). Another stream of articles uses pre-established dictionaries. For example, [Picault and Renault \(2017\)](#) manually build a phrase dictionary for European Central Bank's monetary policy communications. Following this methodology, [Lahura and Vega \(2020\)](#) construct indicators of the tone of the monetary policy statements of Colombia, Chile, and Peru. Similarly, [Mello and Ponce \(2020\)](#) do the same for the statements of the Central Bank of Uruguay.

We contribute to this line of research by proposing an indicator of the tone of monetary policy communication. Our indicator is not based on text analysis techniques or on pre-established dictionaries. To build the tone indicator, we make a survey. Respondents were asked to rank “contractive”, “neutral” or “expansive” scale, to randomly assigned passages of monetary policy communications. Hence, our tone indicator is informative about the perceived tone of monetary policy communications. This indicator complements traditional ones that generally account for the effective tone of communications.

Psychological factors, asymmetries of information and lack of literacy of agents may explain the observed differences between perceived and effective tone indicators (Van der Crujssen et al., 2010). Blinder (2007) provides evidence supporting that American households are not able to identify with precision recent inflationary events. Coibion et al. (2018) show that entrepreneurs in New Zealand lack knowledge about the inflation rate. Additionally, we argue that differences between the indicator of perceived tone contributed in this paper and that of the effective tone (Borraz and Mello, 2020; Mello and Ponce, 2020) are explained by the linguistic complexity of monetary policy communications. This argument may be particularly important when analyzing the relevance of monetary policy communication on the general public; as we do with firms. Indeed, our results suggest that the readability and perspicuity of the communications play a role in central bank communication.

Indicators of the tone of monetary policy communication have been used to measure its effect. For instance, Hansen and McMahon (2016) study the impact of central bank communication on macroeconomic variables, and Picault and Renault (2017) on capital markets. Similarly, Lahura and Vega (2020) do the same for the cases of Colombia, Chile and Peru. However, they focus on the relation on inflation expectations of professional analysts and we focus on inflation expectations of firms, a group that may be considered non-professional inflation forecasters, more similar to the general public.

We propose an indicator of the perceived tone of monetary policy communication so that our paper complements recent work aimed to explain firms’ inflation expectations. Licandro and Mello (2015) assume that news referring to an increase (decrease) in the monetary policy interest rate is contractionary (expansive), Borraz and Mello (2020) study the effect of statements and press conferences by the President of the central bank over inflation expectations and Mello and Ponce (2020) built and indicators of the effective tone of monetary policy communication.

3. Tone indicators

In this paper, we propose an indicator of the tone of monetary policy communication that accounts for the consolidated perception of multiple readers. Tone indicators generally used are generated by text analysis techniques and pre-established dictionaries through mechanical process. These indicators account for the effective tone of the communications; there is no perception of a receiver of the message involved. The perceived tone indicator does not focus on the content of the communications but on the perception or sentiment of the readers.

It may be important to complement effective tone indicators with perceived tone ones because they may capture different elements of central bank communications; a result that we find in the data (please see below). In turn, these differences may be important when identifying their effect over key economic variables. In particular, the perceived tone rather than the effective one may affect agents’ behavior in general, and the formation of inflation expectations in particular. This may be particularly important for the case of non-professional agents and the general public. Hence, it may be relevant to use an indicator of the perceived tone of monetary policy communication when studying its impact on firms’ inflation expectations.

If agents were totally rational, there should not be discrepancies between the indicators. However, once sociological, behavioral economics or information asymmetries are considered, differences can emerge. For example, individuals may slowly modify their perceptions by discarding any new information that is not aligned with their previous beliefs (Rabin, 1993), and they may suffer a confirmation bias by giving more weight to new information that reaffirms their previous thought (Tversky and Kahneman, 1973). The environment, and the set of prior information available to an agent can affect the interpretation of the communications (Babcock and Loewenstein, 1997).

The perceived tone was obtained from the responses to an online survey. The survey was proposed to people with certain knowledge about economics and monetary policy. More precisely, people linked to the central bank and advanced economics students (at the graduate level). To our knowledge, this procedure has not been used before in sentiment analysis applied to monetary policy statements.

The survey was designed as follows. The text of the monetary policy releases was divided into sentences. Because they are self-contained sentences (generally no other sentence was needed to understand their tone) and they have an extension that provided an agile reading, each question contains a single sentence. Hence, single sentences belonging to a statement are requested to be classified by the reader in the following categories: “contractive”, “expansive”, or “neutral” (a fourth category of ‘does not apply’ was also available). For the entire period under analysis, 586 questions were proposed. In addition to the text to be classified, each question contains relevant information on the economic environment at the time of publication of the statement: the inflation rate in the last 12 months, the current monetary policy rate, the GDP growth rate and the rate of unemployment.²

The survey was implemented online, the respondents received a sentences to classify randomly, they answered the number of questions they wanted. The survey was distributed in two waves in a three-month period, between September and November 2020. In the first wave, it was only distributed to the BCU’s internal network. In the second wave, the survey was distributed to BCU members and also to advanced economics students. In both cases, participation was voluntary. In total, 49 respondents participated,

² Details of the survey can be found in [Appendix A](#).

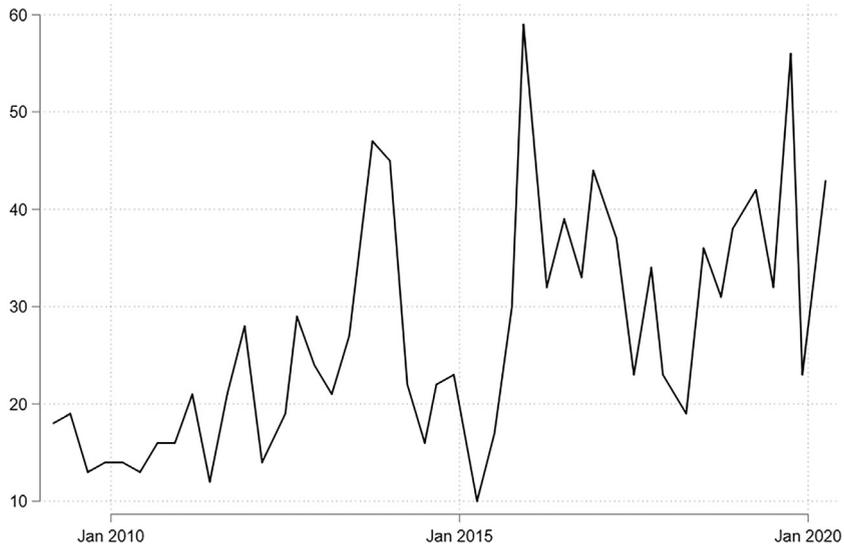


Fig. 1. Number of answers.

