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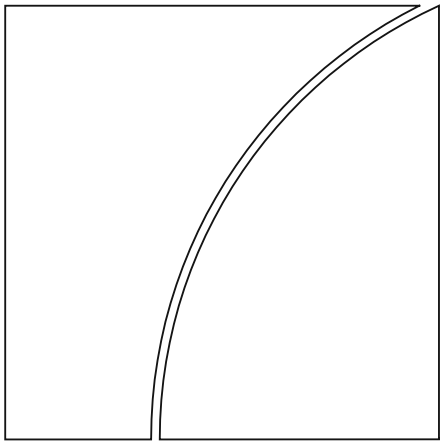

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New information and inflation expectations among firms

by Serafin Frache and Rodrigo Lluberas

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New information and inflation expectations among firms

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Abstract

Using data from a unique and novel monthly firm-level survey on inflation expectations in Uruguay we first present stylized facts about the inflation expectation formation process and then show how information acquisition affects firms' inflation expectations. We show that firms' forecasts are close to observed inflation, that a sizable proportion of firms do not revise their expectations, and that there is substantial disagreement about future inflation among firms. We also present evidence on industrial sector effects on inflation forecasts and show that the correlation between inflation expectations and cost expectations increases with the forecast time horizon. We then exploit peculiarities of the collective wage bargaining negotiation mechanism to estimate the impact of acquiring information about past inflation on expected future inflation. Our results imply that firms that adjust wages expect lower inflation, revise their expectations downwards and make smaller forecast errors than firms that do not adjust wages. We find no effect of wage adjustments on firms' own cost expectations and that disagreement among firms is lower in the months of wage adjustment. The latter suggests that inflation expectations tend to converge as firms are more informed about past inflation.

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1 Introduction

Understanding inflation expectations is key in an inflation-targeting framework. Central banks must monitor firms' inflation expectations as they are determinants of firms decisions regarding investment, employment, and price setting. The empirical evidence on inflation expectations is focused on households and professional forecasters, whilst there is scarce evidence on how firms, as price setters, form their expectations.

In this paper, we study firms' inflation expectations in Uruguay using a unique monthly longitudinal dataset covering 88 months of data from a representative sample of about 550 firms. Of those, there are 210 firms that regularly answer the questionnaire and for which we have at least 80 monthly observations. Until very recently the focus has been, either on qualitative questions to firms (Conference Board, Ifo Business Survey) or quantitative questions to professional forecasters (Survey of Professional Forecasters by many central banks) or households (Michigan Survey of Consumers or the Survey of Consumer Expectations by the New York Fed).

Our survey is also unique because it is about firms in Uruguay, a country with a history of high inflation until recently. Inflation expectation studies have been mostly about developed countries with, at least in the last couple of decades, stable and low inflation rates. That is not the case in Uruguay. During the early 1990s and until 1997 average annual inflation rate was around 60%, declining to 6% in the late 1990s until the 2001-2002 economic crisis that resulted in the devaluation of the peso and, shift away from the exchange rate as the nominal anchor for monetary policy. Both of these changes resulted in a sharp rise in inflation that peaked to 28% in the first months of 2003. After the economic crisis and during the ensuing recovery, the Uruguay Central Bank moved towards an inflation targeting regime. The inflation target range is currently between 3% and 7%. Uruguay's historically higher than average inflation rate and its recent economic history make the Uruguayan case different than that of the US or New Zealand, two countries for which there is growing evidence on firms' inflation expectations. Besides using data from a unique survey, the contribution of this paper to the literature is twofold.

In the first part of the paper we present several stylized facts about firms' inflation expectations. We show that firms' forecasts are close to observed inflation albeit there is persistence in expectations for some time periods. Given that firms make errors in their forecasts, it is expected that they would revise their inflation prospects. We present evidence of a certain degree of information friction as a non-negligible proportion of

firms do not revise their short and long run inflation expectations. We also show that the correlation between firms' inflation expectations and cost expectations increases with the forecast horizon and even more so with observed inflation. We present evidence that there is disagreement across firms and that it had increased from mid-2014 to beginning of 2017, a period of increasing inflation, and it had declined until recently when inflation started to converge to the Central Bank inflation target range. Finally, making use of additional information from firms' balance sheets we show that there is a correlation between inflation expectations and firms' observable characteristics. In particular, we find that small firms' forecast errors and disagreement about future inflation are larger than those of medium and large firms and that there is heterogeneity about 12-month forward inflation and average forecast errors across industrial sectors.

The second part of this paper is focused on how firms acquire new information. We make use of the variation in the month of wage adjustment previously agreed on in the negotiation between workers and firms to estimate the impact of acquiring information about past inflation on expected future inflation. In general, given that wage adjustments are based on past inflation, then, at the time of the wage adjustment, firms are obliged to get information about past inflation. In this sense, we take the month of wage adjustment as a sign that firms are acquiring new or more information. If this is the case, we should expect differences in inflation expectations between firms that adjust and those that do not adjust wages in a given month. This exogenous variation in firms' incentive to acquire new information when wages are adjusted is a novel contribution to the evidence on information frictions.

Our estimations imply that firms that adjust wages expect lower inflation, revise their expectations downwards and make smaller forecast errors than firms that do not adjust wages. We find no effect of wage adjustments on firms' own cost expectations and we find that disagreement among firms is lower in the months of wage adjustment. The latter suggests that inflation expectations tend to converge as firms are more informed about past inflation.

Our results reject the full information rational expectations theory and point to the idea of the existence of information frictions. Thinking about the two main information friction competing models, the sticky information model of Mankiw and Reis (2002) and the rational inattention model of Woodford (2003), Sims (2010) and Maćkowiak and Wiederholt (2009), our results suggest that neither match the data well. Then, in light of our results, it seems that we need a hybrid model between the sticky and noisy information models in order to describe our empirical facts.

The rest of the paper is organized as follows. In the next section, we present a summary of the relevant literature on the topic. In section 3 we present the data used in the empirical analysis and the notation and definitions that follow in the paper. Section 4 presents stylized facts about the inflation expectations of Uruguayan firms, how they evolve over time, how firms revise their forecasts, the forecast errors, and the degree of disagreement across firms. In section 5 we summarize how wage negotiation agreements work and present our main estimation results on how wage adjustments induce firms to acquire new information. In section 6 we discuss the theoretical implications of our findings. Finally, section 7 presents the conclusion of the paper.

2 Literature review

There is a growing body of theoretical literature concerned with information problems faced by economic agents. Several explanations have been proposed to explain information frictions. One type of model is, the noisy information model proposed by Woodford (2003), Sims (2010) and Maćkowiak and Wiederholt (2009). In this model agents continuously update their information set, but get the information with a noisy signal. Another set of models, for example Mankiw and Reis (2002), assumes that agents update their information sets infrequently, but that when they do, they behave as fully rational.

The different information friction models have been tested empirically. For instance, Coibion and Gorodnichenko (2012) find that the degree of information rigidities is large and is likely to have important consequences on the dynamics of macroeconomic variables as well as in the optimal policy. Moreover, they test the different information rigidity models and conclude that the noisy-information model is the one that best matches the expectations of economic agents. Similarly, Coibion and Gorodnichenko (2015) using inflation expectations from the U.S Survey of Professional Forecasters, reject the full information rational expectations hypothesis due to the existence of information frictions.

Carroll (2003) and Carroll (2005) present an epidemiological based model of macroeconomic expectations and study the transmission of information and its impact on the formation of inflation and unemployment expectations. In particular, Carroll looks at how households' expectations derive from news reports based on the opinion of professional forecasters. Consequently, households are not expected to be constantly updating their information to form expectations of macroeconomic variables, but rather rely on the views of economic

analysts and commentators to, probabilistically and sometimes with delay, adjust their expectations. He derives an empirical equation from the model to estimate the evolution of mean inflation and unemployment expectations using data from the Michigan Survey of Consumers. Results suggest that the expectation formation mechanism is in-between the fully rational expectation and adaptive expectation models.

Despite the role of firms as price setters, survey data on firms' inflation expectations is scarce, Coibion et al. (2015) being a notable exception. They implement a novel survey of firms' expectations about a set of macroeconomic variables in New Zealand, including expectations on future inflation and beliefs about recent inflation. They demonstrate how despite New Zealand's status as the first country to implement an inflation targeting regime almost 20 years ago and its recent history of low inflation close to the central bank target, firms' average inflation expectations are systematically above observed inflation. Moreover, they find that disagreement across firms is larger than among professional forecasters; this results from a dispersion of beliefs about recent macroeconomic conditions. They also study firms' incentives to gather macroeconomic information and find patterns consistent with rational inattention. In particular, they find that firms make smaller errors and have less uncertainty about macroeconomic variables that are important for their business.

Andrade and Bihan (2013) analyze the expectation formation process of professional forecasters in the European Central Bank Survey. First, they find that there is stickiness in professional forecasters expectations, each quarter 25% of professional forecasters do not update their one-year or two-year ahead forecasts. Second, consistent with Sims' noisy information model, they find evidence that those who update their information set do not agree on their forecasts. Finally, they develop a model with both sticky and noisy information and show that matching the professional forecasters expectations smoothness would imply a higher degree of inattention than that estimated amount from the microdata.

Mankiw et al. (2004) study the disagreement about inflation expectations across households, professional forecasters, and economists working in the industry. They find that the amount of disagreement is important, it varies over time, and correlates with other macroeconomic variables. The authors also state that the sticky information model can explain the evolution of the median and the dispersion of inflation expectations over time. However, they claim the model is not able to explain, for example, the positive correlation between the level of inflation and the level of disagreement across agents.

Most of the literature on expectations is based on data from developed countries; Carrillo and Emran (2012) being a notable exception. They look at how public information affects the inflation expectation

formation process in Ecuador by using a natural experiment. They claim public information aggregates dispersed information and provides a hint about the actions of others. Carrillo and Emran (2012) take into consideration that for a period of time the official statistics agency in Ecuador made a mistake in its inflation statistics due to a programming error. When the error was detected, the series of official inflation was revised downward for 14 months starting in January 2005. They use households' inflation expectations and find that the public information about prices is key in explaining households' inflation expectation formation process.

There are also several papers that, using the same firm level survey we use in this paper, study firms' inflation expectations in Uruguay. Borraz et al. (2013) study wage and price setting by introducing specific questions about price setting, the frequency of price adjustments and the main factors behind price increases. They find that there is no specific frequency for price adjustment and that firms adjust their prices immediately after a wage increase. The three papers that are more related to our work are Licandro and Mello (2014), Licandro and Mello (2015) and Borraz and Orlik (2016). In the first paper, the authors study how monetary policy affects firms' inflation expectation formation process. They find that a 1% increase in the interest rate results in a reduction of 0.3% in firms inflation expectation, showing the importance of the expectations channel of monetary policy in Uruguay. Licandro and Mello (2015) study how inflation expectations react to news about monetary policy. They find that monetary policy news affects firms' inflation expectations, particularly, an expansionary (contractionary) change in monetary policy increases (decreases) inflation expectations, suggesting that the communication of monetary policy is key in the formation of inflation expectations in Uruguay. Finally, Borraz and Orlik (2016) study the degree of attentiveness of firms in Uruguay using specific questions about past inflation. They find that firms make smaller forecast errors than professional forecasters and that they are well aware of past and future inflation.

