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Price Setting in Retailing: the Case of Uruguay*

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Abstract

We use a rich and unique dataset of 30 million daily prices in groceries and supermarkets across the country to analyze stylized facts of the behaviour of consumer prices. Our findings are as follows: i) The median duration of prices is two months and half. Therefore, retail prices in Uruguay are less sticky than in the US, Brazil and Chile, but stickier than in the UK. ii) We do not find evidence of a seasonal pattern in the likelihood of price adjustments. iii) The frequency of price adjustment is only correlated with expected inflation for the personal care product category. However, for the food category we find that firms changes the percentage points of the adjustment and not their frequency. iv) The probability of price change in the first day of the month is nine times higher than in any another day. v) The probability of a price change is not constant over time. Therefore, the evidence presented in this paper indicates that price stickiness in Uruguay is low, in consequence there are doubts regarding the effectiveness of monetary policy.

Keywords. Retail; micro data; prices; price volatility; sticky prices.

JEL: E31, D40, L16, L81.

1.- Introduction

In recent years there has been an increase in the empirical literature of price behaviour. As new and detailed datasets become available we observe an important number of studies on the microeconomic fundamentals of price setting of firms -mainly retailers- and its impact on inflation. This analysis allowed a better understanding of the behaviour, dispersion and volatility of prices.

Although there are different theoretical models that explain these issues in the macroeconomic literature -such as menu cost models, sticky price, sticky information models, or time or state dependent pricing strategies-, the stylized facts pointed out in the literature avoid a unique formalization. Klenow and Malin (2010) provide an up to date and concise overview of the empirical evidence, and confront the data with different theoretical models. They stress ten facts of the microeconomic behaviour of prices. The main ones are that prices do change at last once a year; that the main instrument for downward price adjustment is price discount; that most markets have a stickier reference price; that goods prices differ in their frequency of adjustment and their changes are asynchronous between them; that there exist microeconomic forces that explain the behaviour of prices that differ from aggregate inflation and, finally, prices adjust mainly when wages change.

Gopinath and Rigobon (2008) study the stickiness of traded goods using micro data on US import and export prices at-the-dock for the period 1994-2005. They find long price duration of traded goods -10.6 months for imports, and 12.8 months for exports-; large heterogeneity in price stickiness across goods at the disaggregated level; a declining probability of price adjustment over time for imports and a rather low

exchange rate pass-through into US import prices.

Nakamura (2008) studies price dynamics at the retail and wholesale level. Her retail dataset consists of weekly observations for 100 products and 7,000 groceries across US. She decomposes the variance of prices into price variation common to all items within a product category and price variation idiosyncratic to a particular product. For each category she further decomposes price variation into: i- variation that is common across all stores; ii- variation that is common only to stores within the same retail chain; and iii- variation that is completely idiosyncratic. She finds that chains explain 64% of price variation, product about 16%, stores just 2%, and that 16% of total price variation is totally idiosyncratic to a particular store and product. She concludes that pricing strategies at retail level are difficult to reconcile with variations in demand or costs, and they might be the consequence of retailers or manufacturers dynamic pricing strategies.

Nakamura and Steinsson (2008) use the Consumer Price Index (CPI) and the Producer Price Index (PPI) from the Bureau of Labor Statistics (BLS) in the US for the period 1988-2005 to study price stickiness. Their results show a duration of regular prices of between 8 and 11 month, after excluding price sales; that temporary sales are an important source of price flexibility -mainly downward price flexibility-; that excluding sales roughly one third of price changes are price decreases; that price increases covariates strongly with inflation, but price decreases not; and that price changes are highly seasonal -mainly in the first quarter-. Finally, they find that the hazard function of price changes, which estimates the probability of a price change after t periods without changing, is slightly downward slopping, which implies that the probability that a price change decreases the longer the time span from last change.

Some of these conclusions have been relativized by Klenow and Kryvtsov (2008). They analyze monthly price information from the BLS for the period 1988 - 2004. They found that prices change quite frequently, every 3.7 months if sales are included and up to 7.2 months if sales are not included. They compare their results with those of other papers for the U.S. and discuss its differences. They conclude that different methodologies on how to include or not sales, or take into account prices of substituted goods change the estimated rigidity of prices. Price changes are quite large, up to an average of 10% a year in their sample. Also, they found a large number of small price changes; nearly 44% of price changes are smaller than 5% in absolute value, with 12% smaller than 1%. The distribution of the size of price changes is similar between price increases and decreases. Hazard rate estimates for a given item are quite flat, once taking into account the mix of heterogeneous hazard rates for different goods, that is survival bias. Finally, they decompose the variance of inflation between the intensive margin -the size of price changes- and the extensive margin -the number of items changing prices-. The intensive margin mainly explain the variance of aggregate inflation. In explaning inflation, that is its variance, both price increases and price decreases have a say.

Ellis (2009) studies the behaviour of prices in the UK using weekly prices for 280 products in 240 supermarkets from February 2005 to February 2008. He finds low price rigidities in the UK retailing industry. Prices change frequently (the mean duration is about two weeks) even after discarding promotions and sales. He relates this finding to the frequency of the data: using weekly data translates into more price changes rather than monthly. When analysing the sign of the price change in price reversals -that is, price changes that later reverted to the original price-, he finds that there is a prevalence

of price decreases, which is consistent with sales. Also the range of price changes is very wide: there are some products that display large changes in prices, and a large number that have small changes. Lastly, he finds that all products have declining hazard functions as Nakamura and Steinnson (2008).

Studies for Latin America are scarce due to the lack of availability of scan data, and they have concentrated on micro CPI data. Because of the access to scan data the literature has focused in the USA and the Euro area. Barros et al (2009) Medina et al (2007) analyze price formation in Brazil and Chile respectively. They show that the frequency of adjustment is different than the one obtained using macro data. They estimate median duration of 4 and 3 months for Brazil and Chile respectively. Because their data is monthly they can not capture prices change within a month. Also, the CPI data has to deal with higher measurement error than scan data.

Chaumont *et al* (2010) study price setting behaviour in Chile using weekly data. They find significant heterogeneity in price behaviour by supermarkets. In contrast with Nakamura (2008), they find that nearly 35% of price changes are idiosyncratic to product or chain shocks, and 65% of prices changes are common shocks that affect all products in a category and all stores in the country at the same time. They find that prices change frequently in Chile.

The only paper that analyzes price rigidities in more than one Latin American country is Cavallo (2010). He uses scraped online data from Argentina, Brazil, Chile and Colombia. He finds price stickiness in Chile and relatively price flexibility in Brazil.

