Monetary policy communication and inflation expectations: new evidence about tone and readability

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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 of them have the expected negative sign and are statistically significant in panel data regressions with firms' inflation expectations as dependent variable, suggesting that communication has an important impact on inflation expectations. Second, we compute readability and perspicuity indicators of the communications. In the sample, readability has improved through time, but there is still room for further improvements on the perspicuity of the messages. Better readability of monetary policy communication reinforces the effect of the tone. The impact is larger when combined with the indicator of effective tone, suggesting that readability is an important component in monetary policy communication.

JEL Codes: C23, E52, E58.

Keywords: Inflation expectations, monetary policy communication, tone, readability.

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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 in order to ensure price stability. Towards this goal, monetary authorities uses 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 differences between the effective tone of monetary policy communication and the perceived tone by economic agents? Does readability and perspicuity of monetary policy communication reinforce the effect of the tone? In this paper we aim at contributing empirical evidence to answers 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 construct an indicator of the perceived tone of monetary policy communication through a survey to professionals in Economics. Respondent where randomly assigned with passages that appeared in monetary policy communication during that period and asked to classify their tone. The survey collects a total of 1.310 responses that covers all the texts of the monetary policy communications during the period under analysis. The indicator of the perceived tones is computed as the simple average of the answers. This indicator complements traditional indicators of the effective tone of monetary policy communication.[1]

We also compute indicators on the readability and perspicuity of monetary policy communication. While there is a large body of academic evidence that indicates that central bank communication plays a crucial role, most studies have focused 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 have had any impact on 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 main communications accessible to a sufficiently wide audience because their linguistic complexity would make them inaccessible to 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 an impact on firms' inflation expectations.

Empirical evidence shows a negative and statistically significant relationship between

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

the tone of monetary policy communication and inflation expectations. This relationship is robust to a series of controls and robustness checks. Moreover, the size of the coefficients is similar when we use either the indicator of the perceived tone or the effective one. Since the inflation rate and inflation expectations where at the top or above the ceiling of the target range during the period, this empirical evidence suggest that monetary policy 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, a less linguistically complex communication reinforces the negative effect of the tone over the inflation expectations of firms. This result contributes empirical evidence that suggests that central bank communication not only has an impact on the expectations of non-professional forecasters, but also that efforts by central banks to make monetary policy communication more accessible to the general public may be worth.

The rest of the paper is organized as follows. The next section revises related literature. Section 3 describes and show the results of computing the tone indicators. Section 4 describes and compute the readability indicators. Section 5 describes the empirical strategy, 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. However, before 1990 the opposite extreme was prevalent. As central banks moved from an extreme to the other, the academic literature rapidly contributes new theoretical and empirical results. Blinder et al. (2008) provides a detailed compilation of the literature, both theoretical and empirical, on monetary policy communication. Our article contributes with new empirical evidence on the impact of monetary policy communication and inflation expectations.

Our article is related to the literature that develops sentiment indicators from monetary policy statements, in particular on their expansive or contractionary 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 use pre-established dictionaries. For example, Picault and Renault (2017) manually builds a phrase dictionary for European Central Bank's monetary policy communications. Following this methodology, Vega and Lahura (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. Differently from previous work, our indicator is not based on text analysis techniques nor on pre-established dictionaries. To build the tone indicator, we survey a large sample of professionals and advanced students in Economics. They were were asked to rank randomly assigned actual passages of monetary policy communications on a "contractive", "neutral" or "expansive" scale. Hence, our tone indicator is informative about the tone that is perceived by the readers of monetary policy communications. This indicator complements traditional ones that generally account for the effective tone of the 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 Cruijsen et al. 2010). Blinder (2007) provides evidence supporting that Americans are not able to identify with precision recent inflationary events. Coibion et al. (2019) show that entrepreneurs in New Zealand lack of knowledge about the inflation rate. Additionally, we argue that the differences between the indicator of perceived tone contributed in this paper and that of the effective tone (contributed by Mello and Ponce 2020) could also be explained by the linguistic complexity of monetary policy communications. This argument may be particularly important when analyzing the impact 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 tone of monetary policy communication has been used to measure its impact. For instance, Hansen and McMahon (2016) study the impact of central bank communication on macroeconomic variables, and Picault and Renault (2017) on capital markets. We analyze the impact of monetary policy communication on inflation expectations. Similarly, Vega and Lahura (2020) do the same for the cases of Colombia, Chile y Peru. However, they focus on the impact on inflation expectations of professional analysts and we focus on inflation expectations of firms, a group that may be considered non-professional in terms of inflation forecasting and that is closer to the general public.

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

Haldane et al. (2020) provide empirical evidence that suggests that non-professional forecasters, e.g. 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 better communicate with the general public is to try to build public understanding as a means of establishing trust and credibility about central banks and their policies. In turn, trust helps manage expectations. They also claim that there is few empirical evidence that monetary policy communication have had any impact on expectations and behaviour of the general public. We contribute to fill 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 the tone of monetary policy communication on the inflation expectations of non-professional forecasters.

3 Tone indicators

In this paper we propose an indicator of the tone of monetary policy communication that accounts for the perception of readers. Tone indicators generally used in this kind of research are generated by text analysis techniques and pre-established dictionaries through a more or less mechanical process. Because of the methodology that is apply, these indicators account for the effective tone of the communications; there is not perception of a receiver of the message involved but a more or less mechanic assignation of tone to words or phrases in a communication. Differently from these indicators of effective tone, the indicator of perceived tone does not focus on the contain 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 data (please see below). In turn, these differences may be important when identifying their impact on 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 fact 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 as we do.

If agents were totally rational, there should be no 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). Also, the environment as well as the set of prior information available to an agent can

affect the interpretation of the communications (Babcock and Loewenstein 1997).

The indicator of perceived tone is constructed from the responses to an online survey. The survey is 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 apply to monetary policy statements. In general, previous work classify the text at the discretion of the researcher, use text analysis techniques or rely on a dictionary of terms to classify the tone of the texts mechanically.

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 according to the tone perceived by the reader in the following categories: 'contractive', 'expansive' or 'neutral' (a fourth category of 'does not apply' is also available). For the entire period under analysis, a total of 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 variation rate and the rate of unemployment.[2]

The survey was implemented through a computerized system that allows a person to answer the number of questions they want, go out and continue answering later. For each respondent, the questions are ordered randomly. The survey was distributed in two batches in a three-month period, between September and November 2020. In the first batch, it was only distributed on the BCU's internal network. In the second round, the survey was distributed to BCU members and also to advanced Economics students. In both cases, participation was voluntary. In total, 49 people participated, with an aggregate number of 1,310 responses. Figure 1 shows the number of responses obtained by monetary policy communication. It varies between a minimum of 10 responses and a maximum of 60.