3 Data

3.1 Firm survey

Our empirical analysis is based on two main data sources. First, we use a novel firm level survey carried out by the National Institute (INE) commissioned by the Central Bank of Uruguay (BCU), to measure firms' inflation and own cost expectations at different time horizons. The logistics of the survey are arranged by INE, a well-respected Uruguayan public agency and in charge of several regular household and firm level

surveys.

Each month since October 2009 a representative sample of around 500 firms with at least 50 employees are questioned about their expectations. The firms receive the questionnaire electronically by e-mail the first day of each month and have until the end of the month to answer it. If there are doubts about an answer, it is followed-up by a telephone call by members of INE. Even though it is not compulsory to answer the questionnaire, the response rate ranges between 54% and 88%. The resulting sample is an unbalanced panel and representative of all the sectors in the economy, except for the financial, agricultural, and public sectors. The database is a long panel with a total of 88 months. During the sample period, 565 firms completed the survey at least once, with 10% answering less than 20 times, and 80% answering at least 40 times. There are 210 firms (35% of the total) that regularly answer the questionnaire and for which we have at least 80 monthly observations.

Table 3.1 shows the proportion of firms in each sector for the whole sample period used in the analysis of this paper (January 2010 to April 2017) together with a comparison with the sectoral composition of the population of firms with 100 or more employees. There are no substantial differences in the sectoral structure of the sample vis-a-vis the population of firms in Uruguay.

The person answering the questionnaire is supposed to be the one responsible for pricing decisions of the firm, but could also be the owner, a general, or area manager. In March 2016, we asked the respondents about their role within the firm and found that 42% were directors, general managers, or area managers; 19% economic analysts; 12% consultants; and 28% had different roles within the firm.

Table 3.1: *Proportion of firms by sector: sample and population (in %)*

	Sample	Population
Manufacturing	30.9	25.0
Electricity, gas and water supply	0.1	3.0
Construction	1.8	2.3
Trade	20.5	16.2
Hotels and restaurants	3.0	2.3
Transport, storage and communications	9.0	12.8
Real estate, renting and business activities	16.3	17.4
Education	11.1	10.2
Health and social work	7.4	10.9

Firms are asked about their expected annual change in the Consumer Price Index for the current year, for the next 12 months, and for the monetary policy horizon, which was 18 months until July 2013 and has

been 24 months since then. For example, in August 2013 firms were asked about the expected change in the CPI during the year 2013, between August 2013 and July 2014 and between August 2014 and July 2015. The specific wording of the question is: *What do you believe is going to be the change in the CPI?* [1]. From the wording of the question we interpret that firms are asked about their expectations about the general CPI and not their specific prices [2].

Moreover, the questionnaire also digs into the expected change of firms' own costs for the same time horizons. Then, firms are also asked *What do you believe is going to be the average change in your firm's costs in local currency?* [3] For the same time horizon, we have both the firm inflation and own costs expectations.

On top of the regular questions about inflation and own cost expectations, firms are asked special questions in certain months. We asked firms about financial decisions, access to credit, price setting decisions, uncertainty about inflation expectations, and currency of invoicing, among other topics.

3.2 Notation and definitions

In general, we define $F_t^i \pi_{t+h}$ as the h-month ahead inflation expectation of firm i at time t. Then, for instance, $F_t^i \pi_{t+12}$ is firm's i 12-month ahead inflation expectation formed with the information available at time t. Alternatively, $F_t^i \pi_y$ is defined as the expected inflation at time t for the current year.

We can also define the forecast error of firm i at time t as the difference between its h-month ahead inflation expectation at time t and the actual inflation during the same period. Thus:

$$FE_{it,T} = \pi_{t+h} - F_t^i \pi_{t+h}$$

Note that even though the expectation and the actual inflation refer to the same time period, whilst $F_t^i \pi_{t+h}$ is observed at time t, inflation between t and $t+h$, π_{t+h}, is observed at time $t+h$, once it is realized.

Given the panel dimension of our data and the fact that firms are asked about their inflation expectations for different time periods, we can also look at firms' expectation revisions. We have different measures of

[1] In Spanish, the original wording is: *¿Cuál cree usted que será la variación del IPC (Indice de Precios al Consumo)?*.

[2] The wording of the questions is important. For instance, de Bruin et al. (2012) find that expectations were lower and there was less disagreement if households in the Michigan Survey of Consumers are asked about "inflation" instead of "prices in general" or "prices you pay". On the other hand, Coibion et al. (2015) find no difference in expectations if firms in New Zealand are asked about "changes in prices" or directly "inflation".

[3] In Spanish, the original wording is: *¿Cuál cree usted que será la variación promedio de los costs de su empresa en pesos uruguayos?*.

firms' expectation revisions depending on the time horizon under study.

First, we exploit the fact that firms are asked every month about their inflation expectation for the current year. For instance, in every month of 2013 firms were asked about their expected inflation for the year 2013 [4]. This gives us up-to 11 observations per firm in each year and allows us to look at how firms revise their expectations throughout the year. Define the current year (y) inflation revision of firm i at time t as $R_t^i\pi_y$. Then, for instance, for two consecutive months t and $t-1$, we define the revision of inflation expectations for year y as $R_t^i\pi_y = F_t^i\pi_y - F_{t-1}^i\pi_y$.

A second measure of expectations revision can be obtained by exploiting the fact that firms are asked at the same time about their inflation expectations for the next 12 months and, at the same time, their expectations of annual inflation in 18 and 24 months [5]. In general, we define revision in expectations between $t-j$ and t for annual inflation up to time $t+h$ as:

$$R_t^i\pi_{t+h} = F_t^i\pi_{t+h} - F_{t-j}^i\pi_{t+h}$$

For example, if we are in August 2013 (t) and j is 6, then $t-j$ is February 2013 and inflation expectations in both periods are for the 12-month period between August 2013 and July 2014.

4 Stylized facts

4.1 Summary statistics

In Table 4.1 we show descriptive statistics of inflation and costs expectations. Average and median one-year ahead expected inflation is 8.8%. The disagreement over inflation expectations (measured by the standard deviation) across firms increases with the time horizon; from 1.8 to 2 and then to 2.3 for the 12 month, 18 and 24 months ahead expectations, respectively. Although Uruguayan firms expect on average, a higher one-year ahead inflation rate than their New Zealand counterparts, we find similar disagreement about future inflation among these firms. Whilst the standard deviation for the one-year inflation forecast among New

[4] Note that the National Institute of Statistics (INE) usually release monthly inflation within the first 10 days of the next month. Then, inflation in December is released within the first 10 days of January.

[5] Firms' were asked about their 18-month ahead inflation expectations until July 2013, and about their 24-month ahead inflation expectations from July 2013 onwards. This is consistent with the change in the monetary policy horizon of Uruguay Central Bank.

Zealand firms is between 2.3 and 3.2 [6], it is 1.8 for Uruguayan firms.

A unique feature of our survey is that firms are asked not only about their inflation expectations at different time horizons but also, about their own cost expectations. On average, firms expect costs to increase above inflation at all time horizons. While the mean year-ahead inflation expectation is 8.8%, firms expect their cost to increase over the next 12 months, on average, by 10.3%. Not only do firms expect their costs to grow faster than general inflation, but also there is more heterogeneity across firms about their costs changes than about inflation expectations. The standard deviation of cost expectations ranges from 3.7% for the 24-month ahead expectation to 4.1% for the 18-month expectations; compared to 1.8% to 2.3% for inflation expectations, respectively.

Table 4.1: *Descriptive statistics: inflation and costs expectations (in %)*

	Mean	Median	S.D.	Min	Max
Inflation					
Year	8.9	9.0	2.0	0.0	40.0
12 months	8.8	8.8	1.8	0.0	35.0
18 months	8.4	8.0	2.0	0.0	40.0
24 months	9.6	9.0	2.3	0.0	75.0
Costs					
Year	10.3	10.0	3.8	-30.0	120.0
12 months	10.3	10.0	4.0	-50.0	120.0
18 months	9.9	9.0	4.1	-30.0	120.0
24 months	10.8	10.0	3.7	-10.0	80.0

Notes:
18-months expectations are for the period October 2009 to July 2013.
24-months expectations are for the period July 2013 to April 2017.

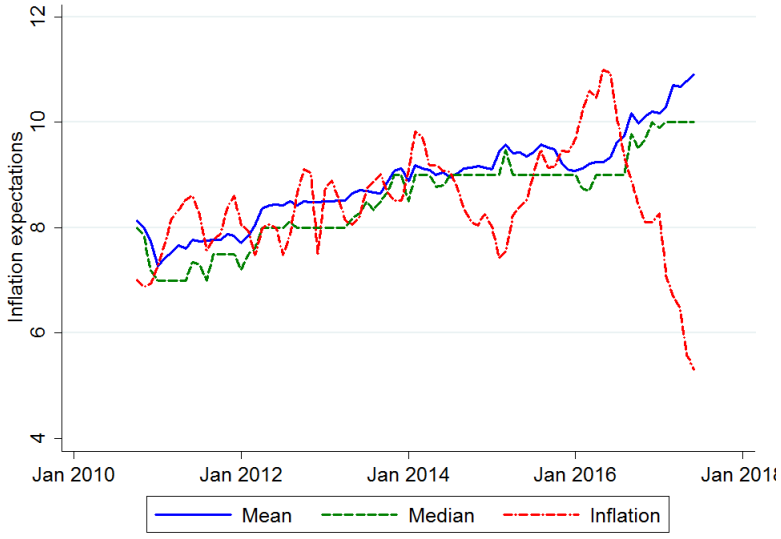
4.2 Average inflation expectations

Figure 4.1 shows the evolution of mean and median 12-month ahead inflation expectations together with actual inflation, observed 12 months later. In general, firms' inflation expectations are not far from actual inflation, but there are some periods in which inflation expectations depart from observed inflation. In particular, inflation expectations were well above actual inflation between February and June 2015. On the other hand, firms' inflation prospects were above observed inflation at the end of the sample period, when Uruguay experienced a deceleration of its price level growth. The aforementioned results suggest persistence

[6] See Table 1 in Coibion et al. (2015).

in inflation expectations during the sample period, a finding already documented by Licandro and Mello (2014).