This paper is the first one that analyzes the pricing behaviour of retailers in Uruguay. Additionally, to the best of our knowledge this is the first paper to use daily price data. The objective of this study is to describe stylized facts of price formation in Uruguay, and compare them with those of the existing literature. The paper is organized as follows. The next section presents a discussion of our priors about price rigidities in Uruguay. After that, we provide a detailed description of the database. Next we present the main findings of the analysis, and offer a brief comparison with the available evidence. In the section 5 we discuss the implication of our findings for monetary policy. Finally, section 6 shows the main conclusions.

2.- What do we Expect about Price Rigidities in Uruguay

As we mentioned and discussed above the theoretical and empirical evidence for price rigidities in Latin America is scarce. To the best of our knowledge this is the first study to use microdata to analyze price stickiness in Uruguay.

Our priors regarding price stickiness in Uruguay are ambiguous. By one side, because of the significance of commodities in the Uruguayan consumption price basket and their lower domestic content, we expect flexibility in the local prices. On other side, because of the relatively low openness of the country given its small size we expect a higher importance of the non tradeable goods and services (in particular wages) and therefore higher stickiness. The low openness can be explained for the high transportation cost to access global market. Additionally, Uruguay integrated the Mercour (Mercado Común del Sur), a relatively closed trade agreement with Argentina, Brazil and Paraguay.

Amjadi and Winters (1997) find that transportation margins on trade within Mercosur countries are a significant 6% lower than on trade with other countries.

Also, the high level of unionization of the labor force, the fact that wage changes are mandatory by the Wage Council, the high level of concentration in some industrial sectors leads us to expect high levels of price stickiness in Uruguay. Therefore, it is relevant to provide empirical evidence to quantify the Uruguayan price rigidities.

Finally, the Uruguay evidence based in daily supermarket non-error prices can shed light to set up stylized facts about price formation in Latin America.

3.- Data

We analyze a micro dataset with a daily frequency compiled by The General Directorate of Commerce (DGC, by its Spanish acronym) which includes more than 300 grocery stores all over the country and 155 products (see Annex I for a map with the cities covered in the dataset). The products brands were chosen to be the most representatives of the product being described, and they were chosen to be the most selling brands of each category. The products in the sample represent at least 12.6% of the goods and services in the CPI basket (see Annex II).

The DGC is the authority in charge of the enforcement of the Consumer Protection Law at the Ministry of Economy and Finance. In 2006 a new tax law was passed by the legislative which changed the tax base and rates of the value added tax (VAT). The basic rate was reduced from 23% to 22% and its minimum rate (staple

foods, hotel rooms (high season), certain health related services and electricity for public consumption) from 14% to 10%. In addition exemptions were eliminated (e.g. health, passengers transport, sales of new homes). A tax on intermediate consumption of goods at a 3% rate (COFIS) was eliminated. The tax reform also reduced the asymmetries between sectors of activity regarding the employer contribution to social security and introduced a personal income tax.

As the Ministry of Economy and Finance was concerned about incomplete pass-through from tax reduction to consumer prices, it publishes an open public dataset of prices in different groceries and supermarkets in order to monitor its pass-through to consumers. In this regard, the DGC issued Resolution Number 061/006 which mandates groceries or supermarkets to report the daily prices for a list of products if they fulfil the following two conditions: i- they sell over 70% of the products listed in the Annex II of such Resolution, and ii- they have more than four grocery stores under the same name, or have more than three cashiers in a store. The information sent by each supermarket is an affidavit, which means that it is subject to penalties in case of misreport.

The DGC made the information public through a web page that published the average monthly prices of each product for each store in the defined basket (see http://www.dgc-mef.gub.uy/publico/). This information is available within the first ten days of the next month. It should be noted that there are no further uses for the information; eg. no price control, nor further policies were instrumented to control supermarkets with this price information. The idea was to give consumers more information about prices so they can do their shopping at the cheapest store.

The products to be reported to the DGC were defined after a survey to the main supermarket chains inquiring about their annual sells for each item and brand. After

discarding supermarkets own brands, the three most selling brands were chosen to be reported in each item. Most items were homogenized in order to be comparable, and each supermarket reports always the same item. As an example, bottled sparkling water of the SALUS brand is reported in its 2.25 litter's presentation by all stores.

Each item is defined by its universal product code (UPC) with the exception of meat, eggs, ham, some types of cheese and bread. In some cases, as meat and some types of cheese, general definitions were set, but items could not been homogenized. In the case of bread, most groceries buy frozen bread and bake it, they do not produce them at the store. Grocery shops differ in the kind of bread they sell, so in some cases the reported bread does not coincide with the definition, or grocery shops prorate the price submitted to the DGC; i.e. if the groceries sold bread in 450 grams each, and the requested bread is 225 grams, they submit half the price of it.

Each month, the DGC issue a brief report with details of the price evolution. This report counts the number of products that increase or decrease their prices. The prices used for these calculations are the simple average market prices for each product.

The database starts in March 2007 and the new tax base was put into place in July 2007. A few months later, new products were added to the database, after a push of inflation in basic consumer products in 2008. The government made "voluntary sectoral price agreements" with producers in the salad oil, rice and meat markets. Additionally, in the second semester of 2010 new goods were added to the dataset.

Within two days after a month ends, each supermarket uploads its price information to the DGC. After that, it begins a process of so-called price consistency check of the information. This process starts by calculating the average price for each item in the basket. Each price bigger or lower than 40% average price is selected. Then

the supermarket is contacted in order to check if the price submitted is right. If there is no answer from the supermarket, or if the supermarket confirms the price submitted, the price is posted online as it was reported. If the supermarket corrects the price, which is an exception, the price is corrected in the database and posted online.

Our database has daily prices from April 2007 December 2010 on 155 items. From the database, we eliminated those items that were not used (marked as 'XXX' and '0'). The complete list of products can be found in Annex II. We also eliminate March 2007 observations, because they were preliminary and had not been posted online. Finally, we eliminate those products -and supermarkets- for which we do not have observations for more than half of the period.

We end up with data for 117 products in 303 grocery stores from 45 cities in the 19 Uruguayan departments (see Annex I). These cities represent 80% of the total population in Uruguay. The capital city -Montevideo- with 45% of the population concentrates 60% of the supermarkets in the sample.

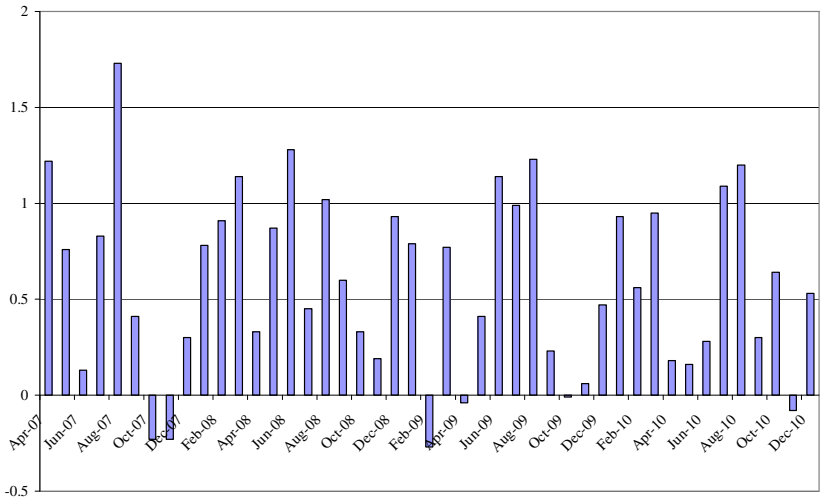
Table 1 summarizes the total number of price observations (30 millions) according to four product categories: food, soft drinks, alcohol, and personal care and cleaning items (named personal). Food is the main category, followed by products of personal cleaning, and lastly beverages.