Figure 2 shows the standard deviation of responses per release. 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, in general the variance remains limited. This fact indicates certain agreement of opinions regarding the tone of a 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 *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 for the statement c and $Neutral_c$

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

Figure 1: Number of answers

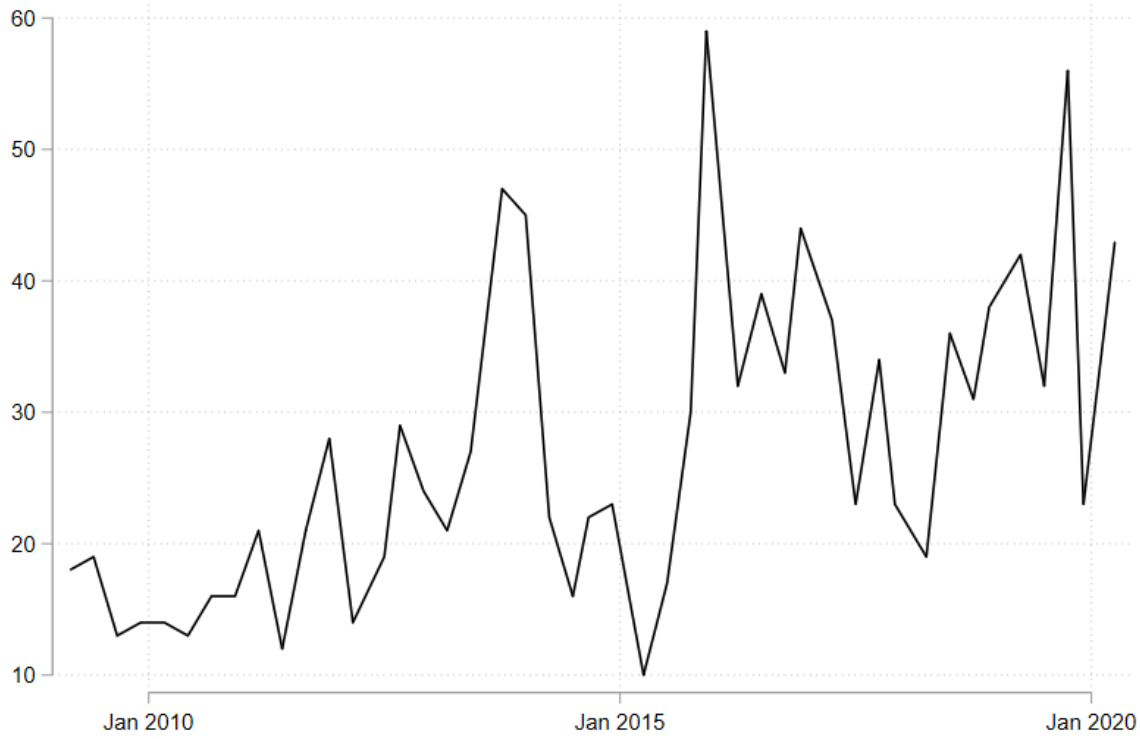


Figure 2: Standard deviation of the answers

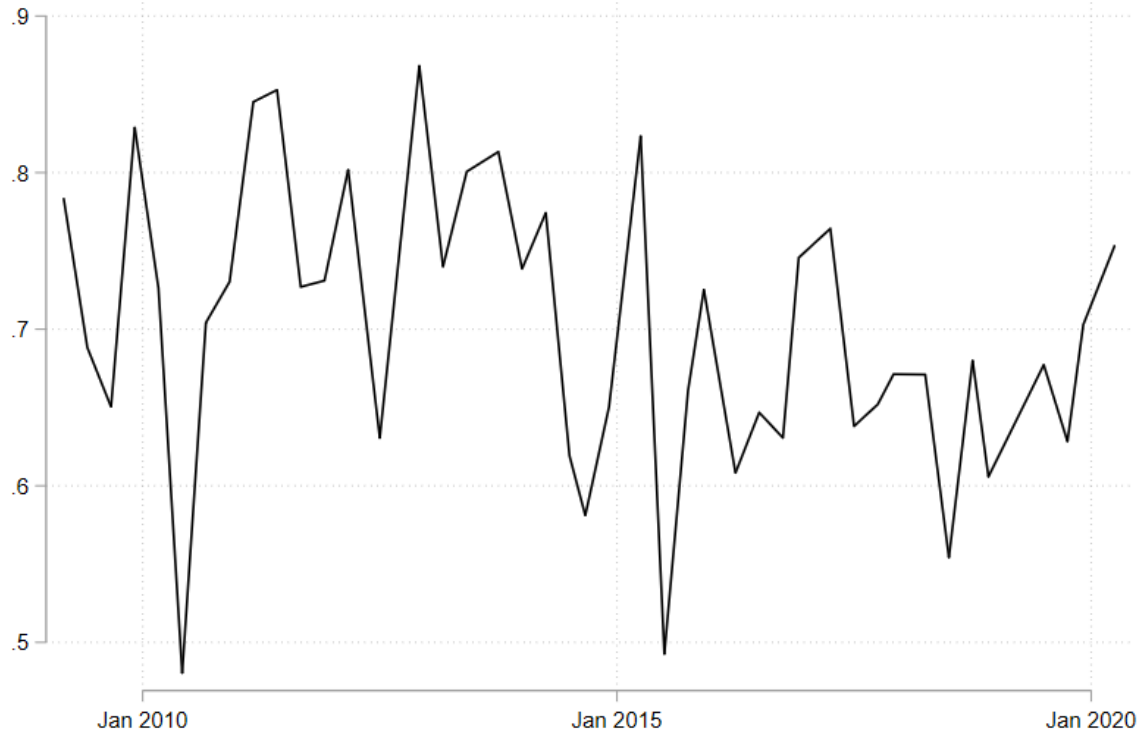
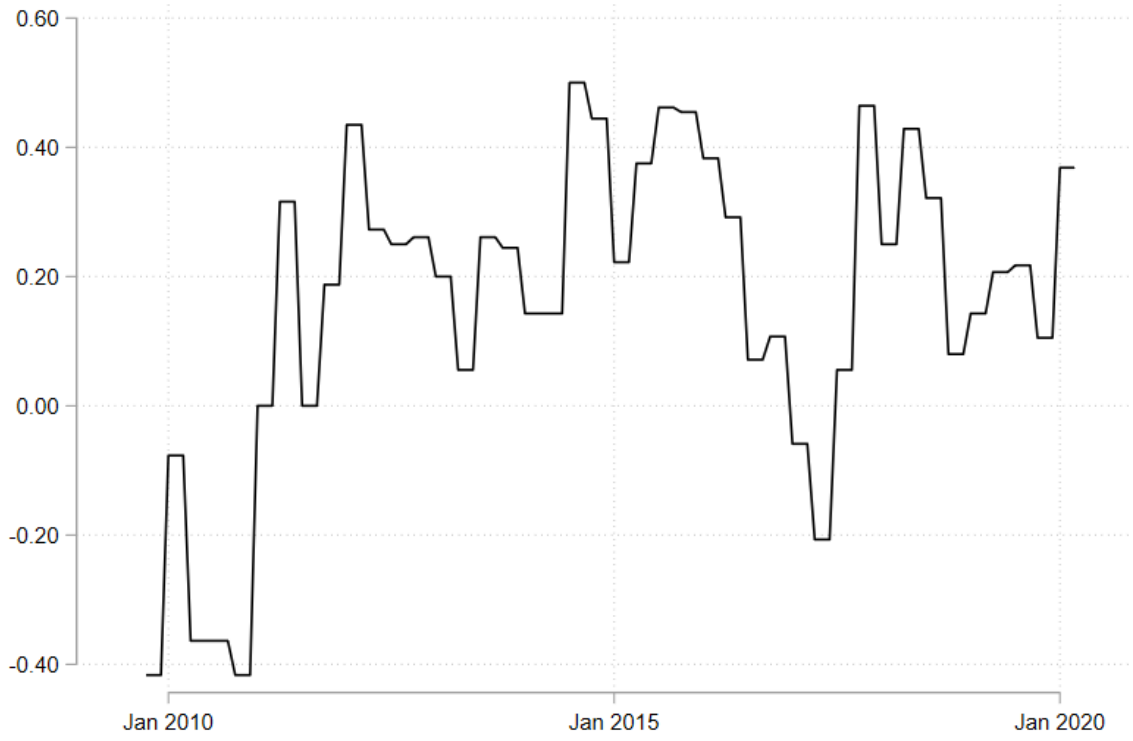


