UNIVERSIDAD DE LA REPÚBLICA

FACULTAD DE CIENCIAS SOCIALES

DEPARTAMENTO DE ECONOMÍA

Tesis Maestría en Economía

Price dispersion in Uruguay

Iael Klaczko Castiñeiras

2021

Price dispersion in Uruguay

Iael Klaczko Castiñeiras*
dECON - UdelaR.

October 24, 2021

Abstract

Retail prices for a product vary across time and places. The sources that drive price dispersion can be grouped into three categories: (i) price differences across markets, (ii) price differences across stores in a market, and (iii) within-store price variation over time.
I find there is price dispersion in the retail market in Uruguay. The decomposition shows that 39.16 percent is across-markets, 36.90 percent corresponds to across-store, and 23.94 percent over time. These results highlight the relevance of intertemporal pricing strategies of stores, and how they set prices at the local market to understand price dispersion. Nevertheless, in recent years across-market price dispersion has been increasing, which can imply a structural change of price dispersion sources.

The price dispersion phenomenon and its decomposition are heterogeneous. Across products, stores, and over time I find differences in price dispersion as well as differences in the sources behind it.

JEL: L11
Palabras clave: price dispersion, regular prices, variance decomposition, Uruguay

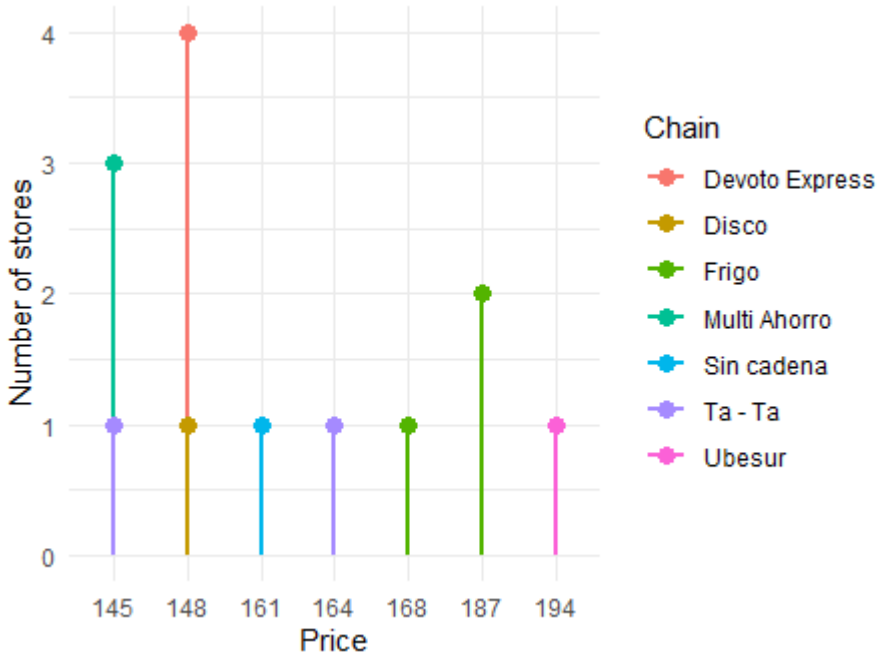
*Departamento de Economía - FCS - UdelaR. E-mail: iae1.klaczko@cienciassociales.edu.uy.
Code available on https://github.com/iae-k/PriceDisperion.

1 Introduction

Recent empirical work has focused on the way prices behave in an economy. As more micro price data become available, it has been possible to measure the degree of price dispersion, the frequency of price changes, the presence of price change seasonality, and price synchronisation. These insights are helpful to understand how prices are related to economic cycles and monetary policy, how firms set their prices, and their competitive implications. This paper focuses on the magnitude and the sources of price dispersion in the retail market in Uruguay. I analyse the price dispersion and its sources across different products, stores, and over different periods.

If we look for a specific product at a given moment and place (i.e., city or neighbourhood) it is not surprising to find it being sold at different prices, as shown in Figure 1. This phenomenon is called price dispersion.

Figure 1: Number of stores for each regular price of Dulce de leche Conaprole 1kg.



Source: author's calculation.

Notes: Each line represents the number of stores for each price of Dulce de leche Conaprole 1kg. in CCZ 1 (Montevideo) on March 2019. Each colour represents a chain.

As shown in Figure 1 Dulce de leche Conaprole 1kg. can be found at seven different prices for a given time and place. Its price ranges from $145 to $194 in March 2019 in CCZ 1 of Montevideo, which means you can buy it in some store downtown 34% cheaper than in the most expensive one. Even if we look at the chain level (represented by colour in the graph), we can see that stores from the same chain (i.e., Ta - Ta) set different prices. On the other hand, we can see stores of different chains that set the same price. This phenomenon remains for other products, periods, and places. A more extensive list of products is in Figures 13 to 16 of the Appendix.

To address the price dispersion phenomenon in Uruguay, I begin by measuring the degree of price dispersion. Borraz & Saldain (2017) calculate it for Montevideo using the same data, but another methodology. Although it is not possible to compare magnitudes, they found substantial price dispersion as well as I do. For the United States, Hitsch et al. (2019) found price dispersion is between 9.9 percent, and 11 percent at the local level, while Daruich & Kozlowski (2017) found that price dispersion, for a specific geographic region, ranges from 6.7 percent to 9.6 percent in Argentina. In this paper, I find the average price dispersion in Uruguay is 5.9 percent, which is lower than the one found for Argentina and the United States.

Then, I analyse the drivers behind price dispersion. Following Hitsch et al. (2019) I apply a variance decomposition analysis to decompose price dispersion into three sources: i) price differences across geographic markets, ii) price differences across stores at the same market, and iii) within-store price variation over time. I find the main sources of price dispersion are due to price level differences across and within stores, but at the same time, the relative share of across market source has been increasing steadily across time. For the United States, Hitsch et al. (2019) found that the main sources of price dispersion are also persistent differences across and within stores. In contrast for Argentina, it results to be differences across chains rather than stores. The results show a similar degree of price dispersion to Argentina, but the main sources behind it are similar to those of the United States. This implies that, like in the United States, in Uruguay price dispersion is related to pricing strategies applied by stores at local markets.

Finally, I analyse the heterogeneity of price dispersion across products, stores,

and time. There is a wide variety of products, stores, and periods, so I analyse whether this heterogeneity has implications in the degree of price dispersion. Then, I apply a variance decomposition analysis to different dimensions of products, and stores to find out whether sources across those dimensions are heterogeneous or not. And, I study if the main sources of price dispersion remain unchanged along time.

The results show that in Uruguay price dispersion and its sources are heterogeneous across products, stores, and time.

2 Literature review

The literature on price dispersion can be divided into two groups, one that is related to its macroeconomic implications, and another that analyses the microeconomic foundations of price dispersion to which this paper is highly related to. Moreover, the empirical literature about price dispersion, in which this paper fits, is extended towards developed countries while in developing countries is incipient.

Bils & Klenow (2004) analyse the rigidity of prices measuring the frequency of price change. They found that in the United States prices last between 4.3 and 5.5 months and that the price rigidity is heterogeneous across product categories.