Table 1
Number of Daily Price Observations by Category
April 2007 to December 2010

Category	Number of Observations	Percentage of Total
Food	20,380,541	66
Soft Drinks	1,814,628	6
Alcohol	1,486,176	5
Personal	7,038,089	23
Total	30,719,434	100

Finally, as our results could be driven by differences in the overall inflation in the sample, we plot the monthly variation of prices. This period was characterized by inflation pushes (the median monthly inflation rate is 0.56%), and the government was worried that inflation reach a high level in the medium term.

Figure 1. Monthly Inflation Rate (%)



4.- Results

This section shows the main results of the analysis, and it is divided into five facts. The first section reviews the frequency of price adjustment, and compares its results with the existing literature. The second section linked to the first one, stud the existence of seasonality in the pricing adjustment of supermarkets. In the third one we study the nexus between price changes and expected inflation. The fourth section analyzes price changes by day of the month, which is new in the literature. Finally, we compute the hazard rates of price changes.

4.1 Frequency of Price Adjustments

As is standard in the literature, we first study the rigidity of prices by computing the median probability of daily price changes, the median duration of prices in months, and contrast the results separating between price increases and price decreases. It should be noted that we study the whole sample, not differentiating between sales or not. From a theoretical point of view if there is a price decrease because of a sale this fact is showing evidence of price flexibility and we do not want to eliminate such observation.

The median daily price change for the whole sample is a non trivial 1.3%. This implies a medium price change every 75 days or every two months and half on average, which is considerably lower than the estimate of Nakamura and Steinsson (2008) and Nakamura (2008), but higher than the results of Ellis (2009) of two weeks. This result is slightly smaller than the median duration of 3 and 4 months find by Barros et al (2009) and Medina et al (2007) for Brazil and Chile respectively.

We offer two explanations for this behaviour. First, this is a period of relatively high inflation, so one could expect that prices change fast: the median monthly inflation in the period in Uruguay was 0.56%. Second, as our database has daily prices, we can calculate more accurately prices changes than in previous studies, that use weekly or monthly data. In this case, we can detect earlier price changes and our measure of price rigidity would be more sensitive to them. This would result in less price stickiness for our database.

In line with Nakamura and Steinsson (2008), 40% of the price changes are price decreases. Table 2 presents the median probability of price changes, the percentage that are decreases and the median monthly duration by product category.

Table 2
Price Variation and Duration by Category

Category	Median Probability of Daily Variation	Percentage Decrease	Monthly Duration
Food	0.013	40.6	2.5
Soft Drinks	0.010	33.3	3.2
Alcohol	0.009	30.0	3.5
Personal	0.017	42.0	1.9
Total	0.013	40.4	2.5

Our results show that personal cleaning are the products that change price more frequently, and alcohol is the opposite. There is an important variation in price stickiness across product categories ranging from 1.9 months for food to 3.5 months for alcohol. In the Annex III we present a detailed analysis of this result for each product in the sample. There is a high variability of results across products. For example, we found products that change prices quite quickly, such as Cheese "Disnapt" and "Cerros del Este" which prices change 5 and 2 times a month respectively, and others that change prices more slowly such as Brown Eggs "El ecologito" and Salt "Torrevieja" whose prices last up to 5 months.

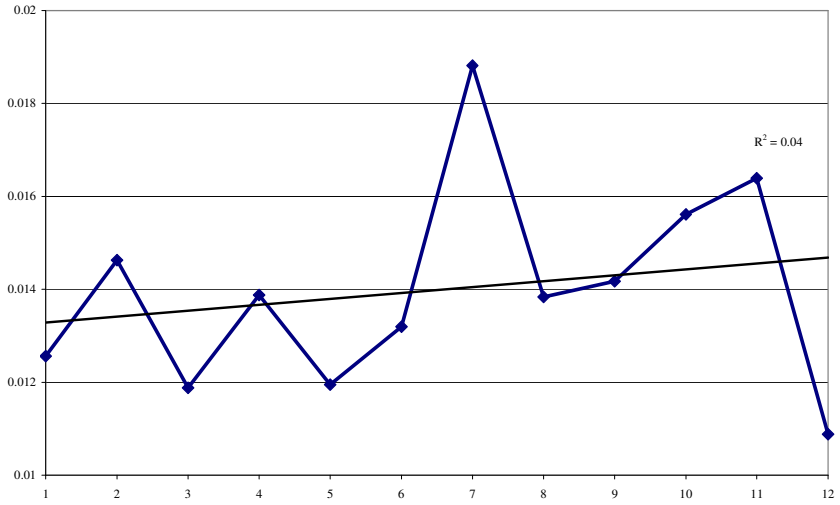
4.2 Seasonality of Price Changes

A second issue we study is the existence of a seasonal adjustment pattern of prices. Nakamura and Steinsson (2008) find that price changes in the US are highly seasonal, and concentrated in the first quarter and then declining. This seasonality of Nakamura and Steinsson (2008) is consistent with their price rigidity calculation of about 8 month. By contrast, Ellis (2009) found no monthly seasonality in its study, a result in line with it finding of just 2 weeks of price rigidity. As we found price duration of two and half

months, we should expect to find no seasonality in the data.

Studying monthly data we observe an increasing tendency of *price changes* from January to December, although the relationship is not significant (see Figure 2).

Figure 2. Probability of Price Change by Month



However, this pattern nearly disappears when looking at data on a quarterly basis. The percentage of daily price changes n the first quarter is 1.28, 1.29 in the second quarter, 1.58 in the third quarter, and 1.49 in the fourth quarter. The highest price change seems to be concentrated in the third quarter. Next we look at the seasonal behaviour of prices by categories (see Table 3).

