

News of disinflation and firms' expectations: new causal evidence*

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Abstract

We study how firms' inflation and other economic expectations respond to news of disinflation using a randomized control trial (RCT) experiment where a sub-sample of firms receive information on changes in the monetary policy framework intended to lower inflation. Treated firms lower their inflation and cost expectations when receiving the information. The evidence suggests that the causal effects are persistent. However, it comes at the cost of temporarily lower growth expectations.

JEL Codes: C23, E52, E58.

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1 Introduction

Expectations about future inflation are a first-order driver of inflation dynamics in broad classes of forward-looking macroeconomic models. Nevertheless, empirical evidence on the factors behind the formation of inflationary expectations is limited to relatively recent literature. Most of these studies rely on randomized control trial (RCT) exercises for causal identification. Due to data availability, they are generally restricted to countries with fixed monetary policy frameworks and consolidated monetary regimes with low and stable inflation rates. Examples are [Coibion *et al.* \(2018\)](#) for New Zealand, [Coibion *et al.* \(2020c\)](#) for Italy, and [Hunziker *et al.* \(2018\)](#) for Switzerland.

As a consequence, the empirical evidence is silent about how inflation expectations respond to news of policies aimed at permanently lowering inflation. Importantly, this is a fundamental question for central bankers trying to lower inflation without an unnecessarily large recession because their size depends crucially on the response of expectations to news of permanent disinflation, which varies markedly across macroeconomic models (see, for instance, [Taylor, 1982](#); [Buiter and Miller, 1983](#); [Fischer, 1986](#); [Ball, 1994a](#)).

Existing empirical evidence studying episodes of disinflation can help distinguish between these models ([Sargent, 1982](#); [Easterly, 1996](#); [Ball, 1994b](#); [Hazell *et al.*, 2020](#)). Even so, these studies rely on observational data which makes it impossible to establish a causal relationship between the news of disinflation and expectations. This task would require external variation in the news of disinflation to credibly identify the effect of the news. A randomized control trial (RCT) experiment would generate such random variation.

In this paper, we carry out an RCT experiment that randomly assigns an informational treatment to firms and allows us to causally quantify the effect of the news on inflation and other economic expectations. The treatment consists of information about a comprehensive reform in the monetary policy framework, which is a major difference from previous studies. The reform consisted of a change in monetary policy instrument and a change in the inflation target band which became lower and narrower. In addition, the reform includes several improvements in terms of communication and the information provided by the central bank to the general public. The intention behind the reform is to bring down inflation significantly in the coming years and reduce the reliance of the local economy on foreign currency.

Our experiment circumvents two major obstacles that have not permitted a study like this one before. The first is that events of comprehensive reforms in monetary policy frameworks intended to lower inflation are very rare in the recent period.

The second is that an RCT requires collecting information on expectations in real-time. Very few countries systematically collect information on firms' expectations, Uruguay being one the few exceptions. We use the Uruguayan firm inflation expectations survey (IES) to carry out the RCT. The survey is conducted monthly since 2009 to a sample of firms, which is representative of the universe of private firms in Uruguay with at least 50 employees. It is one of the few systematic and quantitative surveys of firms' macroeconomic expectations (Candia *et al.*, 2021). The survey has fixed and rotating modules, with an open module in June that the central bank uses for research purposes.

To carry out the RCT, we randomly split the sample of the IES into a treatment group that receives a piece of information on the reform and a control group.¹ For the treatment group, the survey began with a short paragraph consisting of a summary of a published article informing about the new monetary policy framework and the policy makers' forecast of inflation for the coming years. We also include a quote from the president of the central bank stating that lower inflation will make it easier for locals to trust the local currency and a link is provided for additional information.

The RCT is based on the assumption that at least some of the information provided is not known to firms. If this assumption did not hold and firms knew the whole content of the information provided, we would expect results to be null. As a consequence, we would be unable to determine whether the reason for null results is that the treatment is not credible or that expectations already include that information. An extensive literature documents that firms are not aware of all information, even if it is part of the public domain (Andrade and Le Bihan, 2013). In our setting, Borraz and Mello (2020a) document that many firms are unaware of the inflation target and also the inflation rate using the same survey we use in this paper. In spite of concerns about whether firms already know the information provided to them, our results show that expectations do respond to the treatment in ways that cannot be explained by being previously informed. This is comforting, as it clears doubts about the appropriateness of our assumption.

We find that treated firms lower their inflation expectations by about half a percentage point at both the 12 and 24-month horizons. While the magnitude of the effect varies with time, the effect seems to persist until the end of our sample. In addition to that, treated firms also anticipate lower growth. Unlike inflation expectations which fell for both the 12 and 24-month horizons, treated firms anticipate temporarily slower growth only for the current year.

¹We are extremely grateful to the colleagues at the Instituto Nacional de Estadísticas for making the samples and conduction the survey.

In addition, we also study how the results vary depending on how attentive firms are to monetary policy. To proxy for attentiveness, we ask firms whether they had read the newsletter on monetary policy which had been distributed three months before the treatment, i.e. in March 2021. The results suggest that attentive firms are generally more responsive to the treatment. Unfortunately, given that the sample of attentive firms is small, we are often unable to reject differences between attentive firms and the rest.

The remainder of this paper is structured as follows. Section 2 discusses the relevant literature and our contribution. Section 3 explains the reform in the Uruguayan monetary policy framework, further background about inflation in Uruguay, and a brief discussion of the monetary policy measures taking place around the period of the experiment. Next, section 4 describes our empirical approach in detail. Section 5 shows the effects of treatment. Finally, section 6 discusses our interpretation of the results and offers concluding comments.

2 Related Literature

This paper is motivated by rich literature studying how the acquisition of information and the formation of expectations affect the economy. The seminal paper by [Mankiw and Reis \(2002\)](#) introduces the notion of information stickiness in the form of friction in the acquisition of information. Information stickiness has important implications for macroeconomic phenomena, for example, generating costly disinflations and hump-shaped impulse responses to monetary policy shock. [Reis \(2006a,b\)](#) studies consumers' and producers' incentive to acquire costly information, which endogenously generates inattention and sluggish dissemination of information.