Nakamura & Steinsson (2008) analyse also price behaviour using a larger dataset than Bils & Klenow (2004). They also measure how frequently prices change, and add other characteristics of price behaviour, which are the percentage of price changes that corresponds to price decreases, the covariation of prices with the inflation rate, the seasonality of price change, and how are the hazard functions of price changes. They found that the duration of regular prices range from 8 to 11 months, higher than the one established by Bils & Klenow (2004).

Related to price dispersion and its sources several papers apply a variance decomposition for prices in the United States but they differ on the sources for decomposing variance. Kaplan & Menzio (2015) decompose price variation into a source that is specific to the store, a second source specific to the store and the product, and a third one specific to the transaction. They found that price dispersion occurs because of differences within-store. Kaplan et al. (2019) analysed price dispersion using a different variance decomposition, and provide a theoretical

model to explain it. In this case, the variance decomposition distinguishes two sources of price dispersion: a store component and a store-good component. They show that persistent differences across stores are the main source of variation.

Hitsch et al. (2019) provide a decomposition of the price variance using scanner weekly prices for the United States. They decompose price dispersion into three sources: i) price differences across geographic markets, ii) price differences in the same market and iii) within-store price differences over time. I adopt the same decomposition in this paper. The key difference with their paper is that they have weekly data, for a non-representative sample, while my data is for monthly prices for a sample that represents the three top-selling brands for each product category. They find the main sources of price dispersion for the United States are due to persistent local differences, which is the same I find for Uruguay. In their paper heterogeneity in price dispersion across products is explained by the number of households that buy each product, and the number of retail chains that sell each product.

There have been few attempts to measure price dispersion and look for its sources in developing countries. Borraz & Zipitria (2012) characterise price behaviour in Uruguay using the same dataset but for a shorter period. Some of their key findings are used as a general benchmark during this paper since we use the same data, specifically results that are related to structural aspects since they only cover up to 2010 and I have data up to 2019. According to Borraz & Zipitria (2012), retail prices in Uruguay are less sticky than in the United States, the average price duration is 2.5 months, there is no seasonality on price adjustments, the probability of price change is not constant over time, and there is high synchronization of price changes.

Related to sources of price variation, Borraz & Saldain (2017) apply a variance decomposition analysis to understand if price dispersion in the city of Montevideo is related to demand and supply shocks. They decompose price variation into retailer and manufacturer shocks, and find that, like in the United States, chain shocks explain most of the price variation, which means price strategies apply by chains are relevant to understand price behaviour.

Daruich & Kozlowski (2017) analyses price dispersion in Argentina using a large dataset of daily prices, and decompose price variation into the same sources

as Kaplan & Menzio (2015). Contrary to what is found in Kaplan & Menzio (2015), chains are the main source behind price variation in Argentina. Borraz & Saldain (2017) found the same result for Uruguay.

Heterogeneous price dispersion across product categories and periods has been broadly explored in the literature for developed countries. Nakamura & Steinsson (2008) found that there is heterogeneity in the frequency of price change across sectors and product categories in the U.S economy, while Bils & Klenow (2004) also found heterogeneity in the frequency of price change across product categories and years. This paper offers an analysis of the heterogeneity across other relevant dimensions, including product categories, and time, but also other product characteristics, and store characteristics for a developing country. It also explores heterogeneity in the sources of price dispersion. To the best of my knowledge, this has not been done before.

3 Data

I use a dataset of daily posted prices of the retail sector in Uruguay from March 2007 to December 2019. This dataset is gathered by the General Directorate of Commerce (DGC for its Spanish acronym) and includes all stores that meet the following two conditions: 1) they sell more than 70% of the product listed, and 2) they either have more than four stores under the same name or have more than three cashiers in a store. Products are defined at the universal product code (UPC) level. The three top-selling brands are reported for each product category, and each supermarket must report always the same products.

To focus on regular prices I take the monthly mode for each product in a store. The final monthly database has 4,931,909 observations for 424 stores that belong to 20 different chains[1] and 154 products. For each store, there is geographical information available about the city and department where it is. For Montevideo, there is also information at a more detailed level about the "Centro Comunal Zonal" (CCZ, for its Spanish acronym), an ad-hoc geographic division. For the analysis, geographic markets are defined taking into account the number of stores

[1]Some stores do not belong to any chain, these are mainly stores with only one branch that are included in the sample because they have more than three cashiers.

in each CCZ for Montevideo, and in each city for the rest of the country. There are cities and even departments that just have a few stores in the database. Table 5 in the Appendix detail the number of stores by the minimum geographic level. As a result, I define a geographic market as a department except for Montevideo where I use CCZ to identify markets, and for Canelones and Maldonado where I define markets as their main cities. Finally, there are 46 markets with at least 2 stores each, and the maximum number of stores in a market is 30. Table 6 in the Appendix shows a detailed list of stores distributed along markets using the definition mentioned above. Table 1 shows summary statistics of the data.

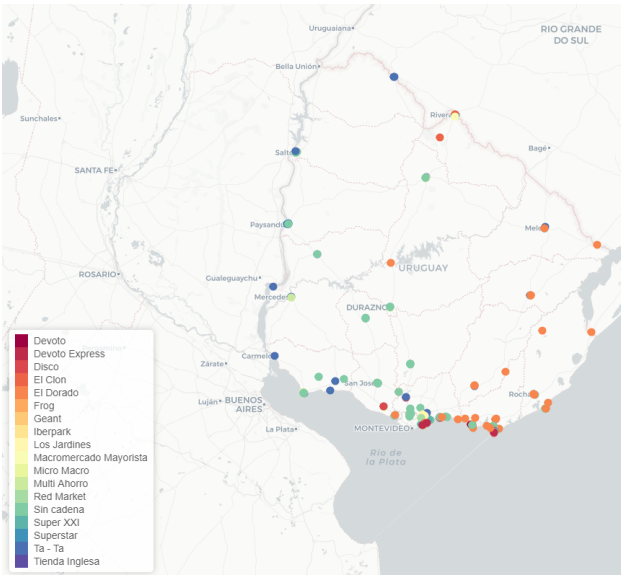
Table 1: Data summary.

	Number
Products	154
Stores	424
Chains	20
Cities	59
Departments	19
Markets	46
Months	156
Observations	4,931,909

Source: author's calculation.

