Variety as a Source of Law of One Price Deviations*

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We explore a new mechanism for prices to deviate from the Law of One Price. Stores chose the price of their goods but also the number of varieties to offer within a given market category. We extend the Hotelling (1929) model to show that the availability of different products between stores increase price dispersion. We test our prediction using a unique country-level database and a new instrumental variable method to take into account the endogeneity of varieties. We estimate that a lower bound for the effect of a store adding an additional variety in a given market is a price drop of 4%. Also, to have a difference of one variety in a product market between two stores explains up to 0.6% of price dispersion. The effect of varieties is sizable and robust to several controls.

Abstract

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1 Introduction

The convergence of retail prices across geographical regions, which gives rise to the Law of One Price (LOP), has been extensively debated in macroeconomics. Although there are nuances in the degree of the deviations, most of the literature points to a failure in the convergence of prices to the LOP.[1] There are several explanations in the literature for this failure of prices to match across different regions. Among others, this relative price divergence has been attributed to trade costs (see Anderson and van Wincoop, 2003, Anderson and van Wincoop, 2004, and Atkin and Donaldson, 2015), the existence of borders between regions or countries (see Engel and Rogers, 1996, Gorodnichenko and Tesar, 2009, and Gopinath, Gourinchas, Hsieh, and Li, 2011), the existence of high fixed costs of production for some goods (see Coşar, Grieco, and Tintelnot, 2015a, Coşar, Grieco, and Tintelnot, 2015a), price discrimination of consumers (see Haskel and Wolf, 2001, and Dvir and Strasser, 2018), or—within countries—sticky prices (see Crucini, Shintani, and Tsuruga, 2010, and Elberg, 2016).

This paper offers a novel explanation for the deviations to the LOP: differences in the varieties within a product category offered by a store. If stores differ in the varieties of goods, then the price of the same good at different stores does not need to converge, even after controlling for trade costs (i.e., distance). Although the literature has emphasized the role of different varieties across countries (see Gorodnichenko and Tesar, 2009), to the best of our knowledge there is no paper that explicitly examines its effects as a source of LOP deviations.[2]

The definition of variety is borrowed from the trade literature, in particular from models based on monopolistic competition (i.e., Dixit and Stiglitz (1977), Eaton and Kortum (2002), and Melitz (2003)). Within a given market or product category there are goods that offer similar characteristics to the consumer. A variety will be such collection of similar goods: i.e., in the beer market, there is varieties Bud Light, Budweiser, or Coors Light. In empirical papers of trade the narrow category for defining a market for substitute goods is usually referred to as product category (see Gopinath, Gourinchas, Hsieh, and Li (2011), Hong and Li (2017), or Atkin and Donaldson (2015)). We will refer to a specific product as variety—interchangeably—, and the market to which belong as market or product category—interchangeably—.

The idea of price non-convergence due to differences in varieties is as follow. Assume two stores at 100 meters distance from each other that sold Coke. After controlling for distance, we should expect that the price of Coke should be equal between both stores. Now assume the same setting than before—two stores selling Coke at 100 meters distance—but one of the stores also has Pepsi available. Now, Coke has competition from Pepsi at one store but not at the other store. The equilibrium price of Coke shall now not be equal between both stores, even after controlling for

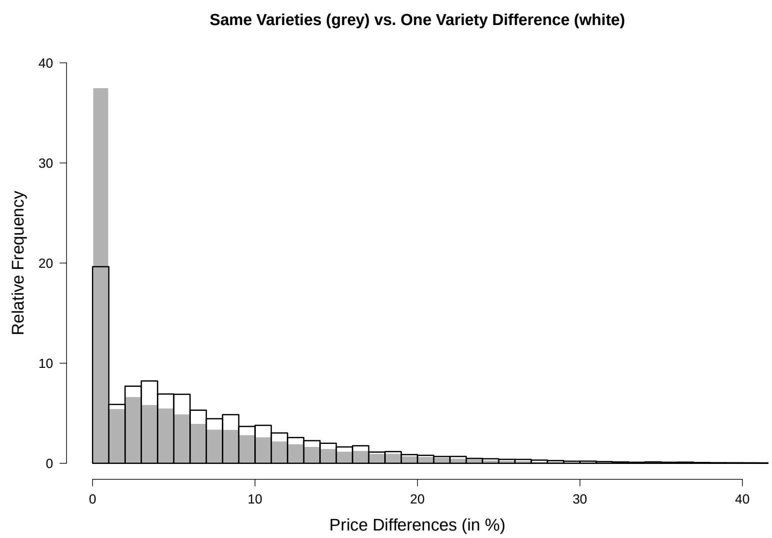
[1]Earlier texts in the literature include Isard (1977) and the review of Rogoff (1996) for macroeconomics and Varian (1980) for microeconomics.

[2]Gopinath, Gourinchas, Hsieh, and Li (2011) partially address this issue by controlling for markup of firms using cost information.

distance, because each product face different competitive conditions within store. As a result, differences in varieties within a product category at the stores will affect the price of similar products between stores, even after controlling for distance.

Figure 1 below motivate the main contribution of the paper. It plots the distribution of the (absolute) log price differences—pooled across products—of a given product for stores up to one kilometer distance. In gray is plotted the distribution of price differences for store pairs that have the same number of varieties at the category level. On the other hand, boxes with heavy black trace show the distribution of price differences for stores that differ in one variety, as in our previous example. The plot shows that the larger the difference of varieties between stores for a given product category the less likely is that prices will converge. This empirical result is also confirmed by our theoretical model at Section 2.

Figure 1: Pooled Price Dispersion for Stores Up to One Kilometer.



The paper offer three contributions to the LOP literature. First, we offer a simple extension of the Hotelling (1929) model that account for different varieties. We show that there is a Nash equilibrium where stores offer different varieties and charge different prices for the goods that have in common. This result holds in an otherwise symmetrical scenario between stores. Second, using a detailed price database for Uruguay, a geographically small and economically homogeneous developing country, we present evidence that differences in varieties within stores in a given category has a significant economic impact on price dispersion. We propose two estimations for price dispersion. One in levels, similar to Gopinath, Gourinchas, Hsieh, and Li (2011), while other one in price differences, similar to Engel and Rogers (1996). To add a variety in a given product category decreases level prices nearly by 4%. This account to nearly 0.6% of the price difference between stores. The effect is robust to several confounding factors. Third, we address the causality of varieties to prices by using a simple methodology. We bundle markets and use similar product categories as an instrument for the number of varieties in a market within a store. If stores increase the space devoted to a product market, less will be available to other markets. Our instrument is statistically significant and shows that the causal effect of varieties on prices could be as twice as larger than the 4% estimated by OLS.

The model, an extension of the Hotelling (1929) model[3] based on Irmen and Thisse (1998), incorporates two competitive dimensions: distance between stores for a homogeneous good and varieties of goods at the store level. As usual in the literature, the model builds on exogenous features of markets (i.e., number of varieties, entry conditions, distance between stores) to show how the availability of different varieties at the store explains deviations from the LOP. This formalization is more realistic in capturing the competitive pressure for products, which results not only from substitution between similar goods–measured by distance–but also by the availability of substitute varieties at the same store, as measured by the varieties available to consumers. The model allow to arise differences in product markups due to differences in competing varieties at the store.

The empirical analysis is based on a detailed database on retail prices collected by the Ministry of Economy and Finance in Uruguay that contains daily data for 154 products, most of them defined at the UPC level, for eight years, in nearly all supermarkets across the country. The database also has information on the exact locations of the stores, whether they belong to a chain, and on their sizes, as measured by the number of cashiers. Our key methodological approach is to measure the number of varieties in a given category at a store. Our database has detailed price information for the three most selling brands—excluding supermarkets own brands—for each product category for supermarkets in Uruguay, a small homogeneous country in South America. For each triple product/store/month-year we compute the number of varieties by counting the number of prices of for different variety of products within a given category.

Uruguay is an excellent country in which to perform this study. It is a small homogeneous country, where people speak the same language, taxes are homogeneous at the country level, movements of goods and factors are free, and the maximum distance between stores in the sample is just 526 kilometers. As a result, no major deviations from the LOP should be expected. Nevertheless, we found a median price dispersion of 5%, which increase to 5.6% if stores differs in one variety in a given market. Also, while the unconditional probability of two prices to be equal when stores have the same number of varieties is one in five, it decrease to one in ten if stores differ in one variety.

Other papers have studied the LOP convergence within countries. Parsley and Wei (1996) and Yazgan and Yilmazkuday (2011) for the US, Ceglowski (2003) for Canada, and Fan and Wei (2006) for China found larger rates of dynamic convergence to the LOP within countries than between countries. Besides transport costs (see Atkin and Donaldson, 2015)–measured by distance–and borders, the main explanation for the relative divergence of prices within countries has been sticky prices. Engel and Rogers (2001) for the US, Crucini, Shintani, and Tsuruga (2010)

[3] A variation of this model is also used by Gopinath, Gourinchas, Hsieh, and Li (2011).

for Japan, and Elberg (2016) for Mexico found that price rigidities are relevant in explaining the failure of the LOP within countries. Nevertheless, those papers typically use pooled data and as a result could suffer from identification problems due to other goods characteristics–such as lower costs, different distribution channels, or marketing strategies–that could bias the estimation of the price stickiness coefficient. In our empirical methodology, we control with product dummies for unobserved product characteristics.