Empirical work is also rich and active on this topic. [Carroll \(2003\)](#) presents a model in which households probabilistically acquire information from rational agents and tests whether the model can match household inflation expectations. [Coibion and Gorodnichenko \(2015\)](#) propose a test for whether expectations are formed under full-information rational expectations. The paper finds expectations underreact to information, consistent with models of sticky information. Similarly, [Andrade and Le Bihan \(2013\)](#) show that professional forecasters in the Eurozone do not systematically update their forecasts following new information and disagree even when they do.

Furthermore, the use of randomized control trials (RCTs) has significantly contributed to our understanding of how information is incorporated into expectations. For example, [Coibion *et al.* \(2019\)](#), [Haldane and McMahon \(2018\)](#) and [Binder and Rodrigue \(2018\)](#) use RCTs to analyze the effect of communication about inflation

on households expectations.

While there is a widespread view that firm expectations should be particularly important for inflation dynamics, information on firm expectations is particularly scarce (Bernanke, 2007; Candia *et al.*, 2021; Coibion *et al.*, 2020b). For firms, Coibion *et al.* (2018), Coibion *et al.* (2020c) and Hunziker *et al.* (2018) carry out experiments in New Zealand, Italy and Switzerland, respectively. The former paper studies the extent to which firms update their beliefs when presented with new information, while the latter one tracks effects on firm decisions.

A limitation of this literature is that it takes place in countries with stable inflation and consolidated inflation targeting regimes. By contrast, this paper studies the effect of information about long-run inflation and a comprehensive review of the monetary policy framework. Episodes such as these are very rare and a rigorous study based on an RCT requires having a running survey collecting information on firm inflation expectations. The number of countries with such surveys is extremely limited (see Candia *et al.*, 2021; Coibion *et al.*, 2020b). To the best of our knowledge, Coibion *et al.* (2020a) is the only paper studying a change in the monetary policy framework.

Furthermore, the overall inflation environment in Uruguay is markedly different from those of previous papers. Inflation had been consistently above 20% in the 1990s and has been around 8% in the last 10 years. As a consequence, firms are more informed about inflation relative to countries such as Italy and New Zealand (see Borraz and Zacheo, 2018). In addition, inflation expectations are anchored consistently above the inflation target. As a consequence, the results of our experiment are more likely to be informative about the possible effect of communication in a typical developing country than in the previous literature.

The question of how expectations adjust information about disinflation is key to understanding the cost of said episodes of disinflation. In theory, immediate disinflations can be costless if agents are forward-looking (Buiter and Miller, 1983), or can even be expansionary if disinflation is credible (Ball, 1994a).

While empirical evidence can help us distinguish between these models, it is impossible to determine causal drivers of inflation expectations without an exogenous source of information. This paper contributes to fill that gap.

3 Setting

The starting point of this paper is a significant reform in a monetary policy framework that includes a change in the policy instrument, from monetary aggregates to the short interest rate, and a change in the inflation target band to one

that is narrower and lower. In addition, the central bank revised its strategy for communication and information sharing with the public. Further details on each of these elements are presented below.

The policy instrument was changed from monetary aggregates to the short-term interest rate starting in September 2020. This was the second time the central bank changed the monetary policy instrument in the last decade, which had been the short-term rate since the adoption of the inflation targeting regime until mid-2013. The main motivation behind the change in the instrument is the greater transparency of the interest rate. As a policy tool, the interest rate is more efficient and easier to observe, although the transmission channels are essentially the same.

A reduction in the inflation target range was announced which would change from its current value of [3-7] to [3-6] in September 2022.² At face value, this looks like a relatively minor change. However, as Figure 1 shows, inflation expectations have been consistently above the upper bound of the target. Inflation has also been above the target for most of the last 15 years despite being relatively stable. Bringing inflation within the target range alone therefore requires lowering inflation significantly. Like the change in the instrument, the target range had been changed in 2013, broadening from [4-6] to [3-7].

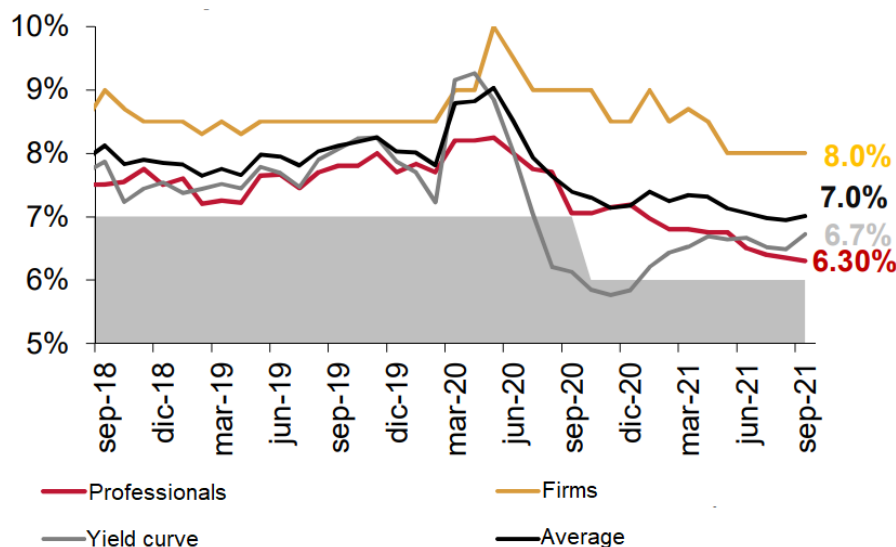


Figure 1: 24 Months Inflation Expectations

An important aspect of the reform is the improvement of the communication of the monetary policy. The frequency of meetings of the Monetary Policy Committee was doubled from four annual meetings to eight. Minutes of the Committee meetings started to be published in April 2020. These minutes highlight the assessments

²See <https://www.gub.uy/presidencia/comunicacion/noticias/uruguay-modificara-rango-meta-inflacion-segundo-semester-2022>

supporting decisions of the Committee and individual members and information about the policy recommendations of technical staff. These actions are intended to increase transparency and build credibility. Technical quarterly monetary policy reports started to include detailed descriptions of the projection models used to inform policymakers in addition to their projection results. Technical boxes were introduced to explain the methodology and assumptions supporting the analysis.