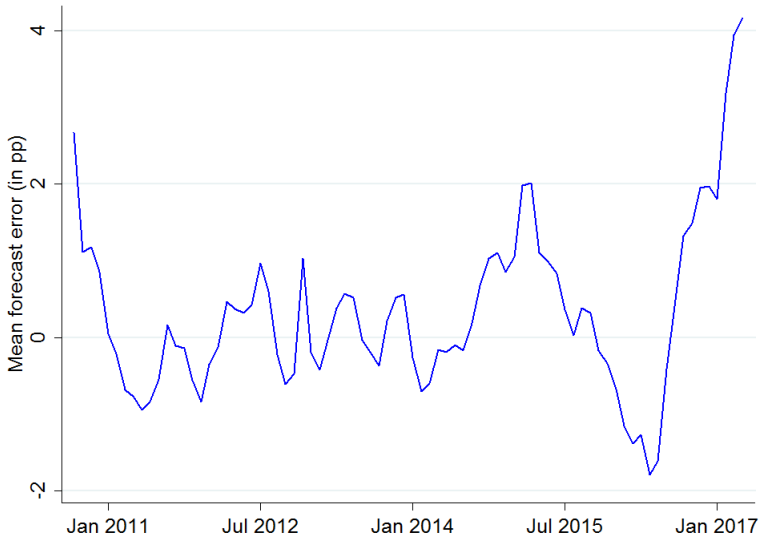
Figure 4.1: *Mean and median inflation expectations: next 12 months*



4.3 Forecast error and inflation expectation revisions

Figure 4.2 shows the mean forecast error for 12-month ahead inflation expectations. The graph shows that on average firms did not anticipate the inflation deceleration that has taken place since the second half of 2016.

Figure 4.2: *Mean forecast error: next 12 months*



If firms make forecast errors and realize, then they should revise their expectations accordingly. Figure 4.3 shows the average long run forecast revision while Figure 4.4 shows the average revision for the current year's expected inflation. It is important to note that during the sample period, the monetary policy horizon was increased from 18 to 24 months; this is captured in the solid and dashed lines reported in Figure 4.3.

Figure 4.3: *Average revision in inflation expectations*

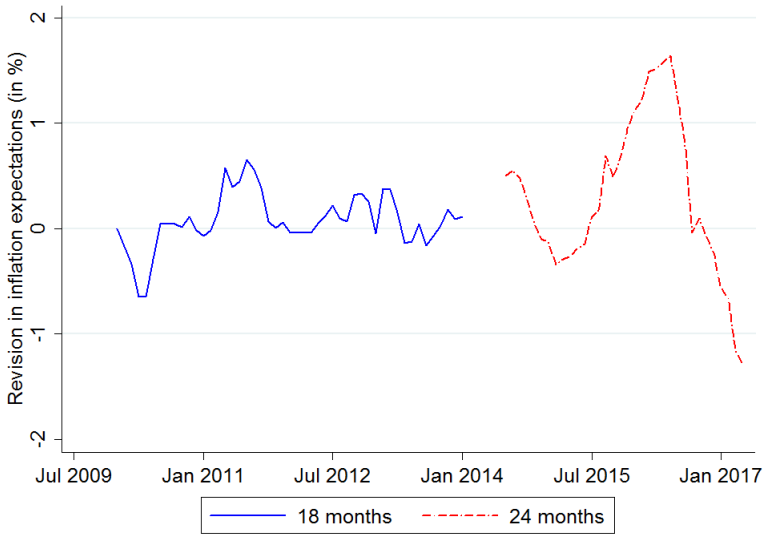
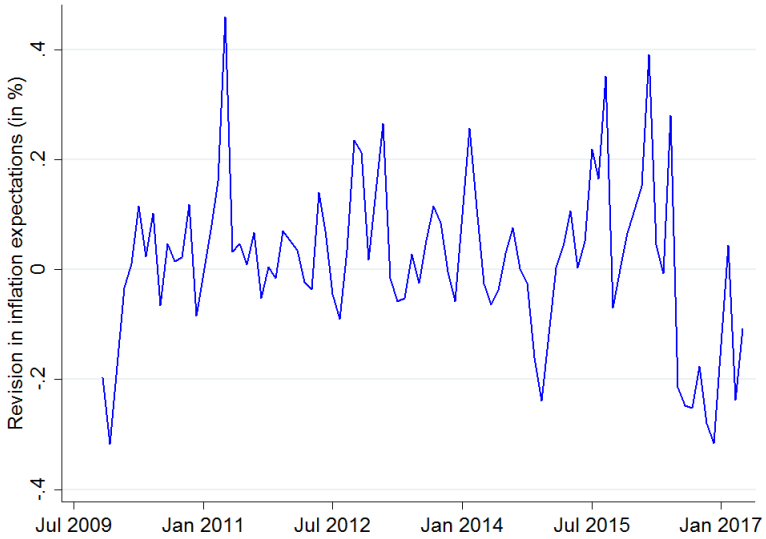


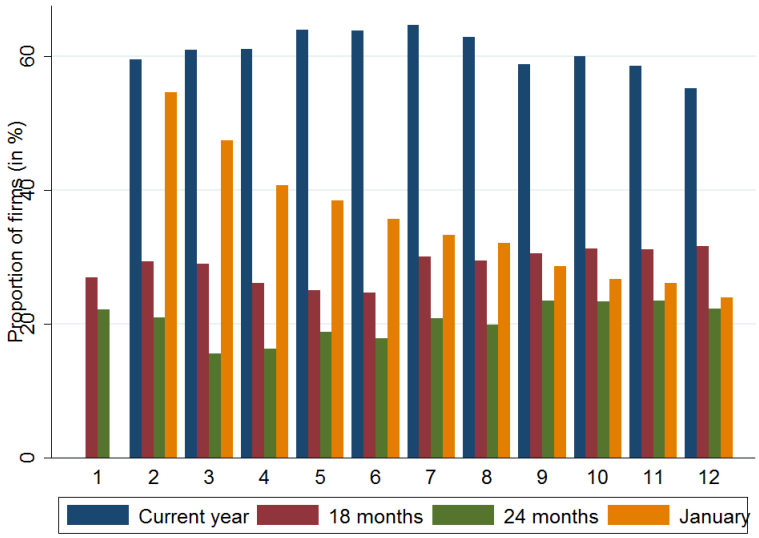
Figure 4.4: *Average revision in current year's inflation expectations*



The average forecast revision masks differences across firms. Figure 4.5 shows the proportion of firms that do not revise their expectations between two time periods. We present different measures of expectation revisions: between $t-6$ and t (*18 months*), between $t-12$ and t (*24 months*), between $t-1$ and t for the

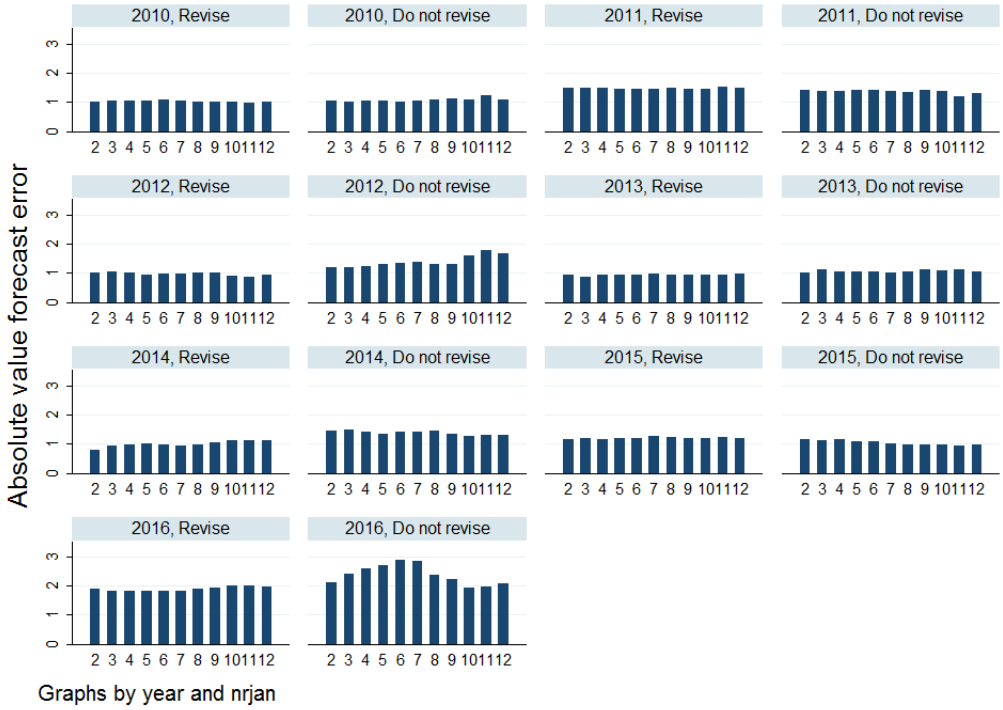
calendar year (*Current year*) and for the current year relative to first inflation expectation reported, which would be in January (*January*). First, we find that between 25% and 30% of the firms in our sample do not change their inflation expectations even after 6 or 12 months. Second, about 60% of the firms in each month do not revise their expectations for the current year's inflation rate. Finally, 25% of the firms expect the same inflation for the current year in December as in January. All these facts reinforce the relative persistence we reported above and suggest the presence of some form of inattentiveness or information friction among firms.

Figure 4.5: *Proportion of firms that do not revise their expectations*



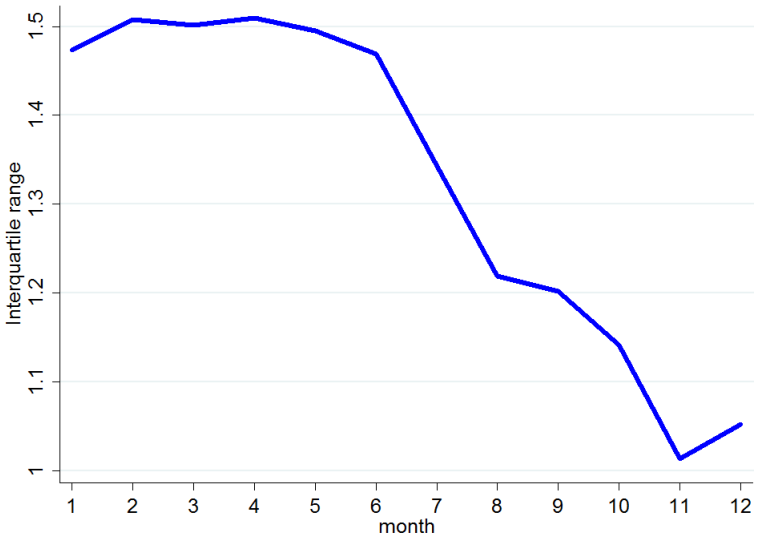
It could be the case that firms do not change their expectations of the current year's inflation as months go by because they are already well informed at the beginning of the year, and if they acquire new information as the year goes on there is no need to update their beliefs. We explore that possibility in Figure 4.6 where the absolute value of the forecast error is reported for the firms that do and do not revise their expectations. To not bias the results, we include those firms that we observe during the whole year. Except for 2011 and 2015, firms that revised their expected inflation perform better in terms of the absolute value forecast error of their estimates. Note that in 2016 the firms that revised their expected inflation achieve substantially better forecast results, as they capture the aforementioned change in inflation behavior.

Figure 4.6: *Forecast error*



As expected, we observe a convergence in firms' inflation expectations for the calendar year as we approach December and the forecast horizon shortens. Even though we reported that about a quarter of firms do not revise their inflation forecast, we find greater agreement among firms. The interquartile range declines 0.4 percentage points throughout the year, from 1.5% in January to less than 1.1% in December (see Figure 4.7), suggesting convergence in the firms' forecasts.