Figure 3: Perceived tone of monetary policy communication



the total number of sentences considered neutral, then the tone of the statement is calculated as follows:

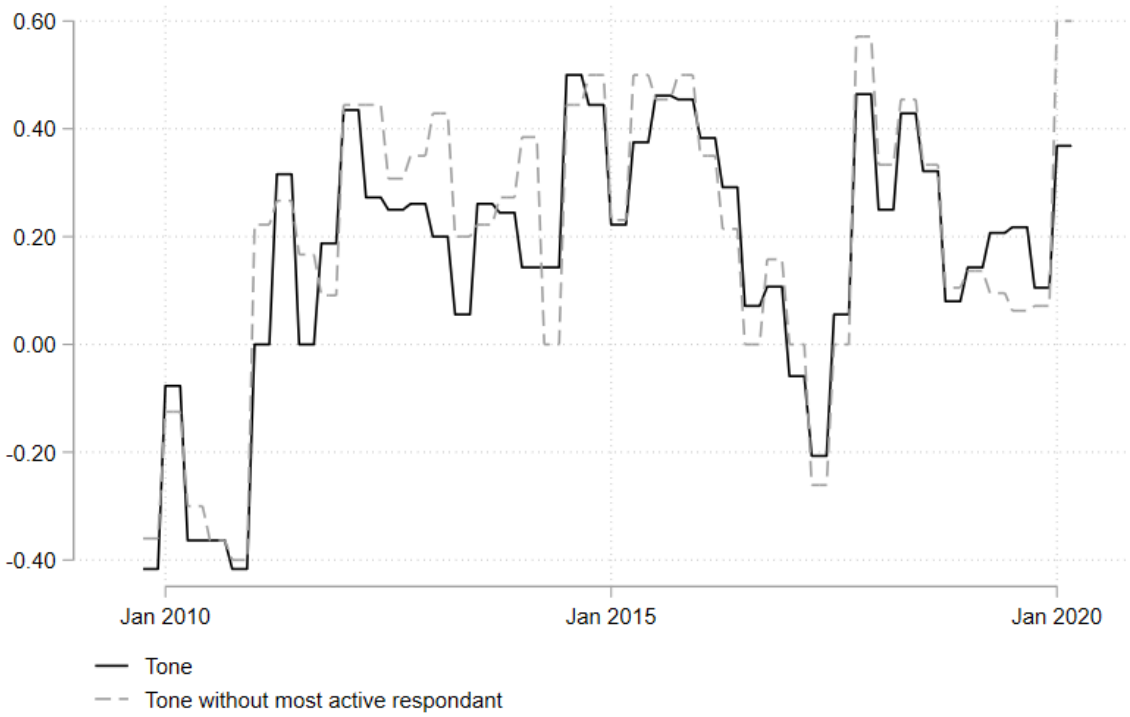
$$Tone_c = \frac{Contractive_c - Expansive_c}{Contractive_c + Expansive_c + Neutral_c}. \quad (1)$$

The tone indicator ranges from -1 for a fully expansive tone of a statement to 1 for a statement with a strongly contractive tone. As the releases have a quarterly frequency, the monthly series is obtained by repeating the values in the corresponding quarter for which the communications is the last released. Figure 3 shows the indicator of the tone resulting from the survey. As can be seen, it is 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 1,310 responses received, the most active user responded 31 %. The remaining users responded in a more uniform way, as can be seen in the figure 11 in the 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. Figure 4 shows the recalculated tone indicator without the responses of the most active user and compares it with the one presented in Figure 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 be-

Figure 4: Tone without most active respondant



havior 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 Figure 5, there are differences between the two indicators. Some of these differences could be explained by an important element in monetary policy communication: the readability of their statements. According to Haldane et al. (2020), the evidence suggest 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.

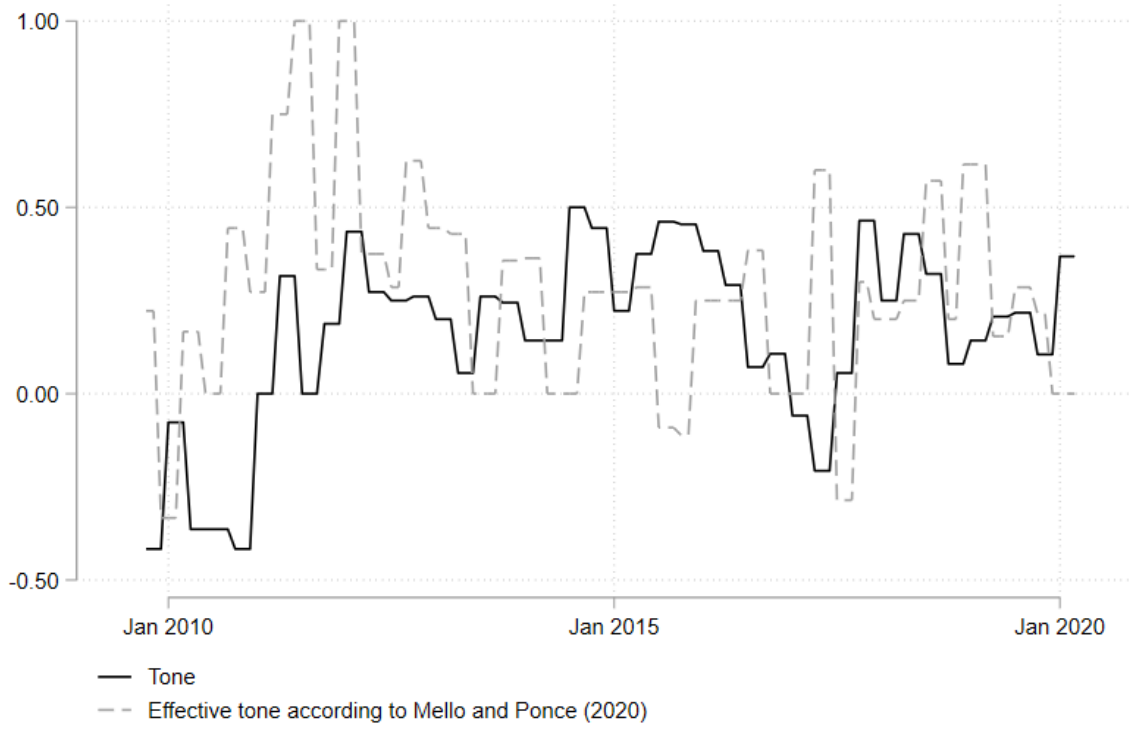
4 Readability indicators

One of the precursors of the readability studies of a text is Flesch (1949), who propose 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 main drawback for the

[3]The methodology followed by Mello and Ponce (2020) consists of 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. Since the tone indicator thus constructed varies between -2 and 2, and in order 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.