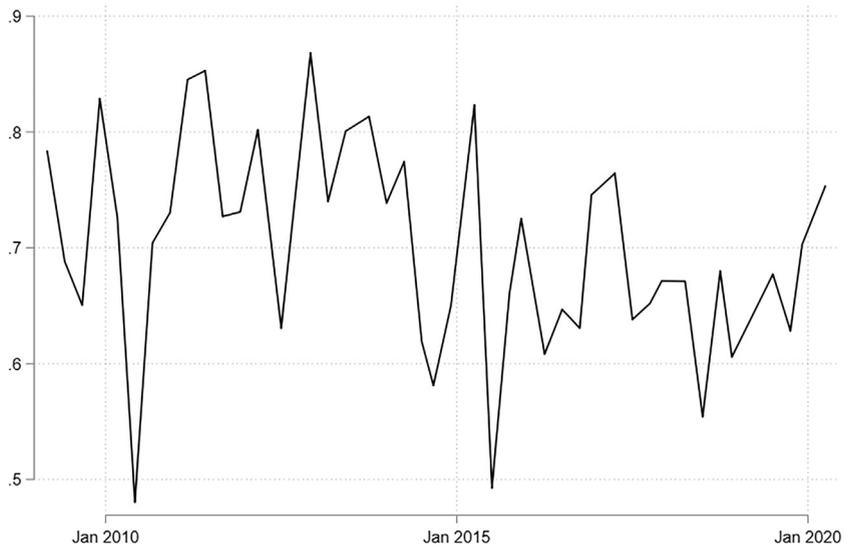


Fig. 2. Standard deviation of the answers.

completing 1310 responses. Fig. 1 shows the number of responses obtained for each monetary policy communication. It varies between a minimum of 10 responses and a maximum of 60.

Fig. 2 shows the standard deviation of responses per release. In general, the disagreement remains limited although in no single statement an absolute majority was obtained (which would have a null standard deviation), and for some statements there was a greater dispersion of opinions than for others. This indicates a degree of agreement of opinions regarding the monetary policy communication.

The tone indicator of each communication results from considering all the answers to the sentences of that statement, except those classified as ‘does not apply’. Let $Contractive_c$ be the total number of sentences considered as contractive for the statement c , $Expansive_c$ the total number of sentences considered as expansive and $Neutral_c$, the total number of sentences considered as neutral, then the perceived tone of the statement is calculated as follows:

$$Perceived\ tone_c = \frac{Contractive_c - Expansive_c}{Contractive_c + Expansive_c + Neutral_c}. \tag{1}$$

The tone indicator ranges from -1 for a fully expansive tone to 1 for a statement with a strongly contractive tone. The releases have a quarterly frequency, the monthly series is obtained by repeating the values in the corresponding quarter. Fig. 3 shows the

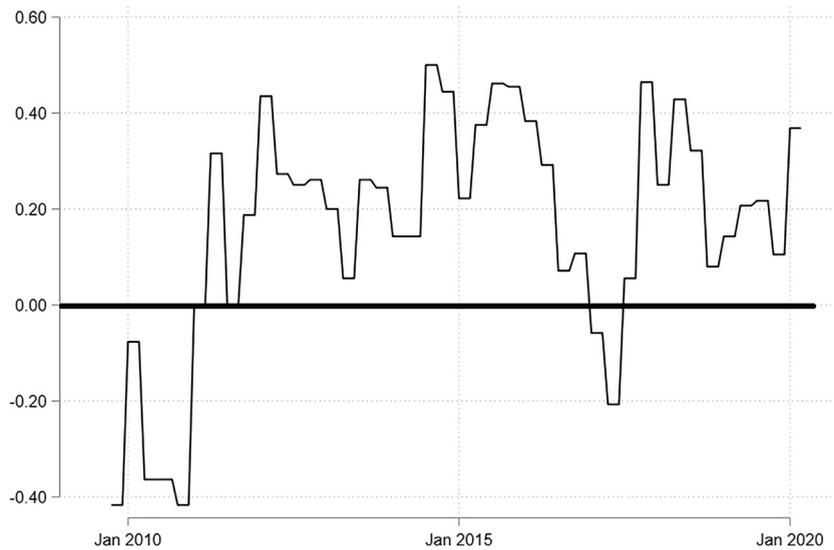


Fig. 3. Perceived tone of monetary policy communication.

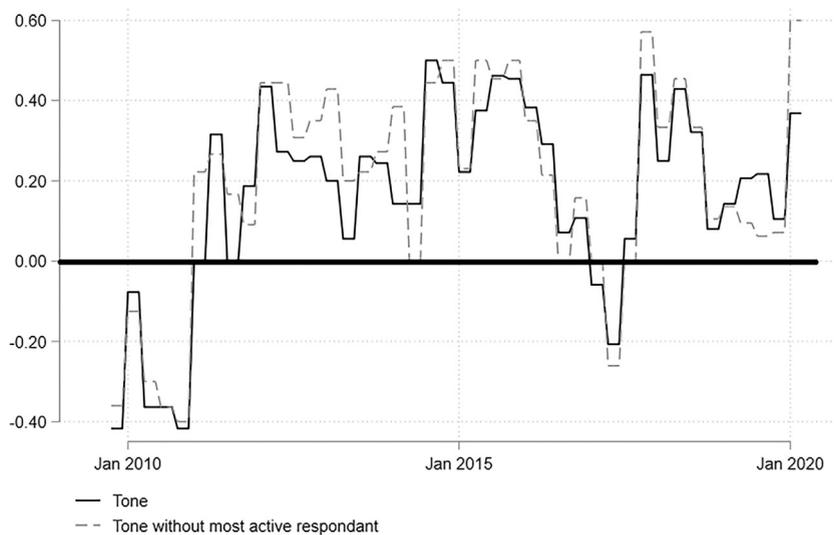


Fig. 4. Perceived tone without most active respondent.

indicator of the tone resulting from the survey. It was predominantly contractive in the period under analysis. The main exceptions are from the last quarter of 2009 to the last quarter of 2010, as well as in the first two quarters of 2017.

Of the 1310 responses received, the most active user provided 31% of the answers. The remaining users responded in a more uniform way, as can be seen in the Fig. 11 in Appendix A. To isolate the potential bias that the responses of the most active user could introduce into the tone indicator, we recalculate it excluding the responses from this respondent. Fig. 4 shows the recalculated tone indicator without the responses of the most active user and compares it with the one presented in Fig. 3. As can be seen, both indicators give the same qualitative message, observing only small quantitative differences.

The indicator of perceived tone obtained through the survey presents a similar behavior to the indicator of effective tone calculated for the same monetary policy communications by Mello and Ponce (2020).³ However, as can be seen in Fig. 5, there are differences between the two indicators. Some of these differences could be explained by the readability of their monetary policy statements.