Figure 4.7: *Inflation expectations during the year*

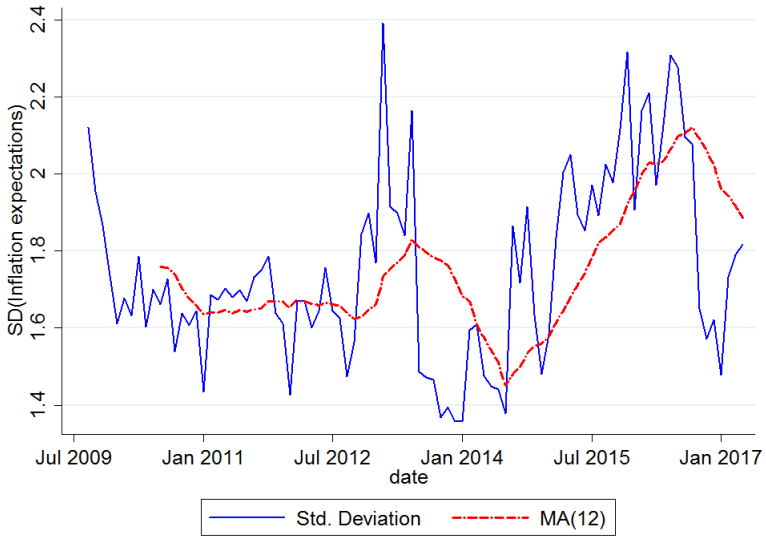


4.4 Disagreement

Under rational expectations with no cost of acquiring information and all firms having the same information set there is no room for disagreement on future inflation across firms. We already showed that there is disagreement about inflation prospects across firms, but how does disagreement evolve over the sample period? In Figure 4.8 we present the monthly cross-section standard deviation of firms' inflation expectations together with the 12-month moving average [7]. Despite the high volatility in the monthly series, it is clear the increasing pattern of disagreement since mid-2014. This is probably linked to other macroeconomic variables and may be the result of lower economic growth, increased unemployment and rising inflation volatility (see Mankiw et al. (2004)). This result is in line with sticky information models.

[7] Similar results are found for the interquartile range.

Figure 4.8: *Disagreement on inflation expectations*

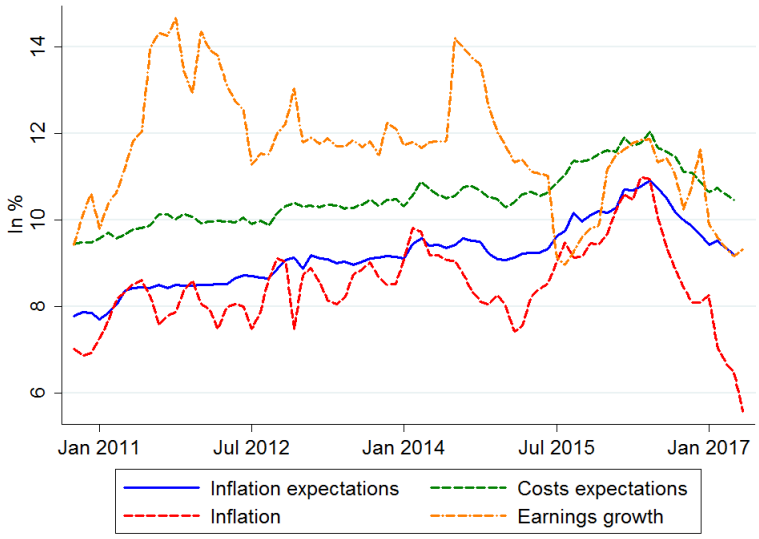


4.5 Unit costs

The survey gathers information on firms' inflation expectations and their own cost expectations. This is a unique feature of this survey as firm surveys usually ask either about inflation or about own unit cost expectations, not both. Figure 4.9 shows average 12-month ahead inflation and unit costs expectations over time. Own costs expectations are consistently above both inflation expectations and observed inflation over the whole sample period.

In the next section, we explore how firms form their cost and inflation expectations. In particular, we argue that the moment firms acquire inflation information to adjust nominal wages they revise their expectations and improve their forecast. The quality of the forecast seems to be related to inflation and not to earning dynamics, as can be seen in Figure 4.9. Indeed, while the correlation between cost expectations and inflation is 0.79, it is just -0.04 between earnings growth and inflation expectations.

Figure 4.9: *Average inflation and unit costs expectations*



Bryan et al. (2014) discuss the wording of questions in surveys for households, professional forecasters, and firms' expectations. They compare these surveys to, a single month in the Federal Reserve Bank of Atlanta's Business Inflation Expectations Survey, firms' unit costs and core Consumer Price Index (CPI) expectations. Similar to our results (see Table 4.1), they find that the disagreement over unit cost expectations among firms is larger than inflation expectations measured by changes in core CPI.

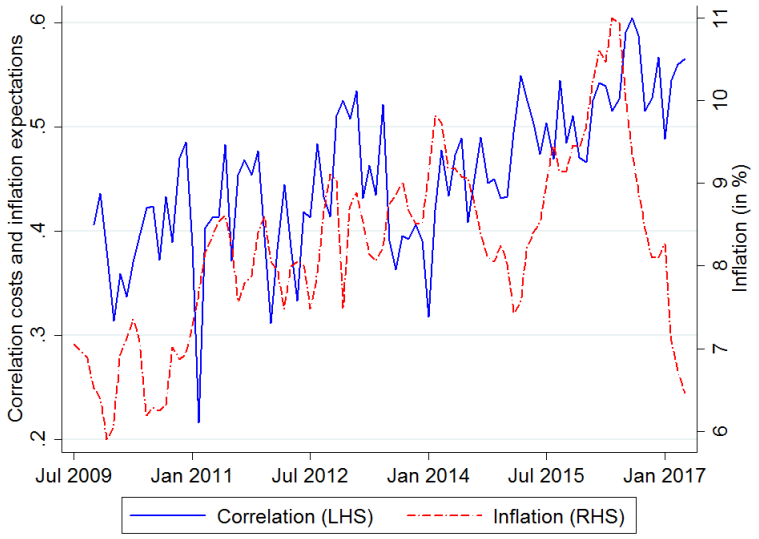
Therefore, an important question is, whether firms revise their inflation and own cost expectations at the same time. There is a high correlation in the timing of firms' revisions of their own costs and general inflation expectations. About 73% of the firms that changed the one-year ahead inflation expectations simultaneously updated their own cost expectations between 2009 and 2017. The correlation between inflation and own costs expectations ranges from 0.38 for the current year to 0.53 for 24 months ahead.

Table 4.2: *Correlation between inflation and unit costs expectations at different time horizons*

	Correlation
12m	0.4687
18m	0.4735
24m	0.5266
Year	0.3846

Moreover, the correlation between inflation and own cost expectations increases with observed inflation. Figure 4.10 shows the cross-section correlation between 12-month ahead inflation and own cost expectations for each month in the sample. The correlation fluctuates around 0.4 in the period between the end of 2009 and beginning of 2014, when inflation was below 10%. From the end of 2014 until July 2016, when inflation peaked at 11%, the correlation jumped to 0.6. With the decline in observed inflation during 2017 we start to observe a decline in the correlation between 12-month ahead inflation and own cost expectations.

Figure 4.10: *Correlation between inflation and unit cost expectations*



4.6 Firm characteristics

In this section, we present descriptive evidence on differences in inflation expectations and projection accuracy by firm size and industrial classification.

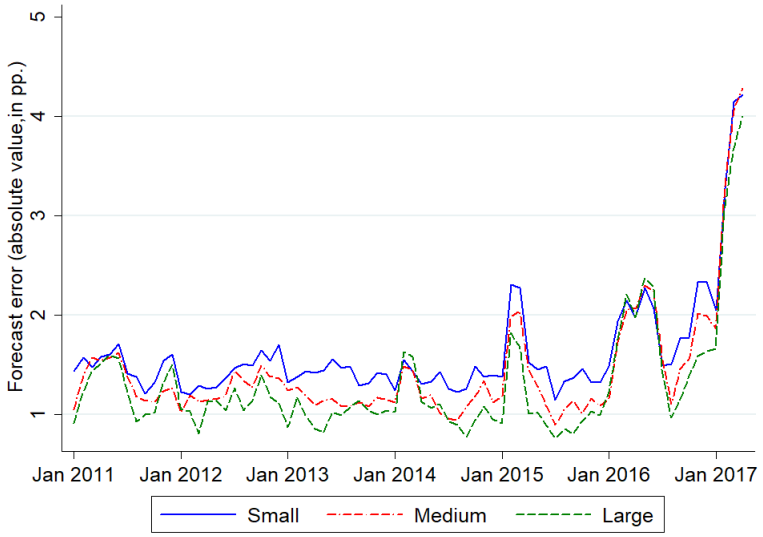
4.6.1 Firm size

Unfortunately, aside from the industrial sector, the inflation expectations survey does not allow us to look at differences across firms due to observable firm characteristics. Even though we have a rich set of information on inflation and cost expectations we are missing information on firm characteristics. To overcome this shortcoming we managed to link 495 firms in our sample with firm level data from the 2012 *Annual Survey*

on Economic Activity [8]. The *Annual Survey on Economic Activity* is the key statistical source on structural characteristics of Uruguayan firms and it contains information on several other characteristics of the firms as well. The sample size is 5,492 and it is representative of all economic units with either more than 10 employees or an annual revenue of more than 94 million Uruguayan pesos.

In particular, we are interested in looking at differences in firms' inflation forecast accuracy and disagreements by production cost level. We divide the sample into three groups according to firm production costs in 2012 and categorize the firm as either small, medium, or large [9]. The average production cost of small firms is USD 3.8 million in 2012, whilst the figure is USD 14.3 million and USD 97.5 million for medium and large firms. Figure 4.11 shows the absolute value of the 12-month ahead inflation forecast error by firm size. Forecast error decreases with firm size. Even though there is a high correlation of the forecast errors of the different groups, large firms have forecast errors that are, on average 0.31 percentage points lower than those of small firms, and 0.19 lower than those of medium size firms.

Figure 4.11: *Forecast error by firm size*



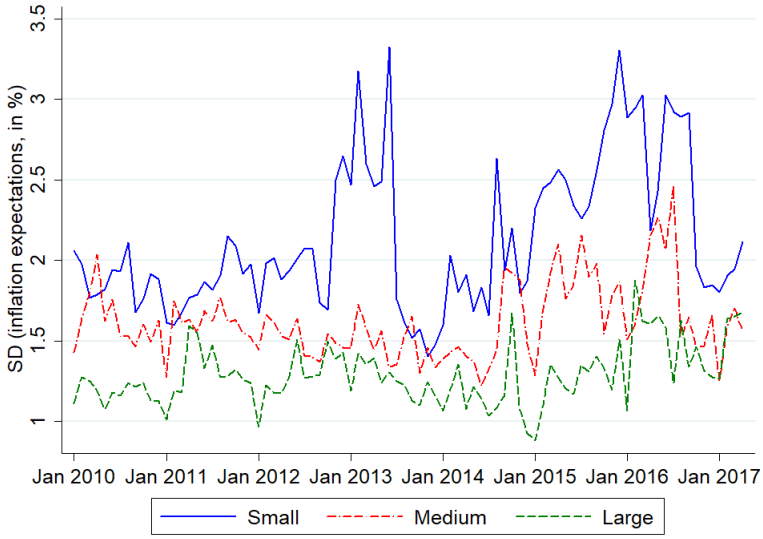
From the graphs we find differences in forecast accuracy by firm size and realize that disagreements about the 12-month ahead inflation expectations decrease with firm size (see Figure 4.12). The standard error of

[8] The actual name in Spanish is *Encuesta Anual de Actividad Económica (EAAE) 2012*.

