Belief-Dependent Pricing Decisions*

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Abstract

[PRELIMINARY VERSION]

This paper studies the effects of inflation and idiosyncratic cost expectations on firms' price-adjusting decisions. We explore a novel monthly survey data on firms' expectations in Uruguay. Through the survey, we can directly assess price-adjustment decisions with firms' expectations while controlling for time and state-dependent factors. While inflation expectations do not play any role in our results, firms' beliefs about an expected increase in their overall costs matter as they positively affect the probability of adjusting prices. The evidence is consistent with the presence of forward-looking pricing at the firm level. The expectation channel is, however, heterogeneous across firms and operates with a delay. We show that the effect is driven exclusively by large firms. Being the beliefs about costs more volatile than inflation, the null reaction to this later expectation is in line with the theoretical predictions of Rationally-Inattentive price-setters.

JEL: D22, D84, E31.

Keywords: inflation expectations, costs expectations, firms' survey, price adjustments.

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1 Introduction

Economic decisions are forward-looking. Beliefs are central as they should have an immediate effect on decisions. For price-setting decisions, any canonical New Keynesian Phillips Curve model would introduce an equation where the optimal price is determined by a discounted sum of firms' future beliefs for the aggregate price level and the expected evolution of the marginal costs. While most of the empirical evidence studying the effects of expectations on pricing decisions are typically at the macro level, Galı and Gertler (1999), Gali et al. (2005) and Sbordone (2005), the evidence is more scarce at the micro-level, Carlsson and Skans (2012). Further evidence on forward-looking pricing is crucial as it will directly support the presence of price-setting frictions at the firm level. However, the lack of firm-level data on price adjustment decisions and their characteristics, *combined* with firm's beliefs about both aggregate and idiosyncratic conditions challenges this task. This paper aims to fill this gap by using a long and unexplored survey of firms' expectations in Uruguay. Thereby, we aim to answer the following questions: Do firm expectations *matter* for price-adjustments decisions? Is the response to aggregate and idiosyncratic expectations similar? Is the effect of beliefs heterogeneous across firms?

Evidence of price-setting frictions using micro-data has been studied through the lens of both time-dependent and state-dependent models.[1] In this paper, we argue that price-adjustments decisions are also *belief-dependent*. Using a novel survey of firms' expectations run by the Central Bank of Uruguay, we provide empirical evidence supporting this third channel as an important driver of price revisions. Firms are asked to provide their predictions about the expected evolution of inflation and the rate by which they think their costs would increase over the next year. Given evidence about the extensive margin of price changes along with firms' time-invariant characteristics allow us to assess separately the role of these two beliefs on pricing decisions.

Our results support the relevant role of expectations on firms decisions. The main contributions are the following. First, we argue that one year ahead expectations significantly affect current price adjustment decisions. On the one hand, we show that idiosyncratic beliefs matter for this decision, while on the other hand, inflation expectations do not seem to play any role. Second, we document that the effect of expectations operates with a *delay*. We show that if firms believe their costs would increase by 1% in a year from now, this

[1] See for instance, Taylor (1980), Calvo (1983), Klenow and Kryvtsov (2008), Nakamura and Steinsson (2008) and Vavra (2013) among others.

significantly increases the probability of adjusting prices by 0.6% after three months. We validate this result and its timing, by adding a special question during one month of the survey, which confirms our empirical results. Third, we show that the effect of expectations on pricing decisions are highly *heterogeneous* across firms since the idiosyncratic belief channel is only present across large firms. Small and medium firms does not seem to react to expectations. To the best of our knowledge, there is no empirical evidence studying the potential heterogeneous effects of beliefs on firms' decisions. Fourth, besides size, we argue that the belief channel is particularly relevant for multi-product firms.

Regarding our main results we argue that they are consistent with existing results in the literature of both price-adjustments and information frictions. Midrigan (2011) argues that idiosyncratic shocks are large and price-adjustment decisions are driven mostly by idiosyncratic rather than aggregate shocks. Moreover, the distribution of price changes does not change from periods of low to high inflation. The delayed effect of costs to prices is documented by Nakamura and Zerom (2010). The authors report that menu-costs are key to rationalize the delayed response.[2] These results documents a tight link between firms costs, price-rigidities and it short-run dynamics. Our belief-dependent channel supports these findings by stressing that the estimated implications of *cost expectations* goes in the same direction as the literature. Finally, and now asking wether our results are useful to understand how firm form their expectations, we claim that the belief-dependent mechanism is consistent with the theoretical predictions of Rationally Inattentive price-setters as documented by Maćkowiak and Wiederholt (2009). As inflation is high but stable in Uruguay, this reduces the incentives of firms to pay attention to its evolution, deciding to learn and react more to idiosyncratic - and more volatile - costs. We build a cost index at the firm level using balance sheet information from which we are able to validate this insight. showing that The evidence thus reinforce theories of inattention as an important constraint to understand firms' information acquisition in line with recent evidence, Coibion et al. (2018). Hence, rather than framing our results within price or information rigidities we interpret them as direct evidence that both of these rigidities coexists at the firm level, supporting theories that combine these two frictions such as Alvarez et al. (2011).

The effect of idiosyncratic beliefs is significant even after controlling for time-dependent (fixed and exogenous price adjustment plans on the firm level) and state-dependent variables which also affect pricing

[2]While the results of Midrigan (2011) focused on retailer prices, Pasten et al. (2019) also found that large idiosyncratic shocks are important to explain PPI data. On the other hand, Dias et al. (2011) also finds significant evidence of delays in price-adjustments using a detailed survey of Portuguese firms.

decisions. We augmented the estimation by controlling for observable firm level characteristics while we aim to capture the potential unobserved time-invariant characteristics by estimating a Correlated Random Effects (CRE, henceforth) Probit Model. In addition, we show that our reported belief-dependent channel and its timing is robust after allowing for the possibility that the cost expectation is endogenous. In this case we rely on a Control Function approach embedded with the CRE model, showing that the magnitude of effects of cost expectations remains unaffected under this scenario. Finally, the results are also robust if we instead rely on a linear probability model where we control for unobserved fixed-effects.

Literature Review. While there is a growing literature on how expectations are formed, Coibion and Gorodnichenko (2012), Andrade and Bihan (2013), and Giacomini et al. (2020), there is much less evidence on how expectations quantitatively affect economics decisions. This is partly because most of the literature studying expectations relies on forecasts from professionals, where the representativeness of these agents and the implications of their decisions for the economy, are at least questionable. Surveys asking for expectations across more relevant economic actors, such as firms or households, are much more scarce. For households, Coibion et al. (2019) studies how different forms of monetary policy communication affects household inflation expectations. Relative to firms, Boneva et al. (2019) documents several stylized facts about how expectations across firms are formed. This paper founds a significant relationship between past expected price and wage increases. Coibion et al. (2018) shows that higher inflation expectations from firms have a significant effect on firms' pricing, hiring, and credit decisions. Our paper contributes to this literature by separating the effect of aggregate and idiosyncratic expectations as well as stressing its heterogeneous effects.

From an empirical point of view, the role of firm's beliefs on price-adjustment decisions has not been much explored, despite the growing literature acknowledging the importance of this channel, Woodford (2003), Maćkowiak and Wiederholt (2009), Matějka (2015), Baley and Blanco (2018) and Stevens (2019). Relative to the evidence on the determinants of price-adjustments decisions at the firm level, Lein (2010) argues that besides time-dependent pricing rules, the evidence supports the presence of state-dependent price adjusting decisions. Bachmann et al. (2019) argues that idiosyncratic business volatility positively affects the extensive margin of prices, leading the volatility effect to dominate the potential "wait-and-see". The results in this paper complement this evidence by claiming that the expectation channel is also a key determinant behind the frequency of price changes.

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 2, we present the data used in the empirical analysis and the notation and definitions that follow in the paper. In section 3, we discuss the main stylized facts of the survey, while in section 4 we discuss the estimation strategy. In 5, we present the main results of the empirical analysis in terms of firms' expectations and pricing decisions. Finally, section 7 concludes.

2 The Survey

Uruguay is characterized by high but stable inflation (8% on average during the last decade), see figure 8.1 in the Appendix.

For our empirical analysis we use a novel firm level survey carried out by the National Statistical Institute (INE) and commissioned by the Central Bank of Uruguay (BCU) aimed to track firms' inflation expectations. The firms' panel is conducted on a monthly bases and started on June of 2009. Importantly, the survey is representative at both country and sector levels, which is not a common feature of these type of surveys.

Every month, firms are asked about their inflation expectations (i.e. the expected annual change in the Consumer Price Index) along with their own costs expectations. These two questions are asked for different time horizons: the current year, the next 12 months and the next 24 months. [3] In addition, recently the survey also collects information about firms' price adjustments decisions. Starting on June 2017 firms are asked when they changed the price of their main product. It is a closed-end question in which firms can answer: this month, a month ago, two months ago, three months ago, four months ago, five months ago, six months ago and seven or more months ago. We consider that a firm changed the price of its main product if its answer to the question in the current month. Our analysis is built around this last question.

Our data is quite unique in several dimensions. Table 2.1 compares the Uruguayan survey with other common surveys of firms' expectations. As mentioned, probably the most distinct feature of our survey is the possibility of separately having quantitative information about inflation and idiosyncratic costs beliefs for different time horizons paired with data on price decisions. Relative to the sampling frequency, the Atlanta FED Business Inflation Expectation (BIS) survey also collects information at a monthly bases but its only representative across six states in the US. The New Zealand survey is not conducted on a regular basis as

[3]More details about the survey can be found in Frache and Lluberas (2018).

in Uruguay and do not have periodic information on beliefs about inflation and own costs together with information on firms economics decisions. Finally, both the UK and the Italian survey collects quarterly information about yearly inflation.

Table 2.1: *Common Surveys of Firms Expectations*

	Uruguay	USA	New Zealand	United Kingdom	Italy
First Survey	2009	2011	1987	2008	1999
Frequency	M	M	Q	Q	Q
Inflation expectations	✓	X	✓	✓	✓
Costs expectations	✓	✓	X	X	X
Forecasted Var.	Year, 12m, 24m	12m	3m, 12m	12m	12m
Bins	Open	5	Open	4	Open
Sampling	Representative	Non-Random	Convenience	Convenience	?
Institution	Central Bank	Atlanta Fed	Central Bank	CBI	Central Bank

Another important survey, which has been used extensively for this type of analysis, is the Ifo Business Climate Survey in Germany. However, we chose to omit this Survey from Table 2.1 mostly for comparability, due to the qualitative nature of the responses.

3 Stylized Facts

In this section we document four stylized facts about firms' expectations about aggregate prices and own costs as well as for firms' pricing decisions.