While the transparency and communication efforts mentioned in the previous paragraph are mainly directed to professionals and markets, a substantial effort was made to open communication channels with the more general public. A newsletter using simple language to communicate macroeconomic trends and monetary policy objectives and decisions started to be published in March 2021.³ The first newsletter was also distributed to commercial chambers and unions in an attempt to reach firms and affect their inflation expectations. We ask respondents whether they have read the newsletter as part of the survey to evaluate differences between firms that already have some prior information.

The main objective of the reform is to bring down inflation significantly in the country. While Uruguay has a history of high inflation, inflation has hovered around 10% in the last 10-15 years. Figure 1 shows that inflation and inflation expectations have been consistently above the upper bound of the inflation target band in this period. However, inflation expectations seem anchored below 10%.

The reform in the monetary policy framework is taken in parallel with additional measures to encourage the use of local currency and decrease the reliance on the local economy in US dollars. Dollarization is a phenomenon that is extremely widespread. About 75% of deposits in the banking sector are denominated in US dollars, 90% of exports and 65% of imports are invoiced in US dollars (Boz *et al.*, 2020), and even dollar invoicing of domestic transactions is frequent (Licandro and Mello, 2019). Licandro and Mello (2016) document that a common practice in Uruguay is to express large sums of money in US dollars, a phenomenon they call cultural dollarization.

De-dollarization is an important aspect of the reform agenda given that reliance on the dollar weakens the transmission of monetary policy to the local economy. As a consequence, policymakers in Uruguay will often argue that monetary policy will be more robust once a regime with lower inflation has been achieved.

³See <https://www.bcu.gub.uy/Politica-Economica-y-Mercados/Paginas/La-inflacion-y-sus-expectativas.aspx>.

4 Empirical Approach

We conduct a randomized control trial (RCT) which assigns an informational treatment to a random sub-sample of firms in the Uruguayan inflation expectations survey (IES) conducted to firms. The informational treatment consists of a small paragraph at the beginning of the survey which tells firms that policymakers forecast inflation will fall significantly in the coming years and that this forecast is based on improvements in monetary policy. We also include a quote from the president of the central bank saying low inflation is important for citizens to trust their currency.

The experimental design requires that the information provided is not known to firms. If it were, we would not expect to see any differences between groups. More importantly, we would be unable to determine the cause of null results, which may arise either because the information provided is not credible to firms or because the information is already incorporated into firms' expectations.

There is growing empirical evidence that firms make their forecasts based on incomplete information, in particular about monetary policy. [Coibion *et al.* \(2018\)](#) find that firms with larger incentives to track and process inflation information are more attentive to inflation information. In a context of moderate inflation like Uruguay, we would expect firms to be more attentive to inflation. [Candia *et al.* \(2021\)](#) find that firms' expectations in Uruguay respond to even transitory changes in inflation, which they argue is an indication that firms pay attention to inflation information. Even so, [Borraz and Mello \(2020a\)](#) document that while about 60% of firms in Uruguay are informed about the inflation rate, the share of firms informed about the inflation target is roughly one third.

In addition, our results do show responses in expectations. Moreover, the results are consistent with the previous literature studying inflation expectations with RCTs. This raises the doubt that the treatment does not contain any new information.

4.1 Data Description

Uruguay is one of the few countries that routinely survey firms' inflation and cost expectations. The survey is commanded by the central bank and carried out by the Instituto Nacional de Estadísticas (INE), the national statistics office. The survey is sent to 500 firms every month with an average response ratio of 64%.

The survey is representative of the universe of the Uruguayan private companies with at least 50 employees, being one of the few systematic and quantitative surveys of firms' macroeconomic expectations ([Candia *et al.*, 2021](#)). The survey, however, does not cover the agricultural and financial sectors. Table 1 from [Borraz and Mello](#)

Sector	Sample	Population
Manufacturing	41.48	46.60
Trade and commerce	29.99	23.06
Services	18.40	14.96
Health	4.47	11.61
Primary activities	2.36	1.06
Education	1.99	1.73
Utilities	0.58	0.74
Source: Borraz and Mello (2020b)		

Table 1: Firms’ distribution by sectors - sample and population in percentage

(2020a) shows that the survey is broadly representative of the Uruguayan economy.

The IES began in October 2009 and continues towards the present. In this project, we use the data from October 2020, when the sample was refreshed, to December 2021. The treatment takes place in June 2021. The resulting data set is an unbalanced long panel with a total of 15 months and 3,973 observations. During the sample period, 333 firms completed the survey at least once, while 256 of the firms answered the questionnaire more than 66% of the time (10 months).

The IES surveys firms’ inflation and cost expectations every month. In addition, there are rotating modules that survey the frequency of price and cost changes, and access to financing among other variables. Finally, there is an open module in June, in which we introduced questions about expectations on GDP growth, firms’ investment, and exchange rate forecasts.

The IES is a vital input to the BCU assessment of inflation expectations, which in turn is used to inform monetary policy in the country. That makes this data source extremely unique since a different survey prepared specifically for an experiment such as this one would not have this feature.

4.2 Pretreatment Characteristics

This section shows statistical tests to evaluate the process of randomization. The INE, which carries out the survey, assigned the treatment randomly. While this minimizes the risk that the treatment was unbalanced, we still test for systematic differences between treatment and control groups. More precisely, we estimate the following regression equation by OLS:

$$Y_i = \alpha + \beta T_i + \varepsilon_i, \quad (1)$$

where Y_i is a variable of interest and T_i is a dummy variable that takes the value one if firm i is in the treatment group and zero otherwise. We estimate this equation for

a broad array of firm characteristics previous to the treatment, i.e. for the month of May 2021. Under successful randomization, we would expect β to be zero.

The results of the regression are presented in Table 2. The table shows that the null hypothesis is not rejected for any of the variables at conventional levels. Overall, the results are consistent with successful randomization.