The paper is organized as follows. The next section shows that price dispersion arise in equilibrium if stores offer different varieties. Section 3 describes the database used to estimate the effect of varieties on deviations from the LOP. Section 4 introduces the equations to be estimated, the econometric results, and the robustness test to check the main results. Section 5 address the causal link from varieties to prices. Finally, Section 6 presents the conclusions of the analysis.

2 A Simple Model of LOP Deviations

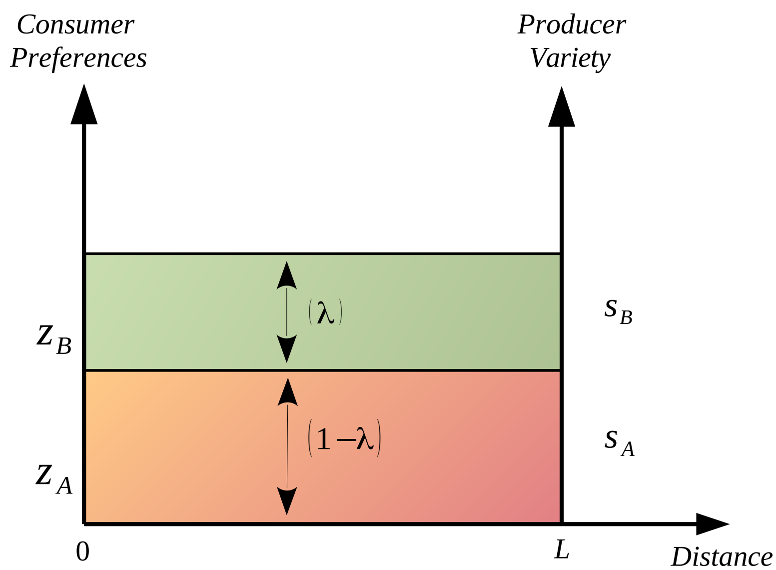
This section offer a simple model to explain sources of deviations from the LOP. We propose an extension of the Hotelling (1929) model, which has previously used in the literature (see Gopinath, Gourinchas, Hsieh, and Li, 2011), that incorporates a two way horizontal product differentiation.[4] This extension allows to capture trade costs—the distance dimension—, but also competition between varieties at the store—the variety dimension. The Hotelling (1929) linear city model of product differentiation could be though as representing either physical distance between stores, or variety distance between similar goods. In the model stores choose first the number of varieties of a good that will offer and then set the price for the selected varieties.

The main setting is a road that has two types of consumers uniformly located, and at each store two potential varieties that can be sold of a given product; say Coke and Pepsi. More formally, we propose a modification of Irmen and Thisse (1998) and assume that there is a continuum of consumers uniformly located along a line of distance L. The locations are indexed from the beginning of the street, either for consumers or stores (i.e., the consumer/store located at 0 is at the beginning of the street). At each point in the line, there are two types of consumers that differ in their preference for varieties $z_i = \{z_A, z_B\}$. This imply that there is a continuum in the distance dimension, but variety is a discrete dimension. Also, at each point in the line there is a mass $(1 - \lambda)$ of consumers that prefers variety z_A, and a mass λ consumers that prefers variety z_B. The model could be represented as two lines of distance L, one on top of the other. The first line is for consumers that prefers variety z_A, its thickness is $1 - \lambda$, and the total mass of consumers is $L \times (1 - \lambda)$. The second line is for consumers that prefers variety z_B, its thickness is λ, and there is a total mass of consumers of $L \times \lambda$. Figure 2 below depicts the main setting of the model. The

[4] A previous version of this paper offers a model with vertical and horizontal differentiation. In the model, there were two qualities instead of two different varieties. That model shows the same results as the one shows here. The previous version of the paper is available upon request to the authors.

left y axis represent the consumers preferences for variety (z_A, z_B), while the right y axis depict the possible varieties sold by stores (s_{Ai}, s_{Bi}).

Figure 2: The two dimensional model.



Products have a physical—distance—identification (d) but also a variety identification (s). Stores are—exogenously—located at one point in the distance dimension, and they may sold different varieties of the good in a store. A consumers that prefers variety i and is located at distance j have an—indirect—utility function:

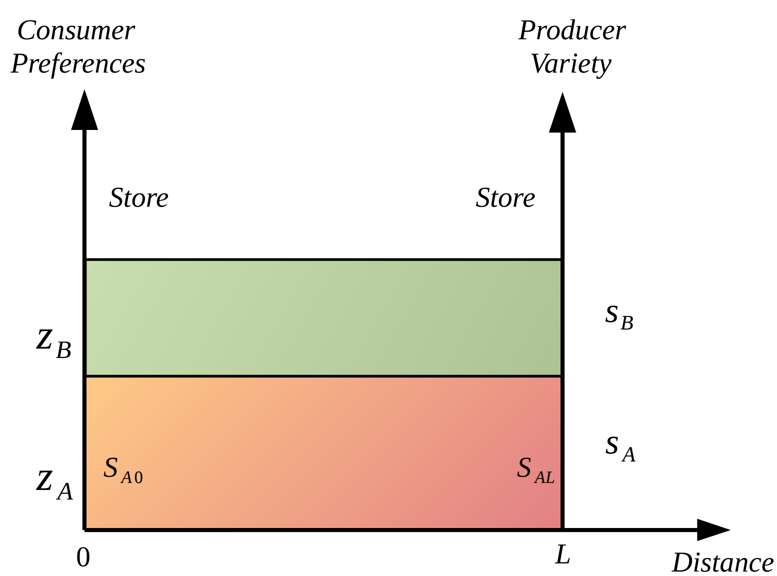
$$U_{ij} = r - \theta \left\{ if \; z_i \neq s_q \right\} - t \left| x_j - x_d \right| - p_{qd},$$

where r is the reservation utility of the consumer—equal for all consumers—, i indicates the variety preference of the consumer ($i.e.,. z_i = \{z_A, \, z_B\}$), θ is the cost that a consumer pay if he buys a good of variety s_q that differ from his preferred variety z_i at the store located at d, t is the transport cost the consumer located at j has to pay to buy at store located at d, and p_{qd} is the price of the good of variety q charged by a store located at d. As variety is discrete the consumer will pay a cost only if he buys a variety different from his preferred one. In the following analysis we will just subtract θ if the variety of consumer and producer differ. For simplicity, we assume that the production costs of firms is equal to zero, but that there is a fixed cost for each variety equal to F. Although not formalized in the model, fixed costs represent the opportunity cots each variety impose on the store because the limited slotting space. Each variety a store choose to sell will leave less space available to other varieties or products. In turn, this opportunity cost will allow us to be used as an exogenous instrument for varieties in the empirical section.

This simple setting will allow us to show that there exists a Nash equilibrium in which one firm sold two varieties and the other sell just one. This equilibrium under symmetrical demand and cost conditions will result in different prices being charged for the same product. First, we will show that, under the previous assumptions, stores will prefer to sell only one brand. This is due to the fact that having two brands do not increase income for the store but double its fixed costs. Secondly, using the previous conditions, we show that prices will differ in equilibrium if varieties differ between stores. Varieties will differ in equilibrium because a store that has two varieties will increase its cost but also expand the demand at the expense of the store that sold just one brand. On the contrary, although the firm that sold one brand lose market share—and income—it also saves fixed costs.

Suppose there are two stores that sell the same variety $z_A = s_A$. The stores are located in opposite sides on the street. The first store is located at 0 and the second store at L, being L also the distance between the stores. We label store selling variety s_A as S_{A0} if the store is located at 0, and S_{AL} if the store located at L. Fixing the location of the stores eliminates one variable in the analysis (i.e., distance). We fix the store location to concentrate on the effects of variety on price dispersion. The situation is depicted in Figure 3.

Figure 3: The model with two stores and one variety.



This is the traditional Hotelling (1929) model with two stores, were S_{A0} is the store located at the beginning of the line and S_{AL} is the one located at the end of the line. In order to find the price equilibrium, as we have assumed that the locations of both stores are exogenously given, the indifferent consumers must be found in order to establish the demand. We assume that the minimum valuation for each variety is large enough such that all consumers on the street buy the good; i.e., that $r-\theta-tx-p_{A0} \geq 0$ or $r-\theta-t\left|L-x\right|-p_{AL} \geq 0$ or both, $\forall x \in [0,\, L]$. As consumers with different variety preference differ in θ if distance is fixed, we can find the indifferent consumer between both stores as:

$$r - t\widehat{x} - p_{A0} = r - t\left|L - \widehat{x}\right| - p_{AL}, \tag{1}$$

and solving for $\widehat{x}$ we obtain:

$$\widehat{x} = \frac{p_{AL} - p_{A0} + tL}{2t}. \tag{2}$$

The demand for product A at store located at 0 is $\widehat{x}$: $D_{A0} = \widehat{x} = \frac{p_{AL}-p_{A0}+tL}{2t}$, as consumers at the left of $\widehat{x}$ bought at that store regardless of their valuation of variety, and the mass of consumers at each point is 1 (i.e., λ consumers of variety z_A and $1-\lambda$ consumers of variety z_B) and for store S_{AL}: $D_{AL} = L - \widehat{x} = \frac{p_{A0}-p_{AL}+tL}{2t}$.

Then, profits are $\Pi_{A0} = p_{A0} \times D_{A0} - F$ and $\Pi_{AL} = p_{AL} \times D_{AL} - F$, as only one brand is sold at each store. Maximizing profits we find the reaction functions in prices, $p_{A0} = \frac{p_{BL}+tL}{2}$ and $p_{AL} = \frac{p_{A0}+tL}{2}$, and solving for the reaction functions in prices, we find:

$$p_{A0} = p_{AL} = tL,$$

and prices of both firms converge. This result holds as both firms have the same costs (zero in this case) and the same demand –in this case, $L/2$–. Profits if both firms sell one variety will be:

$$\Pi_0^{11} = \Pi_{A0} = \Pi_L^{11} = \Pi_{AL} = \frac{tL^2}{2} - F,$$

where the superscripts denote the number of varieties of each firm, with the first superscript being that of the firm and the second superscript the number of varieties of the rival store.