³ The methodology in Mello and Ponce (2020) consisted in identifying the words “inflation” (and its variants) and “monetary policy” (and its variants) in each monetary policy statement and assessing the text made up of the six previous and the six subsequent words. The tone indicator thus constructed varies between -2 and 2, and to make the comparison with the perceived tone indicator constructed in this paper (as well as in the regressions), both variables are presented in standardized values.

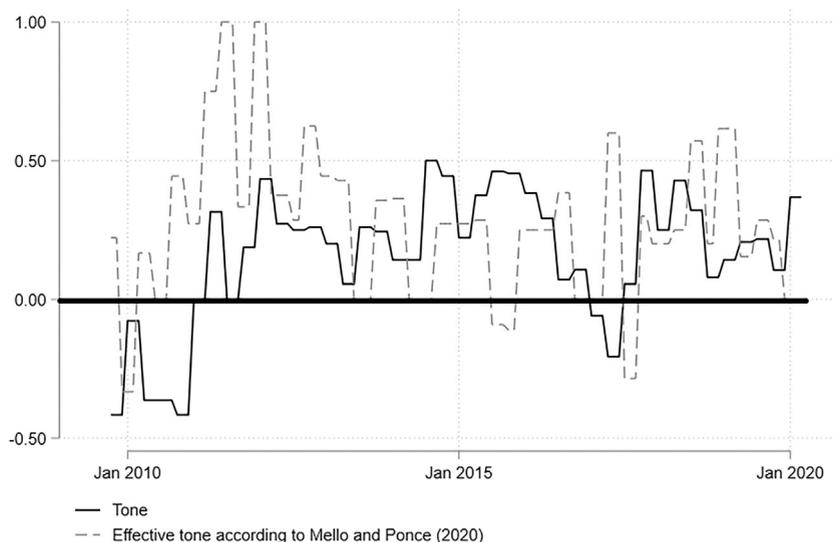


Fig. 5. Comparison between tone indicators.

Table 1
Readability scale according to Fernández-Huerta (1959).

Index	Grade	Style
0 - 30	Professional	Very difficult
30 - 50	University	Difficult
50 - 60	High school	Somewhat difficult
60 - 70	7 or 8	Normal
70 - 80	6	Somewhat easy
80 - 90	5	Easy
90 - 100	4	Very easy

According to Haldane et al. (2020), the evidence suggests that many households may never engage with central bank communication because it is written in a way that they cannot understand. In the following sections, we will investigate further this argument.

4. Readability indicators

One of the precursors of the readability studies of a text is Flesch (1949), which proposes a formula for the difficulty of understanding a reading that is intended for the adult population. The formula has been widely used.⁴ However, the use of this methodology to monetary policy communication of the Central Bank of Uruguay is not direct, since it was designed for the English language. However, there are, variants for texts in Spanish. In this work, we will consider three indicators designed for texts in Spanish: Fernández-Huerta (1959), Pazos (1993) and Cantalejo et al. (2008).⁵

Fernández-Huerta (1959) proposed the following indicator, which is based on the formula developed by Flesch (1949), to establish the reading facility coefficient of a text in Spanish:

$$\text{Readability} = 20,684 - 0,60 \times P - 1,02 \times F, \quad (2)$$

where P is the average number of syllables per 100 words and F is the average number of words per phrase.

As in Flesch (1949), the formula scores for Fernández-Huerta (1959) range from 0 to 100, with 0 being the most difficult and 100 being the least difficult to read categories. A rating below 30 is considered very difficult, while a rating of 70 is considered appropriate for adult readers. One of the main advantages of the formula of Fernández-Huerta (1959) is its applicability to all types of text, as long as it is made up of 100 words or more. The index can also be associated with a certain level of education required for its understanding, which is measured in years of studies as shown in Table 1.

Fig. 6 shows the results of applying the Fernández-Huerta (1959) methodology to the monetary policy statements of the Central Bank of Uruguay. As with the series of the tone of the communications, a monthly series is obtained by keeping constant the values of the readability indicator for the entire quarter of the validity of each statement.

⁴ As an example, the scale of Flesch (1949) is present in the main word processing software.

⁵ To deepen the information on these formulas please refer to Appendix B.

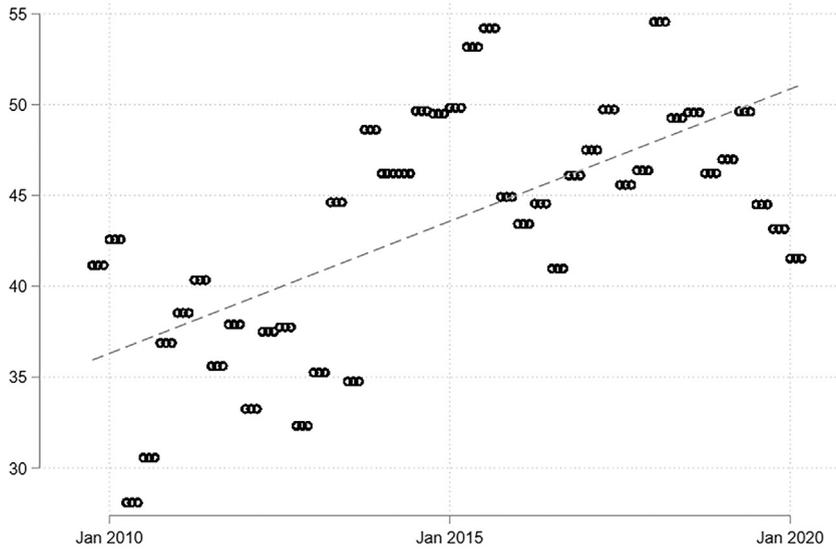


Fig. 6. Readability of monetary policy communication using Fernández-Huerta (1959).

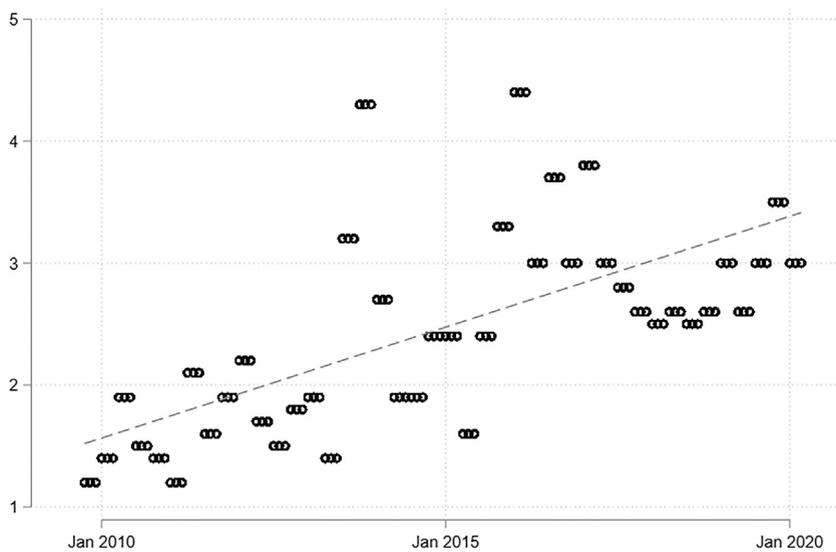


Fig. 7. Reading time.