Variable	Estimated β
Lag 12-Mo. Inflation Expectations	-0.022 (0.213)
Lag 24-Mo. Inflation Expectations	-0.008 (0.196)
Read Newsletter	0.042 (0.054)
Small Firm	-0.031 (0.055)
Medium Firm	0.015 (0.062)
Services	0.023 (0.059)
Manufacturing	-0.074 (0.050)
Obs	259
* p<0.10, ** p<0.05, ***p<0.01	

Table 2: Pretreatment Characteristics

4.3 Treatment Description

The experiment was carried out in the June 2021 wave of the inflation expectations survey (IES). Firms were randomly assigned into a treatment and a control group. For the treatment group, the survey began with the following paragraph:

Inflation in the 12 months to April was 6.76%. In 2020 inflation had been 9.41%. Authorities forecast a gradual decline toward 3.7% in 2024 as a result of the monetary policy measures adopted. The president of the Central Bank of Uruguay stated that "with inflation at 3% or 4%, it will be easier for the Uruguayan to trust their currency." For more information, you can consult this link:

<https://www.gub.uy/ministerio-economia-finanzas/comunicacion/noticias/rango-meta-inflacion-sera-3-6-ciento-2022-se-preve-37-ciento-para-2024>

For the control group, the survey began with the following text:

Inflation in the 12 months to April was 6.76%. In 2020 inflation had been 9.41%.

We can see that the treatment consists of several parts. The first is information about inflation, which is shared by both treatment and control groups. As a consequence, differences in responses capture the effect of the rest of the paragraph. The next sentence claims authorities forecast inflation to decline significantly. The paragraph also tells firms that the forecast is based on monetary policy measures. We chose this over a technical explanation of the link between monetary policy and inflation to avoid making the treatment overly long and complicated. The next sentence gives the respondents a quote by the president of the central bank saying that lower inflation will increase confidence in the local currency. This sentence is easy to understand for Uruguayans, as they are familiar with the pervasiveness of dollarization and probably find the benefits of a more reliable currency intuitive. Last, there is a link to an article which is an extended version of the paragraph included in the treatment. We are able to check whether respondents click on the link, but unfortunately, too few respondents click to draw any meaningful conclusions (see Appendix C for details about the sequence of information).

It is evident that the treatment is a complicated object with many parts. Ideally, we would have multiple treatment arms and we would add each element sequentially to isolate the effect of each part. However, because of the small sample size, around 280 respondents each month, this was infeasible.

The text for the control group also contains some information that may not be known to firms and their expectations may reflect this information. In previous experiments, similar treatments have been shown to affect firm expectations (Coibion *et al.*, 2020c). Even so, we designed the experiment this way so that we could isolate the effect of the information on disinflation, which required comparing inflation at the time with the forecast of future inflation. In addition, we find that the distribution of expectations becomes less dispersed in the control group in June. The reduction in dispersion is a common result in this literature and may reflect information incompleteness, although we lack a proper baseline that identifies this causal effect.

5 Results

5.1 Effect on Inflation Expectations

This section estimates the treatment effect on firms' inflation expectations for the next 12 and 24 months. Visual evidence of the treatment effect is available in Appendix A. The graphs show that the distribution of 12-month inflation expectations moves to the left for the treatment and control group in June, but the shift is larger for the treated group. At the 24-month horizon, the distribution of non-treated firms becomes more concentrated around the same center, while the mode of the distribution of the treated firms moves to the left.

Given that the preliminary evidence looking at the distributions of inflation expectations indicates some reduction in inflation expectations, we proceed to statistically test whether the treatment effect is different from zero. In order to do that, we estimate the following regression model:

$$E_{it}[\pi_{i,t+h}] = \alpha + \beta T_i D_t + \gamma_t + \lambda_i + \varepsilon_{it}, \quad (2)$$

where $E_{it}[\pi_{i,t+h}]$ is firm i 's inflation expectation between periods t and $t+h$, α is a constant, γ_t and λ_i are time and firm fixed effects, T_i is a dummy indicating the firm was treated and D_t is a dummy variable taking the value one for the month of the treatment, i.e. June 2021, and after. The parameter of interest is β in Equation 2, which is a difference-in-difference estimator of the treatment effect. Given that our experimental framework assigns the treatment exogenously, the treatment effect can be estimated by ordinary least squares. In addition, we cluster standard errors by firm given concerns that errors may be serially correlated.

The results are shown in Table 3. The treatment is successful in reducing inflation expectations, which fall by about half a percentage point at both horizons on average after the treatment.

	12-Month Inflation Expectations	24-Month Inflation Expectations
β	-0.566*** (0.094)	-0.544*** (0.103)
Obs	3754	3754
R ²	0.621	0.588
Num. Firms	293	293

* p<0.10, ** p<0.05, ***p<0.01.

Standard errors clustered by firm.

Table 3: Treatment Effect on Inflation Expectations

Next, we are interested in seeing how the effect of treatment evolves with time, in particular, whether it is persistent or short-lived. In order to do that, we estimate the following regression equation:

$$E_{it}[\pi_{i,t+h}] = \alpha + \beta T_i D_t + \beta^{Jul} T_i D_t^{Jul} + \beta^{Aug} T_i D_t^{Aug} + \gamma_t + \lambda_i + \varepsilon_{it}, \quad (3)$$

where D_t^{Jul} and D_t^{Aug} are dummies indicating the observation on and after July and August, respectively. The parameters β^{Jul} and β^{Aug} , therefore, measure the incremental impact of the treatment after one and two months respectively.

The results for Equation 3 are displayed in Table 4. The table shows the effect on impact is smaller for measures of inflation expectations than in the pooled estimate. For the 12-month inflation expectations, about three-fifths of the effect is reversed in July, but differences between the treatment and control group broaden again in August. For the 24-month inflation expectations, we see that differences in inflation expectations are widening as time goes by.

	12-Month Inflation Expectations	24-Month Inflation Expectations
β	-0.490*** (0.128)	-0.376*** (0.132)
β^{Jul}	0.290** (0.138)	-0.154 (0.125)
β^{Aug}	-0.517*** (0.125)	-0.310** (0.155)
Obs	3754	3754
R ²	0.623	0.589
Num. Firms	293	293

* p<0.10, ** p<0.05, ***p<0.01.

Standard errors clustered by firm.

Table 4: Dynamics Treatment Effect on Inflation Expectations: Incremental Impact

To have another look at the persistence of the effect of the treatment on inflation expectations we estimate the following regression equations:

$$E_{it}[\pi_{i,t+h}] = \alpha + \beta^M T_i D_t^M + \gamma_t + \lambda_i + \varepsilon_{it}, \quad (4)$$

where D_t^M is a dummy variable equal to one for observation on and after month M . For instance, for $M = June$, then $D_t^M = D_t$ in Equation 2. Table 5 shows the results of estimating Equation 4 for each month between June 2021, the month in which the treatment takes place, and December 2021, the end of our sample. These

results add evidence to the persistence of the effects of the treatment. Inflation expectations of treated firms are significantly lower than those of the control group after the treatment and up to the end of the sample in December 2021.