3.1 Stylized facts about costs and inflation expectations

3.1.1 Stylized fact 1: Expectations and firms size

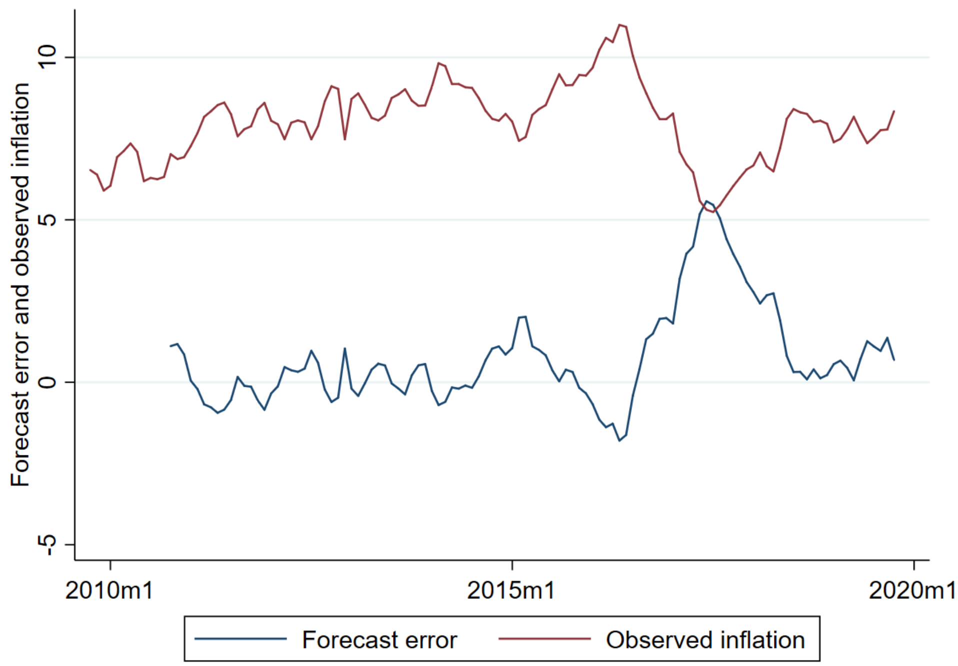
Previous literature has highlighted the role of attentiveness in pricing decisions (Coibion et al. (2018)). In order to explore this, we first define forecast error for firm i at time t, as the difference between its 12-month ahead inflation expectation at time t and observed inflation during that period:

$$FE_t^i = \pi_{t+12} - F_t^i \pi_{t+12}$$

Note that even though the expectation and the actual inflation refer to the same time period, whilst

$F_t^i \pi_{t+12}$ is observed at time t, inflation between t and $t+12$, π_{t+12}, is observed at time $t+12$, once it is realized. Figure 3.1 shows the across firms average forecast errors for inflation and own costs over the sample period. It has already been shown in previous works (Frache and Lluberas (2018)) that firms in Uruguay are much better predictors than firms in New Zealand. On average, forecast errors are close to zero until 2017 when both aggregate inflation and own costs started to fluctuate a bit more and neither the increase between mid-2015 and mid-2016 nor the decline between end-2016 and end-2017 were anticipated by firms.

Figure 3.1: *Mean forecast error and observed inflation*



Frache and Lluberas (2018) showed that there is heterogeneity in attentiveness about aggregate inflation across firms. Then, we are going to classify firms according to their size based on their production cost [4]. We divide the sample in three groups based on firm size and categorize firms in small, medium and large [5].

We then look at how forecast errors change by firm size. Table 3.1 shows average 12-months ahead inflation and own costs expectations as well as the forecast errors according to firm size. On average, large

[4]Information about firms' balance sheet is only available on a yearly basis and, for most years,for a sub-sample of firms. To classify firms by size we use balance sheet information for the year 2012 as for that year we have information for almost all the firms in our survey sample. We then assume that firm's size ranking does not change substantially over time.

[5]We call the first group of firms *small* but it is worth noting that the survey sample is representative of firms with more than 50 employees and thus not considered very small in Uruguay.

firms expect a slightly lower inflation and own costs changes than medium and small firms. Moreover, larger firms are better forecasters than medium and small firms. While inflation forecast error among large firms is just 0.3 percentage points, the figure is 0.7 for medium and 1 for small firms. That pattern is also present when looking at own costs forecast errors: large firms own costs forecast errors is smaller than that of medium and small firms. Overall these results point to the idea that larger firms are more attentive than smaller ones, both in terms of aggregate inflation and idiosyncratic costs.

Table 3.1: *Inflation and costs expectations by firm size (in %)*

	Inflation expectations	Forecast error Inflation	Costs expectations
Small	9.2	1.0	10.9
Medium	8.9	0.7	10.3
Large	8.6	0.3	9.4

3.1.2 Stylized fact 2: Volatility

The second stylized fact is related to the volatility of aggregate and idiosyncratic variables. A point highlighted by previous literature (Maćkowiak and Wiederholt (2009)) about firms' pricing decisions is the idea that firms pay more attention to idiosyncratic conditions when they are more volatile than aggregate conditions. Then, according to Maćkowiak and Wiederholt (2009), if firms' own costs are more variable than aggregate prices, firms would pay more attention to idiosyncratic than to aggregate conditions when setting prices. In order to check this we compute a measure of dispersion for aggregate inflation and for firm specific costs. The standard deviation of idiosyncratic conditions is defined as:

$$Std^{C}_{i,t} = \sqrt{\frac{1}{6}\sum_{j=0}^{5}(C_{i,t-j+12} - \overline{C}_{i,t-5+12}))^2}$$

Where $\overline{C}(.)$ is the average cost of firm i between t and $t-5$ (*rolling window*). We do not have a direct measure of firms cost but can construct a measure of *projected* costs at the firm level defined as:

$$x_{it2} = \text{Proj.Cost}_{it} = PI_{jt}CS_{ij2012} \tag{3.1}$$

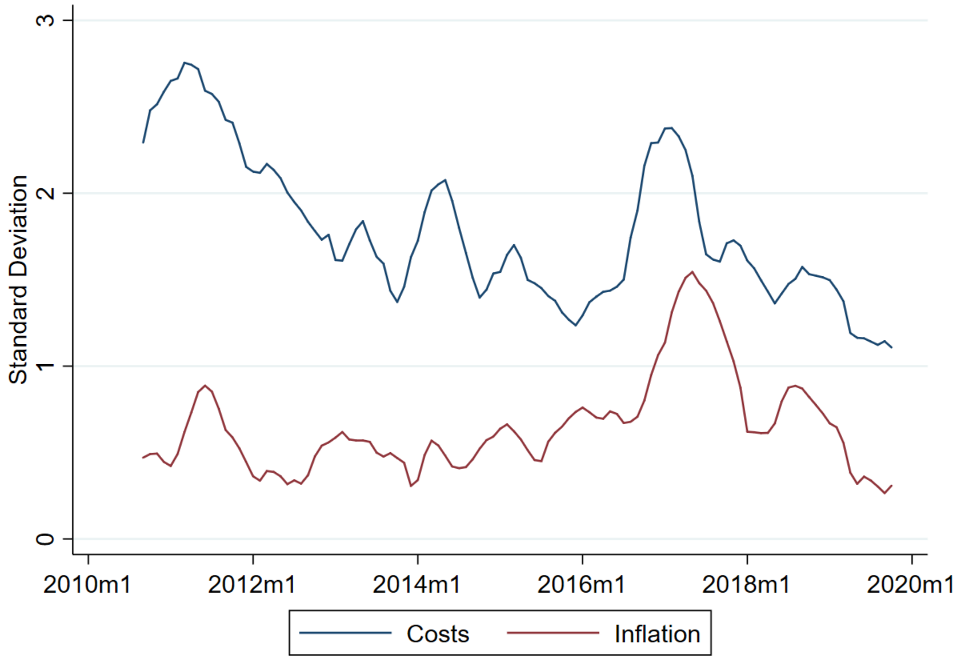
We rely on information from the "Annual Survey of Economic Activity" of 2012. This data collects Balance Sheet information from a large sample of firms in Uruguay. We got granular information of salaries, inputs, expenses and goods which are originally bought by the firm and then resold without transformation. We label each of these four categories with j. PI_{jt} is a price index for each spending category j during month t and CS_{ij2012} is the cost structure for each category during year 2012 for firm i. This variable is going to be used as an instrument for expected costs in a robustness check we perform in Section 6.1.

We also define the standard deviation for aggregate conditions as:

$$Std_t^{\pi} = \sqrt{\frac{1}{6}\sum_{j=0}^{5}(\pi_{t-j+12} - \overline{\pi}_{t-5+12}))^2}$$

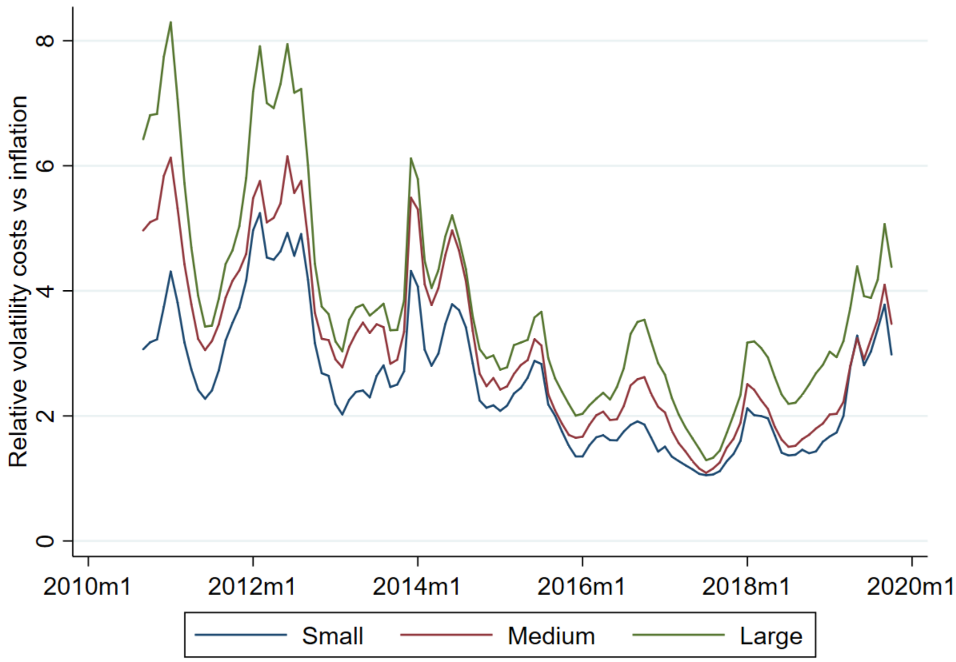
Where $\overline{\pi}(.)$ is average inflation between t and $t-5$ and, as it captures the volatility for aggregate conditions, is constant across firms. Results shown in Figure 3.2 allow us to assess the time-varying patterns of aggregate and idiosyncratic conditions. Given that idiosyncratic conditions are more variable than aggregate conditions, we should expect to see a larger effect of own costs expectations than inflation expectations in firms' pricing decisions. The volatility of both aggregate and idiosyncratic conditions translates in similar patterns for firms' beliefs (see Figure **??**in the Appendix).

Figure 3.2: *Average volatility of own costs and aggregate inflation*



We showed that firms' costs are more volatile than inflation and that is also the case for firms' belief about idiosyncratic and aggregate conditions. Figure 3.3 shows the ratio of the average volatility of own costs to inflation for the three firm sizes considered in our analysis. Idiosyncratic conditions are more variable than inflation for all the firm sizes, but the ratio is larger for large firms. Following Maćkowiak and Wiederholt (2009), we should find that large firms pricing decisions react more to changes in idiosyncratic conditions than small and medium size firms. A similar result is found when we look at the volatility for firms' believes about idiosyncratic and aggregate conditions (see Figure 8.3 in the Appendix).