Under these assumptions, stores will not find optimal to sell both varieties. The problem with two varieties is symmetrical to the one with one variety: the indifferent consumer will be at $\widehat{x}$ for each variety. For this result to hold, we will assume that at 0 and L consumers that have preference z_B will prefer to buy the variety s_B; but consumers that have preference z_A, will prefer to buy the variety s_A. This guarantees consumption for both goods.

As a result, the price of each variety will be the same as before: $p_{A0} = p_{AL} = p_{B0} = p_{BL} = tL$, and the indifferent consumer will be again located at $L/2$. Profits will now be:

$$\Pi_0^{22} = \Pi_{A0} + \Pi_{B0} = \Pi_L^{22} = \Pi_{AL} = \Pi_{BL} = \frac{tL^2}{2} - 2F$$

From the above results it follows that stores prefer to sell only one variety of the good. This is due to the assumption of consumers being discrete in their variety dimension.

2.1 Stores Differ in the number of Varieties

In this simple model prices will diverge if the symmetry between stores is broken. We accomplish this by introducing a second variety at just one of the stores. Specifically, assume that at location 0 the store also offers variety s_B to consumers. Previously we assume that at 0 consumers that have preference z_B will prefer to buy the variety s_B; but consumers that have preference z_A, will prefer to buy the variety s_A. This assumption add one additional restriction to the model. Consumers located at 0 that have preference for variety z_A will prefer to buy variety s_A to variety s_B at store S_0 if $r - p_{A0} > r - \theta - p_{B0} \iff p_{A0} - p_{B0} < \theta$. On the contrary, consumers located at 0 that have preference for variety z_B will prefer to buy variety s_B to variety s_A at store S_0 if $r - p_{B0} > r - \theta - p_{A0} \iff p_{B0} - p_{A0} < \theta$ or $p_{A0} - p_{B0} > -\theta$. Both inequalities establish upper and lower bounds for the prices of brands s_A and s_B at store S_0 in order to both goods have positive demand:

$$|p_{A0} - p_{B0}| < \theta. \tag{3}$$

The availability of a new variety does not change the indifference condition for consumers that prefer variety z_A. Now we find the consumers who are indifferent about buying from variety B at store 0 and variety A at store L. Take the case of a consumer located at $\widetilde{x}$ that prefers variety z_B. She will be indifferent between buying variety B at store 0 or variety A at store L $\iff$

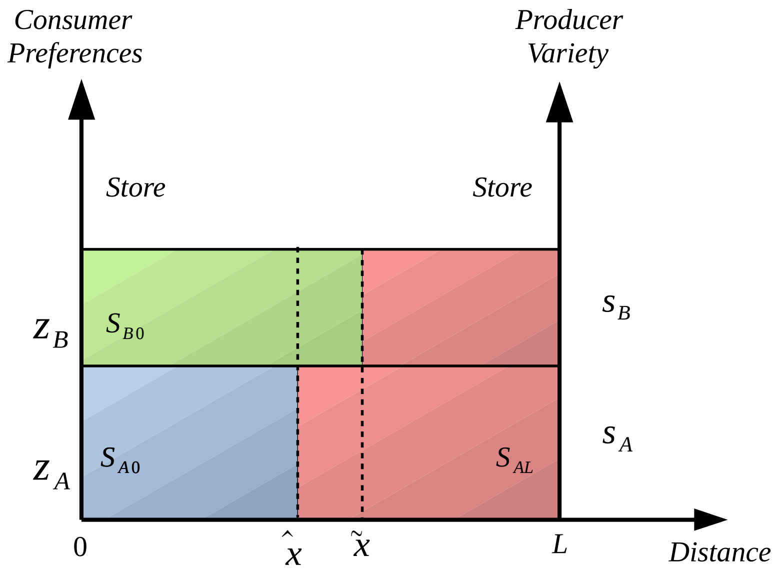
$$r - t\widetilde{x} - p_{B0} = r - \theta - t\,|L - \widetilde{x}| - p_{AL}, \tag{4}$$

and

$$\widetilde{x} = \frac{p_{AL} - p_{B0} + \theta + tL}{2t}. \tag{5}$$

A comparison of equations 2 and 5 shows that $\widetilde{x} > \widehat{x} \iff p_{A0} - p_{B0} < \theta$. If instead we assume that $\widetilde{x} < \widehat{x}$, then equations 2 and 5 imply that $\theta < p_{B0} - p_{A0}$, and this result violate inequality 3. Figure 4 depicts the possible location of $\widetilde{x}$ for a given location of $\widehat{x}$ and the demand for each store.

Figure 4: Possible equilibrium values of $\widetilde{x}$ and $\widehat{x}$.



Note: Demand for variety s_A at store S_0 is depicted in blue, demand for variety s_A at store S_L in red, and demand for variety s_B at store S_0 in green.

Now we proceed to find the demand for each store, taking into account the previous results. Store S_0 will have demand for varieties A and B. Profits will be $\Pi_0^{21} = (1-\lambda)\,\widehat{x}\times p_{A0} + \lambda\widetilde{x}\times p_{B0} - 2F$ $= (1-\lambda)\,\frac{p_{AL}-p_{A0}+tL}{2t}p_{A0} + \lambda\frac{p_{AL}-p_{B0}+\theta+tL}{2t}p_{B0}$. Note that the maximization problem is separable in p_{A0} and p_{B0}. The first order constraints of the problem are $\frac{\partial\Pi_0}{\partial p_{A0}} = 0 = \frac{(1-\lambda)}{2t}\left[p_{AL} - 2p_{A0} + tL\right]$ and $\frac{\partial\Pi_0}{\partial p_{B0}} = 0 = \frac{\lambda}{2t}\left(p_{AL} - 2p_{B0} + \theta + tL\right)$. Therefore the reaction functions are

$$p_{A0} = \frac{p_{AL} + tL}{2}. \tag{6}$$

$$p_{B0} = \frac{p_{AL} + \theta + tL}{2}. \tag{7}$$

Note that the reaction function of product A for store S_0 depends only—increasingly—on the price of variety A sold by firm S_L, but not on the price it set for product B. This result holds because of the discrete nature of the variety dimension.

For store S_L, as $\widetilde{x} > \widehat{x}$, its demand is affected by variety B sold by store S_0. The demand of store L is, $D_{AL} = \underbrace{(1-\lambda)\times(L-\widehat{x})}_{s_A\ consumers} + \underbrace{\lambda\times(L-\widetilde{x})}_{s_B\ consumers} = (L-\widehat{x}) - \lambda\,(\widetilde{x}-\widehat{x})$.

The profit function is: $\Pi_L = p_{AL}\left[\left(\frac{p_{A0}-p_{AL}+tL}{2t}\right) - \lambda\left(\frac{\theta+p_{A0}-p_{B0}}{2t}\right)\right] - F = p_{AL}\left(\frac{(1-\lambda)p_{A0}-p_{AL}+\lambda p_{B0}-\lambda\theta+tL}{2t}\right) -$

F. From the FOC we obtain:

$$p_{AL} = \frac{(1-\lambda)\, p_{A0} + \lambda p_{B0} - \lambda\theta + tL}{2}. \tag{8}$$

The reaction function of store S_{AL} is increasing in p_{A0} and p_{B0} as they are both substitutes. The solution to the three equations system is:

$$p^{'}_{A0} = tL - \frac{\lambda\theta}{6}, \tag{9}$$

$$p^{'}_{AL} = tL - \frac{\lambda\theta}{3}, \tag{10}$$

$$p^{'}_{B0} = tL + \frac{(3-\lambda)\,\theta}{6}. \tag{11}$$

The results show that the prices of variety A sold at stores 0 and L are now lower than if variety B were not available. As competition increase, prices decrease. Also, in this model, the effect of variety is independent of the effect of distance.[5]

The next Proposition establish the conditions for the above prices to be a Nash equilibrium.

Proposition 1. *One store will offer two varieties and the other store will offer one variety if the following inequalities hold:* $\frac{3F}{\lambda\theta} - \frac{\theta}{12t}\left(9 - \frac{5}{2}\lambda\right) \leq L \leq \frac{3F}{\lambda\theta} - \frac{\lambda\theta}{6t}$. *This double inequality holds for all* $\lambda \in [0,1]$.

Proof. In Appendix C. □

The next Proposition summarizes the effect of variety on pricing.

Proposition 2. *Introducing varieties into the distance model:*

1. *Decreases the price of goods;*
2. *Makes prices more volatile (i.e., price convergence less likely to hold)*

Proof. For 1, it is sufficient to note that $p^{'}_{A} = p_A - \frac{\lambda\theta}{6}$ while $p^{'}_{B} = p_B - \frac{\lambda\theta}{3}$. For 2, $p^{'}_{A} = p^{'}_{B} \iff \lambda = 0$, which could not hold because there will be no demand for variety z_A, or $\theta = 0$, that is, if there are not costs for consumers to change variety. □

This simple model allow us to introduce price dispersion in equilibrium without relying on differences in demand at the store level (e.g., differences in the number of consumers z_A and z_B) nor differences in production costs. The model is perfectly symmetric and the result rely only on the assumption of positive fixed costs and a discrete number of varieties. As Proposition 2 showed, store decision on the number of varieties offered will have an impact on the equilibrium price of the product sold.