Estimated β^M for $M =$	12-Month Inflation Expectations	24-Month Inflation Expectations
June	-0.566*** (0.094)	-0.544*** (0.103)
July	-0.506*** (0.093)	-0.520*** (0.112)
August	-0.590*** (0.096)	-0.565*** (0.116)
September	-0.689*** (0.089)	-0.597*** (0.101)
October	-0.843*** (0.091)	-0.703*** (0.100)
November	-0.709*** (0.091)	-0.590*** (0.102)
December	-0.644*** (0.101)	-0.496*** (0.110)
Obs	3754	3754
Num. Firms	293	293

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Standard errors clustered by firm.

Table 5: Dynamics Treatment Effect on Inflation Expectations: Persistence

The previous estimates of treatment effects are based on the assumption of parallel trends. Differences in inflation expectations between the treated and control group that predate the month of treatment would imply a failure of randomization and invalidate our empirical approach while still generating statistically significant estimates. While this possibility is unlikely in an experimental setting, we can carry out placebo tests to verify that differences in inflation expectations arise after June, the month of treatment. The placebo tests consist of estimating Equation 4 for months before the treatment. The results in Table 11 in the Appendix B show that the treatment only appears significant after June 2021, the month of treatment.

5.2 Heterogeneous Effects

One key dimension of heterogeneity between firms is whether they pay attention to monetary policy events. The fact that some firms are more attentive to monetary policy is likely to reflect the usefulness of this information for firms, so the fact that some firms pay more attention to monetary policy is very likely to be endogenous.

We proxy for firm attentiveness to monetary policy by asking firms whether they had read the BCU newsletter which had been distributed in April. The newsletter is a piece of communication about a monetary policy designed specifically for firms. For that reason, firms reading the newsletter are likely to be better informed about monetary policy, in addition to being more attentive to it.

A priori, it is not clear whether firms that read the newsletter should react more or less strongly than inattentive firms. For example, attentive firms may already be aware of the information provided to them, in which case we would expect no effect. On the other hand, firms may be attentive to information on monetary policy because it is easier for them to process the information, in which case attentive firms may respond more strongly to the treatment.

To estimate whether the treatment affects attentive and inattentive firms differently, we estimate the following equation:

$$E_{it}[\pi_{i,t+h}] = \alpha + \beta^{NL} T_i NL_i D_t + \gamma_t + \lambda_i + \varepsilon_{it}, \quad (5)$$

where NL_i is a dummy indicating the firm read the newsletter. The parameter β^{NL} estimates whether attentive firms are more sensitive to the treatment than non-attentive firms. We also estimate the following equation to assess the incremental impact of having reading the newsletter:

$$E_{it}[\pi_{i,t+h}] = \alpha + \beta T_i D_t + \beta^{NL} T_i NL_i D_t + \gamma_t + \lambda_i + \varepsilon_{it}. \quad (6)$$

The results are in Table 6. The table shows that firms reading the newsletter are more sensitive to the treatment, in particular for the 12-Month horizon: -0.645 versus -0.566 in the baseline model. However, the difference is not large enough to be statistically significant. Moreover, the incremental effect of having read the newsletter is not statistically significant in the results from estimating Equation 6 (see columns (2) and (4) in Table 6).

	12-Month Inflation Expectations		24-Month Inflation Expectations	
	(1)	(2)	(3)	(4)
β		-0.508*** (0.105)		-0.512*** (0.115)
β^{NL}	-0.645*** (0.164)	-0.248 (0.183)	-0.539*** (0.199)	-0.138 (0.219)
Obs	3754	3754	3754	3754
R ²	0.616	0.622	0.584	0.589
Num. Firms	293	293	293	293

* p<0.10, ** p<0.05, ***p<0.01.

Standard errors clustered by firm.

Table 6: Heterogeneous Treatment Effect on Inflation Expectations

5.3 Other Variables of Interest

We have single cross-sections for the remaining variables of interest other than inflation expectations. Therefore, we estimate the effect of treatment by estimating the following equation by OLS:

$$X_i = \alpha + \beta T_i + \varepsilon_i, \quad (7)$$

where X_i is each variable of interest.

The results are shown in Table 7. We can see that firms that receive the treatment adjust their growth forecast both for the current and the following year. The point estimate is sizable and is consistent with models of costly disinflation. The response to the question on plans to expand delivers a similar conclusion: the point estimate is surprisingly large although we cannot reject the null of zero with 95% confidence.

	2021 Growth Forecast	2022 Growth Forecast	Plans to Expand	ER 2021	ER 2022	Last Price Change (Months)	No Price Change
β	-0.621** (0.272)	-0.261 (0.251)	-0.107* (0.056)	0.551 (0.606)	0.899 (0.610)	0.357 (0.364)	0.036 (0.035)
Obs	279	279	279	279	279	279	279
R2_W	0.018	0.018	0.014	0.002	0.007	0.004	0.001

* p<0.10, ** p<0.05, ***p<0.01. Huber-Eicker-White standard errors.

Table 7: Effect of Treatment on Other Variables

Table 7 indicates that the treatment has no effect on expectations about the exchange rate although a considerable part of the treatment message involves foreign

currency and the effect on other variables which should, at least in theory, affect the exchange rate. Not only is the point estimate small, but the confidence intervals indicate modest fluctuations in the exchange rate, at best. Last, the confidence intervals on the questions on price changes are too large to find statistically significant effects.

5.4 Cost Inflation Expectations

In addition to inflation expectations, the IES asks firms about how changes in their costs in the next 12 and 24 months. While this is not a measure of price inflation per se, firms have a strong incentive to be informed about cost changes that are more directly linked to their profits. Moreover, the correlation between cost and price inflation expectations is about 50% in our data, indicating both measures have common factors but are not quite the same. This section, therefore, explores whether the treatment has any effect on expected costs for the firms.

Table 8 shows the results when we estimate Equation 2 with the expected change in costs as the left-hand-side variable. The table shows that the effect on 12-month cost inflation expectation is almost -0.40 percentage points. The effect is larger in magnitude for the 24-month horizon, at -0.52 percentage points.