Figure 3.3: *Relative dispersion in own costs and inflation by firm size*

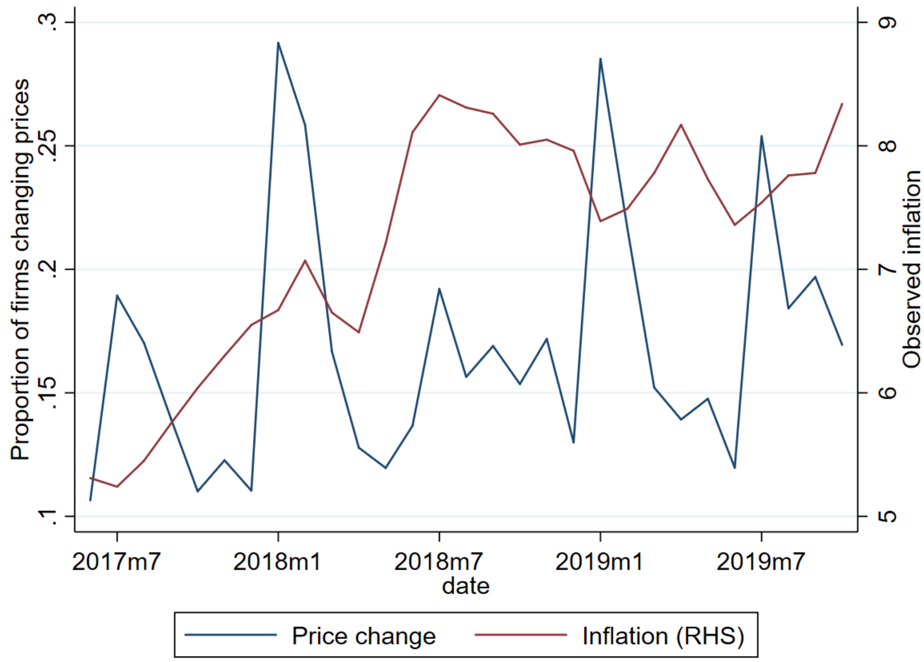


3.2 Stylized facts about prices

3.2.1 Stylized fact 3: Frequency of price adjustment

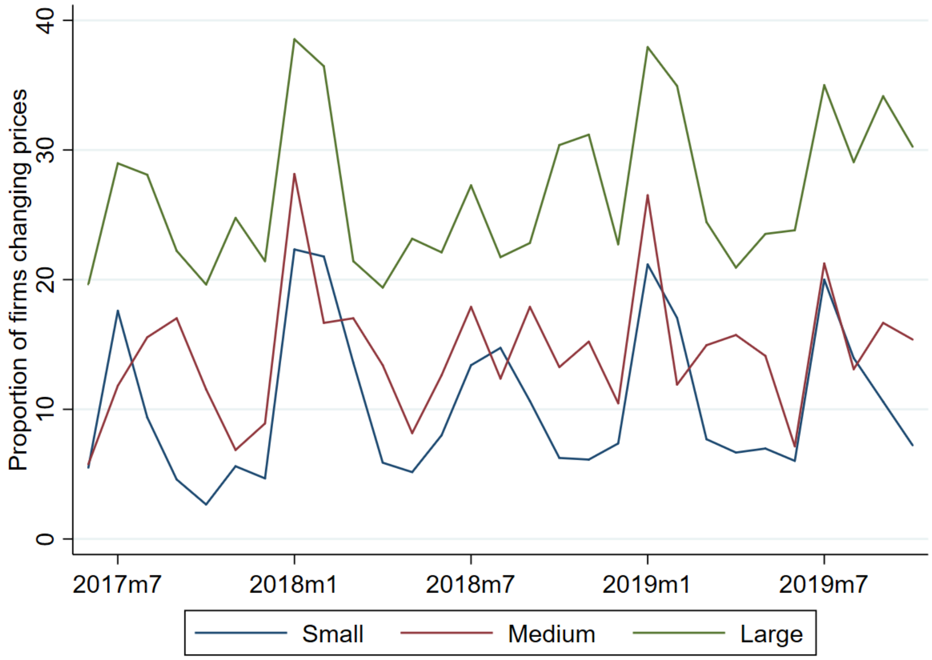
Turning to pricing decisions at the extensive margin, on average, 22% of the firms change the price of their main product each month, but there is seasonality and also differences across firm types. Figure 3.4 shows the evolution of inflation and the proportion of firms that change their price every month. First, there is a slight positive correlation between price adjustment and inflation. As inflation increased in the second semester of 2018, the proportion of firms changing prices also increased.

Figure 3.4: *Proportion of firms changing prices (by month)*



There is also heterogeneity in pricing decisions across firm size (Figure 3.5). Larger firms which are better at forecasting inflation, i.e. those more attentive about inflation, are the ones that change prices more frequently. These results point to the idea that there is a relationship between firms' attentiveness and their pricing decisions.

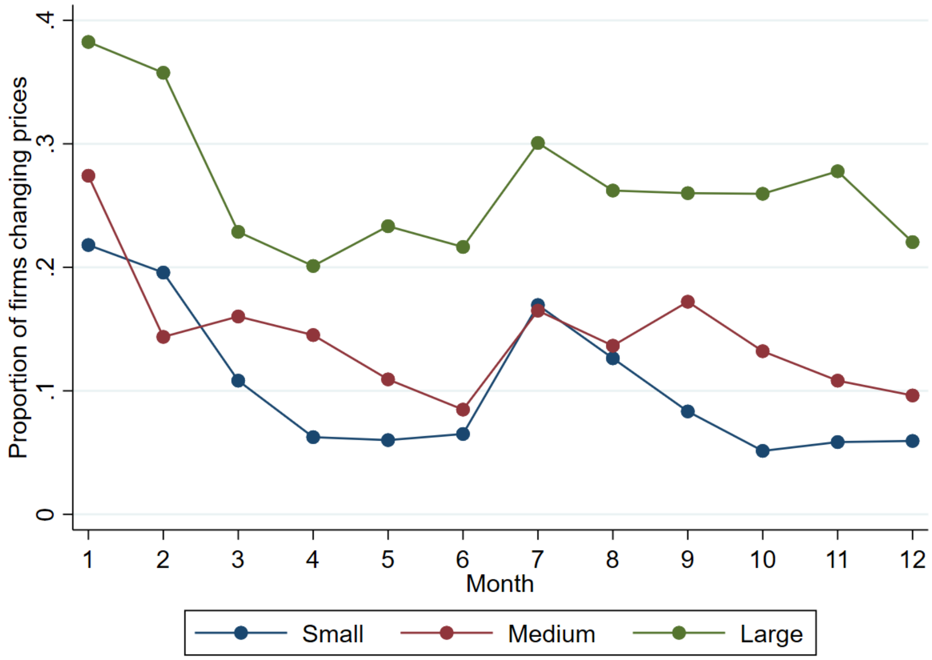
Figure 3.5: *Proportion of firms that change prices by firm size*



Secondly, the average proportion of firms changing prices over the sample period masks large heterogeneity in the seasonality of pricing decisions. Firms are more likely to change their prices in January, February and July. About 30% of the firms change their prices in January, 25% in February and just below 20% in July. On the other hand, just above 10% of the firms change their price between April and June and in December each year [6]. The heterogeneity in pricing decisions across firm sizes is also present when we look at price changes seasonality (Figure 3.6).These results confirm that there is high seasonality in price adjustment in Uruguay.

[6]See Figure 8.4 in the Appendix.

Figure 3.6: *Proportion of firms changing prices: seasonality by firm size*



To confirm these findings about pricing decisions across firm size, Table 3.2 shows the proportion of firms that change their prices, the average number of price changes and the expected price change according to firm size. While, on average, 26% of large firms change their prices every month, only 14% and 10% of medium and small firms respectively change their prices. Large firms changed on average 4 times their prices, while medium firms changed their prices 2.2 times and small firms only 1.7 times over a 26 months period [7]. On the other hand, we find that large firms expect smaller price changes than medium and small firms. This suggests that large firms change prices more frequently but in smaller magnitudes than small and medium size firms.

3.2.2 Stylized fact 4: Number of products and competitors

The last stylized fact is related to the numbers of products firms sell and the number of competitors they face in their markets. Table 3.3 shows the number of competitors and the number of products across firm

[7]This finding is consistent with results shown in Lein (2010) who finds that the probability of price change increases with firm size measured by the number of employees.

Table 3.2: *Prices and firm size*

	Proportion of firms changing prices (in %)	Number of price changes	Expected price change (in %)
Small	10.3	1.7	9.2
Medium	14.2	2.2	8.6
Large	26.1	4.0	7.8

size. The number of products increases with firm size, whilst small and medium firms sell on average 3 products, large firms sell 5. Similar results are found when we look at the median. We do not find a clear pattern when we look at the number of competitors.

Table 3.3: *Number of products and competitors by firm size*

	Number of products		Number of competitors	
	Mean	Median	Mean	Median
Small	3	2	37	6
Medium	3	2	14	5
Large	5	4	90	5

To summarize, our descriptive analysis points to the idea that aggregate inflation and, in particular, own cost expectations matters for price adjustment. Moreover, our results suggest that firms' beliefs matter as more informed firms (large) adjust their prices more frequently than those less attentive to aggregate variables.

4 The Empirical Model

4.1 Correlated Random Effects Approach

As discussed, we are interested in estimating the degree by which price-adjustment decisions react to future beliefs about the inflation and about their own costs. We will estimate a monthly Probit model. Although the survey provides several characteristics at the firm level, it is important to control for any possible time-invariant unobserved heterogeneity at the firm level, μ_i.[8] We will estimate a Correlated Random Effects (CRE) Probit model and report the average partial effects. The results rely on what we assume is the relationship between the regressors and μ_i.

[8] In principle, we could also estimate the Probit model with fixed effects. As the length of T is not large, we decide not to follow this possibility avoiding incidental parameters concerns.

The monthly unobserved effect probit model:

$$\begin{aligned} P(\Delta p_{it} = 1 | x_{it}, \mu_i, v_{it}) &= E(\Delta p_{it} = 1 | x_{it}, \mu_i) \\ &= \Phi(x_{it}\boldsymbol{\beta_1} + \mu_i + v_{it}) \end{aligned} \tag{4.1}$$

Where $\Delta p_{it} = 1$ is a dummy variable indicating whether firm i at month t decided to adjust its price or not. Besides the constant unobserved firm-level effects μ_i, x_{it} represents the exogenous variables that can affect the price adjustment decision. The two expectations along with their lagged values are part of this vector along with Taylor dummy variables which capture any time-dependent price adjustment plans at the firm level. Any other time-invariant characteristic of the firm is also included in x_{it}.