[9] Note that our sample is representative of firms with more than 50 employees and thus representative of large firms in Uruguay. The name of the groups (small, medium and large) is just for exposition.

inflation expectations is higher and more volatile for small firms than for medium and large firms. The increase in dispersion that we showed in the period of inflation acceleration between early 2014 and the end of 2016 is observed for all firm sizes, but is particularly salient for small firms.

Figure 4.12: *Disagreement by firm size*



We also find differences in the correlation between inflation and own cost expectations across firms in each size group (see Table 4.3). For each time horizon, except for 24 months, the correlation decreases with firm size. We already showed that, at least for the whole sample, the correlation between inflation and own cost expectations increases with the time horizon. That is also verified for medium and large firms, but not for small firms. For the latter, the correlation between inflation and own cost forecasts is relatively constant and above 0.50 for each of the different time horizons available in our survey.

Table 4.3: *Correlation between inflation and unit costs expectations at different time horizons: by firm size*

	Small	Medium	Large
12m	0.5420	0.4408	0.3655
18m	0.5150	0.4449	0.3745
24m	0.5250	0.5870	0.4502
Year	0.5167	0.3233	0.2833

4.6.2 Firm industrial sector

We also test whether there are differences in inflation expectations and forecast errors between firms in different industrial sectors. First, we estimate the following model for 12-month ahead inflation expectations, by pooled OLS:

$$F_t^i \pi_{t+12} = \alpha + \sum_j D_i^j \delta^j + \beta_1 \pi_{t-1} + \beta_2 t + \gamma_m + \epsilon_{it}$$

Where D^j are dummy variables capturing industry sector level effects. We consider the following sectors: Electricity, gas and water supply, Construction, Trade, Hotels and restaurants, Transport, storage and communications, Real estate, renting and business activities, Education and Health and social work. The omitted category is Manufacturing. The rest of the variables are defined as before.

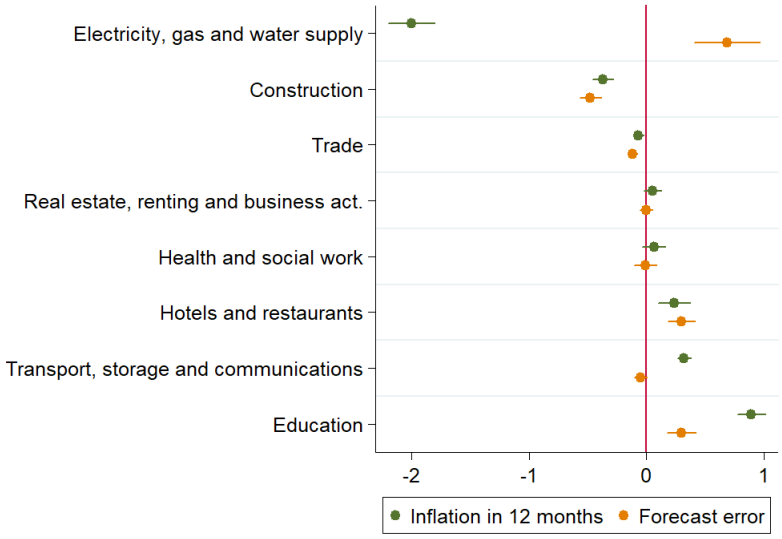
We also look at industrial sector differentials on forecast errors. For that, we estimate the following model for the absolute value of forecast errors:

$$|FE_{it,t+12}| = \alpha + \sum_j D_i^j \delta^j + \beta_1 \pi_{t-13} + \beta_2 t + \gamma_m + \epsilon_{it}$$

The variables in the equation are defined as before. Figure 4.13 shows the dummy variable estimated coefficients expressed relative to inflation expectations and the forecast error of the manufacturing sector [10]. Our results suggest differences in expectations across sectors. The average 12-month ahead inflation expectations for the manufacturing sector during the whole sample period is 8.9%. The mean inflation forecast is 0.37 and 0.07 percentage points lower for the construction and trade sectors, respectively, when compared to the manufacturing sector. Even though regression results suggest that inflation expectation is 2 percentage lower for firms in the electricity, gas and water supply sector relative to the manufacturing sector, this has to be taken with a grain of salt due to the low number of observations in that sector. On the other hand, firms in the education, transport, storage and communications, and hotels and restaurant sectors expect higher inflation.

[10] Results in more detail are shown in the Appendix.

Figure 4.13: *Inflation expectations and forecast error by industrial sector (relative to Manufacturing)*



The average forecast error in the manufacturing sector is 1.45 percentage points. On average, firms in the hotels and restaurants, electricity, gas and water supply, and education sectors make larger forecast errors than the rest while those in the construction, trade and transport, storage and communications sectors are the ones with smaller forecast errors. Overall, our results suggest that there are common factors among the industrial sectors that affect inflation expectations among firms simultaneously.

4.7 Strategic complementarity

Afrouzi (2017) derives an equation for firm k in industry j, with best response pricing, $p_{j,k}$, that relates the degree of strategic complementarity, α, the expectation of the fundamental (aggregate price level) across firms, $E^{j,k}[q]$, and the expectation of the competitors' prices, $E^{j,k}[p_{j,-k}]$. The larger α is, the larger the strategic complementarity in price setting across firms. In other words, a larger weight is given by firms to what the competitors do in deciding their pricing strategies:

$$p_{j,k} = (1-\alpha)E^{j,k}[q] + \alpha E^{j,k}[p_{j,-k}]$$

We follow Afrouzi (2017) and in March 2017 included the following special questions to study strategic

complementarity in wage setting within industries.

Suppose that you get news that the general level of prices went up by 15% in the economy:

(a) By what percentage do you think your competitors would raise their prices on average?

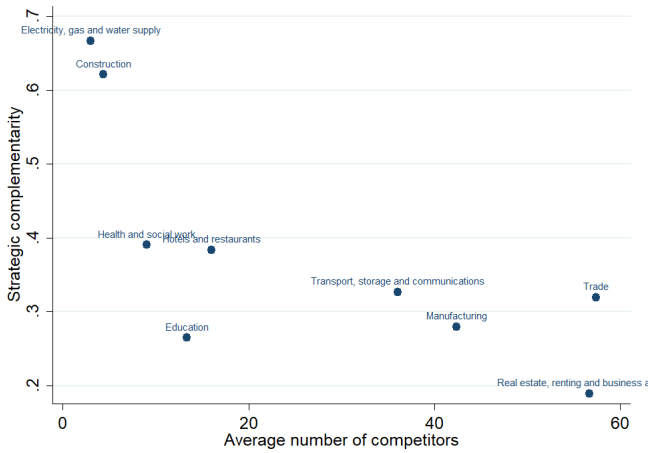
(b) By what percentage would your firm raise its price on average?

(c) By what percentage would your firm raise its price if your competitors did not change their price at all in response to this news?

Using the answers to the questions above and the equation for the pricing best response, we find that the average strategic complementarity among Uruguayan firms is 0.29, far below that of firms in New Zealand found by Afrouzi (2017). This might be related to the fact that general inflation is Uruguay, as opposed to New Zealand, has been historically high. Then, it makes sense for Uruguayan firms to follow closer the aggregate fundamental instead of what their competitors are doing for pricing decisions.

Together with the questions about strategic complementarity, firms were also asked about the number of competitors for their main product or product line. The average firm in our sample has 41 direct competitors, well above the average of 8 reported by Afrouzi (2017) for New Zealand. This difference might also explain the lower strategic complementarity in pricing decisions among Uruguayan firms compared to firms in New Zealand. According to Afrouzi (2017), firms have less incentives to follow what their competitors do - and their mistakes - when faced by a larger number of rivals. Indeed, Figure 4.14 shows the average number of competitors faced by firms in each sector and the corresponding sector average strategic complementarity. There is a clear negative relationship between the degree of attention given to the rivals for pricing decisions and the number of competitors at the sectoral level.

Figure 4.14: *Number of competitors and strategic complementarity by sector*



5 Inflation expectations and wage adjustments

5.1 Wage adjustments

In 2005, there were important changes in labor relations in Uruguay. After more than a decade, the Uruguayan Government, by decree of law, reintroduced wage councils to negotiate minimum wages, wage increases, and other employment related variables [11]. These are tripartite councils in which representatives of the Government, employers, and employees negotiate in 20 different economic groups that are composed of around 170 sub-groups. Negotiations are based on guidelines proposed by the Ministry of Economics and Finance, but the final agreement could deviate from these guidelines. Based on expected inflation and projected economic conditions, the guidelines propose a range of wage increases as well as the time horizon of the agreement. The final agreement includes the time and rate of wage increases; thus, firms know in advance the month in which they have to adjust employees' wages. Not only firms know in advance the time of wage adjustment but also wage increases are, usually, based on past inflation.

We then exploit the variation in the month of wage adjustment previously agreed upon in the negotiations between workers and firms to estimate the impact of acquiring information about past inflation on expected future inflation. In general, if wage agreements include wage adjustments based on past inflation, then, at

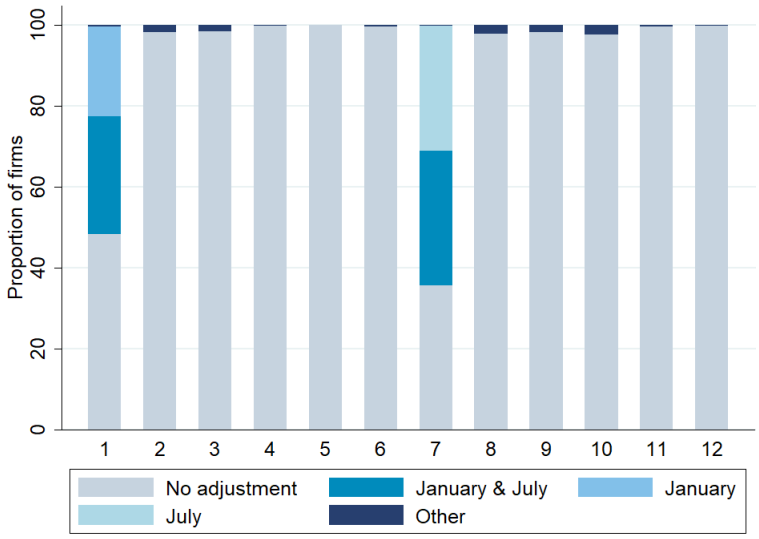
[11] See Mazzuchi (2009) for more details on the changes in employment relations introduced in 2005.

the time of the wage adjustment, firms are obliged to get information about past inflation. In that sense, we take the month of wage adjustment as indicative of firms acquiring new or more information. If this is the case, we should expect differences in inflation expectations between firms that adjust and those that do not adjust wages in a given month.