	12-Month Cost Inflation Exp.	24-Month Cost Inflation Exp.
β	-0.384** (0.184)	-0.521*** (0.194)
Obs	3265	3754
R ²	0.697	0.661
Num. Firms	293	293

* p<0.10, ** p<0.05, ***p<0.01.

Standard errors clustered by firm.

Table 8: Treatment Effect on Cost Inflation Expectations

We also estimate the dynamic effect on cost expectations. Table 9 shows the estimates from Equation 3 with costs inflation expectations as the left-hand-side variable. Unfortunately, the estimates are no longer significant at the 5% level when we look at the incremental contribution of each month. However, the table does show the same qualitative pattern as Table 4. At the 12-month horizon, the treatment generates an initial negative effect, part of which is reversed in July, but that broadens in August. At the 24-month horizon, differences in cost inflation expectations grow across groups with time.

	12-Month Cost Inflation Exp.	24-Month Cost Inflation Exp.
β	-0.302 (0.203)	-0.368* (0.198)
β^{Jul}	0.114 (0.201)	-0.094 (0.197)
β^{Aug}	-0.323 (0.204)	-0.290 (0.218)
Obs	3265	3754
R ²	0.697	0.661
Num. Firms	293	293

* p<0.10, ** p<0.05, ***p<0.01.

Standard errors clustered by firm.

Table 9: Dynamics Treatment Effect on Cost Inflation Expectations: Incremental Impact

The persistence of the cost expectations also follows a similar pattern to inflation expectations. Table 10 shows the results of estimating Equation 4 with the firms' expected change in costs as the left-hand-side variable. Although the level of statistical significance decreases through time, the effect of the treatment on firms' cost expectations seems to persist in the month following the treatment.

Estimated β^M for $M =$	12-Month Cost Inflation Exp.	24-Month Cost Inflation Exp.
June	-0.384** (0.184)	-0.521*** (0.194)
July	-0.367** (0.184)	-0.494** (0.202)
August	-0.426** (0.196)	-0.543** (0.215)
Obs	3265	3754
Num. Firms	293	293

* p<0.10, ** p<0.05, ***p<0.01.

Standard errors clustered by firm.

Table 10: Dynamics Treatment Effect on Cost Inflation Expectations: Persistence

6 Final remarks

This paper presents a novel experiment in which a randomly selected sub-sample of firms is informed about changes in monetary policy and the intention of the central bank to reduce trend inflation significantly in the following years. Our results

show that in spite of being small, the treatment is sufficiently strong to affect inflation expectations. To the best of our knowledge, this is the first evaluation of communication of this type of policy change.

The macroeconomic theory has reached ambiguous results as to whether there is a cost in terms of output to such changes in monetary policy. Our results indicate that when provided this information, firms adjust their growth expectations in addition to those of inflation. This casts doubt on the claim that disinflation can be achieved costlessly if sufficiently gradual. In fact, the sacrifice ratio implied by our causal estimates is rather high compared to the existing literature.

Moreover, our results show that firms that are more attentive to inflation are more responsive to the treatment. These firms have lower inflation expectations and are more likely to postpone price changes as a result of treatment. However, the evidence suggests at least part of the treatment effect on these firms is temporary. We are unfortunately unable to assess whether the temporariness is a feature of the experiment itself or of the context of great uncertainty in which the experiment took place. This is a question left for future research.

Although the message with which firms were treated emphasizes the beneficial effect of disinflation on demand for domestic currency, we find that there is no effect on exchange rate expectations. Even the confidence intervals suggest modest exchange rate variation at best. This is in spite of a rich literature suggesting that monetary policy should be relevant to exchange rates.

There are a number of aspects that make our experiment novel and a series of questions that are opened by this piece of research. First, there is limited research on central bank communication in emerging markets, particularly in one characterized by relatively high inflation. Our results indicate that communication is effective even though firms have a stronger incentive to have knowledge of inflation than in advanced economies with low and stable inflation. Second, we show that the treatment lowers growth expectations in tandem with inflation expectations. This result contrasts with evidence in developed economies where firms seem to associate inflation with stagnation. Future research will need to assess whether these lower growth expectations impact firm decisions such as hiring and investment.

Finally, more research is needed to determine the persistence of treatment. In particular, an interesting question of interest is whether continuously treating firms leads to stronger and more persistent effects. Our results indicate that firms informed about monetary policy are more responsive to the treatment, although previous knowledge is endogenous. Given that these firms are more sensitive to the treatment, further assessment of the role played by heterogeneity is likely to be important for research and central bank practice in the context of rising inflation

worldwide.

References

- Andrade, P. and Le Bihan, H. (2013) Inattentive professional forecasters, *Journal of Monetary Economics*, **60**, 967–982.
- Ball, L. (1994a) Credible disinflation with staggered price-setting, *The American Economic Review*, **84**, 282–289.
- Ball, L. (1994b) What determines the sacrifice ratio?, *NBER Chapters*, pp. 155–193.
- Bernanke, B. (2007) Inflation expectations and inflation forecasting, Tech. rep., Board of Governors of the Federal Reserve System (US).
- Binder, C. and Rodrigue, A. (2018) Household informedness and long-run inflation expectations: Experimental evidence, *Southern Economic Journal*, **85**, 580–598.
- Borraz, F. and Mello, M. (2020a) Communication, information and inflation expectations, Tech. rep., Banco Central del Uruguay.
- Borraz, F. and Mello, M. (2020b) Communication, information and inflation expectations, *BIS CCA Research Network-Fourthcoming*.
- Borraz, F. and Zacheo, L. (2018) Inattention, disagreement and internal (in) consistency of inflation forecasts, *Banco Central del Uruguay Working Papers*, **7-2018**.
- Boz, E., Casas, C., Georgiadis, G., Gopinath, G., Le Mezo, H., Mehl, A. and Nguyen, T. (2020) Patterns in invoicing currency in global trade.
- Buiter, W. H. and Miller, M. H. (1983) Costs and benefits of an anti-inflationary policy: questions and issues, Tech. rep., National Bureau of Economic Research.
- Candia, B., Coibion, O. and Gorodnichenko, Y. (2021) The inflation expectations of U.S. firms: Evidence from a new survey, *NBER working paper 28836*.
- Carroll, C. D. (2003) Macroeconomic expectations of households and professional forecasters, *The Quarterly Journal of Economics*, **1**, 269–298.
- Coibion, O. and Gorodnichenko, Y. (2015) Information rigidity and the expectations formation process: A simple framework and new facts, *American Economic Review*, **105**, 2644–78.
- Coibion, O., Gorodnichenko, Y., Knotek II, E. S. and Schoenle, R. (2020a) Average inflation targeting and household expectations, Tech. rep., National Bureau of Economic Research.