Following the CRE approach, we model the heterogeneity as a linear function of the exogenous variables and we impose a conditional gaussian distribution for the unobserved errors.

$$\mu_i \quad = \quad \gamma + \boldsymbol{\overline{x}_i}\psi + \epsilon_i, \quad \epsilon_i | \boldsymbol{\overline{x}_i} \sim N(0, \sigma^2_{\epsilon_1}) \tag{4.2}$$

While assuming a parametric distribution for μ_i seems restrictive, the model can identify the average partial effects without being subject to the incidental parameters problem. We will refer to Appendix **??** for a further discussion on the main assumptions behind the CRE approach. From the specification in (8.1):

$$\begin{aligned} P(\Delta p_{it} = 1 | x_{it}, \mu_i) &= \Phi(x_{it}\boldsymbol{\beta_1} + \gamma + \boldsymbol{\overline{x}_i}\psi + \epsilon_i + u_{it}) \\ &= \Phi(x_{it}\boldsymbol{\beta_1} + \gamma_1 + \boldsymbol{\overline{x}_i}\psi + s_{it}) \end{aligned} \tag{4.3}$$

Where $s_{it} \equiv \epsilon_i + u_{it}$. The specification is flexible as we can also include include further time-invariant controls at the firm level along with monthly time dummies as part of x_{it}.

5 Beliefs-dependent pricing decisions

We will now assess the effects of beliefs on price-adjustment decisions using the described method. We will initially estimate the models using all firms and then we will add interactions to evaluate the potential interplay between expectations and firm's heterogeneity. For ease of interpretation, below we present marginal effects.

Table 8.2 shows the effect of firm's expectations on the probability of price-adjustment. Column (1) and (2) control only for aggregate beliefs while (3) and (4) focused on costs expectations exclusively. Column (5) uses the two current expectations and (6) controls for its lagged values. Based on the results, neither current nor lagged inflation expectations seems to play any role in the decision of changing prices. Costs expectations, on the other hand, matters for this decision. While there is no effect of current cost expectations, a 1% increase in the lagged cost expectation significantly increases the probability of a price adjustment by 0.6% on average. The magnitude is meaningful as the overall unconditional probability of changing prices is 17% and the average cost growth expectation is 9.6% across firms. The evidence suggests that whenever firms believe their costs would increase, they effectively change their prices. Interestingly, the belief channel operates with a delay of three months. If firms update their costs expectations during the current month, we should then expect a price adjustment three months from now. This points to the presence of deep structural rigidities at the firm level preventing an immediate price reaction. Furthermore, in section **??** we provided further evidence on this delayed effect.

From column (1) to (6) we control for both time-dependent and state-dependent pricing rules. To control for exogenous timing rules on the firm side, we construct Taylor dummies indicating whether the last price adjustment occurred between one and twelve months ago. These dummies accounts for the fact that some firms may adjust their prices following predetermined pricing plans. For state-depending, we control for monthly and yearly dummies. In all specifications, we also control for observable time-invariant characteristics at the firm level such as: size, number of competitors, age, whether the firm produces one or several products (multi-products) along with sector fixed effects. To assess the importance of these two channels, on top of firms beliefs, in column (7) we shut down time-dependent rules while in (8) we remove state-dependent controls. Consistent with Lein (2010), the overall fit of the model decreases when we shut down either of these two channels. In particular, the worsening of the R^2 coefficient in (7) supports time-dependent rules as a central component behind firm's adjustment decisions. However, it is only when the belief channel is added that the overall fit of the model improves the most.

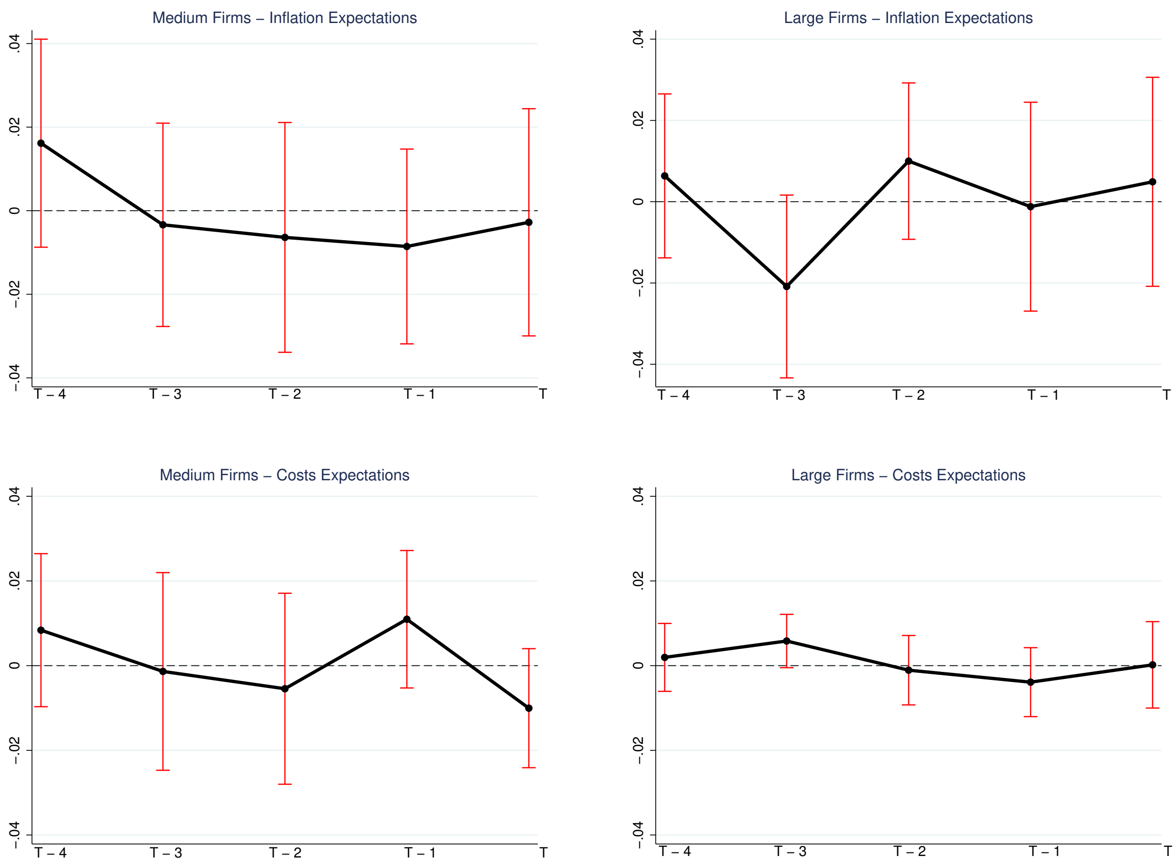
Table 5.1: *Probability of Price Adjustments*

	(1)	(2)	(3)	(4)
$E_{it}(Inf_{12m})$	0.0016	-0.0003	0.0050	-0.0028
	(.0053)	(.0058)	(.0082)	(.0061)
$E_{it-1}(Inf_{12m})$		0.0078	0.0094	0.0078
		(.0058)	(.0067)	(.0061)
$E_{it-2}(Inf_{12m})$		-0.0040	-0.0069	-0.0039
		(.0056)	(.0061)	(.0058)
$E_{it-3}(Inf_{12m})$		-0.0047	-0.0060	-0.0047
		(.0067)	(.0072)	(.0068)
$E_{it-4}(Inf_{12m})$		0.0020	-0.0012	0.0009
		(.0059)	(.0061)	(.0059)
$E_{it}(Costs_{12m})$	-0.0006	-0.0036	-0.0023	-0.0036
	(.0024)	(.0034)	(.0051)	(.0034)
$E_{it-1}(Costs_{12m})$		-0.0012	-0.0005	-0.0011
		(.0028)	(.0034)	(.0030)
$E_{it-2}(Costs_{12m})$		0.0001	0.0021	0.0011
		(.0030)	(.0028)	(.0031)
$E_{it-3}(Costs_{12m})$		0.0058**	0.0035	0.0054**
		(.0025)	(.0031)	(.0026)
$E_{it-4}(Costs_{12m})$		0.0009	-0.0025	0.0002
		(.0029)	(.0032)	(.0031)
Sector FE	✓	✓	✓	✓
Taylor Dummies	✓	✓	×	✓
Month FE	✓	✓	✓	×
Years FE	✓	✓	✓	×
R^2	0.4455	0.4474	0.0951	0.432
Observations	6067	6067	6067	6067

Notes: All estimations include Taylor variables, monthly, yearly and sector dummies. Standard errors are clustered (by firm) and bootstrapped using 500 repetitions.

Given the delayed effect of cost expectations and relaying on firm level information, we assess the potential heterogeneity behind this effect. We repeat the CRE full-estimation (column (6) in 8.2) but adding interactions between the two expectations and firm sizes (small, medium and large). We leave the smallest firms as the omitted category. The coefficients for the other two categories split by aggregate and idiosyncratic expectations are presented in Figure 5.1. The null effects of current and lagged inflation expectations remain independently of firm's sizes. However, while medium firms do not respond at all to expectations, big firms are the one's causing the forward-looking pricing behavior. The marginal probability of adjusting prices increases to 0.7% only for large firms. The significant effect of beliefs helps to rationalize why big firms are the ones that adjust prices more often. There is also very mild evidence that inflation expectations increase the probability of changing prices by 1.3% with a delay of one month, nevertheless the effect is only present for large firms. In section 8.6 of the Appendix we present the specific results along with repeating the exercise of shutting down the time and state-dependent channels.

Figure 5.1: *Marginal Effects - Firm Sizes and Expectations*



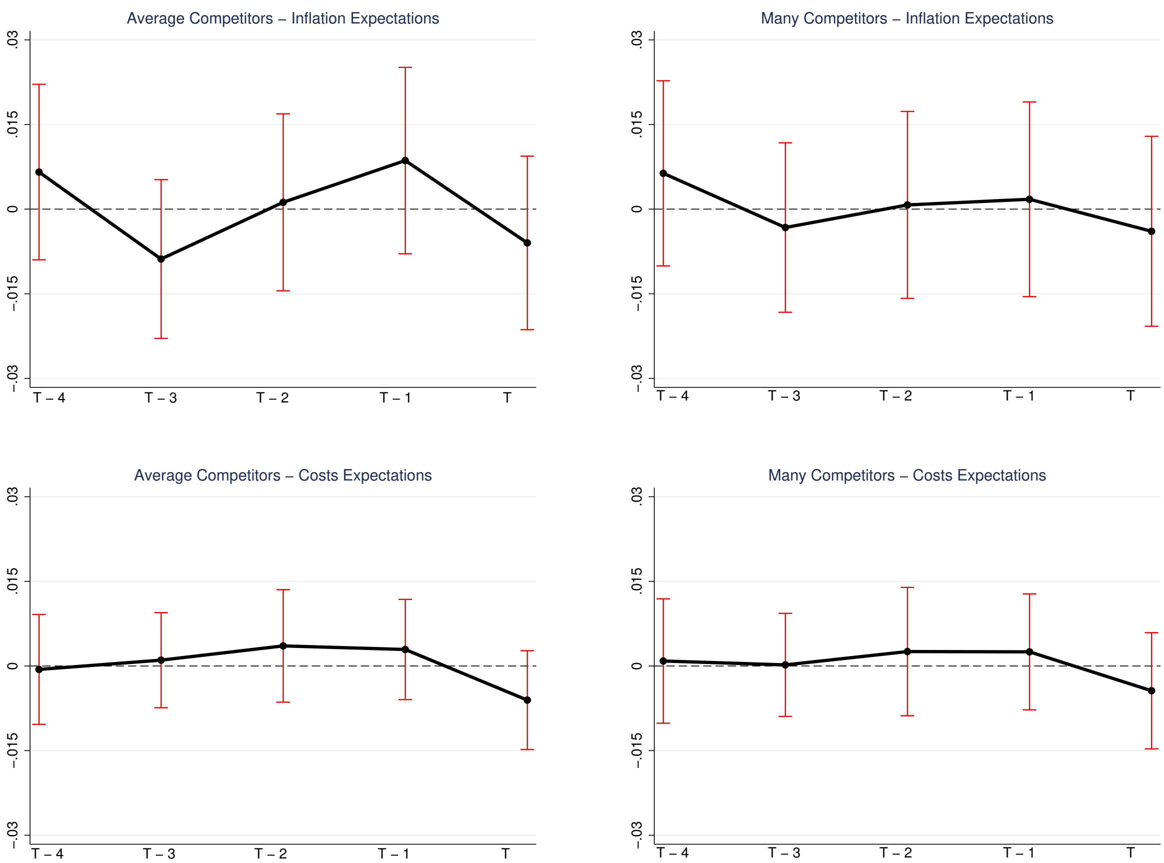
To validate our results concerning the timing of expectations, in June 2019 we intervened the survey. Besides the regular questions we added: "On average, how long does it take your firm to change prices when: (1) inflation increases and (2) costs increases?". Firms provided an open answer measured in weeks. Table 5.2 below, reports the results of this special question conditioning on firms' size. Focusing on costs, small and large firms claimed they take approximately 12 weeks (≈ 3 months) before actually adjusting prices. The results are similar for inflation. The answers externally validate our estimated results and suggest the presence of deep rigidities at the firm level which prevent prices to adjust rapidly. Given the results, we conjecture that the delayed effect is present for both aggregate and idiosyncratic expectations but only the latter is significant due to its higher volatility.