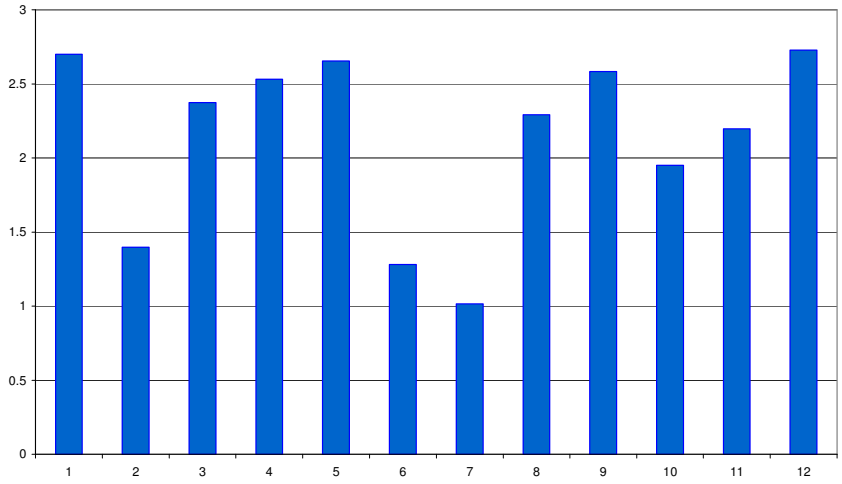
Table 3
Seasonal Probability of Price Change by Product Category

Quarter / Category	Food	Soft Drinks	Alcohol	Personal
1	0.013	0.008	0.006	0.013
2	0.012	0.009	0.008	0.017
3	0.016	0.012	0.010	0.018
4	0.015	0.010	0.009	0.019

All categories but personal have the highest number of price changes in the third quarter, although there is no clear tendency in the data. Therefore, we can not conclude that there is seasonality in the speed of price adjustments.

Next we study if there is seasonality in the *level* of the price adjustments. Figure 23 shows the price growth rate conditional on price change by month. Again, we do not observe a clear pattern of seasonality. It should be said that in Uruguay workers receive half an extra monthly paid in June and December. Also, in the last month are the New Year festivities and supermarkets sales generally boost.[1] Having said that, we do not find demand driven price changes in the data.

Figure 3. Prices Growth Rate giving Price Change by Month (%)



4.3 Individual Price Changes and Inflation Perceptions

Next we study if price changes and inflation expectations move together. Ellis (2009) suggests a positive relationship between the frequency of price changes in its sample and the inflation perception surveyed by Bank of England. Table 4 shows the result of

[1] In Uruguay supermarkets sales usually soar the day before it remain closed. The 1st and 6th of January, the 1st of May, and the 25th of December are usually the days supermarkets do not open.

Ordinary Least Square (OLS) regression estimation where the dependent variable is the median probability of price change and as exploratory variable we include expected inflation and indicator variables for the July 2007 tax reform. The expected inflation variable is the median forecast from a survey of experts performed by the Central Bank of Uruguay. We include an indicator variable before and after the tax reform to capture anticipated effects of the reform. The regression shows no correlation between changes in prices and inflation perception. One would suggest that if prices tend to be stickier, then the inflation expectations should not be of inflation acceleration. It is interesting to point out that we only observe correlation between inflation and the percent variation in individual prices when considering price decreases. The tax reform indicator variables suggest that firm anticipate the reform and changes prices before the implementation of the reform in July 2007.

Table 4. Individual Price Changes and Inflation Perceptions: OLS Regression
April 2007 to December 2010

	Dependent Variable			
	Probability of	Price Change in Percentage		
Variables	Price Change	All	Increases	Decreases
Expected Yearly Yearly Inflation	0.001	-0.024	0.449	-0.640***
	(0.001)	(0.412)	(0.369)	(0.194)
Tax Reform Indicator Variable May 2007	0.008*	3.052*	3.659**	-1.043
	(0.004)	(1.792)	(1.604)	(0.844)
Tax Reform Indicator Variable June 2007	0.012**	-4.102**	2.500	-0.288
	(0.004)	(1.790)	(1.602)	(0.843)
Tax Reform Indicator Variable July 2007	0.011**	-1.371	-4.849***	2.740***
	(0.004)	(1.789)	(1.602)	(0.843)
Tax Reform Indicator Variable August 2007	-0.018***	3.396*	-0.550	-1.401
	(0.004)	(1.793)	(1.605)	(0.845)
Tax Reform Indicator Variable September 2007	-0.009***	-0.390	0.183	0.479
	(0.003)	(1.293)	(1.158)	(0.609)
Constant	-0.001	1.520	5.090**	-4.304***
	(0.007)	(2.780)	(2.488)	(1.309)
Observations	45	45	45	45
R-squared	0.733	0.229	0.405	0.399

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

For a better understanding of the relationship between individual daily prices and inflation we estimate the previous equation by product category. Table 5 shows the results of the coefficient on expected inflation. Interesting, results indicate that only for the personal product category there is a positive association between probability of price changes and expected inflation. For the other product categories, the correlation is zero. This means that expectation about future inflation do not influence the price strategies of firms in those markets. We do found an association between changes in prices and the average rate of prices decreases for the food product category.

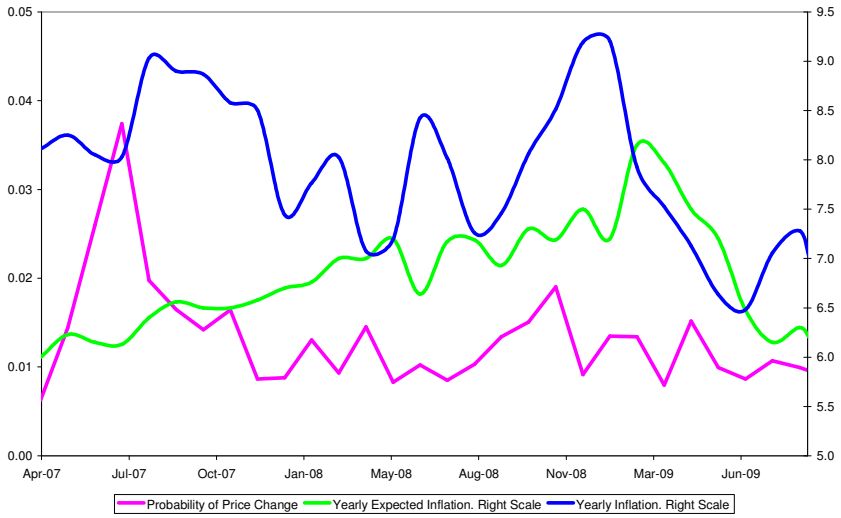
Table 5. Individual Price Changes and Inflation Perceptions: OLS Regression by Product Category
April 2007 to December 2010

	Dependent Variable			
	Probability of	Price Change in Percentage		
Category	Price Change	All	Increases	Decreases
	Cofficient - Standard Error on Expected Yearly Inflation			
Food	0.001	-0.168	0.700	-0.771***
	(0.001)	(0.522)	(0.456)	(0.221)
Soft Drinks	-0.001	-1.644*	-1.678	0.393
	(0.001)	(0.924)	(1.997)	(0.513)
Alcohol	0.003	0.298	0.256	-0.064
	(0.002)	(0.790)	(0.781)	(0.552)
Personal	0.003**	0.839	0.195	-0.602
	(0.001)	(0.527)	(0.477)	(0.361)
Observations	45	45	45	45

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To provide more evidence in this topic Figure 3 plots the probability of price adjustment, (left scale) and the inflation and expected inflation rate (left scale). We observe no association between prices changes and inflation perceptions.