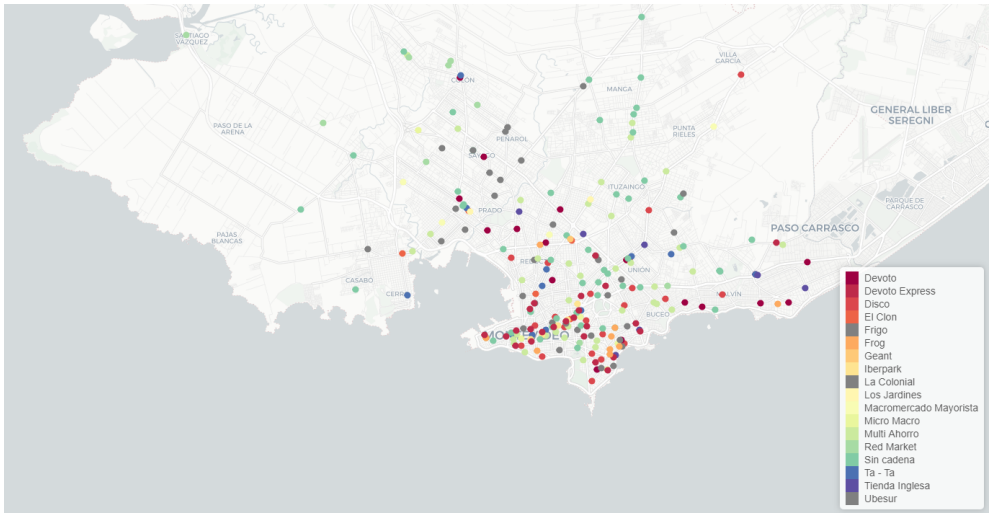
Stores are distributed all over the country but highly concentrated in Montevideo, the capital city of Uruguay - where 45% of the population lives- and have 55% of the stores. Figure 2 shows the geographic distribution of the stores in the dataset coloured by the chain in every department but Montevideo, which is plotted in a separate map, see Figure 3, for visualisation purposes.

Figure 2: Stores geographic distribution.



Notes: Map of Uruguay. Each dot represents a store location, colours represent the chain to which the store belongs to. Montevideo is excluded.

Figure 3: Stores distribution in Montevideo.



Source: author's calculation.

Notes: Each dot represents a store location in Montevideo, colours represent the chain to which the store belongs to.

Products are characterised by categories, brands, producers and whether they are locally produced or imported. There are 43 product categories, grouping products that share a common feature, regardless of the brand (i.e., sunflower oil is a product category different from maize oil). Table 2 summarises product characteristics.

Table 2: Product characteristics.

Products	154
Product categories	43
Brands	105
Producers	69
Origins	3

Source: author's calculation.

For robustness and to control for attrition I use three different samples. The full database, a restricted database for stores that post prices every month, and the third one for products and stores that appear during the whole period.

4 Price dispersion

It is important to distinguish between two groups of prices: regular and sales. Regular prices are the underlying prices that persist when temporal sales are not taken into account, sales prices result from offering a discount over the regular prices. Nakamura & Steinsson (2008) has shown that regular prices change more infrequently than posted prices which imply that they are related to persistent characteristics. Whether to include sales prices or not depends on the analysis goal. The main focus of this paper is to analyse the structural patterns related to price dispersion. For that reason, I focus on regular prices defined as the monthly mode prices taken from a dataset of daily posted prices. In this way, regular persistent prices are considered, since it is highly improbable the most often posted price for a given product in a specific month to be a sales price.

I use the standard deviation of the log of prices from the overall mean as a measure of price dispersion, which is the measure proposed in Hitsch et al. (2019).

$$\sigma_{jt} = \sqrt{\frac{1}{N_{jt}-1}\sum_{s\in S_{jt}}\left(log(p_{jst}) - \overline{log(p_{jt})}\right)^2}. \quad (1)$$

σ_{jt} measures the dispersion of prices as percentage differences from the geometric mean of prices across stores, where j is the product, t is for month/year, and s is for each store.

I calculate this statistic for each month within each year, and take the mean to report the national average. At the national level, price dispersion can be related to differences in prices across different geographic areas. To get rid of this noise, following Hitsch et al. (2019), I look into local markets price differences. First I calculate σ_{jt} for each market m. Then take the weighted average for product j using the number of observations in each market as weights.

I find there is price dispersion in the retail market in Uruguay. The log-price standard deviation range between 0.103 and 0.110 at the national level depending on the sample considered. Results are shown in Table 3 for the three different samples defined in the previous section.

Table 3: Price dispersion.

	Log-price standard deviation		
	(1)	(2)	(3)
National	0.103	0.110	0.108
Local	0.059	0.047	0.055
Observations	4,931,909	3,399,571	2,703,491

Source: author's calculation. Notes: (1) full database, (2) subsample for stores that post prices every period, (3) subsample for products and stores that appear during the whole period.

To measure price dispersion at local markets, I use the definition of geographic markets described in the previous section, which implies that at least there are two stores in each market. The average degree of price dispersion at the local markets level is half that at the national level - between 0.047 and 0.059-. This implies a large dispersion of prices even at small geographic markets. Results are shown in Table 3.

Compared to the United States, the degree of price dispersion at the national level and the local markets level is lower for Uruguay. According to Hitsch et al. (2019) the average log-price standard deviation is 0.163 at the national level, and between 0.114 and 0.103 at the local level for the United States.

5 Variance decomposition

Next, following Hitsch et al. (2019) I decompose the price variance into three sources: (i) price differences across geographic markets, (ii) price differences across stores at the same market, and (iii) price differences over time within a specific store. The procedure is as follows. First, I calculate the overall variance for each product j for a specific month/year t,

$$var\left(p_{st}\right) = \frac{1}{N}\sum_{s\in S}\sum_{t\in T}\left(p_{st} - \overline{p}\right)^2. \tag{2}$$

This overall variance can be decomposed into the three mentioned sources, as shown in Hitsch et al. (2019),

$$var\left(p_{jt}\right) = var\left(\overline{p}_m\right) + \frac{1}{N}\sum_{m\in M} N_m var\left(\overline{p}_s|m\right) + \frac{1}{N}\sum_{s\in S} N_s var\left(p_{st}|s\right) \tag{3}$$

The first term $var\left(\overline{p}_m\right)$, is the average variance of the average market-level prices. It is the weighted variance of the average price level in each market, using the number of markets as weights. The second term, $var\left(\overline{p}_s|m\right)$, is the within-market variance of average store-level prices weighted by stores. It is the weighted variance across stores, using the number of markets as weights. Finally, $var\left(p_{st}|s\right)$ is the within-store variance of prices over time.

The variance decomposition shows that price dispersion is mainly explained by across-market price differences (39.16%), then by across-store price differences within a market (36.90%), and lastly by within store dispersion (23.94%). The sources of price dispersion can be divided into two groups, one related to the local level, and another related to the national level. Differences across-stores and within-stores belong to the first group, while differences across-market represent

differences at the national level. According to these results, 60.84% of the price dispersion is driven by pricing strategies of stores at the local market, and over time. Thus, to understand price dispersion in Uruguay the pricing strategies carried by individual stores are key. Results are summarised in Table 4.

Table 4: Price variance decomposition.

	(1)	(2)	(3)
Across-market	39.16	44.31	36.50
Across-store	36.90	30.82	43.64
Within-store	23,94	24.87	19.86

Source: author's calculation. Notes: (1) full database, (2) subsample for stores that post prices every period, (3) subsample for all products and stores that appear during the whole period.

For robustness, I apply the same variance decomposition to the three different samples defined, results remain unchanged among the three of them. Around 60% of price dispersion is related to differences at the local level. This emphasizes the fact in Uruguay price dispersion is mainly explained by local factors.

Differences at the local level are also the main source of price dispersion in the U.S.(Hitsch et al. 2019). But if we look at each source, the main source of price dispersion in Uruguay is represented by the differences across different geographic markets, contrary to the United States, where it is the within-store component.