Fig. 6 shows that the monetary policy communications are mostly classified in the “difficult” range to read. Only one of the communications in the period under analysis is classified in the category of “very difficult,” while four are classified in the category of “somewhat difficult.” It is interesting to analyze the evolution of the readability indicators for the releases to see how it has changed over time. The positive value of the slope of the linear adjustment line in Fig. 6 indicates that the difficulty of reading and interpreting the monetary policy statements decreased over time. However, the reading time of the statements increased significantly, as can be shown in Fig. 7: for 2009, the average number of words is 264, while for 2020 (the last year considered), the average number of words in each release is 1,511.

In any case, although the reading difficulty has decreased, the texts are still considered as “somewhat difficult” to understand and required at least a high school level for their correct interpretation. At the same time, the length and reading time of the statements has increased over time.

Pazos (1993) develops an indicator that focuses on the perspicuity of the text, this is its clarity and transparency. The perspicuity indicator of Pazos (1993) complements that of Fernández-Huerta (1959), and it has been widely used to measure the readability of texts in Spanish during the last decades (Ríos, 2003). Details of the perspicuity indicator can be found in Appendix B. In Fig. 8, we show the results of the application of the perspicuity index to the monetary policy statements of the Central Bank of Uruguay.

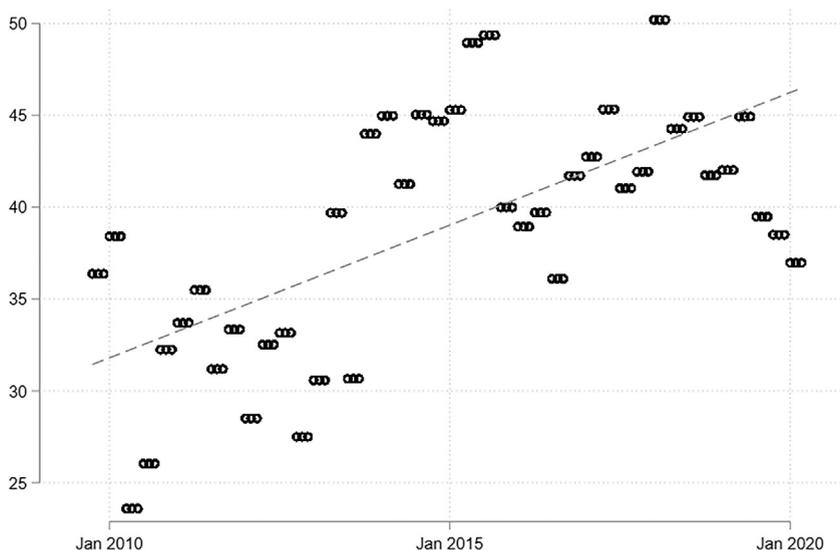


Fig. 8. Perspicuity of monetary policy communication using Pazos (1993).

Table 2
Descriptive statistics.

Indicator	Min	Q1	Med (Q2)	Avg	Q3	Max
Readability	28.09	37.75	44.50	42.80	48.62	54.56
Perspicuity	23.59	33.16	39.48	38.24	43.99	50.20
Lecture time	1.20	1.60	2.40	2.38	3.00	4.4

As the readability indicator reflects an easier lecture in the period, the perspicuity indicator in Fig. 8 shows greater clarity and transparency. However, the perspicuity values are slightly lower than those of readability, which suggests that the communications could still be clearer and more transparent (see Table 2).

In the robustness analysis of the econometric results in the next section, we incorporate a third indicator of the ease of readings of the monetary policy statements, developed by Cantalejo et al. (2008). Details of this indicator are presented in Appendix B. The qualitative results of its application are similar from those found with the two indicators presented in this section.

5. Tone, readability and inflation expectations

In this section, we assess the relationship between the tone and readability of monetary policy communication and the inflation expectations of firms in Uruguay.

5.1. Data

Our main data source is the Inflation Expectations Survey (IES) carried out by the Instituto Nacional de Estadísticas (INE), commissioned by the Banco Central del Uruguay (BCU), to firms in Uruguay. The survey is conducted monthly to a representative sample of the universe of Uruguayan private companies with more than 50 employees. However, it does not cover the agricultural and financial sectors. The sample period is from October 2009 to March 2020.

The IES has a monthly frequency and contains information about firms' inflation and cost expectations. Specifically, our dependent variable corresponds to the answers to the question that reveals inflation expectations in the survey: *What do you think will be the percentage change in the CPI (Consumer Price Index)?* This question is asked considering 4 time horizons: the current year, the next 12, 18, and 24 months. In this work, we consider the firms' inflation expectation in the horizon of monetary policy ($t = H$). In June 2013, the horizon of monetary policy was extended from 18 to 24 months. At the same time, the inflation target was expanded from 4 - 6% to 3 - 7%. We control for these changes in the regressions that are presented in the next section.

The IES is sent monthly to around 500 firms with an average response ratio of 77% since October 2009 (with a minimum response ratio of 54%). The resulting is an unbalanced, long panel with a total of 126 months and 46,580 observations. During the sample period, 591 firms completed the survey at least once, while 65% of the firms answered the questionnaire more than 50% of the time (64 months).

Table 3
Descriptive statistics.

Variable	Obs.	Mean	Std.Dev.	Min	Max
Inflation expectations	46,580	8.95	2.057	5	25
Market inflation expectations	126	8.30	1.26	6.07	11.38
Inflation	126	8.01	1.16	5.24	11
Short-term interest rate	126	9.76	2.60	6.25	15.66
VIX	126	17.48	5.96	10.01	57.19
EMBI URU	126	203.19	41.88	121.00	330.00
GDP Growth	126	3.40	3.24	-13.67	13.13
Perceived tone	1310	0.15	0.25	-0.42	0.50
Perc. tone without most active	904	-0.18	0.27	-0.60	0.40
Perception disagreement	1310	0.62	0.17	0.15	0.96
Effective tone	126	0.28	0.29	-0.33	1
Readability	126	42.80	6.62	28.09	54.56
Perspiciuity	126	38.24	6.69	23.59	50.20