[5]Note that inequality 3 holds, as $\left|p^{'}_{A0} - p^{'}_{B0}\right| = \frac{\theta}{2} < \theta$.

3 Data

This section offers a detailed description and descriptive statistics of the database used in the empirical section, as well as some preliminary results on the relative convergence to the LOP. We perform the analysis using a detailed good-level database of daily posted prices compiled by The General Directorate of Commerce (DGC), a unit of the Ministry of Economy and Finance in Uruguay, which comprises information about grocery stores all over the country.[6] Moreover, the DGC is the authority responsible for the enforcement of the Consumer Protection Law. The DGC requires retailers to report their daily prices once a month using an electronic survey.

The database has its origins in a tax law passed by the Uruguayan legislature in 2006, which changed the tax base and rates of the value added tax (VAT). The Ministry of Economy and Finance was concerned about incomplete pass-through from tax reductions to consumer prices and hence decided to collect and publish the prices in different grocery stores and supermarkets across the country. The DGC issued Resolution Number 061/006, which mandates that grocery stores and supermarkets report their daily prices for a list of products if they meet the following two conditions: i) they sell more than 70% of the products listed, and ii) they either have more than four grocery stores under the same brand name or have more than three cashiers in a store. The information sent by each retailer is a sworn statement, and there are penalties for misreporting. The objective of the DGC is to ensure that prices posted on the DGC website reflect the actual posted prices in the stores. In this regard, stores are free to set the prices they optimally choose, but they face a penalty if they try to misreport them to the DGC in an attempt to mislead costumers.

The data is an unbalanced panel for up to 386 stores and includes daily prices from April 1st of 2007 to September 30th of 2014 for 154 products, most of them defined by UPC code. This detailed information allows us to track the exact same good in stores across the country, avoiding measurement problems resulting from different products being compared (see the discussion in Atkin and Donaldson, 2015). The markets for the goods included in the sample represent 15.6% of the CPI basket. Most items have been homogenized to make them comparable, and each supermarket must always report the same item. For example, the soft drink of the brand Coca Cola is reported in its 1.5 liter variety by all stores. If this specific variety is not available at a store, then no price is reported. The data are then used on a public web site that allows consumers to check prices in different stores or cities and to compute the cost of different baskets of goods across locations.[7]

The three best-selling brands are reported for each market, disregarding supermarket's own brands. Products were selected after a survey to some of the largest supermarket chains in the year 2006. In November 2011, the list of products was updated, including some markets and

[6] This is an updated database from Borraz and Zipitría (2012) and Borraz, Cavallo, Rigobon, and Zipitría (2016).

[7] See http://www.precios.uy/servicios/ciudadanos.html and Borraz and Zipitría (2012) for a detailed description of the database and an analysis of price stickiness.

reviewing the top brands for others. The price information for the goods that were discarded was deleted from the database, so we lose part of the information in some markets. Two characteristics of the database are critical to our analysis. On the one hand, due to its construction, the database has the most relevant products in each market, simplifying the task of finding them or defining which goods should affect product pricing decisions.On the other hand, eliminating supermarkets own brands could induce noise in our variety variable. Although, supermarkets' own brands are not comparable across different chains, they could induce variation not completely captured by the prices of the other varieties relieved at the store.

The 154 products in the database represent 50 markets or product categories (e.g., sunflower oil and corn oil and wheat flour 000 and wheat flour 0000 are different markets in our analysis). For some of them, the information does not allow the identification of the goods at the UPC level; in the meat and bread markets, products do not have brands. In other cases, products could be open and sold in pieces; such as hot dogs, or ham. In both cases, we exclude those products from the analysis. Lastly, we delete information on one quince jam brand, as there were no varieties in the database. The detailed list of goods used in the empirical analysis can be found in Appendix B. The list include the market of the good, its presentation, when the sample started, the producer, and the class to which each product belongs. The class for each product is defined by the Classification of Individual Consumption According to Purpose (COICOP) by the United Nations Statistics Division, and is adopted by the Uruguayan National Statistic Institute (INE, by its Spanish acronym) for the construction of the price index.[8] Class classification will be used to construct the instrument to varieties in Section 5.

For each store in the database we have detailed information about their exact location given by its Universal Transverse Mercator (UTM) as well as about whether it belongs to a supermarket chain. We use the UTM information to calculate the linear distance between each pair of supermarkets in the database. Uruguay is divided into nineteen political states, called "*departamentos*." The database has information for up to 386 supermarkets across all nineteen political states, comprising 54 cities. Montevideo, the capital city of Uruguay, is also the country's largest city, with nearly forty percent of the Uruguayan population.[9] Figure 7 in Annex A shows the cities in the database and the supermarket distribution for Montevideo, which accounts for 54% of all supermarkets in the sample.

We construct two databases to be used in the empirical section. First, a price level database using the information from the DGC. Secondly, a price difference database, which has traditionally used to analyze the role of distance in price differences. For the database in level, for each product and store, we calculate the monthly mode of the daily prices to avoid introducing variations in LOP due to sales (see Eichenbaum, Jaimovich, and Rebelo, 2011, Nakamura and Steinsson, 2008,

[8]The detailed description of products into classes can be found at INE CPI methodology (in Spanish).
[9]More information is available at http://www.ine.gub.uy/uruguay-en-cifras (in Spanish).

and Nakamura and Steinsson, 2013).[10] The inclusion of sales in the analysis will induce spurious deviations related to producer or retail commercial policies that introduce noise in the analysis of deviations of prices to the LOP. The final price database contains 2,096,310 monthly observations for 125 goods—varieties—in 42 product categories. Descriptive statistics of prices—including minimum, median, maximum, standard deviation, number of observations, and the maximum share of stores where the product is available—can be found in Table 10 in Annex A.

Then we construct the price difference database. For for each triple product/store/month, we calculate the (absolute) price difference, (absolute) variety difference, and distance between stores, and obtain 272,370,229 observations. Descriptive statistics of price differences—including minimum, median, maximum, standard deviation, number of observations, and the exact number of zeroes—can be found in Table 12 in Annex A. As a result of the large size of the database we will perform the empirical analysis by using a random sample of 10% of the observations in the database. Also, we will check the results against year 2011, which has the cross distribution of varieties that closely mimics that of database. Nevertheless, the next subsection shows descriptive statistics for the complete price difference database.

Our measure of variety is the key variable in the empirical analysis. We propose a very simple measure to capture the role of different varieties on prices. We simply count for each triple product/store/month the number of prices—less one—listed in the database for each market. To put it in another way, we just count the number of products—less one—in each triple market/store/month. This measure is a trade off between aggregation across markets with variation within markets. Assume market Z with three products—as in our database–. We will have a value of one for the variable variety if there are brands A and B, but also if there are brands A and C or B and C. Clearly, to have brand A competing with brand B could be very different than competing with brand C. In this case, we lose some variation within markets, but we are able to aggregate between markets. If we differentiate within a market as previously stated, implies that these differences need to be made for each market. As a result, to represent each possible combinations of products in each market will end with thousands of different measures of variety that will hide the general picture. With our simple measure of variety, a value of one for the that variable implies that there is another product available at the store, whatever the market. Nevertheless, by construction the variety measure will be noisy.

3.1 Descriptive statistics

First, we offer some statistics on the variation in the number of varieties in the database. Table 1 below shows the share of observations by number of varieties in the price database and in the price difference database. In the price database most observations are up to two varieties, while

[10] Previously, we delete outliers, defined as those prices lower than one third or larger than three times the median monthly price for each product. This procedure eliminates less than 0.01% of the daily prices.

larger number of varieties are for the rice market only. The price difference database shows that nearly two third of the observations have the exact same number of varieties—although not the same number of products, due to our noisy measure—, but a non negligible 30% of observations differ in one variety.

Table 1: Number of Varieties in the Price Database (in percentage).

# Varieties	Share Price Database	Share Price Difference Database
0	10.6	65.5
1	42.4	29.3
2	43.9	4.5
3	1.2	0.5
4	1.7	0.2
5	0.2	0.0

Source: Author's calculation.

One of the goals of the paper is to compare the effect of varieties vis-à-vis the effect of distance in explaining deviations from the LOP. Using the location of each store we calculate the distance for each pair of supermarkets (74,305 combinations). The distance between pairs of stores varies considerably in the database, taking into account if the stores are within or between cities. The next table shows statistics for the distance between supermarkets pairs.