With the assistance of the Ministry of Work and Social Security we assigned each firm in our expectations survey sample to its corresponding subgroup in the wage councils. That gave us the month of wage adjustment for each firm. We work with the 2010, 2012 and 2015 negotiation rounds so that the month of wage adjustment for each of the wage council groups might change from one negotiation round to the next one. That would give us variation in the month of wage adjustment not only between wage council negotiations subgroups but also within firms.

Figure 5.1 shows the proportion of firms that adjust wages per month pooled across the 2010-2017 period. Most firms adjust wages in January and July, there are firms that adjust wages on January, firms that adjust wages in July and firms that adjust wages in both January and July. On top of that, there is also variation in wage adjustment as firms adjust wages in other months of the year. Then, this variation in the time of wage adjustment allows us to identify the effect of acquiring information due to wage adjustment (likely about past inflation) on inflation expectations forecast errors, inflation expectation revisions, disagreement and own cost expectations.

Figure 5.1: *Proportion of firms that adjust wages by month*



5.2 Regression results

In this section we present several panel data models to study how acquiring new information affects inflation expectations. We are also able to study forecast errors and, given the longitudinal dimension of our database, we study how firms revise their inflation expectations. We also present evidence illustrating how the disagreement about inflation expectations across firms diminishes in the months of wage adjustment and if wage adjustments affect cost expectations.

We first want to test if there is any effect of wage adjustments on firms' inflation expectations. If firms acquire new information when adjusting wages, we should expect differences in inflation expectations between firms that adjust and those that do not adjust wages. To test this hypothesis, we estimate the following fixed effect panel data model [12], controlling also for month seasonality, γ_m, and time trends, t:

$$F_t^i \pi_{t+12} = \alpha_i + \beta_1 A_{it} + \beta_2 \pi_{t-1} + \beta_3 t + \gamma_m + \epsilon_{it}$$

Where $F_t^i \pi_{t+12}$ is 12-month ahead inflation expectations for firm i at time t and A_{it} is a dummy variable that takes the value 1 when firm i adjust its wages at time t and 0 otherwise. Our main interest is in β_1, which

[12] In all the fixed effects panel data models we used Driscoll-Kraay standard errors to take into account the potential cross-sectional and temporal dependence of regression disturbances. See Driscoll and Kraay (1998) and Hoechle (2007).

captures the effect of wage adjustment on firms' inflation expectations. Results are summarized in Table 5.1 [13]. According to our estimates, in the months of wage adjustment, firms that adjust their wages expect future inflation to be 0.075 percentage points lower on average than firms that do not adjust wages. This confirms that there are differences in inflation expectations across firms in the months of wage adjustments. We argue that, given how wages are indexed to past inflation, in the months of wage adjustment, firms acquire new information, which affects their inflation prospects.

To further investigate this, we estimate three models for inflation expectations revisions in absolute value:

$$|R_t^i \pi_{t+h}| = \alpha_i + \beta_1 A_{it} + \beta_2 \pi_{t-1} + \beta_3 t + \gamma_m + \epsilon_{it}$$

Where, as before, $R_t^i \pi_{t+h} = F_t^i \pi_{t+h} - F_{t-j}^i \pi_{t+h}$, captures the revision in inflation expectations. We estimate the model using two measures of inflation expectations revision. First, we look at how firms revise their expectations 6 and 12 months ahead. For that, we exploit the fact that firms are asked about their inflation prospects for the same time period but in different moments. We define inflation expectations in that case as $R_t^i \pi_{t+h} = F_t^i \pi_{t+h} - F_{t-j}^i \pi_{t+h}$, where $j = 6$ or 12. Second, we look at how firms revise their expectations of inflation in the current year, y, throughout the year. Then, for two consecutive months we have: $R_t^i \pi_y = F_t^i \pi_y - F_{t-1}^i \pi_y$. Results are again summarized in Table 5.1. We do not find differences in inflation expectations revisions between firms that adjust wages and those that do not, at least for revisions 6 or 12 months apart and revisions of the current year inflation. Our results do suggest that wage adjustment affect current year inflation expectations revisions during the year and compared to answers given in January. Thus, wage adjustments are associated with a downward revision of current year inflation expectations of 0.08 percentage points with respect to answers in January.

To test whether firms that adjust wages are more informed than those that do not, we study how well they forecast inflation. Better information should result in more accurate inflation forecasts. Then, if firms are better informed about past inflation at the time of wage adjustment, assuming that inflation is persistent over time, we should find a lower forecast error among firms that adjust their wages. We estimate the following fixed effects panel data model for the absolute value of the forecast error for the 12-month ahead inflation expectations, $FE_{it,t+12} = \pi_{t+12} - F_t^i \pi_{t+12}$:

[13] For full results see Table 8.3 in the Appendix.

$$|FE_{it,t+12}| = \alpha_i + \beta_1 A_{it-12} + \beta_2 \pi_{t-13} + \beta_3 t + \gamma_m + \epsilon_{it}$$

Note that while the inflation forecast is observed at time t, the forecast error is observed once 12-month inflation is realized at time $t+12$. Then, we control for lagged inflation at the time of the forecast, π_{t-13}. We also estimate this same model but instead of considering general inflation we use core inflation and define forecast error with respect to core inflation as FEX. Firms' inflation forecasts are more accurate at the time of wage adjustments. Indeed, the absolute value of the forecast error is 0.155 percentage points lower among firms that adjust their wages. A similar result if found when using core instead of general inflation. All the evidence points to the idea that firms acquire information at the time of wage adjustment as their inflation expectations are lower, they are thus able to revise their inflation prospects downward, and their inflation forecast is more accurate.

Finally, to test our hypothesis we look at firms' own cost expectations. If, as we argue, firms acquire information about past inflation at the time of wage adjustment, there should be no effect on their own cost forecast. Firms are more likely to be aware of their own costs than general inflation so information on past inflation should not affect their own cost expectations. To test this, we estimate the following model:

$$F_t^i C_{t+12} = \alpha_i + \beta_1 A_{it} + \beta_2 \pi_{t-12,t-1} + \beta_3 t + \gamma_m + \epsilon_{it}$$

Where $F_t^i C_{t+12}$ is the 12-month ahead own cost expectations for firm i at time t. The coefficient on wage adjustment is statistically not significant different from zero.

Table 5.1: *Regression results summary*

	β_1	s.e	t	p-value
$F_t^i \pi_{t+12}$	-0.0751*	0.0402	-1.87	0.065
$\|FE_{it,t+12}\|$	-0.155**	0.0648	-2.39	0.019
$\|FE_{it,y}\|$	-0.0932	0.0715	-1.30	-0.196
$\|FEX_{it,t+12}\|$	-0.211**	0.0976	-2.16	0.034
$\|R_t^i \pi_{t+h}\|$	-0.0109	0.0439	-0.25	0.804
$\|R_t^i \pi_y\|$	-0.00649	0.0216	-0.30	0.765
$\|R_t^i \pi_{y_0}\|$	-0.0808***	0.0236	-3.42	0.001
$F_t^i C_{t+12}$	-0.0619	0.0638	-0.97	0.334

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

Another interesting fact is related to the disagreement about future inflation among firms. We showed that there is substantial disagreement about future inflation across firms. If all firms have the same information, their inflation expectations should be the same. If firms acquire information in the month of wage adjustment, we should observe less disagreement about future inflation among firms that adjust wages. In that sense, we show how disagreement across firms is related to acquiring information about past inflation. Therefore, let $D^e_{t,t+12}$ be the disagreement about 12-month ahead inflation expectations measured either by the standard deviation or the interquartile range. We estimate the following model by OLS for each measure of disagreement:

$$D^e_{t,t+12} = \alpha + \beta_1 A_t + \beta_2 t + \epsilon_t$$

Results are summarized in Table 5.2. Even after controlling for time trend effects, both the standard deviation and the interquartile range of the 12-month ahead inflation expectations are lower among firms that adjust their wages. The standard deviation is 0.20 percentage points lower among firms that adjust their wages. The difference between the 25th and the 75th inflation expectations percentile is 0.39 percentage points lower in the month of the wage adjustment. These results suggest that inflation expectations tend to converge as firms are more informed about past inflation.

Table 5.2: *Regression results: disagreement*

	Std. Deviation	Interquantile range
A_t	-0.204	-0.386**
	[0.117]	[0.131]
t	0.00294***	-0.00101
	[0.000855]	[0.00151]
Cons.	-0.113	2.408*
	[0.541]	[0.976]
N	92	92
R-sq	0.132	0.09

Standard errors in brackets
* p<0.05, ** p<0.01, *** p<0.001

Given that firms can complete the survey during the calendar month and some may have more information than others, we test whether the effect of wage adjustment persists in the months before and the months after. The estimation results are summarized in Table 5.3 and the full set of results are shown in Table 8.4

in the Appendix. Results suggest that the effects persist the month before, the month after and the month of the wage adjustment.

Table 5.3: *Regression results summary: lags and leads*

	Lag	A_{it}	Lead
$F_t^i\pi_{t+12}$	-0.0933*	-0.0671	-0.053
$\lvert FE_{it,t+12}\rvert$	-0.151*	-0.173**	-0.154*
$\lvert FE_{it,y}\rvert$	-0.0852	-0.0883	0.0136
$\lvert FEX_{it,t+12}\rvert$	-0.268**	-0.246**	-0.203*
$\lvert R_t^i\pi_{t+h}\rvert$	-0.0381	-0.00557	0.00822
$\lvert R_t^i\pi_y\rvert$	-0.00635	-0.0037	-0.0366
$\lvert R_t^i\pi_{y_0}\rvert$	-0.029	-0.0808***	-0.0359
$F_t^iC_{t+12}$	-0.0721	-0.0625	-0.0594

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

5.3 Sign of revisions

As usual in the literature, we reported inflation expectation revisions and forecast errors in absolute value. We showed that while firms that adjust wages forecast inflation more accurately, there are no statistical significant differences in expectation revisions between firms that adjust and those that do not adjust wages. This is the case when revisions are expressed in absolute value, but could be that in the month of wage adjustment firms revise their expectations systematically up or down.

Let define S_{it} as a dummy variable that takes the value 1 if firm i revises its inflation expectation upwards or do not revise it at all at time t and, 0 otherwise - i.e. revise downwards. Then, we estimate a conditional fixed-effects logit model of S_{it} controlling for the month of wage adjustment, A_{it}, month, time trend and lagged observed inflation. To further investigate the mechanism of expectations revisions, we also estimate the following model for inflation expectations revisions:

$$R_t^i\pi_{t+h} = \alpha_i + \beta_1 A_{it} + \beta_2\pi_{t-1} + \beta_3 t + \gamma_m + \epsilon_{it}$$

Results are summarized in Table 5.4. First, firms are less likely to revise their inflation expectations upwards or do not revise them at all in the months of wage adjustment. This is also confirmed in the revision regression: firms that adjust wages revise, on average, their expectations downwards.