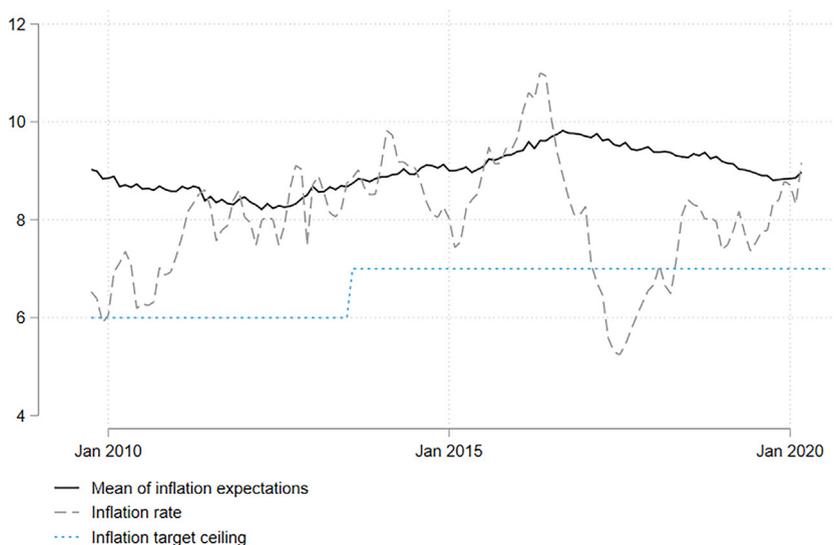
**Fig. 9.** Inflation rate and inflation expectations.

Table 3 presents the descriptive statistics for the variables of interest. Particularly, inflation expectations for the monetary policy horizon are on average 8.95% during the period under analysis. This is nearly 2 percentage points above the ceiling of the inflation target range, as can be appreciated in Fig. 9.

The monthly inflation rate, computed as the variation of the CPI, is published by the Instituto Nacional de Estadísticas the third business day of the each month.⁶ As Fig. 9 shows, the rate of inflation was most of the time, above the ceiling of the inflation targeting range. On average, the inflation rate was 8% (see Table 3).

In an inflation-targeting regime, the monetary policy aims to affect inflation expectations with the objective of maintaining inflation in the target range. One channel to do so goes through the interest rate and is commonly known as the credit channel of monetary policy. The basic mechanism implies that a market interest rate above that considered neutral indicates a contractive stance, affecting market conditions and in turn, inflation expectations. Monetary policy aims to affect the market interest rate by using its instruments. In the case under study, the selected instrument was a short-term interest rate until June 2013 and monetary aggregates since then. To account for the above-mentioned mechanism throughout the entire period under analysis, we introduce a short-term interest rate in the empirical regressions. More precisely, we compute the short-term interest rate as the 30-day node of the ITLUP curve developed by the Electronic Stock Exchange (BEVSA).⁷

The variables related to the tone of the monetary policy communications, their readability and perspicuity indicators are those computed in Sections 3 and 4.

In a series of robustness checks, we introduce other control variables. To account for market inflation expectations, we use the break-even inflation expectation that is implicit in the prices of financial market instruments. We account for the global volatility by

⁶ See <http://www.ine.gub.uy/indicadores?indicadorCategoryId=11421>.

⁷ ITLUP is the Uruguayan yield curve in local currency. See <https://web.bevsa.com.uy/CurvasVectorPrecios/CurvasIndices/ITLUP.aspx>.

Table 4
Main results.

	M1	M2	M3	M4
Expectations ($t - 1$)	0.109*** (0.031)	0.103*** (0.029)	0.110*** (0.031)	0.103*** (0.031)
Inflation ($t - 1$)	0.321*** (0.012)	0.337*** (0.013)	0.316*** (0.012)	0.335*** (0.013)
Short-term interest rate	-0.379*** (0.028)	-0.293*** (0.025)	-0.341*** (0.021)	-0.297*** (0.027)
Perceived tone	-0.166*** (0.018)		-0.155*** (0.017)	
Effective tone		-0.142*** (0.010)		-0.144*** (0.010)
Perceived tone \times Readability			-0.002 (0.012)	
Effective tone \times Readability				-0.025*** (0.009)
Observations	41,078	41,078	41,078	41,078
Groups	570	570	570	570
AR(1)-p	0.000	0.000	0.000	0.000
AR(2)-p	0.322	0.511	0.359	0.472
Hansen-p	0.742	0.718	0.749	0.746
Year fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes

Notes: Endogenous variables: Short-term interest rate, Tone, Contractivity, Readability. Instruments: lagged endogenous, time average 12 months expected inflation. Other controls: number of responses per month and monetary policy target change. Estimating Method: Two-step GMM, robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

using the VIX index and for Uruguay's country risk by considering the EMBI index for this country. Business cycle is approximated through GDP growth. Finally, we consider the disagreement among respondents to the tone survey through the standard deviation of the answers.

5.2. Empirical strategy

We use a dynamic and unbalanced panel database with monthly information on inflation expectations, by firms in Uruguay from October 2009 to March 2020. The main regression model is the following:

$$E_{it}(\pi_H) = \alpha_i + \beta_1 E_{it-1}(\pi_H) + \beta_2 \pi_{t-1} + \beta_3 i_t^{st} + \beta_4 \text{Tone}_t + \beta_5 \text{Tone}_t \times \text{Read}_t + \varepsilon_{it}, \quad (3)$$

Were $E_{it}(\pi_H)$ is the inflation expectation of firm i at time t for the monetary policy time horizon H .⁸ Additionally, π_{t-1} is the annual inflation rate observed at $(t - 1)$, which is the most recent data about inflation that is available to firms when making inflation expectations at time t . To account for the monetary policy stance, we include i_t^{st} , the short-term interest rate in period t . Tone_t is the indicator of the tone of the monetary policy communication, available in period t . Alternatively, we use both the *perceived* tone indicator developed in Section 3 and the *effective* tone indicator by Mello and Ponce (2020). $\text{Tone}_t \times \text{Read}_t$ accounts for the combined effect of tone and readability. Since a less-linguistically-complex monetary policy communication should enhance the impact of the tone embedded in that communication, we expect a negative coefficient β_5 . In the main regression model, we use the readability indicator computed in Section 4 following Fernández-Huerta (1959). The robustness analysis using the perspicuity indicators proposed by Pazos (1993) and Cantalejo et al. (2008) confirms the qualitative results (see Section 5.4). The results for the model proposed in Eq. 3 appear in column M3 in Table 4. Columns M1 and M2 present results for a benchmark model, excluding the readability indicator.

We use the Generalized Method of Moments (GMM) to estimate the proposed models. This is an appropriate estimation method because the inflation expectations are highly persistent, especially in monthly frequency. We include an autoregressive term and firm fixed effects, α_i . Also, we included time effects, an year fixed effect to control for the learning of the firms in the inflation forecast and a monthly fixed effect to account for the intra-annual seasonality of the variables included in the regression.

We introduce a control variable that accounts for the diminishing rate of response to the IES, which affects the composition of inflation forecasters answer the survey. More precisely, we introduce the number of responses to the IES each month. Finally, we control for the change in the policy target and instrument that occurred in June 2013 by introducing a dummy variable that takes the value since July 2013.