Table 5.2: *Timing of Price Adjustments*

	Change in inflation		Change in costs	
	Mean	Median	Mean	Median
Small	12.4	5.0	11.8	5.0
Medium	8.6	4.0	7.8	4.0
Large	11.7	4.0	12.1	4.0
Total	**11.0**	**5.0**	**10.5**	**4.0**

We also estimated the CRE model replacing the heterogeneous size effects with further interactions between expectations and (1) the number of competitors firms face and (2) whether the firm produces one or several products. For the number of competitors we allow for three categories: few, average and many competitors. In the estimations the omitted category is the few competitors one. In the case of multi-products, we create a dummy variable to account for firms that produces more than one good. The estimated coefficients are reported in Figures 5.2 and 5.3 respectively. In all estimations we are still controlling for firm time-invariant characteristics, such as size. Relative to the number of competitors, there is no significant evidence that the expectation channel plays any role relative to this margin. On the other hand, the results suggest that lagged cost expectations across multi-product firms matters for price-adjustment decisions. Although the evidence is also mild with a p-value of 0.073, the probability of changing prices increase by 0.5% for these type of firms. Our evidence is consistent with the results of Yang (2019), who finds that the unconditional probability of price adjustments across firms in New-Zealand is higher for multi-product firms. The results are also consistent with the delayed effect of expectations. The specific results are reported in table 8.5 of the appendix.

Figure 5.2: *Marginal Effects - Number of Competitors*

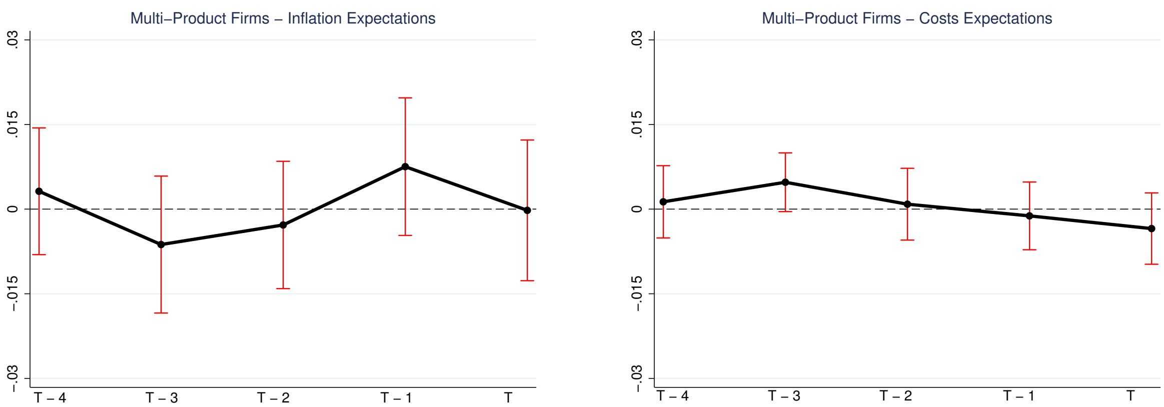


6 Robustness

6.1 Cost Endogeneity

In this section we address the possibility that cost beliefs may be correlated with time-varying unobservables, in addition to firm latent heterogeneity μ_i. In particular, the expected costs could be formed as a function of current costs c_{it} and firm's own predisposition to produce such forecast. For instance, assuming an AR(1) process for the costs $c_{it} = \rho_{i0} + \rho_{i1} c_{it-1} + \varepsilon_{it}$, the expected cost at $t + 12$ is then $\rho_{i0} + \rho_{i1}^{12} c_{it}$. We assess the potential endogeneity of the cost expectation by extending our CRE estimation to include a Control Function. The extension follows Papke and Wooldridge (2008). We will refer to Appendix 8.3 for the specific details about the estimation.

Figure 5.3: *Marginal Effects - Multi-Product Firms*



To deal with the potential endogeneity of the cost expectation we will construct an instrument. The instrument follows Carlsson and Skans (2012) where we built a measure of *projected* costs at the firm level:

$$x_{it2} = \text{Proj.Cost}_{it} = PI_{jt}CS_{ij2012} \tag{6.1}$$

We rely on information from the "Annual Survey of Economic Activity" of 2012. This data collects Balance Sheet information from a large sample of firms in Uruguay. We got granular information of salaries, supplies, expenses and goods which are originally bought by the firm and then resold without transformation. We label each of these four categories with j. PI_{jt} is a price index for each spending category j during month t and CS_{ij2012} is the cost structure for each category during year 2012 for firm i. By keeping the cost structure for each category fixed, we create a proxy for the time-varying evolution of such cost which prevent firms from adjusting the production scale. The Proj.Cost$_{it}$ index affects pricing only through it effects on costs, which ultimately affects the expectation.

Table 8.6 in the Appendix, we estimate the CRE model using the cost index through the control function. In the last row of the table, we added the estimated coefficient for the first stage residual. The coefficient is interpreted as a Heckman test. Although a similar index has been used in the literature, in our estimation this parameter is not significant. We treat this result with caution as it could either suggest that the instrument is not suitable enough or that the possible endogeneity caused by the omission of a relevant variable is not meaningful.

6.2 Linear Probability Model

While the CRE approach aims to deal with the unobserved heterogeneity at the firm level, still we could be worry about the implications of the belief-channel is we omit fixed effects. Thus, in this section we estimate our model using a linear probability model (LMP) that allow us to remove any fixed effects at the firm level. The results of the estimations are presented in Table 8.7 in the appendix. The core of our results hold under the LPM as inflation expectations does not play any role in the probability of price-adjustments while lagged cost expectations significantly increase the probability by 0.64% approximately.

Tbc.

7 Conclusion

We assess the role of aggregate and idiosyncratic expectations on firms' price adjustments decisions. Our results suggest that besides time-dependent and state-dependent pricing rules, the belief channel also matters for price-adjustment. However, only their own costs expectations ultimately affect pricing decisions with a delay. Moreover, we found significant heterogeneity in the effects of expectations, as only large firms are the ones that ultimately react.

tbc.

References

Alvarez, F. E., F. Lippi, and L. Paciello (2011). Optimal price setting with observation and menu costs. *The Quarterly Journal of Economics 126*(4), 1909–1960.

Andrade, P. and H. L. Bihan (2013). Inattentive professional forecasters. *Journal of Monetary Economics 60*(8), 967 – 982.

Bachmann, R., B. Born, S. Elstner, and C. Grimme (2019). Time-varying business volatility and the price setting of firms. *Journal of Monetary Economics 101*, 82–99.

Baley, I. and J. A. Blanco (2018). Menu costs, uncertainty cycles, and the propagation of nominal shocks. *American Economic Journal: Macroeconomics forthcoming.*

Boneva, L., J. CLoyne, M. Weale, and T. Wieladek (2019). Firms' expectations of new orders, employment, costs and prices: Evidence from micro data. *The Economic Journal forthcoming.*

Calvo, G. A. (1983). Staggered prices in a utility-maximizing framework. *Journal of monetary Economics 12*(3), 383–398.

Carlsson, M. and O. N. Skans (2012). Evaluating microfoundations for aggregate price rigidities: evidence from matched firm-level data on product prices and unit labor cost. *American Economic Review 102*(4), 1571–95.

Coibion, O. and Y. Gorodnichenko (2012). What Can Survey Forecasts Tell Us about Information Rigidities? *Journal of Political Economy 120*(1), 116 – 159.

Coibion, O., Y. Gorodnichenko, and S. Kumar (2018, September). How do firms form their expectations? new survey evidence. *American Economic Review 108*(9), 2671–2713.

Coibion, O., Y. Gorodnichenko, and T. Ropele (2018). Inflation expectations and firm decisions: New causal evidence. Technical report, National Bureau of Economic Research.

Coibion, O., Y. Gorodnichenko, and M. Weber (2019). Monetary policy communications and their effects on household inflation expectations. Technical report, National Bureau of Economic Research.

Dias, D. A., C. Robalo Marques, F. Martins, and J. Santos Silva (2011). Why are some prices stickier than others? firm-data evidence on price adjustment lags.

Frache, S. and R. Lluberas (2018). New information and inflation expectations among firms. *Manuscript*.

Galı, J. and M. Gertler (1999). Inflation dynamics: A structural econometric analysis. *Journal of monetary Economics 44*(2), 195–222.

Gali, J., M. Gertler, and J. D. Lopez-Salido (2005). Robustness of the estimates of the hybrid new keynesian phillips curve. *Journal of Monetary Economics 52*(6), 1107–1118.

Giacomini, R., V. Skreta, and J. Turen (2020). Heterogeneity, inattention, and bayesian updates. *American Economic Journal: Macroeconomics 12*(1), 282–309.

Klenow, P. J. and O. Kryvtsov (2008). State-dependent or time-dependent pricing: Does it matter for recent us inflation? *The Quarterly Journal of Economics 123*(3), 863–904.

Lein, S. M. (2010). When do firms adjust prices? evidence from micro panel data. *Journal of Monetary Economics 57*(6), 696–715.

Maćkowiak, B. and M. Wiederholt (2009). Optimal sticky prices under rational inattention. *The American Economic Review 99*(3), 769–803.

Matějka, F. (2015). Rationally inattentive seller: Sales and discrete pricing. *The Review of Economic Studies*, rdv049.

Midrigan, V. (2011). Menu costs, multiproduct firms, and aggregate fluctuations. *Econometrica 79*(4), 1139–1180.

Nakamura, E. and J. Steinsson (2008). Five facts about prices: A reevaluation of menu cost models. *The Quarterly Journal of Economics 123*(4), 1415–1464.

Nakamura, E. and D. Zerom (2010). Accounting for incomplete pass-through. *The Review of Economic Studies 77*(3), 1192–1230.