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

Figure 5: Comparison between tone indicators



application of this methodology to monetary policy communication of the Central Bank of Uruguay is that it was designed for the English language, so that its application to texts in Spanish is not direct. There are, however, 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) propose the following indicator, that is based on the formula developed by Flesch (1949), to establish the reading facility coefficient of a text in Spanish:

$$Readability = 206,84 - 0,60 \times P - 1,02 \times F, \tag{2}$$

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.

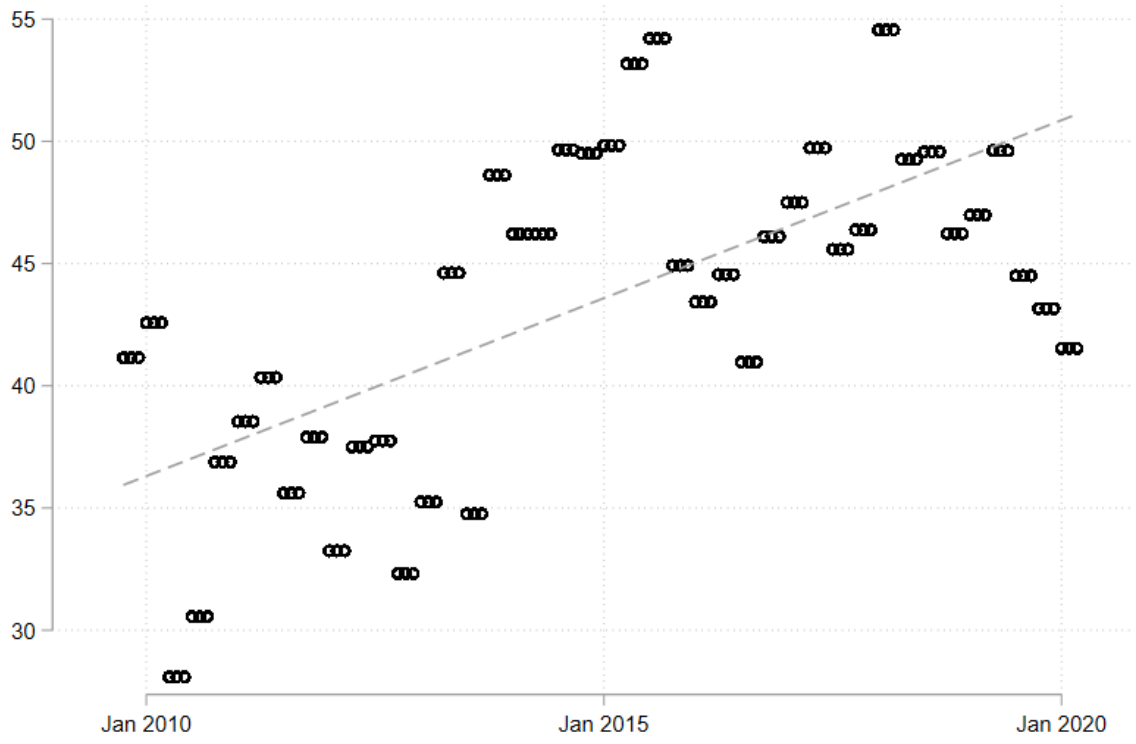
[5]To deepen the information on these formulas please refer to Appendix B.

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 u 8	Normal
70-80	6	Somewhat easy
80-90	5	Easy
90-100	4	Very easy

Figure 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 obtaining by keeping constant the values of the readability indicator for the entire quarter of validity of each statement.

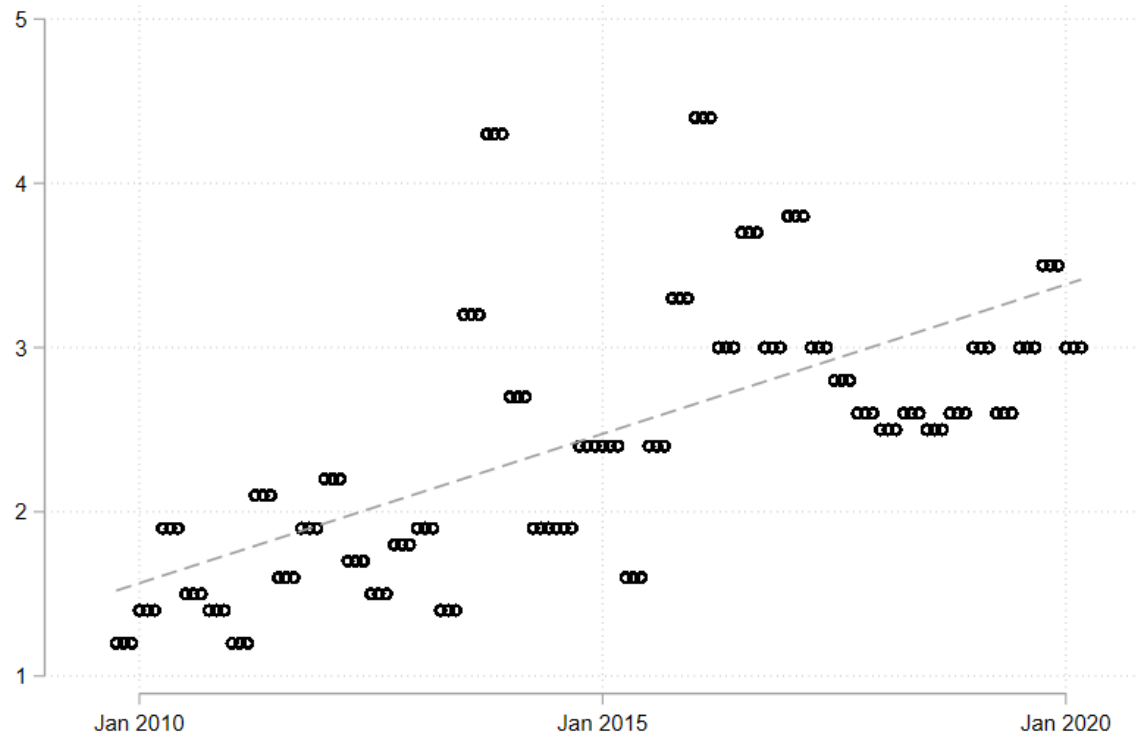
Figure 6: Readibility of monetary policy communication using Fernández-Huerta (1959)



As can be seen, the monetary policy communications of the Central Bank of Uruguay are mostly classified in the 'difficult' range to be 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 in order to see how it has been changing over time. The positive value of the slope of the linear adjustment line in Figure 6 indicates that the difficulty of reading and interpreting the monetary policy statements has been

decreasing over time. At the same time, however, the reading time of the statements increased significantly, as can be shown in Figure 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.