⁸ In June 2013, the monetary policy time horizon was extended from 18 to 24 months, we considered inflation expectations in the 18 months time horizon before that date and in the 24 months after it. The qualitative results remain robust to considering different monetary policy time horizons.

Our regression models face endogeneity problems. Particularly, monetary policy variables, the short-term interest rate, and the tone indicators of monetary policy communication are endogenous. To solve these problems, we follow Arellano and Bond's (1991) methodology, which uses the lags of endogenous variables as instruments. We also introduce the 12-month average change of expected costs and the firm's expected inflation rate as instruments. These two variables are exogenous to and non-observable by individual firms. Therefore, these variables are correlated to monetary variables but they are not correlated with the individual expectation of the firm, so they are adequate instruments.

5.3. Main results

In [Table 4](#) we present the main results of the econometric analysis. As a benchmark, model M1 only introduces the variable of the perceived tone of monetary policy communication calculated in [Section 3](#). The coefficient of the variable *Perceived tone* has the expected negative sign and is statistically significant at the 1% level. This result indicates that a more contractionary tone in the monetary policy statements is related to a decrease in the inflation expectations of the firms (above the ceiling of the target range during the period under analysis). Model M2 considers the effective tone variable calculated by [Mello and Ponce \(2020\)](#). The estimated coefficient is similar in level to the M1 model, indicating the robustness of the previous result. In both models, the short-term interest rate is negative and statistically significant, so a contractionary monetary policy rate is related to a decrease in inflation expectations.

Model M3 includes the combined effect of perceived tone and readability, measured according to the indicator proposed by [Fernández-Huerta \(1959\)](#). This model responds to [Eq. 3](#). The combined coefficient of perceived tone and readability is negative, but is not statistically significant.

Model M4 replaces the *Perceived Tone* indicator with the *Effective Tone* indicator computed by [Mello and Ponce \(2020\)](#). The interaction with the readability indicator has a negative and significant coefficient. This result indicates that easier-to-read monetary policy communication contributes marginally to improving the impact of the tone on firms' inflation expectations. The size of the coefficient, as well as its statistical significance, is higher than that of the M3 model, suggesting that more accessible readability reinforces the impact of the effective tone to a greater extent than it does with the perceived tone. Since the variables entering the regressions are standardized, the relative magnitude of the coefficients is directly comparable: readability increases the impact of the effective tone of monetary policy communication by around 20%.

Furthermore, it can be observed that the summed coefficients of the effective tone (0.144) and readability (0.025) are close to the coefficient of the perceived tone in Model M1: $0.166 \sim 0.144 + 0.025 = 0.169$. One possible interpretation is that the impact of the perceived tone on firms' inflation expectations could be separated into the effect of the effective tone and the ability to convey this tone to the general public, which depends on the readability of the document. This interpretation relies on the fact that the indicator of the perceived tone of monetary policy communication implicitly considers its readability because the classification is done by a group of people who read, understand and interpret the messages that are presented. However, the effective tone indicator is constructed almost mechanically, and its values are unlikely to be affected by the readability or perspicuity of monetary policy communications.

5.4. Robustness check

5.4.1. Perceived tone

As can be seen in [Fig. 11](#) in [Appendix A](#), one person contributes more than 30% of the responses used to compute the perceived tone indicator. For robustness, the perceived tone indicator was recalculated excluding the responses of this person to re-estimate [Eq. 3](#).

Model M5 in [Table 7](#) of [Appendix C](#) shows the results when considering the recalculated perceived tone indicator. When comparing its equivalent with all the responses the M1 model, the coefficients maintain the sign, statistical significance, and order of magnitude. Likewise, the coefficient of the joint interaction between the recalculated perceived tone indicator and the readability variable, increases with respect to the original model and gains statistical significance.

5.4.2. Perspicuity

Other robustness checks were performed by substituting readability for perspicuity. [Table 8](#) in [Appendix C](#) shows the detailed result of the regressions using the [Pazos \(1993\)](#) and [Cantalejo et al. \(2008\)](#) indicators. The qualitative results are robust to using these indicators of perspicuity instead of the readability indicator of [Fernández-Huerta \(1959\)](#).

5.4.3. Other control variables

We check the robustness of the main results in this paper considering a series of control variables that may affect inflation expectations. First, [Table 9](#) in [Appendix C](#) shows that the qualitative results of model M3 do not change after introducing the control variables. Second, [Table 10](#) shows the robustness of the main results in model M4.

The control variables account for the business cycle, the GDP growth, and financial conditions by considering the VIX index, an indicator of global volatility in financial markets, and the EMBI index for Uruguay, an indicator of country risk. In all the checks, the main results remain robust and the control variables have the expected positive sign, and are statistically significant at the 1% level.

We also check that the main results remain robust when considering an indirect channel to affect firms' inflation expectations. More precisely, we include the market inflation expectation that is implicit in financial market instruments.

Finally, when considering the perceived tone indicator, the results are robust controlling for the disagreement among respondents of the survey.

6. Final remarks

We contribute new empirical evidence on monetary policy communication and firms inflation expectations. Our work aims to contribute to answering questions such as: How important is the tone of monetary policy communication to affect inflation expectations by non-professional forecasters like firms? Does readability and perspicuity of monetary policy communication reinforce the effect of the tone?

First, we constructed a new indicator of the *perceived tone* of monetary policy communication with a survey. Respondents were randomly assigned passages that appears in monetary policy communication and asked to classify their tone. The survey collected a total of 1310 responses that covered all the texts of the monetary policy communications during the period under analysis (from October 2009 to March 2020). The indicator of the perceived tone was computed as the simple average of the answers. This complements traditional indicators of the *effective tone* of monetary policy communication such as the proposed in [Mello and Ponce \(2020\)](#).

Second, we compute indicators on the readability and perspicuity of monetary policy communication. Since we work with inflation expectations by firms, which are non-professional forecasters, closer to the general public, these indicators are useful in filling a gap. There is academic evidence that indicates that central bank communication plays a crucial role, but there is far less evidence that monetary policy communication has had any impact on expectations and behavior of the general public ([Haldane and McMahon, 2018](#)). Central banks have often not made their communications accessible to a wide audience because their linguistic complexity would make them inaccessible to a large part of the general public. Hence, we start by computing indicators of the linguistic complexity of monetary policy communications and analyzing whether they have become more accessible to the general public through time. Finally, we assessed if they have any impact on firms' inflation expectations. We find that readability has improved, but there is still room for further improvements in the perspicuity of the messages.

Third, we use micro-data on firm's inflation expectations in Uruguay to assess the impact of the tone, readability, and perspicuity of monetary policy communication. Empirical evidence shows a negative and statistically significant relationship between the tone of monetary policy communication and inflation expectations. This is robust to a series of controls and robustness checks. Moreover, the size of the coefficients is similar when we use the indicator of perceived tone or the effective one. Since the inflation rate and inflation expectations were at the top or above the upper bound of the target range during the period, this empirical evidence suggests that communication is a powerful lever of monetary policy.