Figure 4. Probability of Price Change, Inflation and Expected Inflation



4.4 Prices Changes by Day of the Month

Given the fact that we have daily data we can analyze the pricing decision of firms by day of the month. Figure 5a shows the probability of a price change by day of the month. Interestingly, the probability of price change in the first day of the month is nine times higher than in any other day.

Figure 5a: Probability of Price Changes by Day

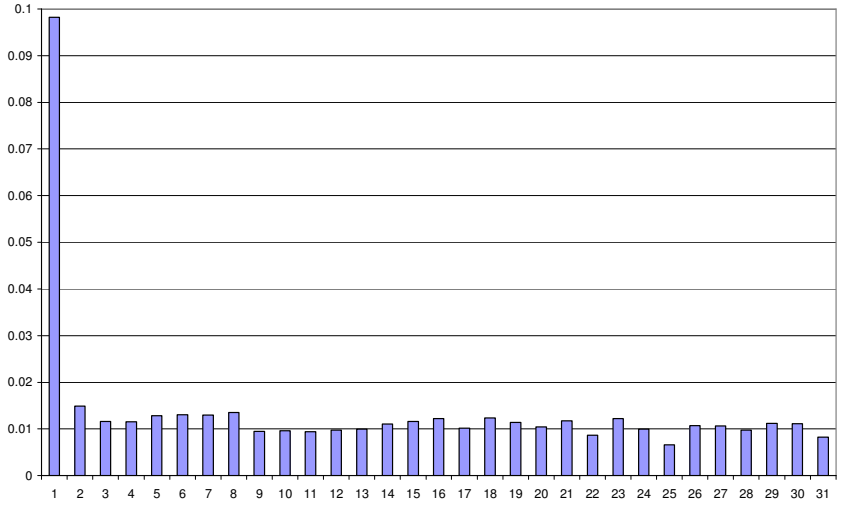


Figure 5.b plots the daily probability of a price change from the second day to the last day of the month. We do not observe a clear pattern in the data.

Figure 5b: Probability of Price Changes by Day
Day 2nd to 31th

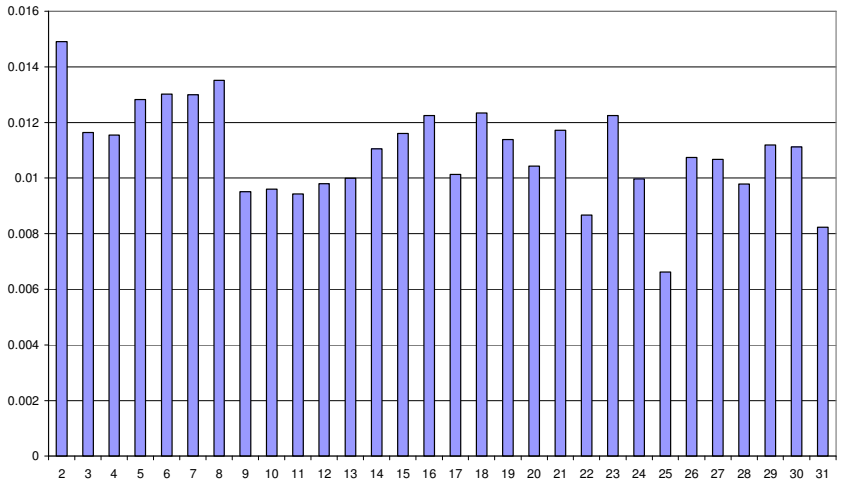


Figure 6 shows that price increases and decreases also are concentrated on the first day of the month. Also, Figure 7 shows that the fact that price changes are

concentrated the first day of the month is a general result valid to all product categories. This is one of the most remarkable finding of our paper, as to the best of our knowledge no other study analyzes the distribution of price changes by day of the month. One supermarket manager told us that this behaviour is related to producers, which tend to adjust their prices the first day of the month. In this case, the observed behaviour could be a response to cost increases by supermarkets. Interestingly however is that this patter is the same for price increases and price decreases. As price decreases are associated with sales, this implies that supermarkets tend to follow a pattern of price change that concentrate most of them in one day, which may indicate the existence of menu cost associated with pricing behaviour or some other rigidity that prevent the supermarkets to change prices.

Figure 6. Probability of Price Increases and Decreases by Day of the Month

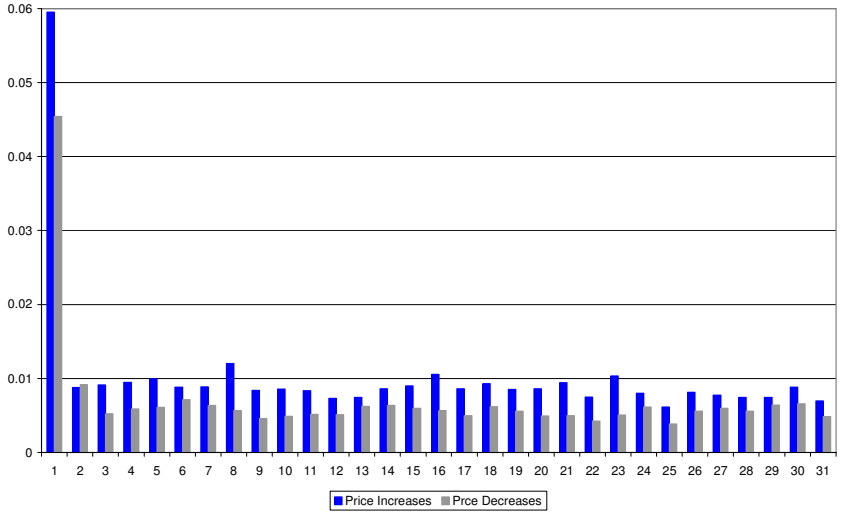
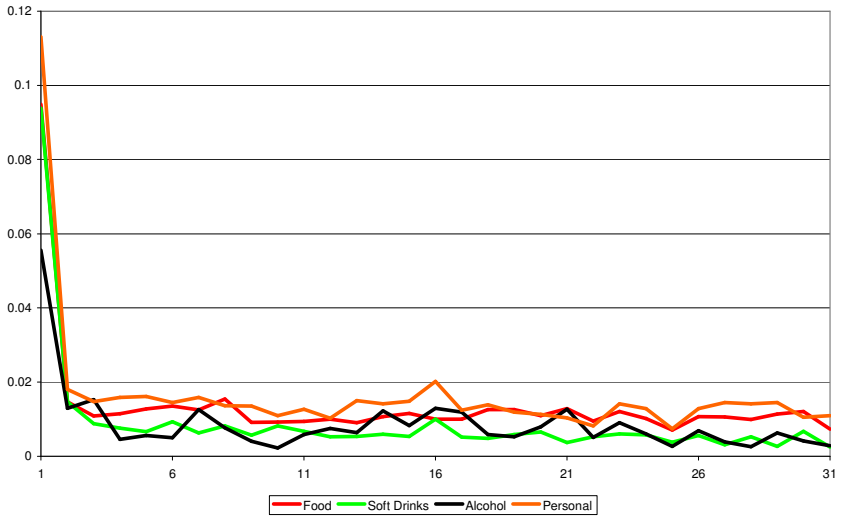
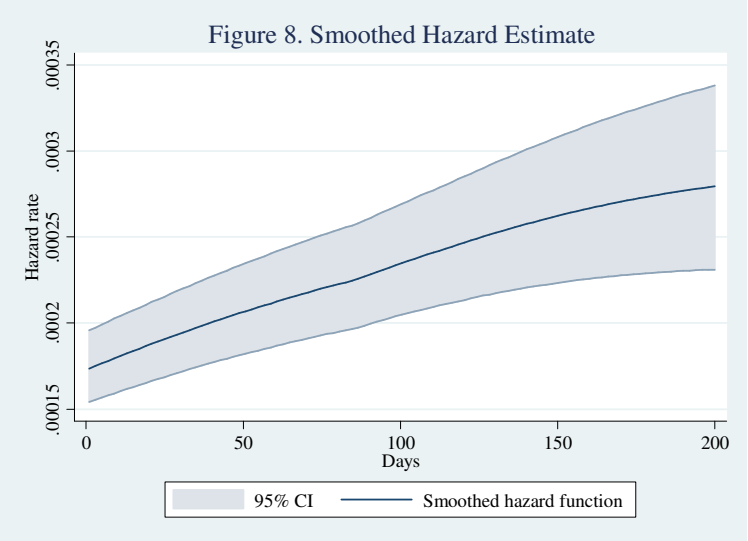