Figure 7: Reading time

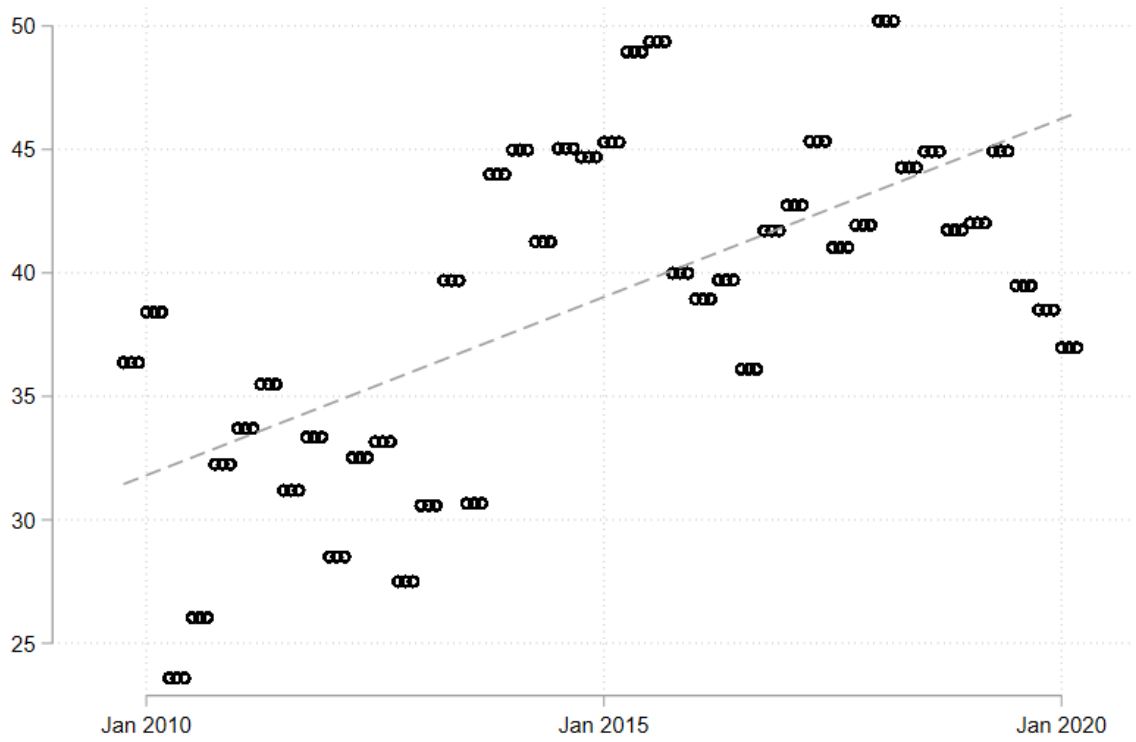


In any case, although the reading difficulty has been decreasing, in the best of cases the texts are considered as 'somewhat difficult' to understand and require at least high school level for their correct interpretation. At the same time, the length and reading time of the statements has also increased through time.

Pazos (1993) develops an indicator that focus on the perspicuity of the text. That is, in terms of its clarity and transparency. The perspicuity indicator of Pazos (1993) complements that of Fernández-Huerta (1959) and 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 Figure 8 we show the results of the application of the perspicuity index to the monetary policy statements of the Central Bank of Uruguay.

As the readability indicator presented in Figure 6 shows a trend towards easier readability in the most recent releases, the perspicuity indicator in Figure 8 shows a trend towards greater clarity and transparency. However, from the point of view of the difficulty of understanding, it is observed that the perspicuity values are slightly lower than those of readability, which suggests that the communications could still be clearer and

Figure 8: Perspicuity of monetary policy communication using Pazos (1993)



more transparent (see Table 2).

Table 2: Descriptive statistics

Indicator	*Min*	*Q1*	*Med (Q2)*	*Avg*	*Q3*	*Max*
Readibility	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

In the robustness analysis of the econometric results in the next section, we incorporate a third indicator of the ease of readingness of the monetary policy statements. It was developed by Cantalejo et al. (2008). Details of this indicator are presented in Appendix B. The qualitative results of its application are not different from those found with the two indicators presented in this section.

5 Tone, readability and inflation expectations

In this section we assess the impact of the tone and readability of monetary policy communication on 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 sample of firms that is representative of the universe of the Uruguayan private companies with more than 10 employees. The survey, however, does not cover the agricultural and the 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 different 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 ($t = H$).[6] 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 dataset 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 times (64 months).

Table 3 presents the descriptive statistics for our interest variables. Particularly, inflation expectations for the monetary policy horizon are in average 8,95% during the analyzed period. This is nearlly 2 percentage points above the ceilling of the inflation target range, as it can be appreciated in Figure 9.