More interestingly, empirical results indicate that, on top of the tone, the readability of monetary policy communication has a statistically significant marginal contribution. More precisely, less linguistically complex communication reinforces the negative effect of the tone on the inflation expectations of firms. This result contributes empirical evidence that suggests that central bank communication has an impact on the expectations of non-professional forecasters, and also that efforts by central banks to make monetary policy communication more accessible to the general public may be worthy to anchor expectations.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. The perceived tone indicator

In this section we detail the survey from which we developed the perceived tone indicator. The monetary policy statements were transferred to a relational database (RDBMS) in a header and lines structure. The header is basically the date of the statement and the lines represent the sentences, ordered numerically and with a unique identifier for the entire period.

To choose the question that was presented to the respondent, who is identified by an e-mail address, an ordered list was formulated with the questions that that user had not yet answered, a number was randomly drawn between 1 and the total number of elements on that list. The question, was the one that corresponded to that location within the ordered list. Once the question was answered, the sentence was marked as already done and excluded in the search for the next question to offer.

To participate in the survey, it was mandatory to enter an email address with a valid format, but it was anonymous. The invitation to participate in the survey was sent by e-mail with an introduction explaining the reasons for carrying it out and thanking the time they to complete it.

The survey's software presents a sentence and the user classify it as *Contractive*, *Expansive*, *Neutral* or *Not applicable*. Additionally, with each sentence information about the economic context at the time the statement was published was presented, the inflation rate in the last twelve months, the monetary policy interest rate, the variation in GDP, and the unemployment rate.

The survey was done in two waves between September and November 2020. In the first wave, it was only published on the BCU's internal network. In the second wave, the survey was distributed online to BCU members and to advanced Economics students.

[Fig. 11](#) presents the relative participation of those who answered the survey. The most active user answered 400 questions, which implies a participation share of 31%. As a robustness check, the tone indicator was calculated excluding this respondent, and the results did not change significantly.

Encuesta: Comunicados del COPOM

Van 0 respuestas dadas por: gcarotta@bcu.gub.uy (si no es esta persona por favor no responda la encuesta)
 ESTÁ ACCEDIENDO DESDE LA COMPUTADORA NEWTON.SERVERS.BCU.GUB.UY CON LA DIRECCIÓN IP 172.20.20.100

Clasifique según el tono la siguiente oración del comunicado del COPOM del día 23/06/11 (oración 7)

<< Los altos precios internacionales y la firme demanda doméstica siguen pautando un sesgo expansivo en la trayectoria de los precios internos. >>

En un contexto de:

8.5% Inflación 7.9% Tasa LRM 5.6% PIB 5.7% Desempleo

Expansivo
Contractivo
Neutral
No aplica

CLASIFICAR ORACIÓN

Fig. 10. Survey's screen.

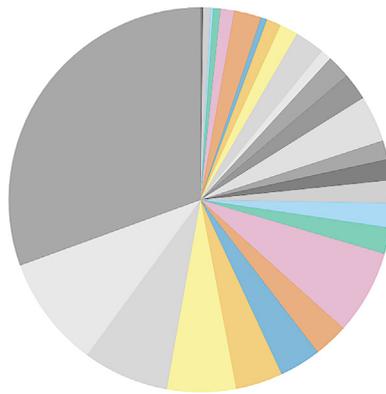


Fig. 11. Participation per respondent.

Appendix B. Readability and perspicuity indicators

Pazos (1993) proposes two indicators of perspicuity, one based on short texts with less than 100 words and another, valid for any length of text. The first version responds to the following formula:

$$Perspicuity = 207 - 0623 \times S - P, \tag{4}$$

where S is the number of syllables and P is the number of words per phrase.

The second version (valid for any text size), responds to the following formula:

$$Perspicuity = 207 - \frac{62,3 \times S}{P} - \frac{P}{F}, \tag{5}$$

where S is the number of syllables, P is the number of words and F is the number of phrases.

Pazos (1993) also developed a rating table adapted to Spanish texts, following Flesch (1949), presented in Table 5.

Table 5
 Perspicuity scale according to Pazos (1993).

Index	Grade	Style	Type
0 - 15	Professional	Very difficult	Scientific
16 - 35	Graduate student	Difficult	Technical
36 - 50	University	Somewhat difficult	Literature
51 - 65	Popular	Normal	Media
66 - 75	12 years old	Somewhat easy	Novels
76 - 85	11 years old	Easy	News
86 - 100	6 to 10 years old	Very easy	Comics

Table 6
Perspicuity scale according to Cantalejo et al. (2008).

Index	Style
0 - 40	Very difficult
40 - 55	Somewhat difficult
55 - 60	Normal
65 - 80	Somewhat easy
80 - 100	Very easy

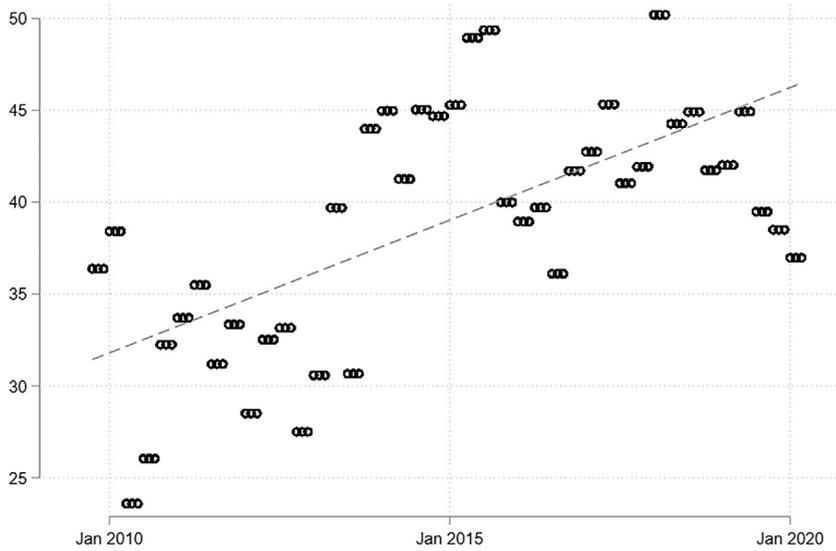


Fig. 12. Perspicuity of monetary policy communication, Cantalejo et al. (2008).

In addition to the two indicators mentioned above the readability developed by (Fernández-Huerta, 1959) and the perspicuity by (Pazos, 1993), we calculated the indicator developed by Cantalejo et al. (2008) and used it in the robustness tests, according to the following formula:

$$Perspicuity = 206,835 - 62,3 \left(\frac{S}{P} - \frac{P}{F} \right), \tag{6}$$

where S is the number of syllables, P is the number of words and F is the number of phrases. According to the authors, this perspicuity formula improves on the previous one because it is developed with a bigger and random sample. Scale proposed for the interpretation is in Table 6. Fig. 12 shows that the results of applying this indicator are similar to those found by applying the Pazos (1993) indicator (see Fig. 8).