Figure 7. Daily Probability of Price Changes by Product Category



4.5 Hazard Rate Estimates

Lastly, we estimate the hazard rate in order to study if the probability of price change is time dependent. The hazard rate at moment *t* is calculated as the quotient of the number of prices that change in *t*, given that they do not change until that moment, over the number of prices that have not change until moment *t*. As the most price duration is half year (see Annex III) we calculate the hazard function up to two hundred days. The Figure 8 shows the smoothed hazard raten. We observe a non constant over time hazard rate. This result is consistent with Nakamura (2008) and Ellis (2009). This fact invalidates de modelling of a constant probability of price change, and implies that supermarkets do not follow a time dependent strategy for price setting. In turn, this result is in line with section 3.2, when we do no find seasonality in price changes.



5.- Implications for Monetary Policy

It is well known in the literature that the higher the level of price stickiness the higher the impact of monetary policy on economic activity. Therefore, in order to assess the impact of monetary policy is relevant the study of price rigidities. The evidence presented in this paper indicates that price stickiness in Uruguay is low and therefore the effectiveness of monetary policy must be relativized. This result is consistent with Gianelli (2010) who using a reduced form of a structural model concluded that the output gap losses of stabilization in Uruguay are low and of an order of magnitude comparable to the one founded in other Latin American countries.

However, these results must be mitigated because our sample does not contain all the items included in the consumption price index. We have price data for the following product categories: food, soft drinks, alcohol and personal care.

6.- Conclusions

We present evidence on price formation at the retail level in Uruguay. We use a rich and unique dataset of 30 million daily prices in grocery stores and supermarkets across the country to analyze the behaviour of consumer prices in Uruguay. We find that retail prices in Uruguay changes frequently. Prices are less sticky than in the US, Chile and Brazil but stickier than in the UK. The median duration of prices in Uruguay is two month and half.

We do not find evidence of a seasonal pattern in the adjustment of prices. The probability of price changes varies positively with expected inflation only for the personal care product category. However, for the food category we find an association between price changes and the percentage rate of price decreases. Also, the probability of price changes in the first day of the month is nine times higher than in other day of the month. Finally, the probability of price adjustments is not constant over time. Therefore, the evidence presented in this paper indicates that price stickiness in Uruguay is low and therefore the effectiveness of monetary policy must be reconsidered.

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ANNEX I

The next figure plot the cities for which we have information of. All “departamentos”, which are Uruguayan's regions, are included in the study.

ANNEX II: List of Products

Product	Brand	Specification	Share in CPI (%)	Category
Beer	Patricia	0.96 L	0.3	Alcohol
Beer	Pilsen	0.96 L	0.3	Alcohol
Wine	Roses	1 L	0.34	Alcohol
Wine	Santa Teresa Clasico	1 L	0.34	Alcohol
Wine	Tango	1 L	0.34	Alcohol
Bovine "Peceto"	No Brand	1 Kg	0.9	Food
Bovine "Botton"	Boneless - No Brand	1 Kg	0.43	Food
Bovine "Botton"	With Bone - No Brand	1 Kg	0.43	Food
Bovine "Needle" Meat	Boneless - No Brand	1 Kg	0.86	Food
Bovine "Needle" Meat	With Bone - No Brand	1 Kg	0.86	Food
Bovine "Paleta"	With Bone - No Brand	1 Kg	n/i	Food
Bovine "Rueda"	With Bone - No Brand	1 Kg	n/i	Food
Bovine Minced Meat	Up to 20% Fat	1 Kg	0.29	Food
Bovine Minced Meat	Up to 5% Fat	1 Kg	0.29	Food
Bread	No Brand	1 Unit Aprox. 0.215 Kg	1.21	Food
Brown Eggs	El Ecologito	1/2 Dozen	0.34	Food
Brown Eggs	El Jefe	1/2 Dozen	0.34	Food
Brown Eggs	Prodhin	1/2 Dozen	0.34	Food
Butter	Calcar	0.2 Kg	0.15	Food
Butter	Conaprole sin sal	0.2 Kg	0.15	Food
Butter	Lacterma	0.2 Kg	0.15	Food
Cacao	Copacabana	0.5 Kg	0.04	Food
Cacao	Vascolet	0.5 Kg	0.04	Food
Cheese	Cerros del Este	1 Kg	0.23	Food
Cheese	Dispnat	1 Kg	0.23	Food
Chicken	Avicola del Oeste	1 Kg	0.64	Food
Chicken	Tenent	1 Kg	0.64	Food
Coffee	Aguila	0.25 Kg	0.1	Food
Coffee	Chana	0.25 Kg	0.1	Food
Dulce de leche	Conaprole	1 Kg	0.14	Food
Dulce de leche	Los Nietitos	1 Kg	0.14	Food
Dulce de leche	Manjar	1 Kg	0.14	Food
Flour	Canuelas	1 Kg	0.16	Food
Flour	Cololo	1 Kg	0.16	Food
Flour	Puritas	1 Kg	0.16	Food
Frankfurters	Cattivelli	8 Units - Aprox. 0.340 Kg	0.26	Food
Frankfurters	Ottonello	8 Units - Aprox. 0.330 Kg	0.26	Food
Frankfurters	Schneck	8 Units - Aprox. 0.330 Kg	0.26	Food
Grated Cheese	Conaprole	0.08 Kg	0.15	Food
Grated Cheese	El Trebol	0.08 Kg	0.15	Food
Grated Cheese	Milky	0.08 Kg	0.15	Food