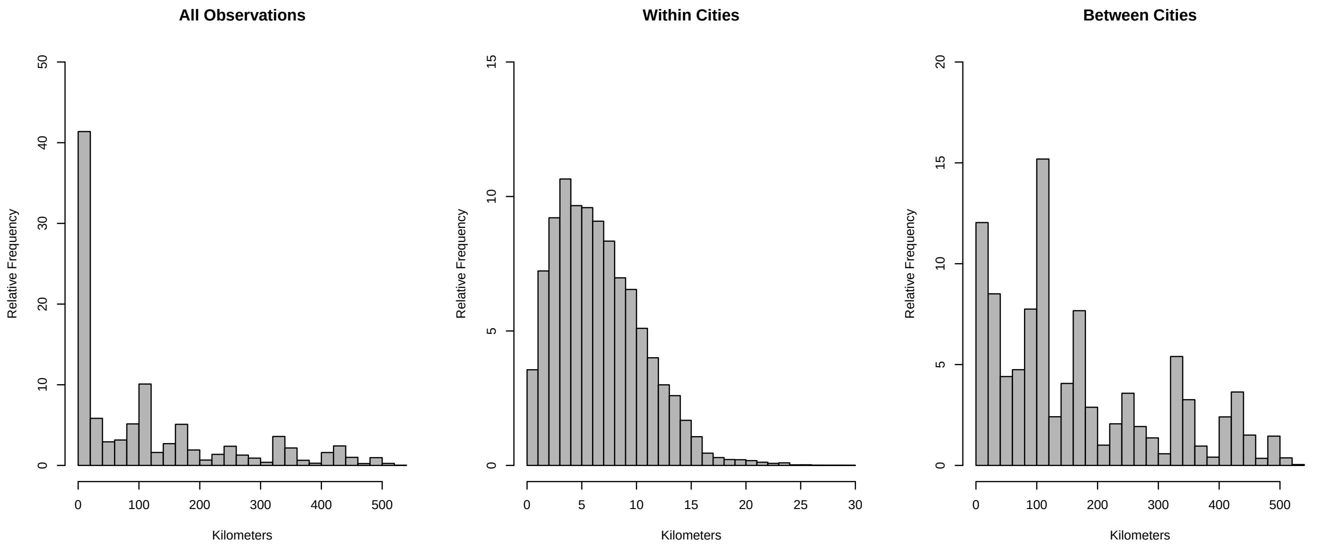
Table 2: Descriptive statistics for distance between supermarkets (in kilometers).

	Total	**Within City**	**Between cities**
Minimum	0.0	0.0	0.4
Median	78	6	119
Maximum	526	29	526

Source: author's calculation.

Figure 5 plots the distribution of observations in the price difference database by distance in the sample. The first histogram (left) shows the distribution of observations for the whole sample, while the second (center) and third (right) show histograms of observations by distance within and between cities. The number of observations in the price difference database are not even distributed along distance. As with distance between supermarkets, nearly 40% of the observations in the database are supermarkets that are less than 20 kilometers apart.

Figure 5: Observations by distance in the sample.



Divergences from the LOP—even within countries—have mainly being associated to the effect of borders. Next, we show histograms of the distribution of price differences for stores in the same and different cities in the sample. The first histogram (left) shows the distribution of price differences for the whole sample, while the second (center) and third (right) show histograms for price differences within and between cities for distances up to 30 kilometers. The figure shows that there seems to be more convergence within cities than between them, although the effect is mild. Nevertheless, differences are much less significant than those due to varieties as shown in Figure 1.

Figure 6: Distribution of Price Differences.

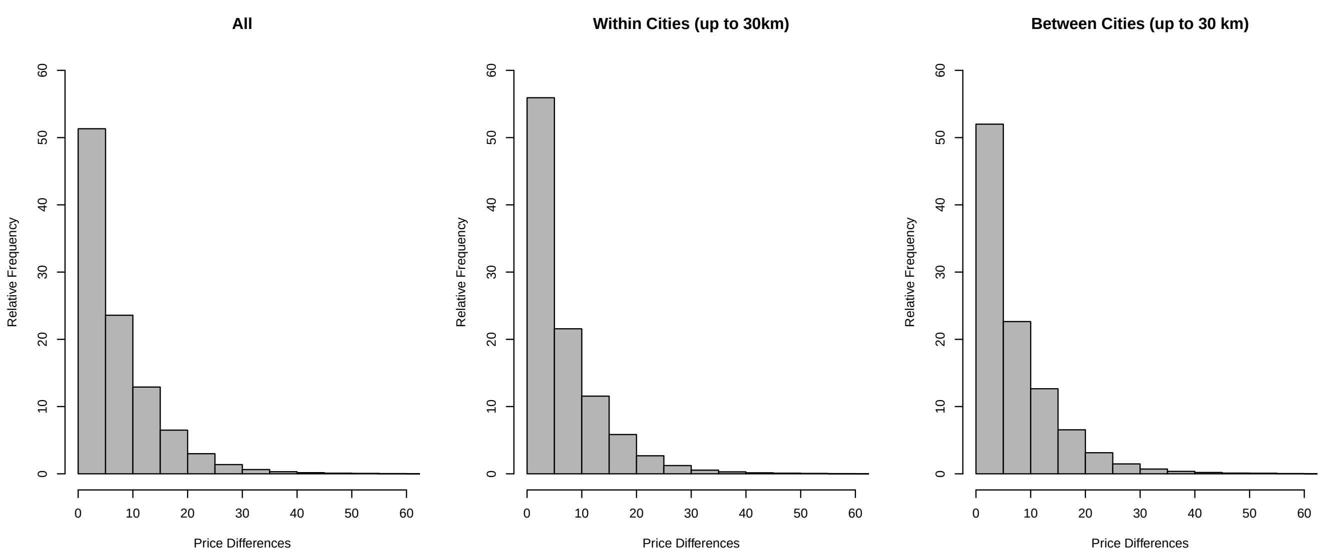


Table 3 below shows summary statistics—median, standard deviation, and number of exact zeroes—of price differences to illustrate the main message of the paper. The median price difference is about 5% and prices are equal nearly a fifth of the time. The price difference is a bit lower than those reported by Elberg (2016) for Mexico (7.6%) and Parsley and Wei (1996) (14.4% for perishables and 12.5% for nonperishable goods) for the US. Nevertheless, the figures are quite large if the size of the country is taken into account. The maximum distance between stores in Uruguay is eight times smaller than in the US and at least three times smaller than for the cities reported by Elberg (2016) in Mexico. Within cities, prices are equal a fourth of the time. The key differences emerge when varieties are taken into account. For products having the same number of varieties price dispersion is 4.3% and the share of equal prices is about to 22%. Nevertheless, when products in two stores differ in one variety the median price difference increase nearly 30% and the share of equal prices decrease to half. Thus, when products between stores have the same number of varieties the unconditional probability of the product having the same price is twice as large as if products differ by one in the number of varieties.

Table 3: Deviations of Law of One Price Under Different Configurations.

	Median	**St. dev.**	**% Exact Zeroes**	**# of obs.**
Total	4.8	7.3	18.2	272,370,229
Between cities	5.1	7.4	14.5	180,944,726
Within cities	4.1	7.2	25.4	91,425,503
Same Varieties	4.3	7.3	21.6	178,487,138
One Variety of Difference	5.6	7.4	11.9	79,607,477

Source: author's calculation.

The table summarize the main message of the paper: when stores differ in the number of varieties they offer, prices will diverge more often. The next section presents several measures of the effect of varieties on relative prices, exploiting the variability in varieties in the database.

4 Empirical Strategy

The Proposition 2 in Section 2 established that if stores differ in the number of varieties in a given product category, then prices will diverge more often. Evidence of price divergence has been shown in Figure 1 and Table 3 in the previous section apply. But Proposition 2 in Section 2 also established that prices will be lower if there are additional varieties in the market. We attempt two different empirical strategies to address the role of varieties on prices. First, we analyze the effect of varieties on prices, in a similar estimation to Gopinath, Gourinchas, Hsieh, and Li, 2011 (equation 5). Secondly, we estimate a more traditional price difference equation to analyze the role of varieties vis-a-vis distance.

Our first estimation is the next price equation:

$$\ln p^m_{ist} = \alpha_i + \alpha_t + \alpha_{st} + \alpha_{mt} + \beta Var_{ist} + \epsilon_{ist}, \tag{12}$$

where i is good, t is time, s is store, and m is market. We regress the log of the nominal prices—times 100—to our measure of the number of varieties for product i in store s in time t. We control for inflation—α_t—and unobservables through a set of store-time fixed effects and market-time fixed effects—i.e., time dummies for each stores and each market/category—. These dummies control for inflation, time specific shocks to stores—i.e., location, cost shocks, opening of new competitors, management, etc.—time specific shocks to markets—i.e., cost increases, regulatory changes, etc.—, as well as product characteristics. As a robust check, we also include product/store dummies in equation 12. The estimation uses a within transformation to absorb the large number of fixed effects in the regression.[11] Standard errors are clustered at the store and time level.

Table 4: Estimation of the effect of Brands and Competition on Prices.

Dependent variable: log of price (times 100)		
Variety	-3.795***	-0.293***
	(0.138)	(0.076)
# Observations	2,096,310	2,096,310
Product Dummies	Yes	Yes
Time Dummies	Yes	Yes
Market-Time Dummies	Yes	Yes
Store-Time Dummies	Yes	Yes
Store-Product Dummies	No	Yes
R square	0.92	0.99

Note: *** $p < 0.01$. Clustered standard errors (by store and time) in parentheses.

In line with our theoretical model, the first column of results of Table 4 shows a sizable economic impact of variety on prices. To add another variety to the shelf decrease prices by 3.8% in relation to having only one product. This effect is nearly a fourth of the estimated border effect between Canada and the US by Gopinath, Gourinchas, Hsieh, and Li, 2011 (15 percent, page 2473), just by adding a second product in the same shelf. The effect remain highly statistically significant even when controlling by store product dummies (second column of Table 4), although the estimated value decreases.

We now turn to the effect of varieties on LOP deviations. We propose an estimation of the relative LOP deviation standard in the literature (see Atkin and Donaldson, 2015, Crucini, Shintani, and Tsuruga, 2010, Dvir and Strasser, 2018, Engel and Rogers, 1996, Goldberg and Knetter,

[11]See Wooldridge (2010) chapter 10.5. We use package lfe in R. See Gaure (2013) for details.