Table 5.4: *Inflation expectations revisions*

	Coeff. on A_{it}	s.e	t	p-value
S_{it}	-0.248***	0.0673	-3.68	0.000
$R_t^i \pi_{t+h}$	-0.143**	0.0691	-2.07	0.042

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

6 Facts and theory

Our results point to the idea of the existence of information frictions and reject the full information rational expectations theory. Thinking about the two main information friction competing models, the sticky information model of Mankiw and Reis (2002) and the rational inattention model of Woodford (2003), Sims (2010) and Maćkowiak and Wiederholt (2009), our results suggest that neither match the data well.

According to Mankiw and Reis (2002) sticky information model, agents update their information set infrequently but when they update their beliefs they acquire full information and form their expectations rationally. This implies that agents that acquire new information have the same information and thus, should have the same inflation forecast. On the other hand, in the noisy information model it is assumed that agents continuously update their information set, but get the information with a noisy signal. At the average level, both models predict infrequent beliefs updating and under-response of inflation expectations to shocks to inflation. These empirical facts are confirmed in our data and thus are consistent with models of information frictions.

Also consistent with the rational inattention model is the fact that smaller firms' inflation expectations are less accurate than larger ones. This is in line with the prediction that firms with a higher benefit from accurate expectations, arguably larger firms, will be more informed and thus produce more accurate expectations. Moreover, we also find that firms that adjust wages form more accurate inflation expectations than those that do not adjust wages, in line with the noisy information model prediction that agents with lower information acquisition costs are more informed and thus form more accurate expectations. Given that in the month of wage adjustment firms are forced to know past inflation, at least in that month, information acquisition cost is lower and forecast errors decrease. Contrary to the noisy information and consistent with the sticky information model is the fact that firms seem to update their information set and revise their inflation expectations infrequently.

Another empirical fact that goes against the noisy information model is the increase in disagreement vis-a-vis with inflation. According to this model, disagreement about future inflation across agents is independent of current inflation and then the dynamics of inflation expectation dispersion should be uncorrelated with observed inflation (Coibion and Gorodnichenko (2012)). On the other hand, the sticky information model predicts a positive response of disagreement to shocks. Then, according to the sticky information model, if we assume that inflation increases unexpectedly, we should expect an increase in inflation expectations disagreement. As we already shown, disagreement increases together with the increase in inflation after mid-2014 and declines gradually with the decline in inflation observed after early 2016 so, as predicted by the sticky information model, it seems to respond positively to shocks to inflation.

As an additional check, we follow Coibion and Gorodnichenko (2015) to test the full-information rational expectations hypothesis and the presence of information frictions. Contrary to Coibion and Gorodnichenko (2015) that use data on US professional forecasters, we focus on Uruguayan firms' inflation expectations. We first test the predictability of ex-post forecast errors controlling for ex-ante forecast revisions. According to both the sticky information and the noisy information models, when averaging across firms, forecast revisions predict forecast errors if information frictions are present. Thus, Coibion and Gorodnichenko (2015) propose the following empirical specification:

$$\pi_{t+12} - F_t\pi_{t+12} = \alpha + \beta(F_t\pi_{t+12} - F_{t-j}\pi_{t+12}) + \epsilon_t$$

Where, in our case, $j = 18, 24$. In their estimation and because of the type of data they have, *beta* is directly related to information rigidities. Then, for the sticky information model they show that $\beta = \frac{\lambda}{1-\lambda}$ where λ is the degree of information rigidity and β is the average duration between information updates. For the noisy information model $\beta = \frac{1-G}{G}$ where G is the Kalman gain or the weight put to new information compared to the previous inflation projection. If the signal received by the agents is noisy, then $G < 1$.

Unfortunately, we do not have forecast revisions in t and $t-1$ so we are not able to estimate Coibion and Gorodnichenko (2015) proposed equation directly by OLS. But we can exploit the fact that our survey asks about inflation expectations in different time horizons to construct our measure of inflation expectations revisions. The problem with our revision measure is that it is not available in adjacent periods. This implies that there are terms that appear in the error term and thus we have to estimate our model by IV as Coibion

and Gorodnichenko (2015) do in their equation 18. Instead of using the change in oil prices, we use the change in the US Dollar-Uruguayan peso exchange rate as the instrument for inflation revisions [14]. Results are shown in Table 6.1.

Table 6.1: *Presence of information rigidity in firms inflation forecasts*

	Forecast error $\pi_{t+12} - F_t\pi_{t+12}$
Forecast revision	1.406***
	[0.489]
Constant	-0.672***
	[0.226]
1st stage F-stat	24.53
Observations	75

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

We estimate a coefficient on forecast revisions of 1.4 for Uruguayan firms. Then, ex-ante forecast revisions predict ex-post inflation forecast errors implying the presence of information frictions. A difference between Coibion and Gorodnichenko (2015) and our results is that we find the constant to be statistically significant different from zero, suggesting that firms in Uruguay forecast inflation with a (negative) bias. The latter is not only a feature of the average forecast error across firms but also appears when looking at the individual level [15]. This results might be because inflation in Uruguay is more volatile than in the US or New Zealand and thus firms do not anticipate shocks to inflation that translate into forecast errors. According to Coibion and Gorodnichenko (2012), in both the sticky and noisy information models, as information rigidity increases the forecast errors are more persistent. The existence of information rigidities together with large inflation shocks might help to explain the negative bias in forecast errors that we find among Uruguayan firms.

In conclusion, our results reject the full information rational expectations theory and confirm the existence of information frictions in the inflation expectations formation process of Uruguayan firms. Our empirical facts, though, are not entirely consistent with the two main theoretical models on information rigidities. In light of our results, it seems that we need a hybrid model between the sticky and noisy information models in order to describe these data.

[14] See Appendix for more details about the relationship between inflation and exchange rate movements in Uruguay.

[15] As reported in Frache and Lluberas (2018) of 342 firms with more than 40 months of information, 36% have a positive bias in inflation forecast errors, another 36% have a negative bias in their forecast errors and the rest, 28%, have no bias in their forecast errors.

7 Conclusion

In this paper, we provide evidence on how firms form their inflation expectations and how this is affected by the acquisition of new information. Using a firm-level survey conducted every month in Uruguay we show that firms generally have persistent forecast errors, that there is an important proportion of firms that do not revise their expectations frequently, and that there is substantial disagreement about future inflation across firms.

In the second part of the paper we provide evidence on how inflation prospects are affected by the acquisition of information about past inflation. For that, we exploit the variation in the month of wage adjustment previously agreed upon in the negotiations between workers and firms to estimate the impact of acquiring information about past inflation on expected future inflation. We argue that the month of wage adjustment is indicative of firms acquiring new or more information. If that is the case, we should expect differences in inflation expectations between firms that adjust and those that do not adjust wages in each month.

Our results suggest that, on average in the months of wage adjustment, firms that adjust their wages expect future inflation to be lower than firms that do not adjust wages. We also show that firms' inflation forecasts are more accurate at the time of wage adjustments and that there is less disagreement across firms about future inflation. All these results point to the idea that the acquisition of information by firms affects their beliefs about future inflation.

Overall, our empirical results reject the full information rational expectations theory and confirm the existence of information frictions in the inflation expectations formation process of Uruguayan firms. Our empirical facts, though, are not entirely consistent with the two main theoretical models on information rigidities and it seems that we need a hybrid model between the sticky and noisy information models in order to capture the features of our empirical facts.

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8 Appendix

Firm industrial sector: detailed results

Table 8.1 and Table 8.2 show the estimated industrial sector level dummy variables shown in Figure 4.13. In both cases the ommitted sector is manufacturing.

$$F_t^i \pi_{t+12} = \alpha + \sum_j D_i^j \delta^j + \beta_1 \pi_{t-1} + \beta_2 t + \gamma_m + \epsilon_{it}$$

Table 8.1: *Mean expected inflation*

	δ^j	s.e	t	p-value
Electricity, gas and water supply	-2.0014***	0.1021	-19.6	0.000
Construction	-0.3678***	0.0448	-8.2	0.000
Trade	-0.0662**	0.0234	-2.8	0.005
Hotels and restaurants	0.2380***	0.0681	3.5	0.000
Transport, storage and communications	0.3215***	0.0299	10.8	0.000
Real estate, renting and business activities	0.0517	0.0377	1.4	0.171
Education	0.8956***	0.0616	14.5	0.000
Health and social work	0.0658	0.0510	1.3	0.197

* p<0.05, ** p<0.01, *** p<0.001

$$AFE_{it,t+12} = \alpha + \sum_j D_i^j \delta^j + \beta_1 \pi_{t-13} + \beta_2 t + \gamma_m + \epsilon_{it}$$

Table 8.2: *Forecast error (absolute values)*

	δ^j	s.e	t	p-value
Electricity, gas and water supply	0.6876***	0.1419	4.84	0.000
Construction	-0.4784***	0.0469	-10.19	0.000
Trade	-0.1139***	0.0202	-5.63	0.000
Hotels and restaurants	0.2990***	0.0591	5.06	0.000
Transport, storage and communications	-0.0501*	0.0274	-1.83	0.067
Real estate, renting and business activities	0.0018	0.0277	0.06	0.950
Education	0.2991***	0.0633	4.73	0.000
Health and social work	-0.0058	0.0494	-0.12	0.906