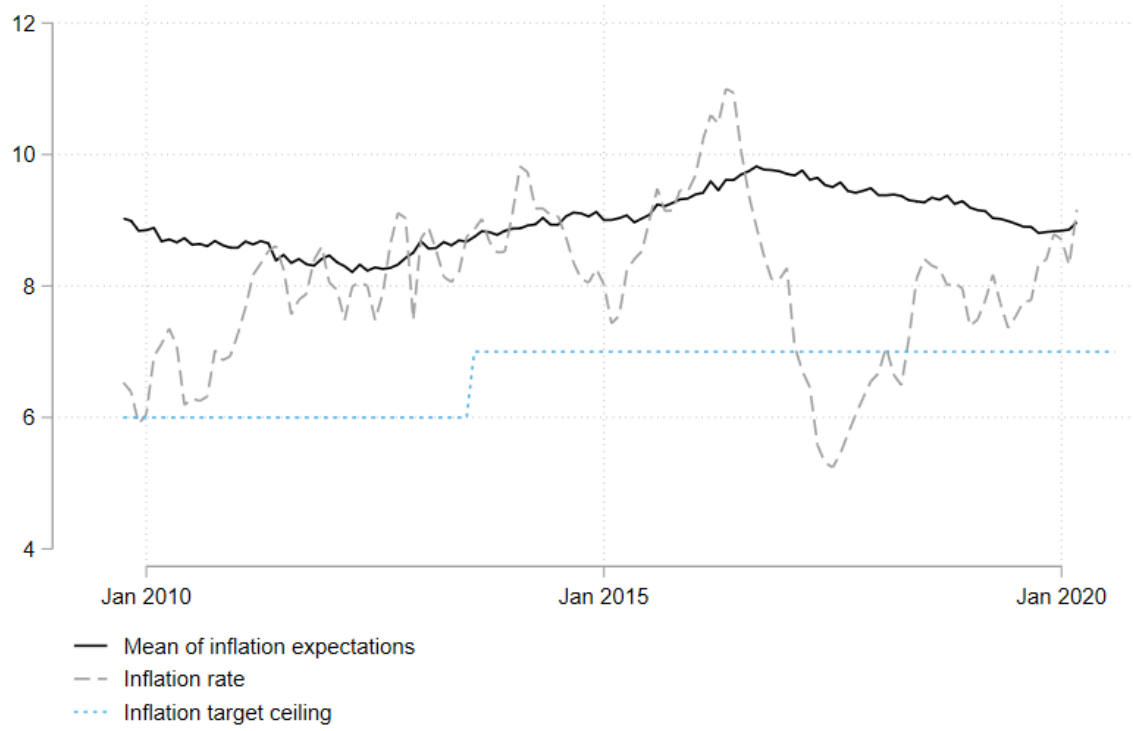
Table 3: Descriptive statistics

Variable	*Obs.*	*Mean*	*Std.Dev.*	*Min*	*Max*
Inflation expectations	46.580	8,95	2,057	5	25
Inflation	46.552	8,01	1,16	5,24	11
Short-term interest rate	46.552	9,76	2,60	6,25	15,66
Tone	46.580	0,15	0,25	-0,42	0,50
Tone without most active	46.580	-0,18	0,27	-0,60	0,40
Effective tone	46.580	0,28	0,29	-0,33	1
Readability	46.580	42,80	6,62	28,09	54,56
Perspicuity	46.580	38,24	6,69	23,59	50,20

Inflation expectations may be affected by the current inflation rate, then we use this

[6] Qualitative results remain robust to considering different horizons.

Figure 9: Inflation rate and inflation expectations



variable as a control in the empirical analysis of the next section. The monthly inflation rate, computed as the variation of the Consumer Price Index, is published by the Instituto Nacional de Estadísticas the third business day of the following month.[7] As it can be seen in Figure 9, the rate of inflation has been most of the time above the ceiling of the inflation targeting range. On average, inflation rate was 8% (see Table 3).

In an inflation targeting regime, 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 as 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 them. In order 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).[8]

[7] See http://www.ine.gub.uy/indicadores?indicadorCategoryId=11421.

[8] ITLUP is the curve of returns of assets denominated in local currency, e.g. Pesos Uruguayos, in the local market. See https://web.bevsa.com.uy/CurvasVectorPrecios/CurvasIndices/ITLUP.aspx.

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

5.2 Empirical strategy

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

$$E_{it}\left(\pi_H\right) = \alpha_i + \beta_1 E_{it-1}\left(\pi_H\right) + \beta_2 \pi_{t-1} + \beta_3 i_t^{st} + \beta_4 Tone_t + \beta_5 Tone_t \times Read_t + \varepsilon_{it}, \quad (3)$$

were $E_{it}\left(\pi_H\right)$ is the inflation expectation of firm i at time t for the monetary policy time horizon. 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. In order 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). $Tone_t \times Read_t$ accounts for the combined effect of tone and readability. Since a less-linguistically-complex monetary policy communication should enhance the impact of the tone inveded in that communication, we expect to find a negative and statistically significant coefficient β_5. In the main regression model we use readability indicator computed in Section 4 by following the methodology by Fernández-Huerta (1959). Robustness analysis using the perspicuity indicators proposed by Pazos (1993) and Cantalejo et al. (2008) confirms the qualitative results (see Section 5.4). Results for the model propose in Equation 3 appear in column M3 in Table 4. Columns M1 and M2 present results for a benchmark model excluding the readability and perspicuity indicators.

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. In all models, we include an autoregressive term. We also incorporate time effects with a 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, specially the inflation rate and inflation expectations.

We introduce a series of control variables. These controls account for the diminishing rate of response to the IES through time, which affects the composition of inflation forecasters answering to 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 taking the value of one since July 2013.

Our regression models face endogeneity problems. In particular, monetary policy variables, the short-term interest rate and the tone indicators of monetary policy communication are endogenous to inflation expectations. To solve these problems, we follow Arellano and Bond's methodology, which takes the lags of the endogenous variables as instruments. We also introduce as instruments the 12-month average change of expected costs and the expected inflation rate by firms.

5.3 Main results

Table 4 shows the main results of the econometric analysis. As benchmark, the model M1 only introduces the variable of the perceived tone of monetary policy communication calculated in Section 3. The coefficient of the variable *Tone* has the expected negative sign and is statistically significant at 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 (which have been above the ceiling of the target range during the period under analysis). The model M2 considers the effective tone variable calculated by Mello and Ponce (2020). The estimated coefficient is similar in level to that calculated in the M1 model, indicating the robustness of the previous result. In both models, the short-term interest rate is negative and statistically significant: a contractionary monetary instance is related to a decrease in inflation expectations as expected.

Model M3 includes the combined effect of tone and readability, measured according to the indicator proposed by Fernández-Huerta (1959). This model responds to the Equation 3. The combined coefficient of perceived tone and readability is negative and statistically significant at the 10% level. This result indicates that an easier-to-read monetary policy communication contributes marginally to improving the impact of the tone of the statement on firms' inflation expectations.

Table 4: Main results

	M1	M2	M3	M4
Expectations $(t-1)$	0,109 **	0,103 **	0,110 ***	0,102 **
	(0,031)	(0,031)	(0,031)	(0,031)
Inflation $(t-1)$	0,321 ***	0,338 ***	0,321 ***	0,335 ***
	(0,012)	(0,013)	(0,012)	(0,013)
Short-term interest rate	-0,379 ***	-0,293 ***	-0,379 ***	-0,297 ***
	(0,028)	(0,026)	(0,029)	(0,027)
Tone	-0,166 ***		-0,166 ***	
	(0,018)		(0,018)	
Effective tone		-0,142 ***		-0,144 ***
		(0,010)		(0,010)
Tone × Readability			-0,001 *	
			(0,012)	
Effective tone × Readability				-0,024 **
				(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	0,512	0,324	0,471
Hansen OverId-p	0,742	0,746	0,728	0,756
Anual fixed effects	Yes	Yes	Yes	Yes
Monthly 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

Model M4 replaces the perceived tone indicator with the effective tone indicator computed by Mello and Ponce (2020). The interaction of the latter with the readibility indicator has a negative and significant coefficient at 5% level. The size of the coefficient, as well as its statistical significance, is higher than that on the M3 model, suggesting that a more accessible readability reinforces the impact of the effective tone to a greater extent than it does with the perceived tone.

Furthermore, it can be observed that the summed coefficients of the effective tone (0.144) and readibility (0.024) are close to the coefficient of the perceived tone in Model M1: $0.166 \acute{s} 0.144 + 0.024 = 0.168$. One possible interpretation is that the impact of the perceived tone on firms' inflation expectations could be decomposed into the effect of the effective tone and the communication's ability to convey this tone to the general

public, which depends on the readability of the document. This interpretation relies on the fact that by construction the indicator of the perceived tone of monetary policy communication implicitly considers its readability because the classification is carried out 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 Tone

As can be seen in Figure 11 in Appendix A, one person contributes more than 30% of the responses. To check the robustness of the results, the tone indicator was recalculated excluding the responses of this person in order to estimate Equation 3.

Model M5 in Table 7 of the Appendix C shows the results when considering only the indicator of the recalculated. When comparing with its equivalent with all the responses, the M1 model, it can be seen that the coefficients maintain the sign and the order of magnitude. Likewise, the joint interaction between the recalculated tone and the readability variable in the M6 model is compared against its equivalent for the original tone indicators that corresponds to the M3 model. It can be seen that all the qualitative results are remain robust. The coefficient for the effect of the joint interaction increases with respect to the original model, although it does so in a minimal way.