1997, and—with some differences—Coşar, Grieco, and Tintelnot (2015b), among others). Our base estimation for LOP deviation—adapted from Engel and Rogers (1996)—is as follows:

$$|p_{ist} - p_{irt}| = \alpha_i + \alpha_{ch} + \alpha_t + \beta_1 \times Dist_{sr} + \beta_2 \times Border_{sr} + \varepsilon_{isrt}, \tag{13}$$

where i is the indexed product and $i \in I$ is the product space; s, r are two stores, where s, $r \in S$ is the store's space in the sample and $s \neq r$; $|p_{ist} - p_{irt}|$ is the (absolute) difference of the log of the price of good i between stores s, r at moment t;[12] α_i is a dummy variable for product i; α_{ch} is a dummy variable that takes the value one if stores s, r belong to the same chain; α_t are time dummies; $Dist_{sr}$ measures the actual distance in (logs of) kilometers between stores s, r—as some distances are less than one kilometer, and as we want to avoid negative distances, we add 1 to the distance in kilometers; $Border_{sr}$ is a dummy variable that takes the value one if stores s, r are located in different cities; and ε_{isrt} is a stochastic error term. The equation includes controls for unobserved differences across cities–border–(see Engel and Rogers, 1996), distance as a measure of trade costs (see Anderson and van Wincoop, 2003 and Anderson and van Wincoop, 2004), product dummies that account for unobserved differences across products, such as differences in relative rigidity of prices (Crucini, Shintani, and Tsuruga, 2010) or production costs (Goldberg and Knetter, 1997), a dummy that accounts for uniform prices in chains (DellaVigna and Gentzkow, 2019 for the US, Borraz and Zipitría, 2012 for Uruguay).

Our analysis proposes a simple modification that add to Equation 13 the differences in varieties between stores at the category level. We define $DVar_{isrt} = |Var_{ist} - Var_{irt}|$, as the differences in the number of varieties between between stores s, r for product i in moment t. Now, equation 13 transforms into the following:

$$\begin{aligned} |p_{ist} - p_{irt}| = \sum \alpha_i + \alpha_{ch} + \sum \alpha_t + \beta_1 \times Dist_{sr} + \beta_2 \times Border_{sr} + \\ + \beta_3 \times DVar_{isrt} + \varepsilon_{isrt} \ , \end{aligned} \tag{14}$$

Due to the size of the database—273 million observations—and the high number of controls, we decide to take a random sample of the database for 10% of the observations. We also control the results by running the same regressions for year 2011, which has a distribution of varieties similar to the whole database. Table 5 shows the main results for the estimation of equations 13 and 14 for the random sample database (Panel A) and for year 2011 (Panel B). All equations have standard errors clustered by store pair—i.e., store s and r—and time.[13] The estimation uses a within transformation to absorb the large number of fixed effects in the regression.[14]

[12]The literature also studies the standard deviation of the price difference.
[13]Price differences are multiplied by 100. The intercept dummy is omitted in all equations.
[14]See Wooldridge (2010) chapter 10.5. We use package lfe in R. See Gaure (2013) for details.

Table 5: Estimation of LOP deviation.

Panel A: Random Sample	*Dependent variable: difference in log of prices (times 100)*			
	(1)	(2)	(3)	(4)
Distance	0.135**	0.383***	0.122**	0.374***
	(0.033)	(0.040)	(0.062)	(0.039)
Variety			0.624***	0.411***
			(0.049)	(0.040)
# Observations	27,237,023	27,237,023	27,237,023	27,237,023
Time dummies	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes
Different City Dummy	Yes	Yes	No	No
Same Chain Dummy	Yes	No	Yes	No
Stores s, r Dummies	No	Yes	No	Yes
R square	0.126	0.174	0.128	0.175

Panel B: Year 2011	*Dependent variable: difference in log of prices (times 100)*			
	(1)	(2)	(3)	(4)
Distance	0.154**	0.380***	0.112**	0.372***
	(0.067)	(0.039)	(0.066)	(0.037)
Variety			0.586***	0.379***
			(0.062)	(0.054)
# Observations	49,383,990	49,383,990	49,383,990	49,383,990
Time dummies	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes
Different City Dummy	Yes	Yes	No	No
Same Chain Dummy	Yes	No	Yes	No
Stores s, r Dummies	No	Yes	No	Yes
R square	0.151	0.201	0.153	0.202

*** $p < 0.01$, ** $p < 0.05$. Standard errors in parentheses. Clustered standard errors (by store s and r, and time) in parentheses.

Results in both panels are similar. To have one additional variety adds nearly half percent variation to price differences, depending on the estimation. The smaller estimation is 0.38 percent, while the largest is about 0.62 percent. In all estimations variety is highly significant. Equations (2) and (4) add store s and r dummies to the estimation which decrease a bit the estimation, and significantly increase the distance estimation. According to estimation in column (3) for the random sample, to add one variety into a store is equivalent to an increase of price dispersion of 165 kilometers of distance! [15] When controlling for stores dummies, the variety coefficient reduces between a quarter and a third, but remains highly significant. Nevertheless, the distance

[15] The distance equivalent measure of variety is calculated as $\beta_3 = \beta_1 \times \ln(d+1)$; i.e., $165 = exp\,(0.624/0.122) - 1$.

equivalence of variety reduces to just 2 kilometers, [16] which seems like a milder walk between stores just for adding a product to a store's shelf. But, it should be noted that the distance coefficient nearly tripled: distance is lower, but more costly.

We repeat our exercise to different distances as a robustness check. First, we run equations 13 and 14 for those stores up to 30 kilometers. These stores should be under similar economic conditions—i.e., transport costs and demand characteristics—, as the maximum distance within a city is 29 kilometers (see Table 2). On the contrary, we then run equations 13 and 14 for those stores further away to 100 kilometers. This stores are all in different cities and, as a result, face very different economic conditions. These two estimation allow us to check the robustness of the results.

[16] The calculation is $2 = exp\,(0.411/0.374) - 1$.

Table 6: Estimation of LOP deviation.

Panel A: Stores up to 30 kms.	*Dependent variable: difference in log of prices (times 100)*			
	(1)	(2)	(3)	(4)
Distance	0.158 (0.099)	0.172*** (0.038)	0.160 (0.095)	0.169*** (0.038)
Variety			0.855*** (0.078)	0.380*** (0.053)
# Observations	125,170,128	125,170,128	125,170,128	125,170,128
Time dummies	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes
Different City Dummy	Yes	Yes	No	No
Same Chain Dummy	Yes	No	Yes	No
Stores s, r Dummies	No	Yes	No	Yes
R square	0.144	0.204	0.148	0.205

Panel B: Stores further away from 100 kms	*Dependent variable: difference in log of prices (times 100)*			
	(1)	(2)	(3)	(4)
Distance	-0.0102 (0.137)	0.432*** (0.120)	-0.013 (0.136)	0.423*** (0.000)
Variety			0.411*** (0.048)	0.351*** (0.044)
# Observations	113,183,208	113,183,208	113,183,208	113,183,208
Time dummies	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes
Same Chain Dummy	Yes	No	Yes	No
Stores s, r Dummies	No	Yes	No	Yes
R square	0.113	0.157	0.114	0.158

*** $p < 0.01$, ** $p < 0.05$. No asterisk, no significant. Standard errors in parentheses. Clustered standard errors (by store s and r, and time) in parentheses.

The variety variable remains highly significant in both estimations. Interestingly, when we do not control for store characteristics, the distance coefficient is no significant in neither estimations. For relative similar economic conditions (Panel A) we found distance estimations that are lower and variety estimations that are larger than in the general setting. Controlling for store characteristics, variety adds price dispersion equivalent to 8 kilometers,[17] or a quarter of the distance between stores in the sample. This change in the estimated value of distance implies that there are other factors that are being picked up by distance in the general setting. This conclusion is reinforced in the estimations in Panel B: we found larger estimations for distance, while lower estimations

[17]The calculation is $8 = exp\,(0.380/0.169) - 1$.

for variety. Nevertheless, it is interesting to note that our variety variable is always statistically significant. The setting for stores farther away to 100 kilometers shows that decisions at the store shelf could have an economic significant effect even hundreds of kilometers away.

This section has shown evidence of an economic and statistically significant effect of varieties on price dispersion. The result is robust to different controls and specification. Nevertheless, the issue of causality of variety to prices remain to be identify. The next section we provide an instrument variable estimation of the effect of varieties on prices.

5 Causality

While previous results seems to be very robust to different controls, causality—i.e., reverse causality of prices on the choice of varieties—remains an issue. The ideal setting to finding causality should be to have an exogenous shock that remove a product in a given market and to analyze the reaction of prices. Unfortunately, we do not have such a setting in our database. Alternatively, we propose a novel instrumental variable for varieties to estimate the causal effect on prices.

Our model in Section 2 showed that stores face a cost for each variety they include into their shelves. Each additional variety implies less available space for the remaining ones. In addition, the model also shown that stores react to the selection of varieties at proximate stores. To introduce our instrument we need to resume some definitions. So far, we have products or varieties (such as Budweiser) in markets or product categories (such as beer). But categories could also be clustered into groups (such as alcoholic beverages) according to consumers intended use, which is the COICOP definition established in Section 3. Now, according to our model, the number of varieties in a product category in a given store is set a reaction to the variety decision for that product category with its nearby competitors. As an equilibrium decision, the choice of varieties in nearby stores for that product cannot be used as an instrument for the number of varieties at a given store.