- Coibion, O., Gorodnichenko, Y. and Kumar, S. (2018) How do firms form their expectations? new survey evidence, *American Economic Review*, **108**, 2671–2713.
- Coibion, O., Gorodnichenko, Y., Kumar, S. and Pedemonte, M. (2020b) Inflation expectations as a policy tool?, *Journal of International Economics*, **124**, 103297.
- Coibion, O., Gorodnichenko, Y. and Ropele, T. (2020c) Inflation expectations and firm decisions: New causal evidence, *The Quarterly Journal of Economics*, **135**, 165–219.
- Coibion, O., Gorodnichenko, Y. and Weber, M. (2019) Monetary policy communications and their effects on household inflation expectations, *National Bureau of Economic Research, Working paper*, **25482**.
- Easterly, W. (1996) When is stabilization expansionary? evidence from high inflation, *Economic policy*, **11**, 65–107.
- Fischer, S. (1986) Indexing, inflation, and economic policy, *MIT Press Books*, **1**.
- Haldane, A. and McMahon, M. (2018) Central bank communications and the general public, in *AEA papers and proceedings*, vol. 108, pp. 578–83.
- Hazell, J., Herreno, J., Nakamura, E. and Steinsson, J. (2020) The slope of the phillips curve: evidence from us states, Tech. rep., National Bureau of Economic Research.
- Hunziker, H.-U., Raggi, C., Rosenblatt-Wisch, R., Zanetti, A. *et al.* (2018) The impact of guidance, short-term dynamics and individual characteristics on firms’ long-term inflation expectations, Tech. rep., Swiss National Bank.
- Licandro, G. and Mello, M. (2016) Cultural and financial dollarization of households in uruguay, *Financial decisions of households and financial inclusion: Evidence for Latin America and the Caribbean*, p. 349.
- Licandro, G. and Mello, M. (2019) Foreign currency invoicing of domestic transactions as a hedging strategy: evidence for uruguay, *Journal of Applied Economics*, **22**, 622–634.
- Mankiw, G. and Reis, R. (2002) Sticky information versus sticky prices: a proposal to replace the new Keynesian Phillips curve, *The Quarterly Journal of Economics*, pp. 1295–1328.
- Reis, R. (2006a) Inattentive consumers, *Journal of Monetary Economics*, pp. 1761–1800.

- Reis, R. (2006b) Inattentive producers, *Review of Economic Studies*, pp. 793–821.
- Sargent, T. J. (1982) 2. *The Ends of Four Big Inflations*, University of Chicago Press.
- Taylor, J. B. (1982) Union wage settlements during a disinflation.

Appendix

A Distribution of Inflation Expectations

The following graphs show the distribution of inflation expectations at the 12 and 24-month horizons in May and June for the treatment and control groups. The graphs show that the distribution of 12-month inflation expectations moves to the left for the treatment and control group in June, but the shift is larger for the treated group. At the 24-month horizon, the distribution of non-treated firms becomes more concentrated around the same center, while the mode of the distribution of the treated firms moves to the left.