Papke, L. E. and J. M. Wooldridge (2008). Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics 145*(1-2), 121–133.

Pasten, E., R. Schoenle, and M. Weber (2019). Price rigidity and the granular origins of aggregate fluctuations. *Chicago Booth Research Paper* (17-25), 2018–54.

Sbordone, A. M. (2005). Do expected future marginal costs drive inflation dynamics? *Journal of Monetary Economics 52*(6), 1183–1197.

Stevens, L. (2019). Coarse pricing policies. *Review of Economic Studies forthcoming.*

Taylor, J. B. (1980). Aggregate dynamics and staggered contracts. *Journal of political economy 88*(1), 1–23.

Vavra, J. (2013). Inflation dynamics and time-varying volatility: New evidence and an ss interpretation. *The Quarterly Journal of Economics 129*(1), 215–258.

Woodford, M. (2003). Imperfect common knowledge and the effects of monetary policy. *In Knowledge, Information, and Expectations in Modern Macroeconomics: In Honor of Edmund S. Phelps, ed. Philippe Aghion, Roman Frydman, Joseph Stiglitz, and Michael Woodford*.

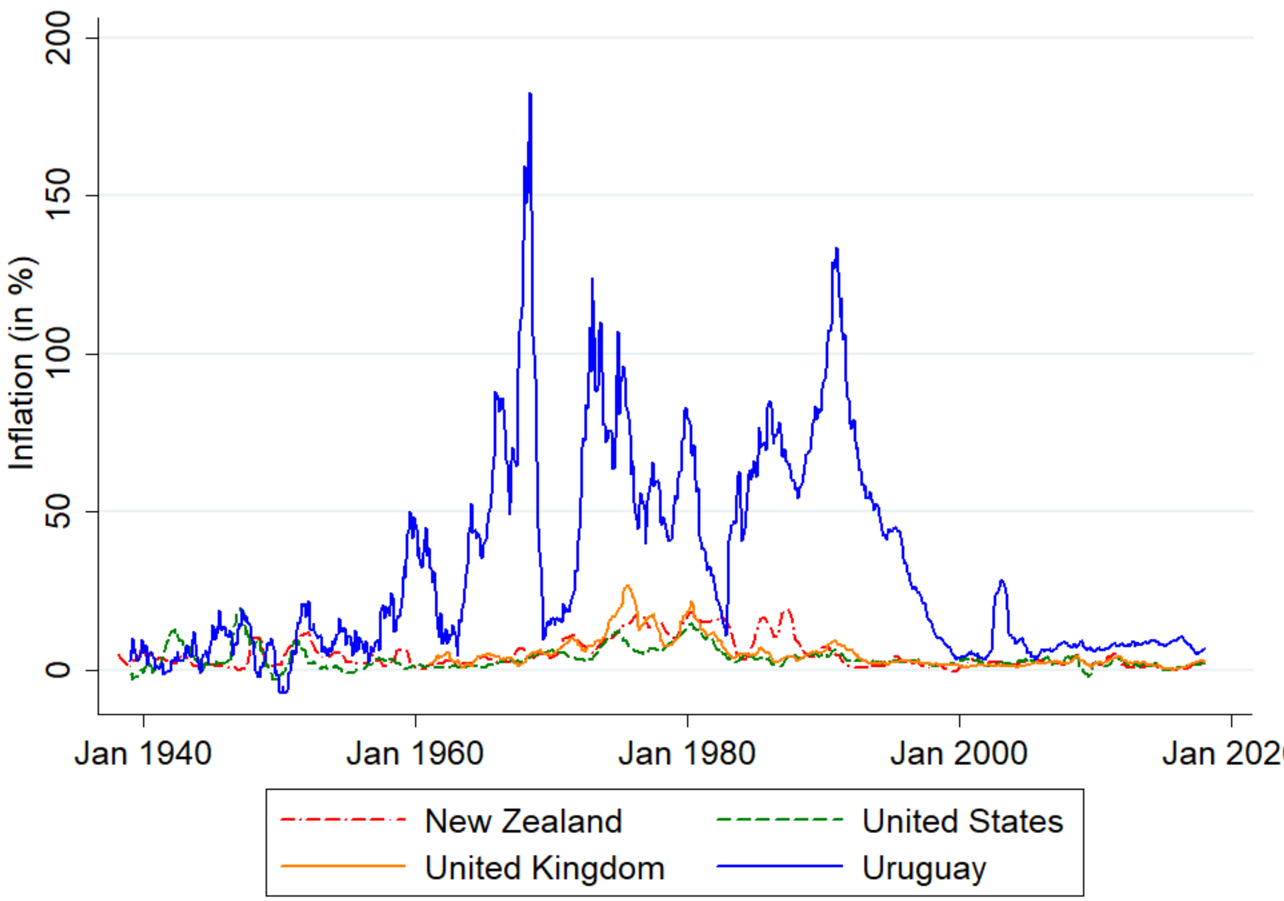
Wooldridge, J. M. (2014). Quasi-maximum likelihood estimation and testing for nonlinear models with endogenous explanatory variables. *Journal of Econometrics 182*(1), 226–234.

Yang, C. (2019). Rational inattention, menu costs, and multi-product firms: Micro evidence and aggregate implications. *Working Paper*.

8 Appendix

8.1 Inflation in Uruguay

Figure 8.1: *Inflation in Uruguay and other selected countries*



8.2 Stylized facts

Figure 8.2 shows the average standard deviation for own costs and inflation expectations. Whilst Figure **??** in the main text shows the volatility of observed conditions, Figure 8.2 shows how these translates to firms expectations. Again, as for observed conditions, firms' own costs expectations are more volatile than inflation expectations.

Figure 8.2: *Average volatility of own costs and aggregate inflation* ***expectations***

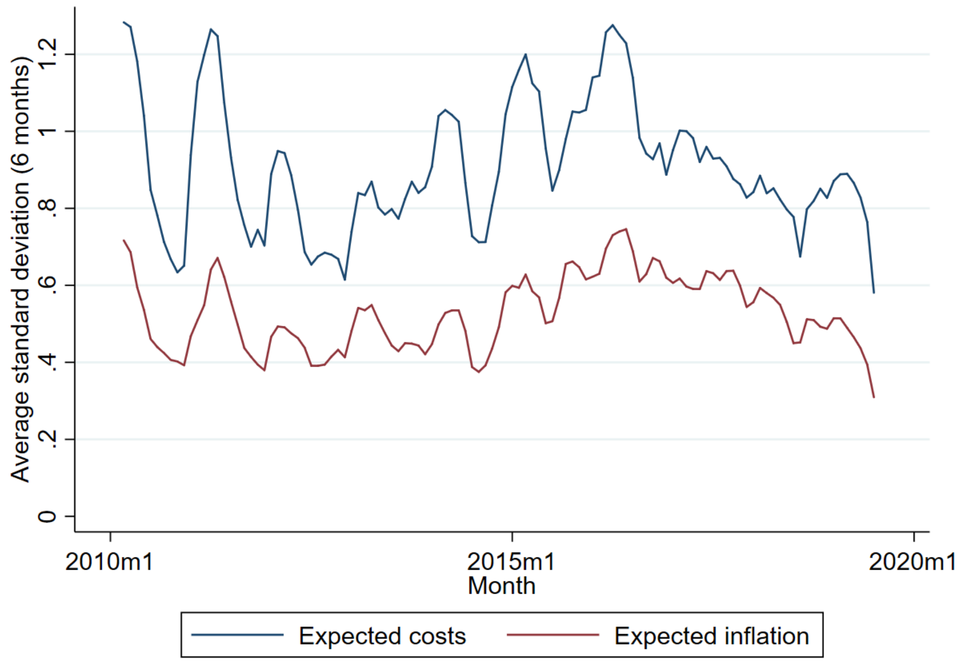


Figure 8.3 shows the relative dispersion of firms beliefs about their own costs and aggregate inflation.

Figure 8.3: *Relative dispersion in own costs and inflation* ***beliefs*** *by firm size*

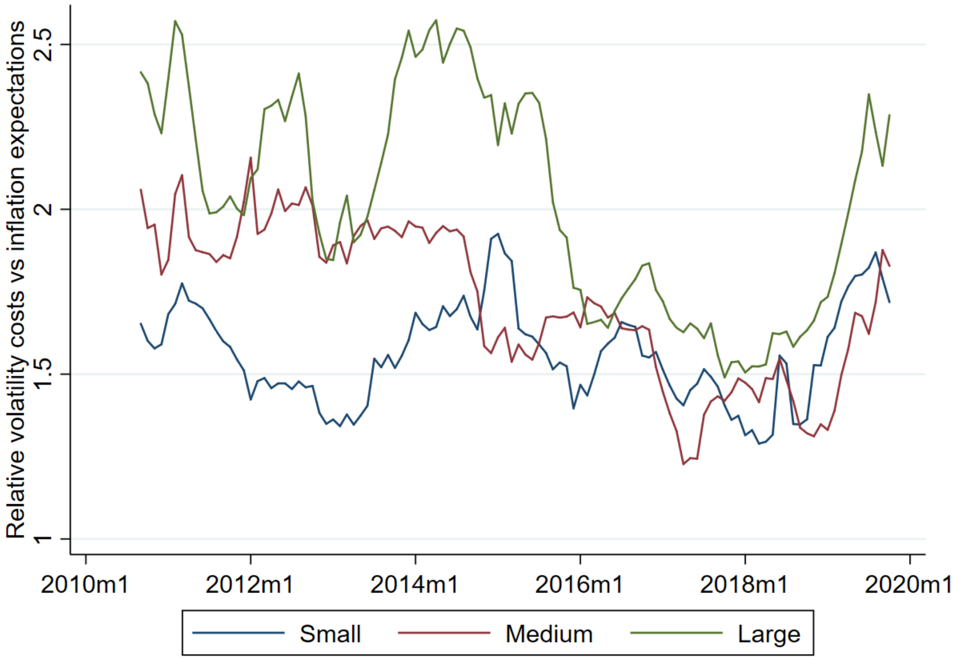
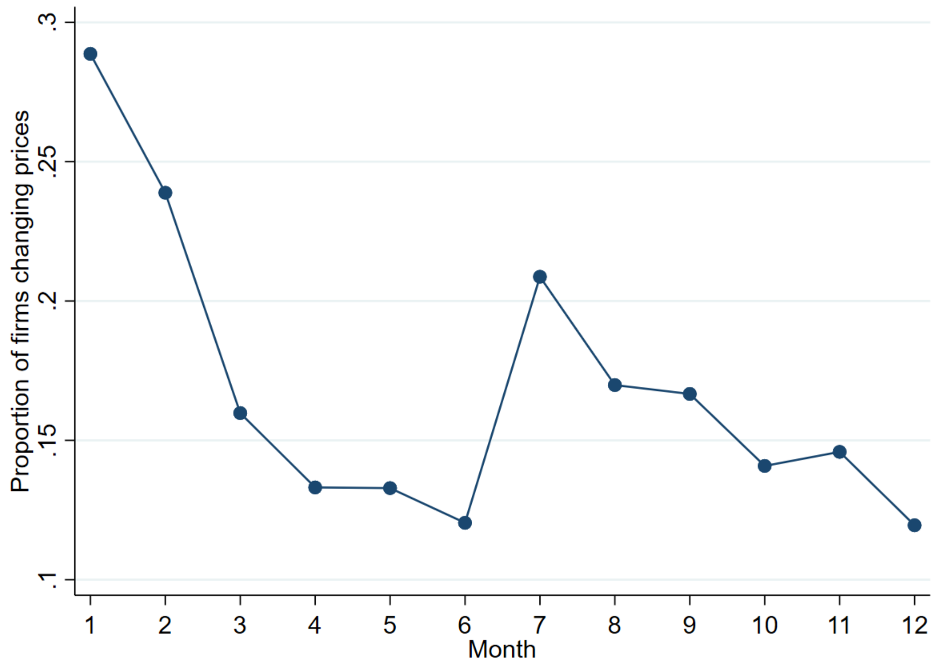


Figure 8.4 shows the seasonality of price adjustments in Uruguay. Firms are more likely to change their prices in January, February and July.