6 Heterogeneity

The average price dispersion shown in the previous section can differ between products, stores or time. To analyse possible variation in price dispersion and its sources I define different subsamples, and then apply Equations 1 and 3 to each of them. The subsamples are defined to identify variation across products, stores, and different periods.

To study differences across products, I group goods by their product category, origin or producer. Heterogeneity between stores is explored by looking at the chain, location, and income quintile for the area where the store is located. Finally,

I explore time heterogeneity by looking at years, quarters, and months.

The analysis of heterogeneity is done in two steps. First I apply Equation 1 for each subsample to see whether there is heterogeneity in the degree of price dispersion or not. Then, I calculate Equation 3 for each subsample to analyse heterogeneity in the sources of price dispersion.

6.1 Price dispersion variation

In this section, I explore whether price dispersion differs between products, stores, and time. Across the three of them, I find heterogeneity in price dispersion. It changes depending on products and stores, is increasing over time, but does not show seasonality.

Across products

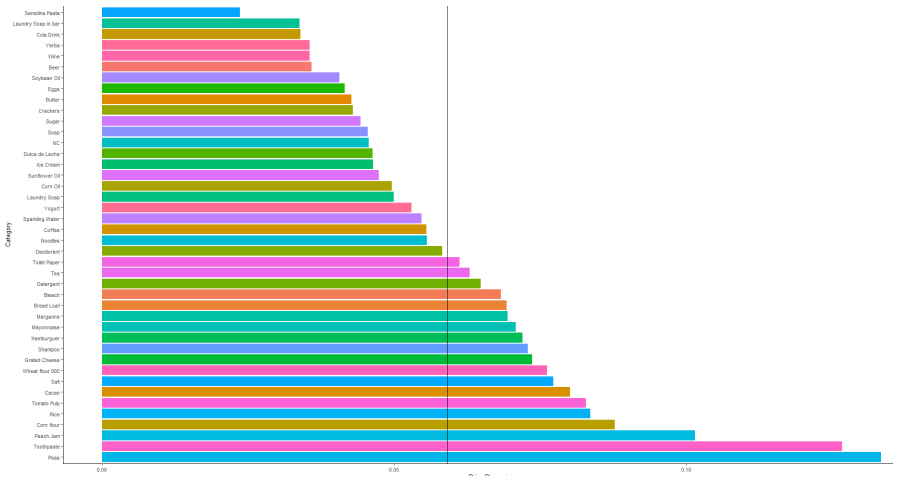
Products differ in the level of price dispersion they show depending on product category, producer, or whether they are imported, as shown in Figures 4, 5, and 6. These findings are in line with the heterogeneity in the relative rigidity of prices found in Borraz & Zipitria (2012). Heterogeneity across product category and producer are not related to a specific family of products. Those categories and producers that are close to the average price dispersion are a mixed group of groceries, cleaning products, and producers that sell a wide variety of products. On the other hand, the degree of price dispersion across product origin shows differences. For national products price dispersion is 21% higher than for imported ones. This is an interesting result, because the reverse should be expected as imported prices should be more volatile due to exchange rates changes, and international prices volatility. Table 4 in the Appendix details these results. When we look at Uruguayan imported goods came up that 54% of them are intermediate goods[2]. Thus, national products have a large imported component, which contributes to understanding why they are more volatile than imported ones.

Across stores

Stores show heterogeneity across all characteristics considered: chains, location and income level of the area where the store is. Across chains, there is a huge

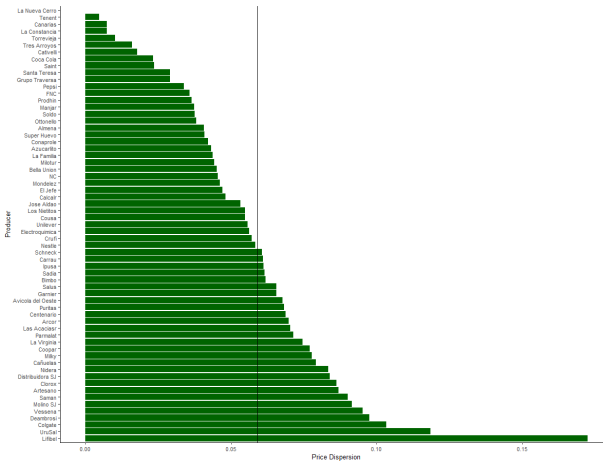
[2]According to the Central Bank of Uruguay annual report.

Figure 4: Price dispersion (σ_{jt}) variation across products categories



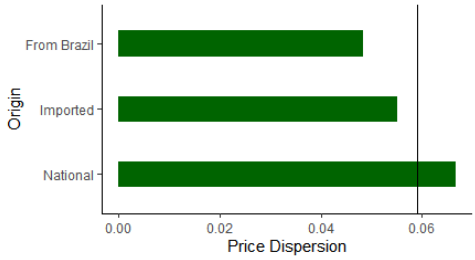
Source: Author's calculation. Notes: Each bar represents the log-price standard deviation in 2019 for product categories. The vertical line represents the average degree of price dispersion.

Figure 5: Price dispersion variation across producer



Notes: Each bar represents the log-price standard deviation in 2019 for each producer. The vertical line represents the average degree of price dispersion.

Figure 6: Price dispersion (σ_{jt}) variation across products origin

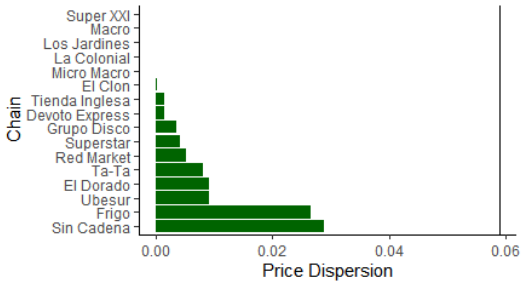


Notes: Each bar represents the log-price standard deviation in 2019 for product origin. The vertical line represents the average degree of price dispersion.

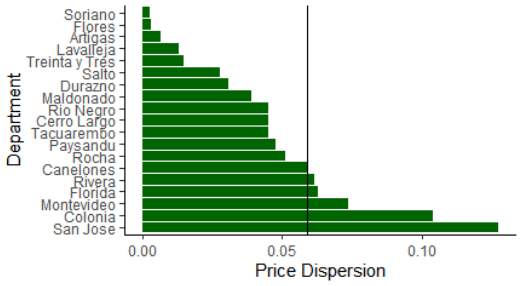
heterogeneity in price dispersion, mostly below average. Across departments and income level, there is also heterogeneity. These results are summarised in Figure 7.

Figure 7: Price dispersion variation across stores

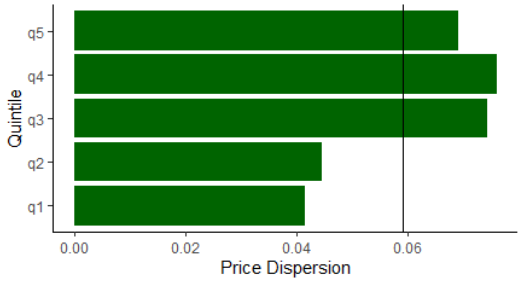
(a) σ_{jt} within chain



(b) σ_{jt} across store department



(c) σ_{jt} across income level of the store area



Notes: Each bar represents the log-price standard deviation in 2019 for store chains in panel (a), store department in panel (b), and income level of the area where the store is in panel (c). The vertical line represents the average degree of price dispersion.