Nevertheless, as stores have a fixed shelf space, increasing the number of varieties in market A will render less space available for market B. As a result, we can use the number of varieties in similar product categories in nearby stores as an instrument for other product category at the store. Take the case of alcoholic beverages defined as a group in the CPI—following the COICOP definition—as an example. In our database, this group includes beer and wine. Assume two stores A and B as in our theoretical model. We propose as an instrument for the number of varieties in the beer market in store A the number of wine varieties in store B. If store B increase the number of wine varieties, then our model predict that store A will be tempted to do the same. In turn, this leave less shelf available for beer varieties. As a result, we could use the number of varieties for a given group category—excluding the product category being instrumented—in stores within a given geographical area as a suitable instrument for the number of varieties for that product category at a store. We postulate that the number of varieties for the remaining categories in a group of products in nearby stores should have a negative impact on the number of varieties for the product and store being instrumented.

We calculate the average number of varieties for all products in a product group after excluding the product being instrumented, for all remaining stores in the city or, in Montevideo city, in each Zonal Communal Center. The capital city Montevideo has the largest number of stores, and there are defined 18 political zones called "Centro Comunales Zonales" dividing the city according to broad economic characteristics of neighborhoods. This definition is also used by INE to report the information of the household survey.[18] As competition could be very different across city areas so to define smaller catchment areas in Montevideo increase the chances of store being active competitors. Nevertheless, it should be noted that defining the geographic area as the city—or the smaller CCZ in the case of Montevideo—could be a very broad and noisy measure of competition. Finally, for some products and cities the instrument cannot be calculated due to the lack of such products or stores.

With our instrument, we estimate equation 12 by a two stage procedure where the first stage is the following equation:

$$\ln Var_{ist} = \alpha_i + \alpha_t + \alpha_{st} + \alpha_{mt} + \gamma Instr_{ist} + \epsilon_{ist}, \tag{15}$$

and the second stage is equation 12 in Section 4, where variety is replaced by its prediction in equation 15. Again, the estimation uses a within transformation to absorb the large number of fixed effects in the regression, and standard errors are clustered at the store and time level. We also include store-product dummies as a further robustness control.

[18]See the dictionary of variables for INE's household survey here.

Table 7: Estimation of the Effect of Brands and Competition on Prices.
Instrumental Variable Estimation.

First Stage: Variety		
Instrument	-0.078*** (0.017)	-0.017* (0.01)
R square	0.61	0.89
Second stage: log of price (times 100)		
Variety	-8.069*** (2.165)	-9.256* (5.411)
R square	0.93	0.99
# Observations	1,928,747	1,928,747
Product Dummies	Yes	Yes
Market-Time Dummies	Yes	Yes
Store-Time Dummies	Yes	Yes
Store-Product Dummies	No	Yes

Note: *** $p < 0.01$, * $p < 0.1$,. Clustered standard errors (by store and time) in parentheses.

The first column shows the result for the base regression, while the second column for the estimation including the store-product dummies. The first column shows a statistical significant and economically large effect of varieties on prices. As previously stated, the instrument is statistically significant and has a negative sign: the larger the number of varieties for the restricted group of products at nearby stores, the lower the number of varieties for a product market at a given store. The estimated coefficient of the effect of varieties nearly double, although the clustered standard errors are also higher. Nevertheless, the estimate of the effect of varieties on prices is statistically larger than the one find in Table 4 at the 10 percent level. Now, the effect of one additional variable is broadly half of the effect of the border between Canada and the US. A large economic effect indeed. The second column shows that the effect is also—at the 10 percent level barely—significant even when store-product dummies are included. Now the point estimation in much larger than the one found in Table 4, but standard errors are quite large as well. In any case, to have an statistically effect with such large number of controls and with an instrumental variable estimation speaks of an economic significant effect.

Although results are quite significant, they could be the result of a spurious association. The instrument could just be an artifact due to the small number of varieties in our database. We propose two robustness estimations to check the validity of our results. First, we split our sample between those stores that belong to a chain and those that do not belong to a chain. As shown in Table 13 in Annex A, nearly a quarter of stores do not belong to any chain and are rather small measured by the number of cashiers. We estimate again the base price regression and the instrumented regression for each sample. If the instrument represent and spurious association, we would find it significant in both samples. If the instrument speak of an economic association, then we should find that it should be significant in one of the samples; i.e., there should be an systematic differences between both estimations. Next Table shows the results.

Table 8: Estimation of the effect of Brands and Competition on Prices by Chains.
Base and Instrumental Variable Regression.

	Chains	**No Chains**
PANEL A: BASE REGRESSION		
Dependent variable: log of price (times 100)		
Variety	-3.789***	-3.109***
	(0.154)	(0.228)
# Observations	1,594,439	501,871
Product Dummies	Yes	Yes
Time Dummies	Yes	Yes
Market-Time Dummies	Yes	Yes
Store-Time Dummies	Yes	Yes
R square	0.92	0.91
PANEL B: INSTRUMENTED REGRESSION		
First Stage: Variety		
Instrument	-0.082***	-0.028
	(0.020)	(0.026)
R square	0.65	0.58
Second stage: log of price (times 100)		
Variety	-7.344***	-14.90
	(2.270)	(12.24)
R square	0.93	0.92
# Observations	1,480,005	448,742
Product Dummies	Yes	Yes
Time Dummies	Yes	Yes
Market-Time Dummies	Yes	Yes
Store-Time Dummies	Yes	Yes

Note: *** $p < 0.01$. Clustered standard errors (by store and time) in parentheses.

Both columns shows that varieties do have an effect on prices regardless of the store belonging to a supermarket chain or not. Nevertheless, the first and second stage are significant only for those stores that belong to a chain. This point to a systematic effect of our instrument on varieties.

Stores not belonging to a chain are mostly small and the geographic area could be too large for these stores.

Secondly, we split our sample in those stores below and above the median number of cashiers (5) as a proxy of store size. Now we have some stores that belong to chains and others that do not in both samples. We repeat the previous exercise with this new sample.

Table 9: Estimation of the effect of Brands and Competition on Prices by Store Size. Base and Instrumental Variable Regression.

	Below Median Size	**Above Median Size**
PANEL A: BASE REGRESSION		
Dependent variable: log of price (times 100)		
Variety	-3.132*** (0.186)	-4.229*** (0.176)
# Observations	917,172	894,990
Product Dummies	Yes	Yes
Time Dummies	Yes	Yes
Market-Time Dummies	Yes	Yes
Store-Time Dummies	Yes	Yes
R square	0.92	0.93
PANEL B: INSTRUMENTED REGRESSION		
First Stage: Variety		
Instrument	-0.079** (0.020)	-0.072*** (0.022)
R square	0.57	0.69
Second stage: log of price (times 100)		
Variety	-3.721 (2.933)	-8.108** (3.145)
R square	0.92	0.93
# Observations	833,643	841,593
Product Dummies	Yes	Yes
Time Dummies	Yes	Yes
Market-Time Dummies	Yes	Yes
Store-Time Dummies	Yes	Yes

Note: *** $p < 0.01$, ** $p < 0.05$. Clustered standard errors (by store and time) in parentheses.

For both estimations, we find our instrument to be significant. Nevertheless, the second stage for those small stores is non significant. We believe that the first stage to be significant due to the effect of those small stores that belong to chains. Results on Table 8 showed the instrument is not significant for stores that do not belong to chains. When we split the sample by size, some stores that do belong to chains are below median size as showed in Table 13 in Annex A. As a result, the chain effect could be driven the first stage statistically significant result. Nevertheless, the second stage fails to be significant due to those stores that do not belong to chains and for which the geographic area of competition defined could be too large.

In summary, we found a significant effect of varieties on prices that cannot be explained by the usual store product dummies (see Hitsch, Hortacsu, and Lin (2019)). Therefore, we find a negative and significant effect of varieties on prices. Our proposed instrumental variety measure is strongly significant and speak of baseline estimations as a lower bound on the effect of varieties on prices. Also, the instrument do not seems to be driven by a spurious relation with varieties.

We use a similar instrumental strategy for the price equation in differences but the first stage was not significant. Nevertheless, our previous estimations could implied a larger effect of varieties on LOP deviations.

6 Conclusions

Several papers have shown deviations from the LOP either across or within countries. The literature offers different sources for this phenomena. This paper add to the burgeoning literature on the macroeconomic effects of retail decisions. We present a new source of relative price divergence: difference in varieties offered by stores. We show that price dispersion arise in equilibrium if stores differ in the number of varieties. The empirical estimation shows a difference in prices of 4% for each additional variety in a market category offered by a store. In terms of price difference, this account to a 0.6% increase in price volatility equivalent up to 165 kilometers of distance. We also propose a new instrumental variable estimation for the effect of varieties on prices. Our instrument is statistically significant, and it increase the effect on prices on an additional variety to nearly 8%. The variety effect is robust to several controls and different specifications.

References

Anderson, J., and E. van Wincoop (2003): "Gravity with Gravitas: A Solution to the Border Puzzle," *American Economic Review*, 93(1), 170–192.

——— (2004): "Trade Costs," *Journal of Economic Literature*, XLII, 691–751.

Atkin, D., and D. Donaldson (2015): "Who's Getting Globalized? The Size and Implications of Intra-national Trade Costs," Working Paper 21439, National Bureau of Economic Research.

Borraz, F., A. Cavallo, R. Rigobon, and L. Zipitría (2016): "Distance and Political Boundaries: Estimating Border Effects under Inequality Constraints," *International Journal of Finance & Economics*, 21(1), 3–35.

Borraz, F., and L. Zipitría (2012): "Retail Price Setting in Uruguay," *Economia*, 12(2), 77–109.

Ceglowski, J. (2003): "The Law of One Price: Intranational Evidence for Canada," *The Canadian Journal of Economics*, 36(2), 373.