Figure 8.4: *Proportion of firms changing prices: seasonality*



8.3 The CRE - Control Function Approach

Following the same notation as in section 4.1. Let the (potential) endogenous variable being the expectation for firm's own cost for one year ahead formed at time t $E_{it}(c_{it+12})$. The monthly monthly unobserved effect probit model:

$$\begin{aligned} P(\Delta p_{it} = 1 | E_{it}(c_{it+12}), x_{it1}, \mu_{i1}, v_{it1}) &= E(\Delta p_{it} = 1 | E_{it}(c_{it+12}), x_{it1}, \mu_{i1}, u_{it1}) \\ &= \Phi(\alpha_1 E_{it}(c_{it+12}) + x_{it1}\boldsymbol{\beta_1} + \mu_i + v_{it1}) \end{aligned} \tag{8.1}$$

Where $\Delta p_{it} = 1$ is a dummy variable indicating where firm i at month t decided to adjust its price or not. Besides the constant unobserved firm-level effects μ_i, v_{it1} represents any omitted variable that can be correlated with $E_{it}(c_{it+12})$. The exogeneous variables are $x_{it} = (x_{it1}, x_{it2})$, where x_{it2} represent the exogenous variables (instruments) to be excluded from the main equation.

In order to partially capture the firm-level unobserved effects, we will follow the CRE approach. We model the heterogeneity as a linear function the exogenous variables and we impose a gaussian distribution for the unobserved errors.

$$\mu_i \quad = \quad \gamma_1 + \overline{\boldsymbol{x}}_{\boldsymbol{i}}\psi_1 + \epsilon_{i1}, \quad \epsilon_{i1}|\overline{\boldsymbol{x}}_{\boldsymbol{i}} \sim N(0, \sigma^2_{\epsilon_1}) \tag{8.2}$$

From the specification in (8.1):

$$\begin{aligned} P(\Delta p_{it} = 1 | E_{it}(c_{it+12}), x_{it1}, \mu_{i1}, u_{it1}) &= \Phi(\alpha_1 E_{it}(c_{it+12}) + x_{it1}\boldsymbol{\beta_1} + \gamma + \overline{\boldsymbol{x}}_{\boldsymbol{i}}\psi + \epsilon_{i1} + u_{it1}) \\ &= \Phi(\alpha_1 E_{it}(c_{it+12}) + x_{it1}\boldsymbol{\beta_1} + \gamma_1 + \overline{\boldsymbol{x}}_{\boldsymbol{i}}\psi + s_{it1} \end{aligned} \tag{8.3}$$

Where $s_{it1} \equiv \epsilon_{i1} + u_{it1}$. To deal with the potential endogeneity, we assume a linear reduce for the expected cost:

$$E_{it}(c_{it+12}) = \gamma_2 + \boldsymbol{x_{it}\beta_2} + \overline{\boldsymbol{x}}_{\boldsymbol{i}}\psi_2 + u_{it2} \tag{8.4}$$

The endogeneity caused of $E_{it}(c_{it+12})$ is then given by the correlation between the error of this auxiliar regression u_{it2} and s_{it1}. Given the two components of s_{it1}, the current expected cost is allowed to be correlated with both the unobserved heterogeneity and the omitted factor. We will assume:

$$s_{it1} = \eta_1 u_{it2} + \varepsilon_{it1}, \quad \varepsilon_{it1}|\overline{\boldsymbol{x}}_{\boldsymbol{i}}, u_{it2} \sim N(0, \sigma^2_{\varepsilon_1}) \tag{8.5}$$

Since ε_{it1} is independent of $\overline{\boldsymbol{x}}_{\boldsymbol{i}}$ and u_{it2}, its also independent of $E_{it}(c_{it+12})$. Finally, with this:

$$P(\Delta p_{it} = 1 | E_{it}(c_{it+12}), x_{it1}, u_{it2}) = \Phi(\alpha_1 E_{it}(c_{it+12}) + x_{it1}\boldsymbol{\beta_1} + \gamma_1 + \overline{\boldsymbol{x}}_{\boldsymbol{i}}\psi + \eta_1 u_{it2}) \tag{8.6}$$

Equation (8.6) is the main equation we will estimate, following the CF approach. Typically in this case, the estimated coefficients are scaled by the volatility of the specification (8.5). However, as discussed by Wooldridge (2014), we can still estimate unscaled coefficients by estimating a Pooled IV Probit QMLE using $(x_{it1}, \overline{\boldsymbol{x}}_{\boldsymbol{i}})$ as regressors in the first equation and $(x_{it}, \overline{\boldsymbol{x}}_{\boldsymbol{i}})$ in the second equation. Hence, in the first stage we estimate the reduced form equation (8.4) (pooled across t) from which we obtain the residuals $\widehat{u}_{it2}$, and then estimate (8.6) using a pooled Probit QMLE of Δp_{it} on $E_{it}(c_{it+12})$, x_{it1}, μ_{i1}, $\overline{\boldsymbol{x}}_{\boldsymbol{i}}$ and $\widehat{u}_{it2}$ to estimate the coefficients. Naturally, we get a simple endogeneity test by assessing if $\widehat{\eta}_1 = 0$ in the pooled Probit. We will also add lags of both expectations in our specifications. Before moving to the estimation results, we will describe the construction of the instrument x_{it2}.

8.4 Probability of Price Adjustments - Full Table

Table 8.1: *Probability of Price Adjustments - all effects*

	(1)	(2)	(3)	(4)
$E_{it}(Inf_{12m})$	0.0016	-0.0003	0.0050	-0.0028
	(.0053)	(.0058)	(.0082)	(.0061)
$E_{it-1}(Inf_{12m})$		0.0078	0.0094	0.0078
		(.0058)	(.0067)	(.0061)
$E_{it-2}(Inf_{12m})$		-0.0040	-0.0069	-0.0039
		(.0056)	(.0061)	(.0058)
$E_{it-3}(Inf_{12m})$		-0.0047	-0.0060	-0.0047
		(.0067)	(.0072)	(.0068)
$E_{it-4}(Inf_{12m})$		0.0020	-0.0012	0.0009
		(.0059)	(.0061)	(.0059)
$E_{it}(Costs_{12m})$	-0.0006	-0.0036	-0.0023	-0.0036
	(.0024)	(.0034)	(.0051)	(.0034)
$E_{it-1}(Costs_{12m})$		-0.0012	-0.0005	-0.0011
		(.0028)	(.0034)	(.0030)
$E_{it-2}(Costs_{12m})$		0.0001	0.0021	0.0011
		(.0030)	(.0028)	(.0031)
$E_{it-3}(Costs_{12m})$		0.0058**	0.0035	0.0054**
		(.0025)	(.0031)	(.0026)
$E_{it-4}(Costs_{12m})$		0.0009	-0.0025	0.0002
		(.0029)	(.0032)	(.0031)
$Taylor_{1,it}$	-0.2198**	-0.2218**		-0.2202**
	(0.0245)	(0.0247)		(.0249)
$Taylor_{2,it}$	-0.2551**	-0.2564**		-0.2649**
	(0.0217)	(0.0219)		(.0216)
$Taylor_{3,it}$	-0.0254**	-0.254**		-0.2658**
	(0.0218)	(0.0217)		(.0215)
$Taylor_{4,it}$	-0.2448**	-0.2453**		-0.2493**
	(0.0214)	(0.0215)		(.0214)
$Taylor_{5,it}$	-0.2078**	-0.2079**		-0.2088**
	(0.0181)	(0.0182)		(.0181)
$Taylor_{6,it}$	-0.1389**	-0.1397**		-0.1297**
	(0.0152)	(0.0153)		(.0157)
$Taylor_{7,it}$	-0.1283**	-0.1303**		-0.1308**
	(0.0296)	(0.0297)		(.0295)
$Taylor_{8,it}$	-0.1401**	-0.1412**		-0.1447**
	(0.0347)	(0.0347)		(.0351)
$Taylor_{9,it}$	-0.1193**	-0.1207**		-0.1214**
	(0.0286)	(.0028)		(.0292)
$Taylor_{10,it}$	-0.1502**	-0.1508**		-0.1458**
	(0.0364)	(0.0366)		(.0366)

Table 8.2: *Probability of Price Adjustments - all effects (continuation)*

	(5)	(6)	(7)	(8)
$Taylor_{11,it}$	-0.0784**	-0.0793**		-0.0757**
	(0.0291)	(0.0292)		(.0291)
$Taylor_{12,it}$	0.0278	0.0252		0.0345
	(0.0247)	(0.0249)		(.0249)
$Month_1$	0.0901**	0.0886**	0.0868**	
	(0.0206)	(0.0205)	(.0286)	
$Month_2$	0.0773**	0.0801**	0.0654**	
	(0.0188)	(0.0186)	(.02501)	
$Month_3$	0.0164	0.0159	-0.0041	
	(0.0195)	(0.0196)	(.0245)	
$Month_4$	0.0231	0.0232	-0.0046	
	(.01896)	(.01896)	(.0221)	
$Month_5$	0.0199	0.0209	-0.0004	
	(.01804)	(.01817)	(.0179)	
$Month_7$	0.0646**	0.0647**	0.1046**	
	(.0162)	(.0164)	(.0198)	
$Month_8$	0.0504**	0.0506**	0.0891**	
	(.01545)	(.01556)	(.0189)	
$Month_9$	0.0479**	0.0483**	0.0893**	
	(.0162)	(.0163)	(.0214)	
$Month_{10}$	0.0307	0.0301	0.0711**	
	(.01597)	(.01585)	(.0217)	
$Month_{11}$	0.0602**	0.0618**	0.0957**	
	(0.0162)	(.0158)	(.0256)	
$Month_{12}$	0.0288	0.0304	0.0706**	
	(0.0207)	(0.0204)	(.0279)	
Sector FE	✓	✓	✓	✓
Taylor Dummies	✓	✓	×	✓
Month FE	✓	✓	✓	×
Years FE	✓	✓	✓	×
R^2	0.4455	0.4474	0.0951	0.432
Observations	6067	6067	6067	6067

Notes: All estimations include Taylor variables, monthly, yearly and sector dummies. Standard errors are clustered (by firm) and bootstrapped using 500 repetitions.