Within chains, some have no price dispersion at all, while on the other side, stores that have no chain show the highest price dispersion (up to 0.028), Table 8 in the Appendix shows details. In general price dispersion within chains is small, and it is far from average. This implies most part of price dispersion arises from differences between chains rather than within chains as Della Vigna & Gentzkow (2019) suggest.

Across departments, price dispersion shows heterogeneity. Montevideo, the department with the largest population and number of stores, has a lower price dispersion than San Jose and Colonia, which have around ten times less population than the capital city, and less than half of the stores.

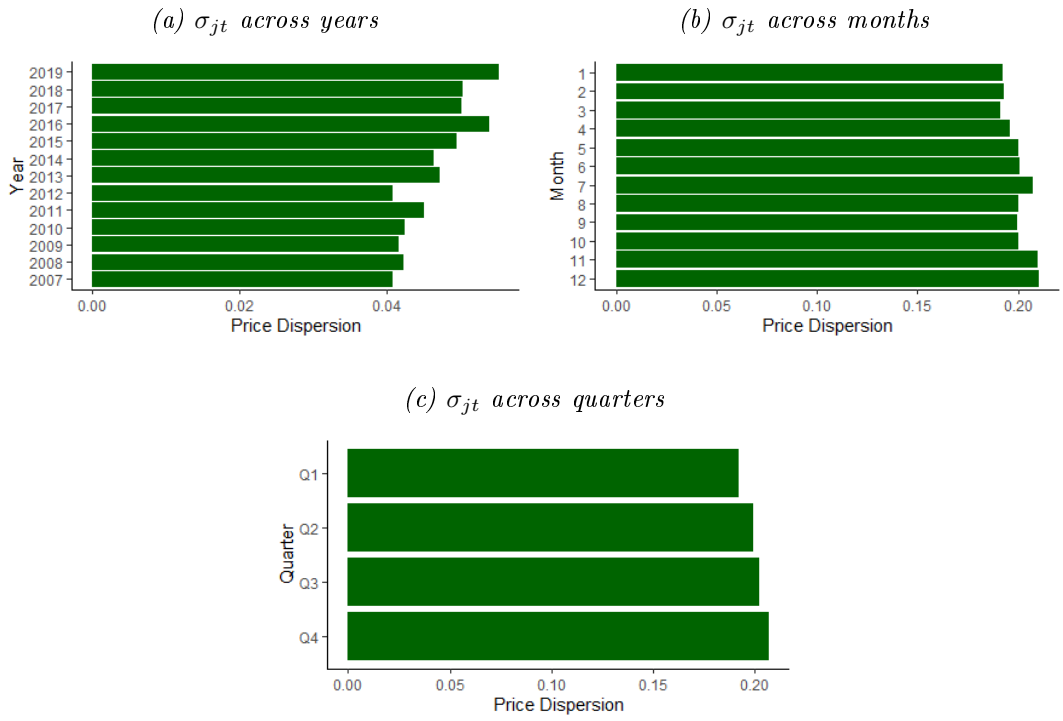
Finally, when I look for the heterogeneity of price dispersion according to the income level of the area of each store I find it is higher in stores located at higher

income level areas. This could imply that in these areas there is higher competition between stores. For the first two quintiles, the poorest, price dispersion is lower than for the richer ones and it is below the average.

Over time

Price dispersion has been sustainably increasing during the years. This remains true even if I control for stores entry, and consider only stores that report prices during all periods. If we look at all quarters and months in the sample, there are not many differences in price dispersion, which implies there is no seasonality. These results are summarised in Figure 8.

Figure 8: Price dispersion variation over time

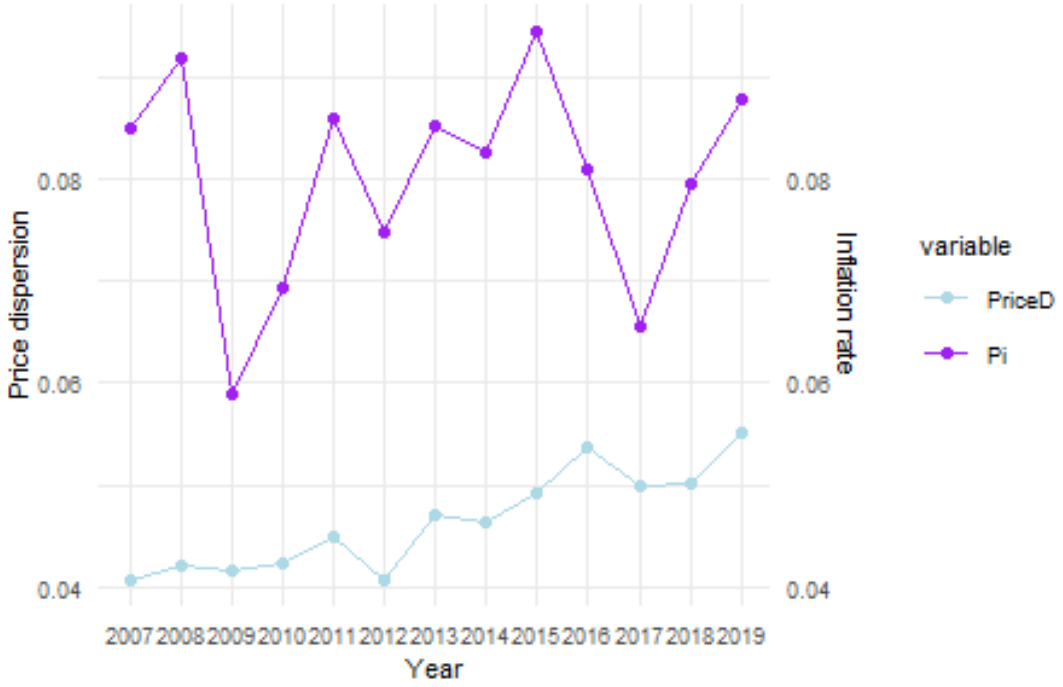


Notes: Each bar represents the log-price standard deviation for years in panel (a), months in panel (b), and quarters in panel (c). The vertical line represents the average degree of price dispersion.

Price dispersion is not constant over time, it has increased 35% in a twelve-year period. It is interesting to look at price dispersion along with the inflation rate, in this period average inflation rate was 8% according to the Central Bank

of Uruguay statistics. Figure 9 shows the evolution of both variables, in periods when the inflation rate is increasing price dispersion also increase, and the other way round. Thus, they seem to move together despite price dispersion having a clear increasing tendency while the inflation rate is more volatile.

Figure 9: Price dispersion and inflation rate



Notes: The Figure plots the annual evolution of the weighted price dispersion along with inflation rate.