5.4.2 Perspicuity

Other robustness checks were performed by substituting indicators of readability for indicators of 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).

6 Final remarks

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

First, we construct a new indicator of the *perceived tone* of monetary policy communication through a survey to professionals in Economics. Respondent where randomly assigned with passages that appeared in monetary policy communication and asked to classify their tone. The survey collects a total of 1.310 responses that covers all the texts of the monetary policy communications during the period under analysis (from October 2009 to March 2020). The indicator of the perceived tones is computed as the simple average of the answers. It complements traditional indicators of the *effective tone* of monetary policy communication like, for instance, that produced by Mello and Ponce (2020) for the same sample.

Second, we compute indicators on the readability and perspicuity of monetary policy communication. Since we work with inflation expectations by firms, which are non-profesional forecasters closer to the general public, these indicators are useful in filling a gap: there is a large body of academic evidence that indicates that central bank communication plays a crucial role; howver, there is far less evidence that monetary policy communication have had any impact on expectations and behavior of the general public (Haldane and McMahon 2018). Central banks have often not made their main communications accessible to a sufficiently wide audience because their linguistic complexity would make them inaccessible to 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 an impact on firms' inflation expectations. We find that readability has improved through time, but there is still room for further improvements on the perspicuity of the messages.

Third, we use micro data on inflation expectations by firms 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 relationship is robust to a series of controls and robustness checks. Moreover, the size of the coefficients is similar when we use either the indicator of the perceived tone or the effective one. Since the inflation rate and inflation expectations where at the top or above the ceiling of the target range during the period, this empirical evidence suggest that monetary policy 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, a less linguistically complex communication reinforces the negative effect of the tone over the inflation expectations of firms. This result contributes empirical evidence that suggests that central bank communication not only has an impact on the expectations of non-professional forecasters, but also that efforts by central banks to make monetary policy communication more accessible to the general public may be worth.

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Appendix

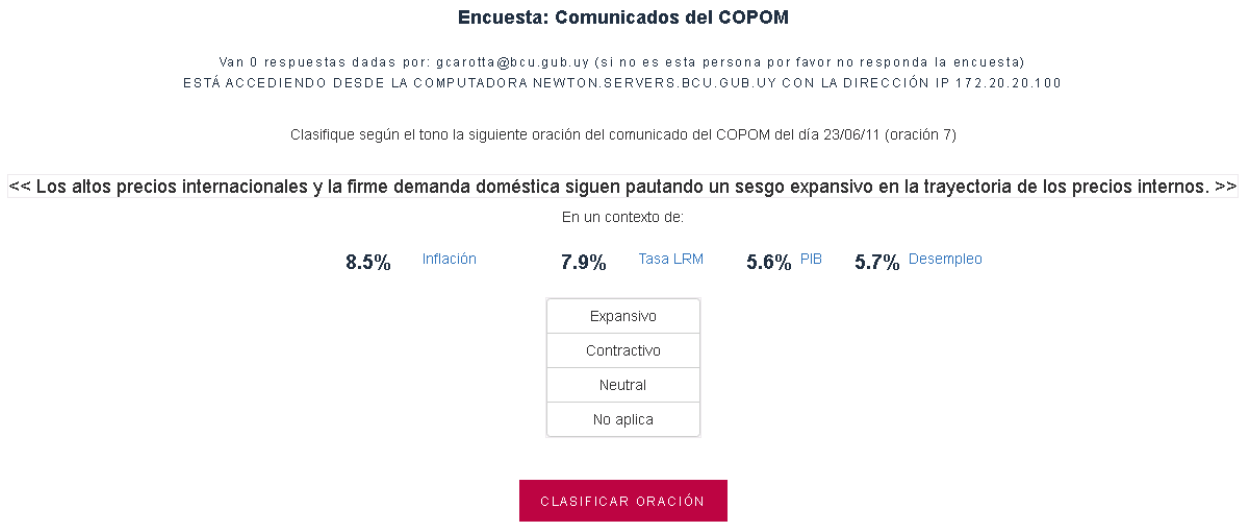
A The survey to construct the perceived tone indicator

For the construction of the computer program that supports the survey, the monetary policy statements were transferred to tables of a relational database in a header and lines structure. The header is basically the date of the statement and the lines represent the sentences of the same, ordered numerically and with a unique identifier for the entire period, which will then be the identifier of the question.

To choose the question that was presented to the user, who is identified by his e-mail address, an ordered list was formulated with the questions that that user had not yet answered and a number was randomly drawn between 1 and the total number of elements on that list. Then, the question was the one that corresponded to that location within the ordered list. Once the question was answered, the sentence was marked among the answers already given by that user so as not to be taken into account in the search for the next question to offer.

Therefore, to participate in the survey, it was mandatory to enter an email address with a valid format (to make the random draw for questions not answered by the user), but it was not mandatory to identify with a name or surname and also to convey confidence you assured the user that their responses would be kept anonymous and at no time would their e-mail address or personal information be published. The link with the invitation to participate in the survey was sent by e-mail and with an introduction explaining the reasons for carrying it out and thanking the time they could take to complete it.

Figure 10: The survey's screen



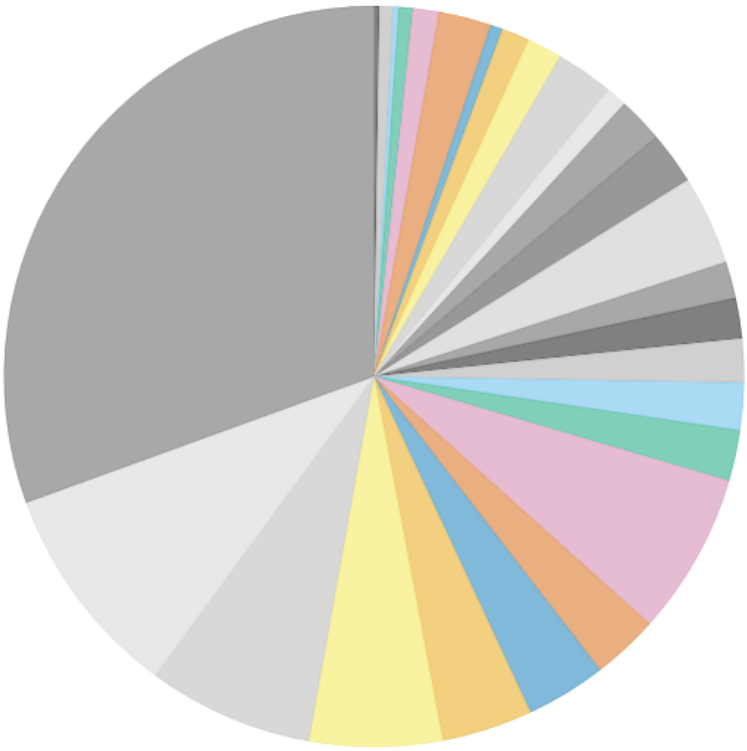
When entering to the survey, the software presents the sentence and the user could classify it as *Contractive*, *Expansive*, *Neutral* or if they considered that the sentence was

Not applicable. Additionally, with each sentence was presented information about the economic context at the time the statement was published: the inflation rate in the last twelve months, the monetary policy interest rate, the variation in GDP and the unemployment rate. Figure 10 shows a screenshot of the survey screen.