8.5 Probability of Price Adjustments - Sizes

Table 8.3: *Marginal Effects - Sizes*

	Medium	Large	Medium	Large	Medium	Large
$E_{it}(Inf_{12m})$	-0.0008	0.0010	-0.0008	0.0053	-0.0042	-0.0014
	(.0065)	(.0063)	(.0086)	(.0091)	(.0067)	(.0064)
$E_{it-1}(Inf_{12m})$	0.0100	0.0129*	0.0146	0.0161	0.0110	0.0129
	(.0066)	(.0066)	(.0080)	(.0079)	(.0067)	(.0067)
$E_{it-2}(Inf_{12m})$	-0.0091	-0.0042	-0.0071	-0.0060	-0.0082	-0.0045
	(.0068)	(.0056)	(.0082)	(.0069)	(.0069)	(.0058)
$E_{it-3}(Inf_{12m})$	-0.0005	-0.0058	0.0021	-0.0051	-0.0012	-0.0061
	(.0070)	(.0071)	(.0084)	(.0082)	(.0070)	(.0071)
$E_{it-4}(Inf_{12m})$	0.0022	-0.0006	-0.0009	-0.0044	0.0012	-0.0014
	(.0071)	(.0064)	(.0083)	(.0077)	(.0072)	(.0063)
$E_{it}(Costs_{12m})$	-0.0068	-0.0032	-0.0034	-0.0021	-0.0077	-0.0036
	(.0042)	(.0038)	(.0053)	(.0051)	(.0044)	(.0039)
$E_{it-1}(Costs_{12m})$	0.0039	-0.0003	0.0050	-0.0012	0.0044	-0.0004
	(.0045)	(.0036)	(.0056)	(.0046)	(.0048)	(.0038)
$E_{it-2}(Costs_{12m})$	0.0026	0.0032	0.0008	0.0030	0.0030	0.0040
	(.0051)	(.0035)	(.0056)	(.0044)	(.0053)	(.0035)
$E_{it-3}(Costs_{12m})$	0.0045	0.0066**	-0.0001	0.0039	0.0055	0.0064**
	(.0045)	(.0028)	(.0056)	(.0038)	(.0046)	(.0028)
$E_{it-4}(Costs_{12m})$	-0.00004	-0.0032	-0.00622	-0.0063	-0.00092	-0.0036
	(.0045)	(.0037)	(.0061)	(.0051)	(.0045)	(.0035)
Sector FE	✓		✓		✓	
Taylor Dummies	✓		×		✓	
Month FE	✓		✓		×	
Years FE	✓		✓		×	
R^2	0.454		0.101		0.439	
Observations	6067		6067		6067	

Notes: All estimations include Taylor variables, monthly, yearly and sector dummies. Standard errors are clustered (by firm) and bootstrapped using 500 repetitions.

8.6 Probability of Price Adjustments - Sizes - COMPLETAR ultimas 6

Table 8.4: *Marginal Effects - Sizes*

	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
$E_{it}(Inf_{12m})$	-0.0023	-0.0026	0.0049		-0.0008	0.0053		-0.0042	-0.0014
	(.0066)	(.0139)	(.0133)		(.0086)	(.0091)		(.0067)	(.0064)
$E_{it-1}(Inf_{12m})$	0.0199**	-0.0089	-0015		0.0146	0.0161		0.0110	0.0129
	(.0076)	(.0122)	(.0133)		(.0080)	(.0079)		(.0067)	(.0067)
$E_{it-2}(Inf_{12m})$	-0.0084	-0.0064	0.0099		-0.0071	-0.0060		-0.0082	-0.0045
	(.0059)	(.0147)	(.0103)		(.0082)	(.0069)		(.0069)	(.0058)
$E_{it-3}(Inf_{12m})$	0.0034	-0.0037	-0.0208		0.0021	-0.0051		-0.0012	-0.0061
	(.0085)	(.0123)	(.0114)		(.0084)	(.0082)		(.0070)	(.0071)
$E_{it-4}(Inf_{12m})$	-0.0030	0.0161	0.0062		-0.0009	-0.0044		0.0012	-0.0014
	(.0081)	(.0128)	(.0096)		(.0083)	(.0077)		(.0072)	(.0063)
$E_{it}(Costs_{12m})$	-0.0025	-0.0106	0.0001		-0.0034	-0.0021		-0.0077	-0.0036
	(.0045)	(.0076)	(.0051)		(.0053)	(.0051)		(.0044)	(.0039)
$E_{it-1}(Costs_{12m})$	0.0019	0.0115	-0.0039		0.0050	-0.0012		0.0044	-0.0004
	(.0049)	(.0089)	(.0041)		(.0056)	(.0046)		(.0048)	(.0038)
$E_{it-2}(Costs_{12m})$	0.0055	-0.0056	-0.0010		0.0008	0.0030		0.0030	0.0040
	(.0051)	(.0122)	(.0044)		(.0056)	(.0044)		(.0053)	(.0035)
$E_{it-3}(Costs_{12m})$	0.0056	-0.0012	0.0059**		-0.0001	0.0039		0.0055	0.0064**
	(.0039)	(.0118)	(.0029)		(.0056)	(.0038)		(.0046)	(.0028)
$E_{it-4}(Costs_{12m})$	-0.0057	0.0083	0.0019		-0.00622	-0.0063		-0.00092	-0.0036
	(.0038)	(.0091)	(.0041)		(.0061)	(.0051)		(.0045)	(.0035)
Sector FE		✓			✓			✓	
Taylor Dummies		✓			×			✓	
Month FE		✓			✓			×	
Years FE		✓			✓			×	
R^2		0.454			0.101			0.439	
Observations		6067			6067			6067	

Notes: All estimations include Taylor variables, monthly, yearly and sector dummies. Standard errors are clustered (by firm) and bootstrapped using 500 repetitions.

8.7 Probability of Price Adjustments - Competitors and Multi-products

Table 8.5: *Marginal Effects - Alternative specifications*

	Competitors		Multi-Product
	Average	Many	
$E_{it}(Inf_{12m})$	-0.0060	-0.0039	-0.0002
	(.0078)	(.0085)	(0.0064)
$E_{it-1}(Inf_{12m})$	0.0086	0.0017	0.0075
	(.0084)	(.0088)	(0.0062)
$E_{it-2}(Inf_{12m})$	0.0012	0.0007	-0.0028
	(.0080)	(.0085)	(0.0057)
$E_{it-3}(Inf_{12m})$	-0.0088	-0.0033	-0.0063
	(.0072)	(.0077)	(0.0062)
$E_{it-4}(Inf_{12m})$	0.0066	0.0064	0.0032
	(.0079)	(.0084)	(0.0057)
$E_{it}(Costs_{12m})$	-0.0060	-0.0044	-0.0034
	(.0045)	(.0052)	(0.0032)
$E_{it-1}(Costs_{12m})$	0.0029	0.0025	-0.0012
	(.0045)	(.0052)	(0.0031)
$E_{it-2}(Costs_{12m})$	0.0036	0.0026	0.0009
	(.0051)	(.0058)	(0.0032)
$E_{it-3}(Costs_{12m})$	0.0010	0.0002	0.0048*
	(.0043)	(.0047)	(0.0026)
$E_{it-4}(Costs_{12m})$	-0.00061	0.0009	0.0013
	(.0049)	(.0056)	(0.0032)
Sector FE	✓		✓
Taylor Dummies	✓		✓
Month FE	✓		✓
Years FE	✓		✓
R^2	0.4503		0.447
Observations	6067		6067

Notes: All estimations include Taylor variables, monthly, yearly and sector dummies. Standard errors are clustered (by firm) and bootstrapped using 500 repetitions.

8.8 Probability of Price Adjustments - Control Function

Table 8.6: *Marginal Effects - Endogeneity*

	(1)	(2)	(3)	(4)	(5)	(6)
$E_{it}(Inf_{12m})$	0.0012	-0.0033			-0.0195	-0.0205
	(0.0049)	(.0062)			(0.0216)	(.0201)
$E_{it-1}(Inf_{12m})$		0.0075				0.0049
		(.0054)				(.0058)
$E_{it-2}(Inf_{12m})$		-0.0039				-0.0036
		(.0053)				(.0054)
$E_{it-3}(Inf_{12m})$		-0.00002				-0.0049
		(.0063)				(.0068)
$E_{it-4}(Inf_{12m})$		0.0023				-0.0002
		(.0054)				(.0061)
$E_{it}(Costs_{12m})$			0.0151	0.0126	0.0224	0.0216
			(0.0150)	(0.0156)	(0.0220)	(.0022)
$E_{it-1}(Costs_{12m})$				-0.0003		-0.0011
				(.0023)		(.0027)
$E_{it-2}(Costs_{12m})$				-0.0013		-0.0003
				(.0028)		(.0029)
$E_{it-3}(Costs_{12m})$				0.0046*		0.0059**
				(0.0023)		(.0026)
$E_{it-4}(Costs_{12m})$				0.0009		0.0015
				(0.0023)		(.0029)
$\widehat{u}_{it2}$	-	-	-0.1171	-0.1184	-0.1574	-0.1795
			(0.1116)	(-0.1131)	(0.1623)	(0.1641)
Sector FE	✓	✓	✓	✓	✓	✓
Taylor Dummies	✓	✓	✓	✓	✓	✓
Month FE	✓	✓	✓	✓	✓	✓
Years FE	✓	✓	✓	✓	✓	✓
R2	0.444	0.446	0.1537	0.444	0.443	0.445
Observations	6,067	6,067	5,886	5,886	5,886	5,886

Notes: All estimations include Taylor variables, monthly, yearly and sector dummies. Standard errors are clustered (by firm) and bootstrapped using 500 repetitions.

8.9 Linear Probability model - estimations

Table 8.7: *Probability of Price Adjustments*

	(1)	(2)	(3)	(4)
$E_{it}(Inf_{12m})$	0.0035	0.0016	0.0046	0.0009
	(.0059)	(.0054)	(.0073)	(.0064)
$E_{it-1}(Inf_{12m})$		0.0029	0.0096	0.0055
		(.0048)	(.0062)	(.0051)
$E_{it-2}(Inf_{12m})$		-0.0035	-0.0055	-0.0057
		(.0044)	(.0061)	(.0050)
$E_{it-3}(Inf_{12m})$		-0.0021	-0.0063	-0.0063
		(.0053)	(.0064)	(.0059)
$E_{it-4}(Inf_{12m})$		-0.0029	-0.0009	-0.0048
		(.0057)	(.0021)	(.0066)
$E_{it}(Costs_{12m})$	0.0007	-0.0034	-0.0008	-0.0042
	(.0037)	(.0041)	(.0056)	(.0048)
$E_{it-1}(Costs_{12m})$		0.0019	0.0004	0.0008
		(.0024)	(.0032)	(.00327)
$E_{it-2}(Costs_{12m})$		0.0015	0.0032	0.0019
		(.0025)	(.0029)	(.0029)
$E_{it-3}(Costs_{12m})$		0.0058**	0.0054	0.0066**
		(.0031)	(.0025)	(.0031)
$E_{it-4}(Costs_{12m})$		0.0034	0.0016	0.0031
		(.0030)	(.0035)	(.0036)
Sector FE	✓	✓	✓	✓
Taylor Dummies	✓	✓	×	✓
Month FE	✓	✓	✓	×
Years FE	✓	✓	✓	×
R^2	0.1571	0.1597	0.0273	0.1437
Observations	6067	6067	6067	6067

Notes: All estimations include Taylor variables, monthly, yearly and sector dummies. Standard errors are clustered (by firm) and bootstrapped using 500 repetitions.