* p<0.05, ** p<0.01, *** p<0.001

Complete results: wage adjustment

Table 8.3: *Estimation results*

	$F_t^i\pi_{t+12}$	$\lvert FE_{it,t+12}\rvert$	$\lvert FE_{it,y}\rvert$	$\lvert FEX_{it,t+12}\rvert$	$\lvert R_t^i\pi_{t+h}\rvert$	$\lvert R_t^i\pi_y\rvert$	$\lvert R_t^i\pi_{y0}\rvert$	$F_t^iC_{t+12}$
A_{it}	-0.0751*	-0.155**	-0.0932	-0.211**	-0.0109	-0.00649	-0.0808***	-0.0619
	[0.0402]	[0.0648]	[0.0715]	[0.0976]	[0.0439]	[0.0216]	[0.0236]	[0.0638]
Lag. inflation	0.364***	0.0512	0.233**	0.154	0.102*	0.0207*	0.0742**	0.296***
	[0.0322]	[0.116]	[0.0982]	[0.187]	[0.0545]	[0.0114]	[0.0285]	[0.0471]
t	0.0206***	0.00899***	0.0022	0.00716	0.00335**	0.00132***	-0.00118	0.0171***
	[0.00106]	[0.00315]	[0.00311]	[0.00739]	[0.00152]	[0.000461]	[0.00126]	[0.00158]
January	Omitted	Omitted	Omitted	Omitted	Omitted			Omitted
February	0.0391	0.442***	-0.0225	0.146	0.0453	Omitted	Omitted	0.00216
	[0.0585]	[0.147]	[0.0970]	[0.237]	[0.0683]			[0.0872]
March	0.029	0.553**	-0.0556	0.292	0.162	-0.0339	0.0924***	0.00101
	[0.0794]	[0.224]	[0.137]	[0.354]	[0.129]	[0.0260]	[0.0317]	[0.107]
April	0.0761	0.528*	-0.08	0.437	0.234*	-0.0378	0.201***	0.021
	[0.0739]	[0.282]	[0.152]	[0.459]	[0.125]	[0.0493]	[0.0560]	[0.114]
May	0.0243	0.162	-0.157	-0.0827	0.15	-0.0879***	0.223***	-0.0316
	[0.0896]	[0.180]	[0.167]	[0.419]	[0.121]	[0.0293]	[0.0587]	[0.112]
June	0.0399	0.133	-0.161	-0.282	0.102	-0.0885***	0.269***	-0.00517
	[0.0840]	[0.177]	[0.177]	[0.400]	[0.127]	[0.0331]	[0.0568]	[0.122]
July	0.117	0.0288	-0.141	-0.165	0.0242	-0.0884***	0.371***	-0.00407
	[0.0797]	[0.133]	[0.175]	[0.345]	[0.0969]	[0.0291]	[0.0562]	[0.120]
August	0.0998	-0.153	-0.245	-0.283	0.0245	-0.0883***	0.353***	0.0279
	[0.0847]	[0.147]	[0.199]	[0.389]	[0.0940]	[0.0263]	[0.0602]	[0.118]
September	0.148*	-0.121	-0.264	-0.23	-0.00852	-0.0736**	0.399***	0.0839
	[0.0835]	[0.139]	[0.200]	[0.402]	[0.0952]	[0.0345]	[0.0694]	[0.119]
October	0.106	-0.0603	-0.29	-0.15	-0.0562	-0.0818***	0.455***	0.0503
	[0.0845]	[0.139]	[0.189]	[0.384]	[0.0810]	[0.0252]	[0.0544]	[0.121]
November	0.0757	0.092	-0.351*	-0.164	-0.128*	-0.0451	0.476***	0.0557
	[0.0717]	[0.114]	[0.178]	[0.311]	[0.0700]	[0.0376]	[0.0430]	[0.114]
December	0.00334	0.0372	-0.465**	-0.128	-0.103*	-0.0445	0.509***	0.0156
	[0.0596]	[0.101]	[0.180]	[0.246]	[0.0580]	[0.0457]	[0.0540]	[0.0964]
Cons.	-7.333***	-4.917**	-1.902	-4.286	-2.061**	-0.622**	0.541	-3.070***
	[0.571]	[1.974]	[1.804]	[4.462]	[0.903]	[0.276]	[0.678]	[0.820]
N	32,022	24,854	30,800	24,854	26,607	29,894	26,700	32,022
R-sq	0.326	0.093	0.092	0.086	0.027	0.007	0.043	0.059

Driscoll-Kraay standard errors in brackets.
* p<0.10, ** p<0.05, *** p<0.01

Table 8.4: *Estimation results: lags and leads*

	$F_t^i\pi_{t+12}$	$\lvert FE_{it,t+12}\rvert$	$\lvert FE_{it,y}\rvert$	$\lvert FEX_{it,t+12}\rvert$	$\lvert R_t^i\pi_{t+h}\rvert$	$\lvert R_t^i\pi_y\rvert$	$\lvert R_t^i\pi_{y0}\rvert$	$F_t^iC_{t+12}$
A_{it-1}	-0.0933*	-0.151*	-0.0852	-0.268**	-0.0381	-0.00635	-0.029	-0.0721
	[0.0500]	[0.0796]	[0.0731]	[0.124]	[0.0428]	[0.0173]	[0.0276]	[0.0870]
A_{it}	-0.0671	-0.173**	-0.0883	-0.246**	-0.00557	-0.0037	-0.0808***	-0.0625
	[0.0463]	[0.0760]	[0.0780]	[0.114]	[0.0480]	[0.0209]	[0.0266]	[0.0715]
A_{it+1}	-0.053	-0.154*	0.0136	-0.203*	0.00822	-0.0366	-0.0359	-0.0594
	[0.0348]	[0.0823]	[0.0446]	[0.113]	[0.0510]	[0.0277]	[0.0319]	[0.0781]
Lag. inflation	0.356***	0.0604	0.243**	0.201	0.127**	0.0256**	0.0847***	0.279***
	[0.0346]	[0.128]	[0.0995]	[0.193]	[0.0552]	[0.0126]	[0.0321]	[0.0532]
t	0.0210***	0.00895***	0.002	0.0064	0.00236	0.00118**	-0.00145	0.0166***
	[0.00108]	[0.00315]	[0.00308]	[0.00722]	[0.00142]	[0.000488]	[0.00138]	[0.00179]
January	Omitted	Omitted	Omitted	Omitted	Omitted			Omitted
February	0.0841	0.503***	0.0366	0.285	0.0525	Omitted	Omitted	0.0476
	[0.0563]	[0.160]	[0.0984]	[0.233]	[0.0780]			[0.0748]
March	0.0421	0.528**	-0.0208	0.342	0.165	-0.0308	0.0757*	0.0292
	[0.0792]	[0.237]	[0.140]	[0.364]	[0.141]	[0.0291]	[0.0408]	[0.109]
April	0.0991	0.503*	-0.0854	0.393	0.156	-0.0446	0.148**	0.0404
	[0.0779]	[0.275]	[0.150]	[0.459]	[0.124]	[0.0518]	[0.0590]	[0.115]
May	0.03	0.135	-0.154	-0.128	0.119	-0.0957***	0.202***	-0.0305
	[0.0880]	[0.184]	[0.163]	[0.430]	[0.124]	[0.0279]	[0.0555]	[0.112]
June	0.0934	0.209	-0.171	-0.191	0.0701	-0.0702**	0.274***	0.0174
	[0.0809]	[0.165]	[0.163]	[0.378]	[0.114]	[0.0333]	[0.0518]	[0.112]
July	0.129*	0.0224	-0.135	-0.169	0.00314	-0.0930***	0.345***	-0.00476
	[0.0774]	[0.132]	[0.175]	[0.351]	[0.0938]	[0.0290]	[0.0536]	[0.109]
August	0.165*	-0.079	-0.196	-0.151	0.0136	-0.0972***	0.341***	0.0675
	[0.0858]	[0.135]	[0.196]	[0.354]	[0.104]	[0.0285]	[0.0589]	[0.0948]
September	0.152*	-0.137	-0.26	-0.255	-0.0165	-0.0747**	0.384***	0.0613
	[0.0867]	[0.141]	[0.198]	[0.410]	[0.100]	[0.0338]	[0.0681]	[0.122]
October	0.127	-0.0733	-0.278	-0.187	-0.0735	-0.0969***	0.435***	0.0534
	[0.0864]	[0.142]	[0.185]	[0.397]	[0.0852]	[0.0256]	[0.0555]	[0.119]
November	0.0897	0.0773	-0.354**	-0.189	-0.151**	-0.0508	0.448***	0.127
	[0.0758]	[0.121]	[0.175]	[0.323]	[0.0739]	[0.0390]	[0.0464]	[0.122]
December	0.056	0.095	-0.457**	-0.0552	-0.126**	-0.0244	0.519***	0.115
	[0.0612]	[0.0968]	[0.181]	[0.238]	[0.0601]	[0.0509]	[0.0643]	[0.124]
Cons.	-7.499***	-4.946**	-1.868	-4.144	-1.615*	-0.572**	0.645	-2.613***
	[0.575]	[1.946]	[1.796]	[4.362]	[0.864]	[0.282]	[0.726]	[0.926]
N	29,462	23,428	28586	23428	24917	27517	24759	30285
R-sq	0.342	0.094	0.098	0.099	0.027	0.008	0.045	0.057

Driscoll-Kraay standard errors in brackets.
* p<0.10, ** p<0.05, *** p<0.01

Complete results: revision mechanism

Table 8.5: *Revision mechanism*

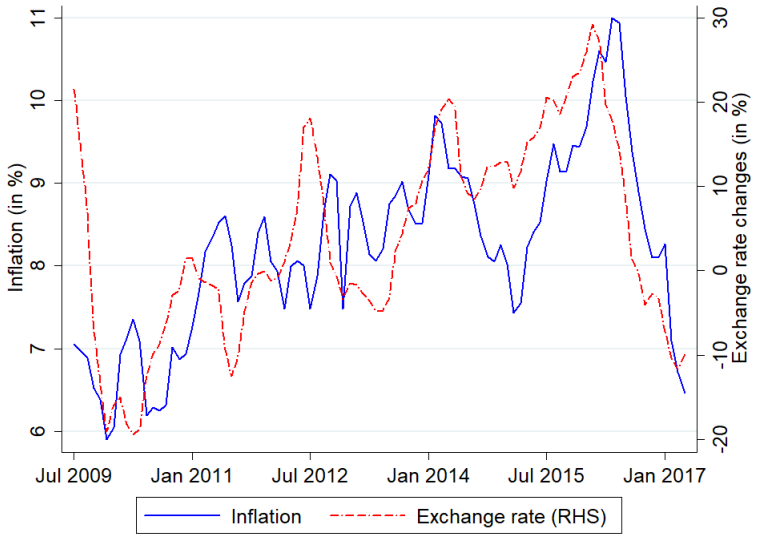
	$R_t^i \pi_{t+h}$	S_{it}
A_{it}	-0.143**	-0.248***
	[0.0691]	[0.0673]
Lag. inflation	0.497***	0.732***
	[0.0873]	[0.0201]
t	-0.00853***	-0.0164***
	[0.00235]	[0.000781]
January	Omitted	Omitted
February	-0.0841	-0.252***
	[0.113]	[0.0815]
March	-0.0358	-0.194**
	[0.149]	[0.0834]
April	-0.114	-0.370***
	[0.184]	[0.0801]
May	-0.195	-0.538***
	[0.203]	[0.0813]
June	-0.0997	-0.389***
	[0.165]	[0.0828]
July	0.164	0.342***
	[0.156]	[0.0724]
August	0.0184	0.127
	[0.190]	[0.0819]
September	0.000793	0.231***
	[0.204]	[0.0821]
October	-0.0349	0.0864
	[0.171]	[0.0796]
November	-0.0496	0.0858
	[0.144]	[0.0803]
December	-0.0797	0.0128
	[0.124]	[0.0799]
Cons.	1.602	
	[1.435]	
N	26,607	26,125
R-sq	0.073	

Inflation and exchange rate changes

We use the 12-months change in the exchange rate between the US Dollar and the Uruguayan peso as an instrument for inflation revisions. Being Uruguay a small open economy in which many transactions are denominated in US Dollars, there is a high correlation between the depreciation of the local currency and inflation. Indeed, movements in the exchange rate have effects on CPI inflation in Uruguay and explain a large proportion of its variation.

Figure 8.1 shows the evolution of annual inflation and exchange rate changes in the period under analysis.

Figure 8.1: *Inflation and exchange rate changes*



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