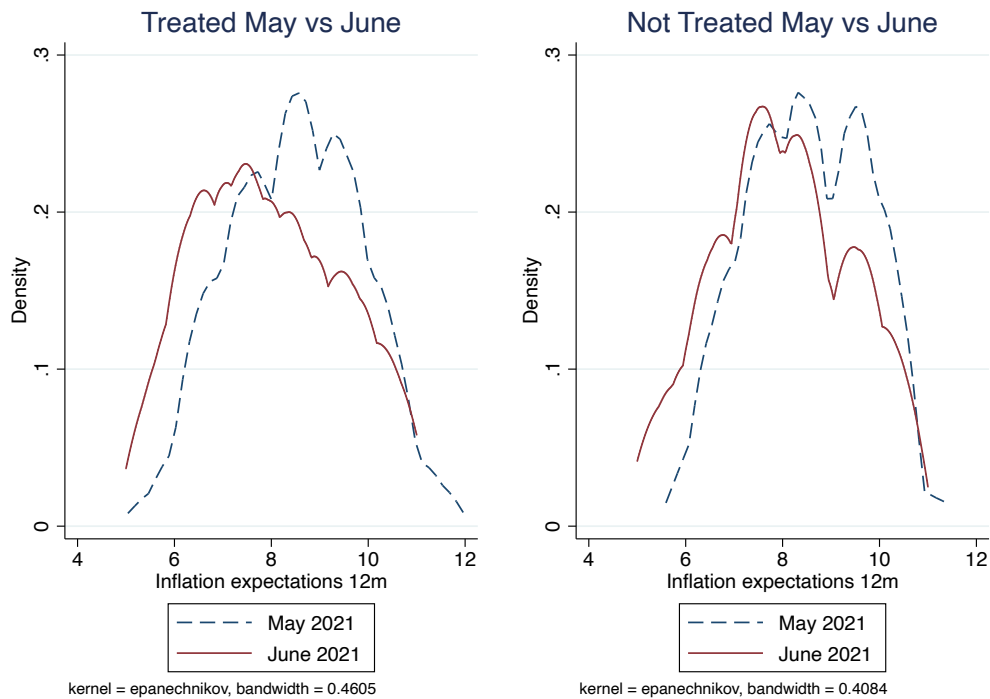


Figure 2: Distribution of 12-Month Inflation Expectations

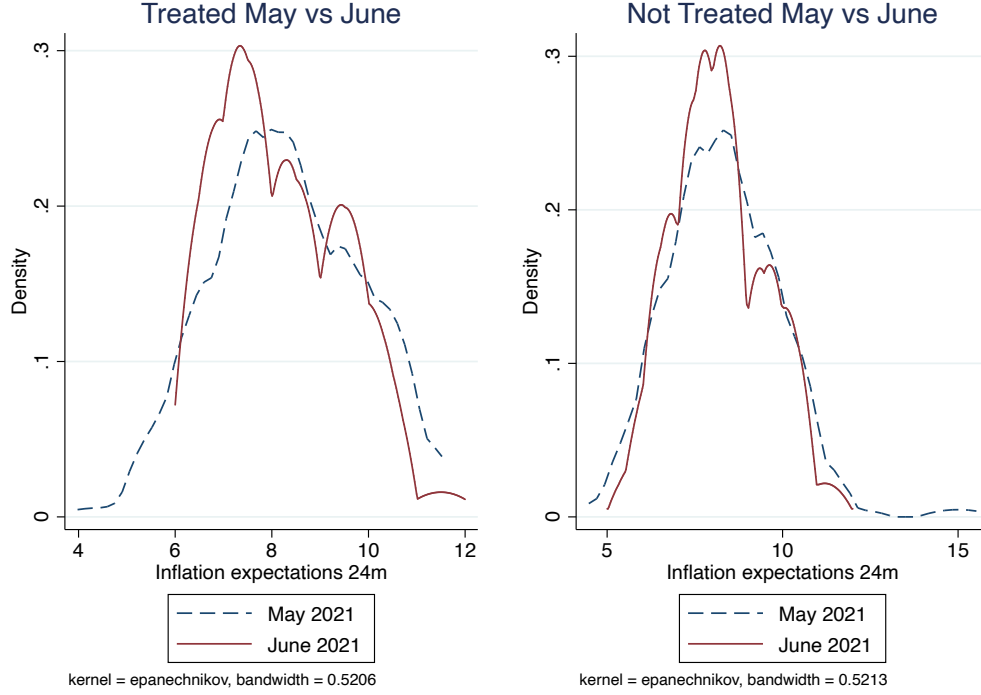


Figure 3: Distribution of 24-Month Inflation Expectations

B Inflation Expectations - Placebo

Difference-in-difference estimates of treatment effects such as the ones presented in section 5 are based on the assumption of parallel trends. Differences in inflation expectations between the treated and control group that predate the month of treatment would imply a failure of randomization and invalidate our empirical approach while still generating statistically significant estimates.

While this possibility is unlikely in an experimental setting, we can carry out placebo tests to verify that differences in inflation expectations arise after June, the month of treatment. The placebo tests consist of estimating Equation 4 for months before June 2021. If the parameter β^M was different from zero, that would be an indication that differences between the treatment and control group predate the experiment, casting doubt on our results.

Table 11 show the results of estimating Equation 4 for the three months prior to treatment: March, April, and May. For comparison, we also include the months of the treatment, i.e. June 2021. While the table shows some differences between the treated and control group before the date of the experiment, the differences are not statistically significant. In addition, the differences are small in magnitude compared to the treatment effect which is approximately -0.5 percentage points.

Estimated β^M for $M =$	12-Month Inflation Expectations	24-Month Inflation Expectations
March	0.152 (0.112)	0.079 (0.145)
April	-0.062 (0.130)	-0.032 (0.126)
May	-0.088 (0.118)	-0.122 (0.136)
June	-0.566*** (0.094)	-0.544*** (0.103)
Obs	3754	3754
Num. Firms	293	293

* p<0.10, ** p<0.05, ***p<0.01.

Standard errors clustered by firm.

Table 11: Dynamics Treatment Effect on Inflation Expectations: placebo test

C Sequence of information

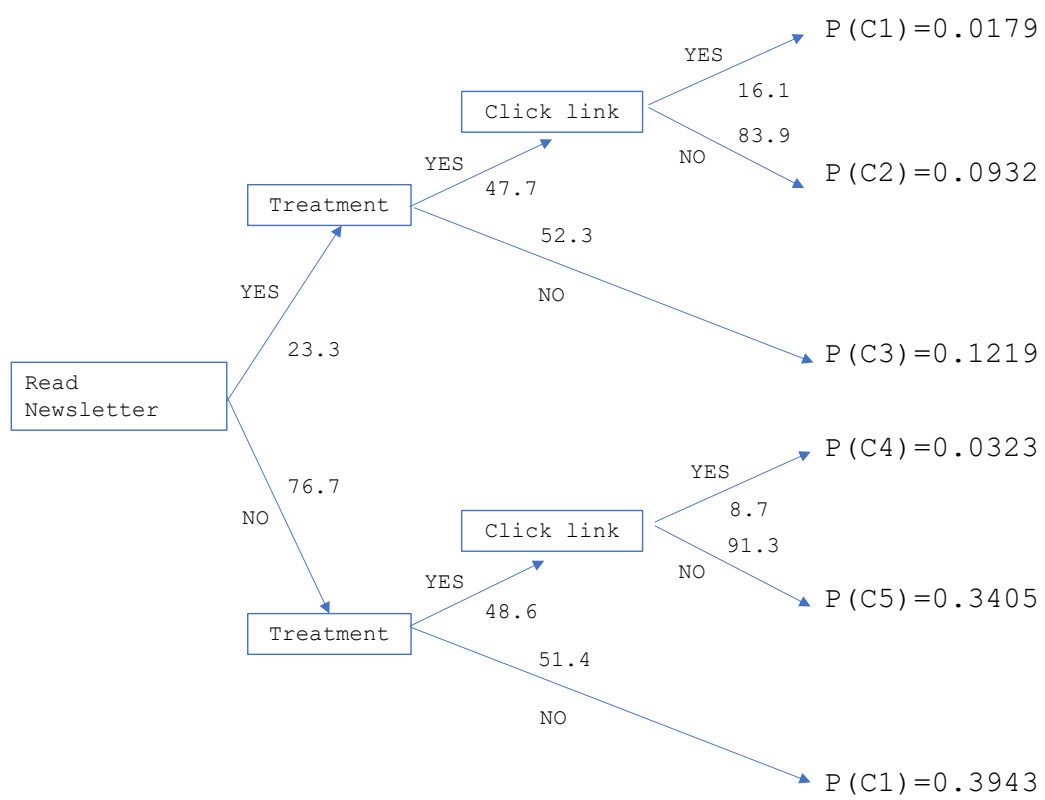


Figure 4: Sequence of information