Product	Brand	Specification	Share in CPI (%)	Category
Grit Noodles	Adria	0.5 Kg	n/i	Food
Grit Noodles	Las Acacias	0.5 Kg	n/i	Food
Ham	Centenario	1 Kg	0.21	Food
Ham	La Constancia	1 Kg	0.21	Food
Ham	Schneck	1 Kg	0.21	Food
Margarine	Danica dorada	0.2 Kg	0.02	Food
Margarine	Doriana nueva	0.25 Kg	0.02	Food
Margarine	Primor	0.25 Kg	0.02	Food
Mayonnaise	Fanacoa	0.5 Kg	0.09	Food
Mayonnaise	Hellmans	0.5 Kg	0.09	Food
Mayonnaise	Uruguay	0.5 Kg	0.09	Food
Noodles	Cololo	0.5 Kg	0.3	Food
Peach Jam	Dulciora	0.5 Kg	0.17	Food
Peach Jam	Limay	0.5 Kg	0.17	Food
Peach Jam	Los Nietitos	0.5 Kg	0.17	Food
Peas	Arcor	0.35 Kg	0.05	Food
Peas	El Hogar	0.35 Kg	0.05	Food
Peas	Trofeo	0.35 K	0.05	Food
Quince jam	Los Nietitos	0.4 Kg	n/i	Food
Rice	Aruba tipo Patna	1 Kg	0.2	Food
Rice	Blue Patna	1 Kg	0.2	Food
Rice	Green Chef	1 Kg	0.2	Food
Rice	Pony	1 Kg	0.2	Food
Rice	Vidarroz	1 Kg	0.2	Food
Salad Cookies	El Trigal	0.15 Kg	0.17	Food
Salad Cookies	Famosa	0.14 Kg	0.17	Food
Salad Cookies	Maestro Cubano	0.12 Kg	0.17	Food
Salt	Sek	0.5 Kg	0.05	Food
Salt	Torrevieja	0.5 Kg	0.05	Food
Salt	Urusal	0.5 Kg	0.05	Food
Semolina Pasta	Adria	0.5 Kg	n/i	Food
Semolina Pasta	Las Acacias - franja celeste	0.5 Kg	n/i	Food
Soybean Oil	Condesa	0.9 L	n/i	Food
Sugar	Azucarlito	1 Kg	0.25	Food
Sugar	Bella Union	1 Kg	0.25	Food
Sunflower oil	Optimo	0.9 L	0.25	Food
Sunflower oil	Uruguay	0.9 L	0.25	Food
Tea	Hornimans	Box 10 Units	0.09	Food
Tea	La Virginia	Box 10 Units	0.09	Food
Tea	Lipton	Box 10 Units	0.09	Food

Product	Brand	Specification	Share in CPI (%)	Category
Tomato Pulp	Conaprole	1 L	0.08	Food
Tomato Pulp	De Ley	1 L	0.08	Food
Tomato Pulp	Qualitas	1 L	0.08	Food
Yerba	Canarias	1 Kg	0.34	Food
Yerba	Del Cebador	1 Kg	0.34	Food
Yerba	Sara	1 Kg	0.34	Food
Yogurt	Conaprole	0.5 Kg	0.06	Food
Yogurt	Parmalat (Skim)	0.5 Kg	0.06	Food
Bleach	Agua Jane	1 L	0.08	Personal
Bleach	Sello Rojo	1 L	0.08	Personal
Bleach	Solucion Cristal	1 L	0.08	Personal
Detergent	Deterjane	1.25 L	0.2	Personal
Detergent	Hurra Nevex Limon	1.25 L	0.2	Personal
Laundry Soap	Drive	0.8 Kg	n/i	Personal
Laundry Soap	Nevex	0.8 Kg	n/i	Personal
Laundry Soap	Skip - Paquete azul	0.8 Kg	n/i	Personal
Laundry Soap in Bar	Bull Dog	0.3 Kg - 1 Unit	0.45	Personal
Laundry Soap in Bar	Nevex	0.2 Kg - 1 Unit	0.45	Personal
Shampoo	Fructis	0.35 L	n/i	Personal
Shampoo	Sedal	0.35 L	n/i	Personal
Shampoo	Suave	0.93 L	n/i	Personal
Soap	Astral	0.125 Kg	0.16	Personal
Soap	Palmolive	0.125 Kg	0.16	Personal
Soap	Suave	0.125 Kg	0.16	Personal
Toilet paper	Higienol Export	4 Unit - 25 M each	0.24	Personal
Toilet paper	Personal	4 Unit - 25 M each	0.24	Personal
Toilet paper	Sin Fin	4 Unit - 25 M each	0.24	Personal
Toothpaste	Closeup Triple	0.09 Kg	0.49	Personal
Toothpaste	Colgate Total	0.09 Kg	0.49	Personal
Toothpaste	Kolynos	0.09 Kg	0.49	Personal
Cola	Coca Cola	1.5 L	1.94	Soft Drinks
Cola	Nix	1.5 L	1.94	Soft Drinks
Cola	Pepsi	1.5 L	1.94	Soft Drinks
Sparkling Water	Matutina	2 L	0.7	Soft Drinks
Sparkling Water	Nativa	2 L	0.7	Soft Drinks
Sparkling Water	Salus	2.25 L	0.7	Soft Drinks

Note: n/i means not included in the CPI, Kg. kilograms, L. liters and M. meters.

ANNEX III: Detailed Price Changes and Duration by Product.