The survey was issued in two batches in a three-month period, between September and November 2020. In the first batch, it was only published on the BCU's internal network. In the second round, the survey was distributed to BCU member and also to advanced Economics students. For its part, the survey could be answered over the internet from any location.

Figure 11 shows the relative participation of those who answered the survey. The most active user answered 400 questions, which implies a participation share of 31%. In any case, when the tone indicator was calculated excluding this person, no significant differences were found with the tone indicator calculated with all the responses. The robustness tests carried out also indicate that the qualitative results remain robust when the most active user is excluded.

Figure 11: Participation per respondant



B Readability and perspicuity indicators

Pazos (1993) proposes two indicators of perspicuity, one based on texts of no more than 100 words and the other valid for any length of text. The first version (for a maximum of 100 words) responds to the following formula:

$$Perspicuity = 207 - 0,623 \times S - P, \tag{4}$$

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 from Flesch (1949) for the application of its formula to Spanish, which is 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	Somewhat easy	Novels
76-85	11	Easy	News
86-100	6 a 10	Very easy	Comics

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

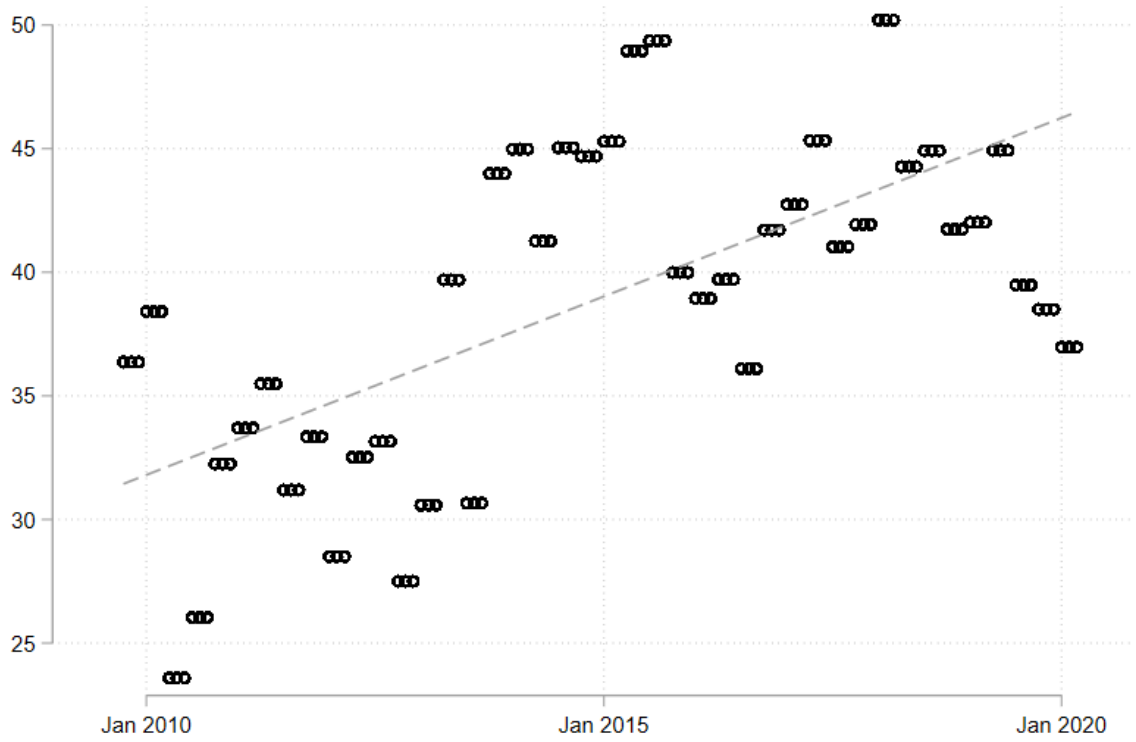
$$Perspicuity = 206,835 - 62,3 \left(\frac{S}{P} - \frac{P}{F} \right), \tag{6}$$

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 the latter had been developed with a small, non-random sample. The scale proposed for the interpretation of the results is found in Table 6. Figure 12 shows that the results of applying this indicator are similar to those found by applying the Pazos (1993) indicator (see Figure 8).

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

Figure 12: Perspicuity of monetary policy communication using Cantalejo et al. (2008)



C Robustness

Table 7: Tone without the most active respondent

	M1	M3	M5	M6
Expectations $(t-1)$	0,109 **	0,110 ***	0,108 **	0,108 ***
	(0,031)	(0,031)	(0,031)	(0,031)
Inflation $(t-1)$	0,321 ***	0,321 ***	0,312 ***	0,310 ***
	(0,012)	(0,012)	(0,012)	(0,012)
Short-term interest rate	-0,379 ***	-0,379 ***	-0,374 ***	-0,370 ***
	(0,028)	(0,029)	(0,028)	(0,027)
Tone	-0,166 ***	-0,166 ***		
	(0,018)	(0,018)		
Tone × Readability		-0,001 *		
		(0,012)		
Tone without most active			-0,180 ***	
			(0,018)	
Tone w/o most act. × Readability				-0,024 *
				(0,012)
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	0,324	0,426	0,440
Hansen OverId-p	0,742	0,728	0,741	0,766
Annual fixed effects	Yes	Yes	Yes	Yes
Monthly fixed effects	Yes	Yes	Yes	Yes

Notes: Endogenous variables: Short-term interest rate, Tone and Tone without the most active respondent and 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

Table 8: Perspicuity

	M7	M8	M9	M10
Expectations $(t-1)$	0,110 **	0,110 **	0,102 **	0,102 **
	(0,031)	(0,031)	(0,031)	(0,031)
Inflation $(t-1)$	0,321 ***	0,321 ***	0,335 ***	0,335 ***
	(0,012)	(0,012)	(0,013)	(0,013)
Short-term interest rate	-0,379 ***	-0,379 ***	-0,297 ***	-0,296 ***
	(0,029)	(0,029)	(0,029)	(0,028)
Tone	-0,165 ***	-0,165 ***		
	(0,018)	(0,018)		
Tone × Pazos (1993)	-0,003 *			
	(0,012)			
Tone × Cantalejo et al. (2008)		-0,003 *		
		(0,012)		
Effective tone			-0,144 **	-0,144 ***
			(0,010)	(0,010)
Eff. tone × Pazos (1993)			-0,025 **	
			(0,009)	
Eff. tone × Cantalejo et al. (2008)				-0,025 **
				(0,010)
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	0,325	0,325	0,471	0,470
Hansen OverId-p	0,728	0,728	0,756	0,757
Annual fixed effects	Yes	Yes	Yes	Yes
Monthly fixed effects	Yes	Yes	Yes	Yes

Notes: Endogenous variables: Short-term interest rate, Tone, Effective tone, Perspicuity. 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