Appendix C. Robustness

Table 7
Tone without the most active respondent.

	M1	M3	M5	M6
Expectations ($t - 1$)	0.109*** (0.031)	0.110*** (0.031)	0.108*** (0.031)	0.108*** (0.031)
Inflation ($t - 1$)	0.321*** (0.012)	0.316*** (0.012)	0.313*** (0.012)	0.311*** (0.012)
Short-term interest rate	-0.379*** (0.028)	-0.341*** (0.021)	-0.373*** (0.028)	-0.370*** (0.027)
Perceived tone	-0.166*** (0.018)	-0.155*** (0.017)		
Perceived tone \times Readability		-0.002 (0.012)		
Perceived tone without most active			-0.179*** (0.018)	
Perceived tone w.o. most act. \times Readability				-0.004*** (0.000)
Observations	41,078	41,078	41,078	41,078
Groups	570	570	570	570
Ar(1)-p	0.000	0.000	0.000	0.000
Ar(2)-p	0.322	0.359	0.427	0.438
Hansen-p	0.742	0.749	0.732	0.745
Year fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes

Notes: Endogenous variables: Short-term interest rate, Tone, Tone without the most active respondent, Readability. Instruments: Lagged endogenous, time average expected inflation. Other controls: Number of responses per month, and monetary policy target change. Estimating Method: Two-step GMM, robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8
Perspicuity.

	M7	M8	M9	M10
Expectations ($t - 1$)	0.109*** (0.031)	0.109*** (0.031)	0.103*** (0.031)	0.103*** (0.031)
Inflation ($t - 1$)	0.321*** (0.012)	0.321*** (0.012)	0.334*** (0.012)	0.334*** (0.012)
Short-term interest rate	-0.379*** (0.028)	-0.379*** (0.028)	-0.295*** (0.026)	-0.295*** (0.026)
Perceived tone	-0.147** (0.072)	-0.147** (0.072)		
Perceived tone \times Pazos (1993)	-0.000 (0.002)			
Perceived tone \times Cantalejo et al. (2008)		-0.000 (0.002)		
Effective tone			0.001 (0.053)	0.001 (0.053)
Eff. tone \times Pazos (1993)			-0.004*** (0.001)	
Eff. tone \times Cantalejo et al. (2008)				-0.004*** (0.001)
Observations	41,078	41,078	41,078	41,078
Groups	570	570	570	570
Ar(1)-p	0.000	0.000	0.000	0.000
Ar(2)-p	0.324	0.324	0.478	0.478
Hansen-p	0.723	0.723	0.742	0.742
Year fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes

Notes: Endogenous variables: Short-term interest rate, Tone, Effective tone, Perspicuity. Instruments: Lagged endogenous, time average expected inflation. Other controls: Number of responses per month, monetary policy target change. Estimating Method: Two-step GMM, robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9
Perceived tone and other control variables.

	M3	M3.1	M3.2	M3.3	M3.4	M3.5
Expectations ($t - 1$)	0.110*** (0.031)	0.100*** (0.032)	0.105*** (0.032)	0.105*** (0.032)	0.097*** (0.032)	0.089*** (0.032)
Inflation ($t - 1$)	0.316*** (0.012)	0.318*** (0.012)	0.313*** (0.012)	0.309*** (0.012)	0.282*** (0.012)	0.202*** (0.013)
Short-term interest rate	-0.341*** (0.021)	-0.356*** (0.022)	-0.337*** (0.021)	-0.352*** (0.021)	-0.382*** (0.022)	-0.437*** (0.023)
Perceived tone	-0.155*** (0.017)	-0.154*** (0.017)	-0.133*** (0.017)	-0.142*** (0.017)	-0.172*** (0.017)	-0.109*** (0.017)
Perceived tone \times Readability	-0.002 (0.012)	0.002 (0.012)	-0.009 (0.012)	-0.018 (0.012)	0.012 (0.012)	-0.000 (0.012)
Perception disagreement		0.438*** (0.050)				
GDP growth			0.024*** (0.003)			
VIX				0.012*** (0.002)		
EMBIURU					0.003*** (0.000)	
Market expectations ($t - 1$)						0.235*** (0.014)
Observations	41,078	41,078	41,078	41,078	41,078	41,078
Groups	570	570	570	570	570	570
AR(1)-p	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)-p	0.359	0.271	0.267	0.283	0.262	0.304
Hansen-p	0.749	0.738	0.766	0.744	0.744	0.766
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Endogenous variables: Short-term interest rate, Tone, Contractivity, Readability. Instruments: Lagged endogenous, time average expected inflation. Other controls: Number of responses per month, monetary policy target change. Estimating Method: Two-step GMM, robust to heteroskedasticity. *p<0.10, ** p<0.05, *** p<0.01

Table 10
Effective tone and other control variables.

	M4	M4.1	M4.2	M4.3	M4.4
Expectations ($t - 1$)	0.103*** (0.031)	0.096*** (0.031)	0.099*** (0.032)	0.098*** (0.031)	0.077* (0.044)
Inflation ($t - 1$)	0.335*** (0.013)	0.332*** (0.014)	0.332*** (0.013)	0.312*** (0.013)	0.202*** (0.024)
Short-term interest rate	-0.297*** (0.027)	-0.296*** (0.026)	-0.331*** (0.028)	-0.325*** (0.027)	-0.429*** (0.042)
Effective tone	-0.144*** (0.010)	-0.136*** (0.010)	-0.134*** (0.010)	-0.119*** (0.011)	-0.135*** (0.024)
Effective tone \times Readability	-0.025*** (0.009)	-0.017 (0.012)	-0.029*** (0.009)	-0.037*** (0.009)	-0.055** (0.027)
GDP Growth		0.026*** (0.003)			
VIX			0.010*** (0.002)		
EMBIURU				0.002*** (0.000)	
Market expectations ($t - 1$)					0.260*** (0.028)
Observations	41,078	41,078	41,078	41,078	41,078
Groups	570	570	570	570	570
AR(1)-p	0.000	0.000	0.000	0.000	0.000
AR(2)-p	0.472	0.375	0.346	0.359	0.370
Hansen-p	0.746	0.746	0.716	0.735	0.735
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes

Notes: Endogenous variables: Short-term interest rate, Tone, Contractivity, Readability. Instruments: Lagged endogenous, time average expected inflation. Other controls: Number of responses per month and monetary policy target change. Estimating Method: Two-step GMM, robust to heteroskedasticity. *p<0.10, ** p<0.05, *** p<0.01

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