To sum up, the stylized facts about price dispersion heterogeneity are as follows:

- There is a huge heterogeneity in price dispersion across product categories.
- Price dispersion is higher for national goods.
- Price dispersion differs greatly between departments, it is especially remarkable that two departments with low population and number of stores -Colonia and San Jose- have the highest price dispersion.

- Chains prices have some heterogeneity, but at very low levels of price dispersion.
- Lower-income level areas have lower price dispersion.
- Price dispersion has increased 35% for the last twelve years.

6.2 Variance decomposition variation

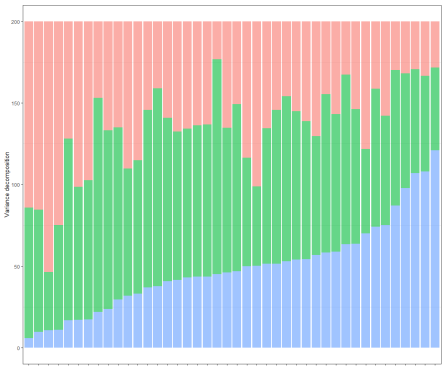
Finally, I look for heterogeneity in the sources of price dispersion across products, stores, and time. I apply the variance decomposition explained in Section 4 for each dimension. The results show there is also heterogeneity in the sources of price dispersion.

Across products

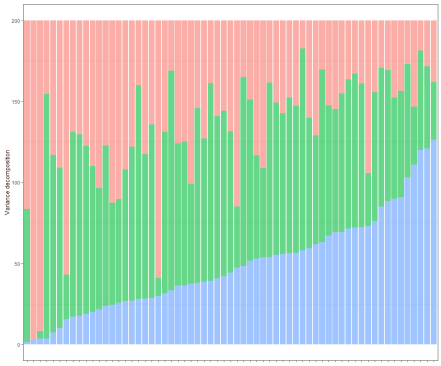
When I look across product categories, and producers, variance decomposition shows heterogeneity. The main sources are not always across-store and within-store, like was found for price dispersion at an aggregate level. Figure 10 summarises these results. For some product categories across market rises as the main price dispersion source, as well as in the case of some producers. Regarding product origin, there is also heterogeneity. However, variation of prices over time (within-store source) has the least relative weight for the three origins. This implies inflation does not affect price dispersion across product origins, but it does when we compare producers and product categories.

Figure 10: Sources of price dispersion variation across products

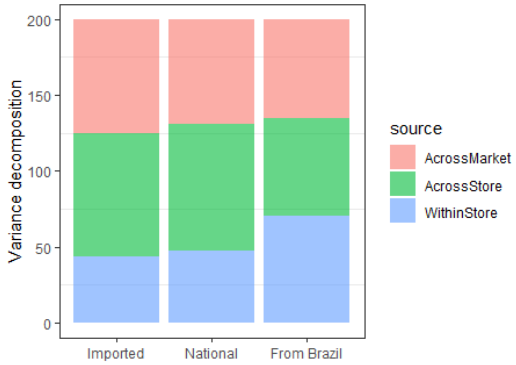
(a) σ_{jt} Across product category



(b) σ_{jt} Across product producer



(c) σ_{jt} Across product origin



Notes: panels (a) to (c) show variance decomposition across product categories, product producers, and product origins respectively.

Across stores

Across stores I find the same result: there is heterogeneity in the variance decomposition of any of the store characteristics analysed. The main sources of price dispersion are not always related to local markets when I look across departments, chains, and income level of the area where the store is, as shown in Figure 8.

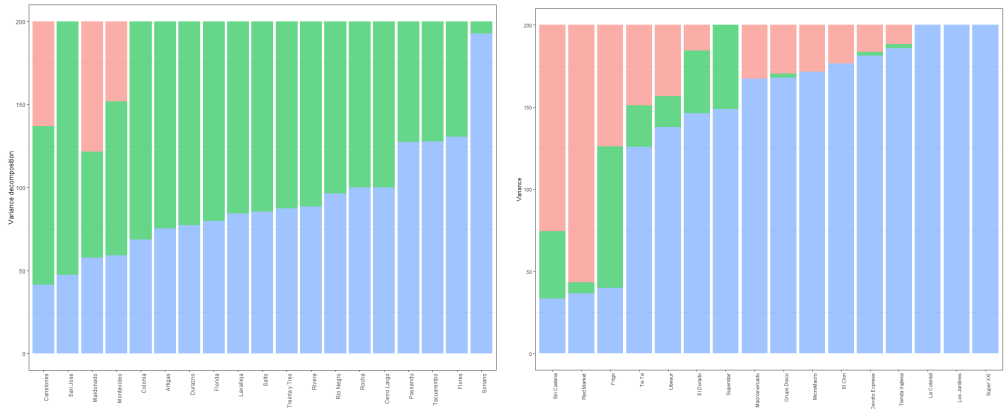
Across store locations we can see clearly that across-market source does not have a role at all, this implies geographic markets are highly segmented. While there is almost no between market competition, within market competition explain almost half of the price dispersion. Within chains this changes, the main source of price dispersion is within-store for those stores that belong to a chain. Stores

that do not belong to any chain, are more affected by competition across markets. Finally, if we look for the heterogeneity across store's area average income, we find once again, a huge heterogeneity between the poorest and the richest quintiles. For the first ones, price dispersion is mainly explained by differences in prices across markets, while for the richest it is mainly explained by local market characteristics as price evolution and competition between stores located nearby.

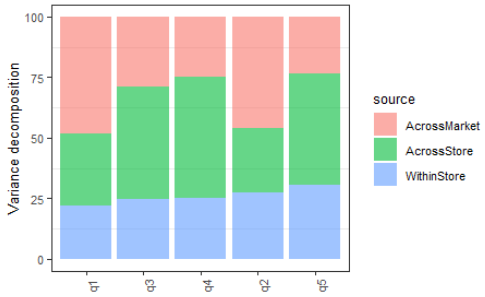
Figure 11: Sources of price dispersion variation across stores

(a) Across store location

(b) Within chains



(c) Across income level of the store's area



Notes: panels (a) to (c) show variance decomposition across store chain, store location, and income level of the area where the store is respectively.

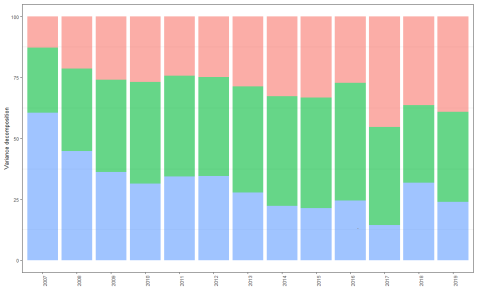
Across time

Sources of price dispersion have been changing over time. For every year in the sample, both across-store and within-store represent the main sources behind price variance. Nevertheless, in recent years the across-market source has been

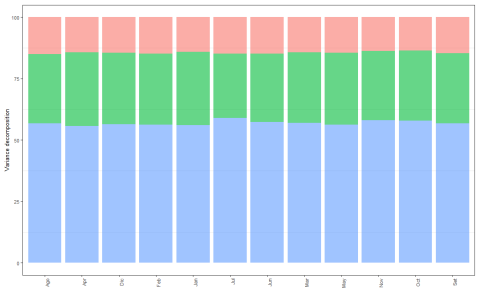
growing, and now represent nearly half of the price variance. Figure 9 shows these results.