Product	Brand	Probability of Daily Variatior	Monthly Price Duration	Percentage Decrease
Beer	Patricia	0.008	3.9	20.4
Beer	Pilsen	0.009	3.5	23.2
Wine	Roses	0.008	4.0	22.1
Wine	Santa Teresa Clasico	0.012	2.7	38.3
Wine	Tango	0.011	2.9	39.4
Bovine "Peceto"	No Brand	0.026	1.2	40.3
Bovine "Botton"	Boneless - No Brand	0.027	1.2	43.1
Bovine "Botton"	With Bone - No Brand	0.015	2.2	34.2
Bovine "Needle" Meat	Boneless - No Brand	0.018	1.8	34.7
Bovine "Needle" Meat	With Bone - No Brand	0.027	1.2	40.1
Bovine "Paleta"	With Bone - No Brand	0.028	1.2	39.9
Bovine "Rueda"	With Bone - No Brand	0.013	2.5	34.2
Bovine Minced Meat	Up to 20% Fat	0.022	1.5	37.5
Bovine Minced Meat	Up to 5% Fat	0.019	1.7	36.6
Bread	No Brand	0.011	2.9	28.6
Brown Eggs	El Ecologito	0.007	5.0	24.7
Brown Eggs	El Jefe	0.008	4.2	29.5
Brown Eggs	Prodhin	0.012	2.8	33.8
Butter	Calcar	0.018	1.8	41.8
Butter	Conaprole sin sal	0.016	2.0	32.3
Butter	Lacterma	0.007	4.7	43.2
Cacao	Copacabana	0.011	2.9	34.4
Cacao	Vascolet	0.019	1.7	40.7
Cheese	Cerros del Este	0.068	0.5	45.0
Cheese	Dispnat	0.145	0.2	48.4
Chicken	Avicola del Oeste	0.041	0.8	42.8
Chicken	Tenent	0.039	0.8	44.6
Coffee	Aguila	0.009	3.7	34.0
Coffee	Chana	0.007	4.6	42.6
Dulce de leche	Conaprole	0.013	2.5	33.3
Dulce de leche	Los Nietitos	0.013	2.6	40.0
Dulce de leche	Manjar	0.013	2.6	31.4
Flour	Canuelas	0.027	1.2	43.7
Flour	Cololo	0.024	1.4	39.6
Flour	Puritas	0.015	2.2	36.3
Frankfurters	Cattivelli	0.010	3.2	45.7
Frankfurters	Ottonello	0.012	2.7	42.4
Frankfurters	Schneck	0.015	2.1	36.1
Grated Cheese	Conaprole	0.009	3.8	25.1
Grated Cheese	El Trebol	0.009	3.5	36.9
Grated Cheese	Milky	0.007	4.4	30.0

Product	Brand	Probability of Daily Variatior	Monthly Price Duration	Percentage Decrease
Grit Noodles	Adria	0.015	2.2	36.6
Grit Noodles	Las Acacias	0.019	1.7	40.2
Ham	Centenario	0.008	4.2	29.0
Ham	La Constancia	0.034	1.0	46.1
Ham	Schneck	0.015	2.2	35.8
Margarine	Danica dorada	0.012	2.7	39.0
Margarine	Doriana nueva	0.013	2.6	42.6
Margarine	Primor	0.016	2.1	41.2
Mayonnaise	Fanacoa	0.011	3.0	39.5
Mayonnaise	Hellmans	0.021	1.5	41.9
Mayonnaise	Uruguay	0.024	1.3	42.3
Noodles	Cololo	0.017	1.9	38.8
Peach Jam	Dulciora	0.012	2.6	35.9
Peach Jam	Limay	0.008	4.1	30.4
Peach Jam	Los Nietitos	0.011	3.0	37.9
Peas	Arcor	0.010	3.3	42.9
Peas	El Hogar	0.009	3.5	25.3
Peas	Trofeo	0.017	1.9	44.4
Quince jam	Los Nietitos	0.011	2.9	38.6
Rice	Aruba tipo Patna	0.018	1.8	43.4
Rice	Blue Patna	0.024	1.4	41.4
Rice	Green Chef	0.027	1.2	42.6
Rice	Pony	0.009	3.5	41.1
Rice	Vidarroz	0.012	2.7	49.3
Salad Cookies	El Trigal	0.009	3.6	32.4
Salad Cookies	Famosa	0.010	3.2	29.5
Salad Cookies	Maestro Cubano	0.012	2.6	41.1
Salt	Sek	0.011	3.1	41.9
Salt	Torrevieja	0.007	4.7	30.4
Salt	Urusal	0.012	2.7	41.7
Semolina Pasta	Adria	0.015	2.2	35.6
Semolina Pasta	Las Acacias - franja celeste	0.018	1.9	41.1
Soybean Oil	Condesa	0.029	1.1	56.2
Sugar	Azucarlito	0.017	1.9	35.3
Sugar	Bella Union	0.017	2.0	34.7
Sunflower oil	Optimo	0.033	1.0	42.1
Sunflower oil	Uruguay	0.032	1.0	40.9
Tea	Hornimans	0.009	3.5	46.5
Tea	La Virginia	0.010	3.2	46.8
Tea	Lipton	0.009	3.8	40.6

Product	Brand	Probability of Daily Variatior	Monthly Price Duration	Percentage Decrease
Tomato Pulp	Conaprole	0.017	1.9	36.3
Tomato Pulp	De Ley	0.012	2.7	34.4
Tomato Pulp	Qualitas	0.012	2.8	45.8
Yerba	Canarias	0.013	2.5	38.1
Yerba	Del Cebador	0.013	2.5	36.4
Yerba	Sara	0.015	2.2	40.4
Yogurt	Conaprole	0.013	2.6	29.5
Yogurt	Parmalat (Skim)	0.012	2.8	34.1
Bleach	Agua Jane	0.018	1.8	37.7
Bleach	Sello Rojo	0.015	2.2	33.6
Bleach	Solucion Cristal	0.018	1.8	43.3
Detergent	Deterjane	0.024	1.3	44.1
Detergent	Hurra Nevex Limon	0.024	1.4	43.3
Laundry Soap	Drive	0.015	2.2	43.1
Laundry Soap	Nevex	0.023	1.4	44.8
Laundry Soap	Skip - Paquete azul	0.018	1.8	45.3
Laundry Soap in Bar	Bull Dog	0.016	2.0	39.6
Laundry Soap in Bar	Nevex	0.015	2.2	39.8
Shampoo	Fructis	0.022	1.5	44.5
Shampoo	Sedal	0.016	2.1	47.3
Shampoo	Suave	0.011	3.0	45.0
Soap	Astral	0.018	1.8	46.3
Soap	Palmolive	0.023	1.4	50.0
Soap	Suave	0.013	2.5	46.6
Toilet paper	Higienol Export	0.016	2.1	32.7
Toilet paper	Personal	0.013	2.5	31.8
Toilet paper	Sin Fin	0.021	1.6	41.8
Toothpaste	Closeup Triple	0.009	3.7	38.1
Toothpaste	Colgate Total	0.023	1.4	39.1
Toothpaste	Kolynos	0.013	2.5	34.6
Cola	Coca Cola	0.010	3.3	25.5
Cola	Nix	0.008	4.0	34.6
Cola	Pepsi	0.010	3.2	31.7
Sparkling Water	Matutina	0.011	3.0	43.0
Sparkling Water	Nativa	0.007	4.6	27.0
Sparkling Water	Salus	0.013	2.6	35.0