Figure 12: Sources of price dispersion variation over time

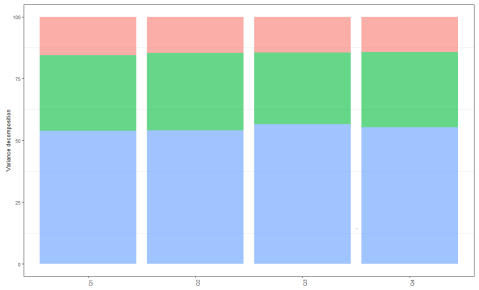
(a) Over years



(b) Over months



(c) Over quarters



Notes: panels (a) to (c) show variance decomposition across years, months, and quarters respectively.

To sum up, stylized facts about heterogeneity in sources of price dispersion are as follows:

- Sources of price dispersion are heterogeneous across products, stores, and over time.
- Across product categories and producers, sources of price dispersion differ a lot.
- Imported goods from Brazil have the greatest within-store component, while the rest of imported goods have the least, national ones are in the middle.
- There is a huge geographic segmentation.
- Price dispersion at chain level stems mainly from within market competition.

- Lower-income level areas are highly segmented, its main source of dispersion is across-store.

- The relative weight of sources of price dispersion has been changing steadily, while within-store is decreasing, across-market is increasing.

7 Concluding remarks

The main contribution of my work is to provide evidence of price dispersion, its sources, and heterogeneity, in a small, developing, open economy.

Uruguay degree of price dispersion is mainly found at the local market level. The intertemporal pricing strategies of stores, and how stores at the same geographic market set prices are the main sources behind price dispersion between 2007 and 2019. These findings are similar to those found for Argentina and the United States, where both countries present a higher degree of price dispersion than the one I found for Uruguay. Moreover, the main sources behind price dispersion in the United States are the same I found for Uruguay.

The analysis of variation on the sources of price dispersion reveals that the drivers behind this phenomenon in Uruguay have been unchanged for more than a decade, but in recent years it has started to change. This can be an indicator of a change in the underlying structure of the sources of price dispersion. Across-market differences in prices may become the main source of price dispersion in Uruguay in the next years.

When I analyse price dispersion across products and stores characteristics, the next dimensions show heterogeneity: product categories, producers, product origin, geographic area, and income level of the store. In the other hand, within chains price dispersion is low, while between chains there are differences in the level of price dispersion. This results are in line to those found in Argentina and the United States.

The heterogeneity found across every dimension on price dispersion show up too when looking at variance decomposition heterogeneity.

The most remarkable results are related to stores. Chains show heterogeneity in the sources of price dispersion as well as in the level of price dispersion

between different chains but not within chains. When we look at variance decomposition of price dispersion, we found it is mainly related to the evolution of prices, so inflation become key to analyse this heterogeneity. Regarding income level, price dispersion is higher in stores located at higher income level areas. This could suggest that in those areas there is higher discrimination. Finally, variation on sources of dispersion across store location are related to segmentation of geographic markets. Different departments in Uruguay show their price dispersion stems from differences in prices across stores in the same geographic market.

References

Bils, M. & Klenow (2004), 'Some evidence on the importance of sticky prices', *The Journal of Political Economy* **112**, 947–985.

Borraz, F. & Saldain, J. (2017), 'Variance decomposition of prices in an emerging economy', *Monetaria* .

Borraz, F. & Zipitria, L. (2012), 'Retail price setting in uruguay', *Economia Journal, LACEA* **12**, 77–104.

Borraz, F. & Zipitria, L. (2019), 'Long run price or variety convergence?', *está publicado?* .

Daruich, D. & Kozlowski, J. (2017), 'Retail prices: New evidence from argentina'.

Della Vigna, S. & Gentzkow, M. (2019), 'Uniform pricing in us retail chains', *Quarterly Journal of Economics* **134**, 2011–2084.

Hitsch, G. J., Hortaçsu, A. & Lin, X. (2019), 'Prices and promotions in u.s. retail markets: Evidence from big data', *National Bureau of Economic Research* **26306**.
URL: *http://www.nber.org/papers/w26306*

Kaplan, G. & Menzio, G. (2015), 'The morphology of price dispersion', *International Economic Review* **56**(4), 1165–1206.

Kaplan, G., Menzio, G., Rudanko, L. & Trachter, N. (2019), 'Relative price dispersion: Evidence and theory', *American Economic Journal: Microeconomics* **11**(3), 68–124.

Nakamura, E. & Steinsson, J. (2008), 'Five Facts about Prices: A Reevaluation of Menu Cost Models*', *The Quarterly Journal of Economics* **123**(4), 1415–1464.
URL: *https://doi.org/10.1162/qjec.2008.123.4.1415*

A Appendix

Figure 13: Number of stores for each regular price of every product in the Rice category

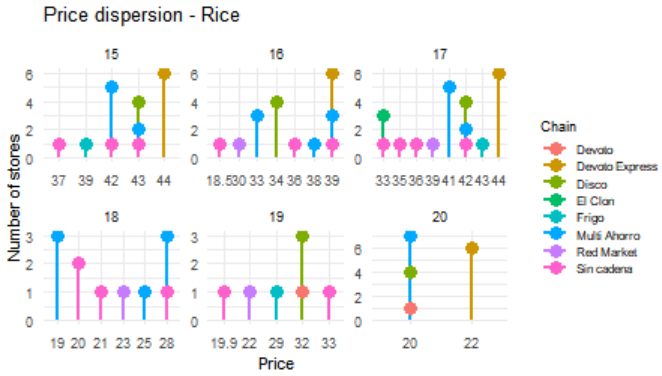


Figure 14: Number of stores for each regular price of every product in the Yerba category

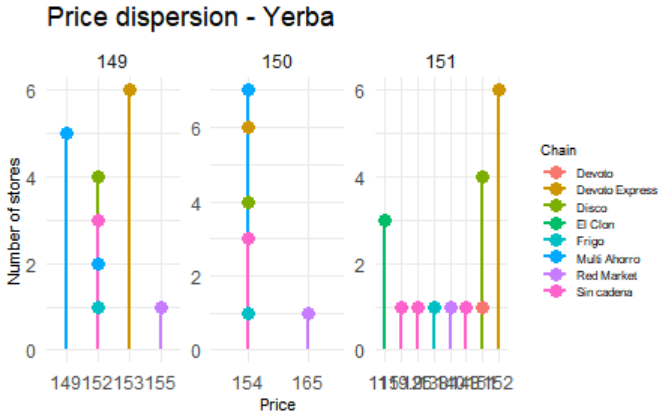


Figure 15: Number of stores for each regular price of every product in the Sugar category

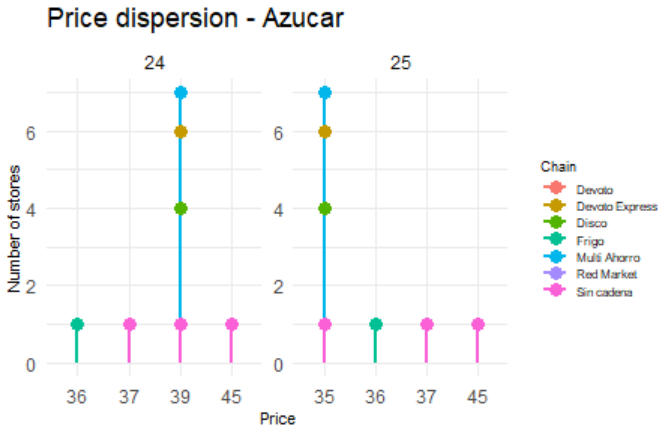


Figure 16: Number of stores for each regular price of every product in the Dulce de leche category

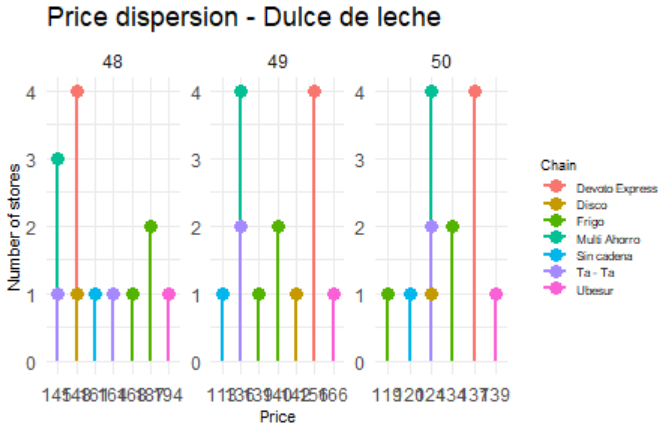


Table 5: Stores by city or county.

Department	City or county	Number of stores
Artigas	Artigas	2
Canelones	Santa Lucia	30
Canelones	Las Piedras	25
Canelones	Progreso	25
Canelones	Pando	25
Canelones	Atlantida	25
Canelones	Ciudad de la Costa	25
Canelones	Canelones	25
Canelones	Cuchilla Alta	25
Canelones	Paso Carrasco	25
Canelones	La Floresta	25
Canelones	La Paz	25
Canelones	Las Toscas	25
Canelones	Suarez	25
Canelones	Sauce	25
Canelones	Cap. Juan A. Artigas	25
Canelones	Pinares	19
Cerro Largo	Melo	16
Cerro Largo	Rio Branco	16
Colonia	Nueva Helvecia	16
Colonia	Colonia del Sacramento	15
Colonia	Carmelo	15
Colonia	Tarariras	14
Colonia	J. Lacaze	14
Colonia	Rosario	13
Durazno	Durazno	4
Flores	Trinidad	12
Lavalleja	Minas	11
Maldonado	Balneario Solis	11

Continued on next page

Table 5 – *Continued from previous page*

Department	City or county	Number of stores
Maldonado	Maldonado	10
Maldonado	Piriapolis	10
Maldonado	Punta del Este	9
Maldonado	Barra de Maldonado	9
Maldonado	Aigua	8
Maldonado	Pan de Azucar	8
Maldonado	San Carlos	3
Paysandú	Paysandu	7
Rio Negro	Young	7
Rio Negro	Fray Bentos	6
Rivera	Rivera	2
Rivera	Tranqueras	2
Rocha	La Pedrera	2
Rocha	Lascano	2
Rocha	Rocha	2
Rocha	La Paloma	2
Rocha	Chuy	2
Salto	Salto	2
San Jose	San Jose de Mayo	2
San Jose	Libertad	2
San Jose	Delta del Tigre	2
San Jose	Ciudad del Plata	2
Soriano	Mercedes	2
Tacuarembo	Tacuarembo	2
Tacuarembo	Paso de los Toros	2
Treinta y Tres	Treinta y Tres	2
Montevideo	CCZ1	25
Montevideo	CCZ2	35
Montevideo	CCZ3	14
Montevideo	CCZ4	16

Continued on next page

Table 5 – *Continued from previous page*

Department	**City or county**	**Number of stores**
Montevideo	CCZ5	30
Montevideo	CCZ6	14
Montevideo	CCZ7	8
Montevideo	CCZ8	11
Montevideo	CCZ9	10
Montevideo	CCZ10	5
Montevideo	CCZ11	13
Montevideo	CCZ12	7
Montevideo	CCZ13	12
Montevideo	CCZ14	15
Montevideo	CCZ15	5
Montevideo	CCZ16	5
Montevideo	CCZ17	4
Montevideo	CCZ18	5

Source: author's calculation.

Table 6: Stores by geographic markets.

	Number of stores
CCZ 2	35
CCZ 5	30
CCZ 1	25
Maldonado	19
CCZ 4	16
Canelones	16
Rocha	16
CCZ 14	15
Ciudad de la Costa	15
CCZ 6	14
CCZ 3	14
CCZ 11	13
Colonia	12
CCZ	12
CCZ 8	11
San José	11
Salto	10
CCZ 9	10
Punta del Este	9
Las Piedras	9
CCZ 7	8
Paysandú	7
CCZ 12	7
Tacuarembó	6
Piriápolis	6
CCZ 10	5
CCZ 15	5
CCZ 18	5
CCZ 16	5
Florida	5
CCZ 17	4
Treinta y Tres	4
Lavalleja	4
Flores	4
Cerro Largo	4
Durazno	4
Atlántida	3
Río Negro	3
Paso de Carrasco	3
La Paz	3
San Carlos	3
Artigas	2
Santa Lucía	2
Pando	2
Soriano	2

Source: author's calculation.

Table 7: Price dispersion across products.

	log-price sd
Origin	
Imported	0.06663629
National	0.05515353
From Brazil	0.04841437

Source: author's calculation.

Table 8: Price dispersion across products.

	log-price sd
Chain	
Sin cadena	0.0288495600
Frigo	0.0265379400
Ubesur	0.0091256710
El Dorado	0.0009093525
Red Market	0.0005067754
Superstar	0.0004085630
Ta-Ta	0.0002144605
Devoto Express	0.0001342381
Tienda Inglesa	0.0001306921
Disco	0.0000193819
El Clon	0.0000602144
Micro Macro	0.0000018960
Macro	0.00
Los Jardines	0.00
Super XXI	0.00
La Colonial	0.00
	log-price sd
Department	
Montevideo	0.0288495600
Frigo	0.0265379400
Ubesur	0.0091256710
El Dorado	0.0009093525
Red Market	0.0005067754
Superstar	0.0004085630
Ta-Ta	0.0002144605
Devoto Express	0.0001342381
Tienda Inglesa	0.0001306921
Disco	0.0000193819
El Clon	0.0000602144
Micro Macro	0.0000018960
Macro	0.00
Los Jardines	0.00
Super XXI	0.00
La Colonial	0.00
La Colonial	0.00
La Colonial	0.00
La Colonial	0.00
	log-price sd
Income level	
Q1	0.0288495600
Q2	0.0265379400
Q3	0.0091256710
Q4	0.0009093525
Q5	0.0005067754

Source: author's calculation.