Coşar, A. K., P. L. Grieco, and F. Tintelnot (2015a): "Bias in estimating border- and distance-related trade costs: Insights from an oligopoly model," *Economics Letters*, 126, 147 – 149.

——— (2015b): "Borders, Geography, and Oligopoly: Evidence from the Wind Turbine Industry," *The Review of Economics and Statistics*, 97(3), 623–637.

Crucini, M. J., M. Shintani, and T. Tsuruga (2010): "The Law of One Price without the Border: The Role of Distance versus Sticky Prices," *The Economic Journal*, 120(544), 462–480.

DellaVigna, S., and M. Gentzkow (2019): "Uniform Pricing in U.S. Retail Chains," *The Quarterly Journal of Economics*, 134(4), 2011–2084.

Dixit, A. K., and J. E. Stiglitz (1977): "Monopolistic Competition and Optimum Product Diversity," *The American Economic Review*, 67(3), 297–308.

Dvir, E., and G. Strasser (2018): "Does marketing widen borders? Cross-country price dispersion in the European car market," *Journal of International Economics*, 112, 134 – 149.

Eaton, J., and S. Kortum (2002): "Technology, Geography, and Trade," *Econometrica*, 70(5), 1741–1779.

Eichenbaum, M., N. Jaimovich, and S. Rebelo (2011): "Reference Prices, Costs, and Nominal Rigidities," *American Economic Review*, 101(1), 234–62.

ELBERG, A. (2016): “Sticky prices and deviations from the Law of One Price: Evidence from Mexican micro-price data,” *Journal of International Economics*, 98(C), 191–203.

ENGEL, C., AND J. H. ROGERS (1996): “How Wide is the Border?,” *American Economic Review*, 86(5), 1112–1125.

ENGEL, C., AND J. H. ROGERS (2001): “Violating the Law of One Price: Should We Make a Federal Case Out of It?,” *Journal of Money, Credit and Banking*, 33(1), 1–15.

FAN, C. S., AND X. WEI (2006): “The Law of One Price: Evidence from the Transitional Economy of China,” *The Review of Economics and Statistics*, 88(4), 682–6970.

GAURE, S. (2013): “lfe: Linear Group Fixed Effects,” *The R Journal*, 5(2), 104–116.

GOLDBERG, P. K., AND M. M. KNETTER (1997): “Goods Prices and Exchange Rates: What Have We Learned?,” *Journal of Economic Literature*, 35(3), 1243–1272.

GOPINATH, G., P.-O. GOURINCHAS, C.-T. HSIEH, AND N. LI (2011): “International Prices, Costs, and Markup Differences,” *American Economic Review*, 101(6), 2450–86.

GORODNICHENKO, Y., AND L. TESAR (2009): “Border Effect or Country Effect? Seattle may not be so far from Vancouver after all,” *American Economic Journal – Macroeconomics*, 1(1), 219–241.

HASKEL, J., AND H. WOLF (2001): “The Law of One Price - A Case Study,” *Scandinavian Journal of Economics*, 103(4), 545–558.

HITSCH, G. J., A. HORTACSU, AND X. LIN (2019): “Prices and Promotions in U.S. Retail Markets: Evidence from Big Data,” Working Paper 26306, National Bureau of Economic Research.

HONG, G. H., AND N. LI (2017): “Market Structure and Cost Pass-Through in Retail,” *The Review of Economics and Statistics*, 99(1), 151–166.

HOTELLING, H. (1929): “Stability in Competition,” *The Economic Journal*, 39(153), 41–57.

IRMEN, A., AND J. THISSE (1998): “Competition in Multi-characteristics Spaces: Hotelling Was Almost Right,” *Journal of Economic Theory*, 78(1), 76–102.

ISARD, P. (1977): “How Far Can We Push the "Law of One Price"?,” *The American Economic Review*, 67(5), 942–948.

MELITZ, M. J. (2003): “The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity,” *Econometrica*, 71(6), 1695–1725.

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.

——— (2013): "Price Rigidity: Microeconomic Evidence and Macroeconomic Implications," *The Annual Review of Economics*, 5, 133–63.

Parsley, D. C., and S.-J. Wei (1996): "Convergence to the Law of One Price Without Trade Barriers or Currency Fluctuations," *The Quarterly Journal of Economics*, 111(4), 1211–1236.

Rogoff, K. (1996): "The Purchasing Power Parity Puzzle," *Journal of Economic Literature*, 34(2), 647–668.

Varian, H. (1980): "A Model of Sales," *The American Economic Review*, 70(4), 651–659.

Wooldridge, J. M. (2010): *Econometric Analysis of Cross Section and Panel Data*. The MIT Press, 2nd edition edn.

Yazgan, M. E., and H. Yilmazkuday (2011): "Price-level convergence: New evidence from U.S. cities," *Economics Letters*, 110(2), 76 – 78.

A Additional Tables

Table 10: Price Database Descriptive Statistics.

Market	Brand	Minimum	Median	Maximum	Standard Deviation	N	Share Stores (%)
Sunflower Oil	Optimo	17.90	51.00	84.00	6.72	27,531	100.00
Sunflower Oil	Rio de la Plata	29.50	52.00	83.00	4.99	7,510	59.00
Sunflower Oil	Uruguay	24.90	50.00	73.00	6.22	16,067	68.00
Corn Oil	Delicia	39.90	59.00	99.00	5.81	14,725	97.00
Corn Oil	Rio de la Plata	37.90	58.00	79.00	6.03	12,736	86.00
Corn Oil	Salad	32.00	55.00	65.80	5.56	2,672	22.00
Soybean Oil	Condesa	19.90	36.00	51.50	4.09	21,297	95.00
Soybean Oil	Rio de la Plata	26.80	38.00	62.00	3.50	10,475	84.00
Soybean Oil	Salad	27.90	37.00	49.90	3.34	3,339	31.00
Sparkling Water	Matutina	12.90	19.00	32.50	3.15	24,855	98.00
Sparkling Water	Nativa	13.00	23.00	33.00	3.36	17,773	77.00
Sparkling Water	Salus	14.50	26.00	37.00	4.14	27,049	100.00
Rice	Blue Patna	10.90	28.90	49.80	4.44	23,223	87.00
Rice	Green Chef	10.50	26.50	38.00	4.14	22,571	84.00
Rice	Saman	16.60	28.00	42.00	2.80	12,908	87.00
Rice	Aruba	9.90	19.90	34.00	3.17	19,353	86.00
Rice	Pony	12.00	20.00	30.00	2.34	10,646	68.00
Rice	Vidarroz	9.90	18.90	30.00	3.02	11,172	63.00
Peas	Campero	7.50	10.90	17.00	1.42	1,690	35.00
Peas	Cololo	7.90	19.00	31.50	2.82	10,472	74.00
Peas	Nidemar	7.00	12.50	20.00	2.81	5,418	51.00
Sugar	Azucarlito	12.50	29.00	39.00	6.65	23,142	96.00
Sugar	Bella Union	11.50	29.00	39.00	6.50	25,226	99.00
Coffee	Aguila	31.90	68.00	109.00	9.31	25,293	97.00
Coffee	Chana	32.50	78.50	170.00	11.99	26,158	99.00
Coffee	Saint	34.90	69.00	108.00	12.61	5,474	53.00
Beer	Patricia	31.50	48.00	80.00	10.48	27,422	99.00
Beer	Pilsen	28.80	44.00	76.00	8.72	27,425	99.00
Beer	Zillertal	46.00	61.50	89.00	7.06	14,728	95.00
Shampoo	Fructis	31.90	94.50	169.00	16.03	18,015	85.00
Shampoo	Sedal	31.00	80.00	139.00	16.41	21,747	99.00
Shampoo	Suave	19.90	61.50	111.00	19.02	21,497	97.00
Cacao	Copacabana	21.90	78.00	149.00	13.80	25,580	99.00
Cacao	Vascolet	26.50	76.90	119.00	15.08	25,086	98.00
Deodorant	Axe Musk	54.90	79.00	112.00	9.39	15,154	99.00
Deodorant	Dove	60.00	92.50	141.00	12.56	14,972	98.00
Deodorant	Rexona	48.50	80.00	113.20	9.09	14,792	99.00
Dishwashing Detergent	Deterjane	19.90	38.00	69.00	8.60	18,299	98.00
Dishwashing Detergent	Hurra Nevex	23.50	38.50	90.00	6.55	27,550	100.00
Dishwashing Detergent	Protergente	14.50	25.50	48.00	3.53	9,628	78.00
Dulce de Leche	Conaprole	32.50	104.00	157.00	15.44	26,518	96.00
Dulce de Leche	Los Nietitos	23.90	78.50	132.00	14.52	24,786	94.00
Dulce de Leche	Manjar	24.50	77.00	117.00	11.19	25,403	96.00
Noodles	Adria	15.90	31.00	53.00	5.22	24,370	95.00
Noodles	Cololo	14.90	29.00	49.90	6.24	16,769	77.00
Noodles	Las Acacias	14.00	27.50	59.90	4.70	21,578	94.00
Semolina Pasta	Adria	12.90	24.00	43.00	5.08	14,843	85.00
Semolina Pasta	Las Acacias	11.90	22.00	41.00	4.16	20,471	93.00
Semolina Pasta	Puritas	11.90	25.00	46.90	4.28	3,968	35.00

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Market	**Brand**	**Minimum**	**Median**	**Maximum**	**Standard Deviation**	**N**	**Share Stores (%)**
Crackers	Famosa	9.90	19.00	37.90	4.16	21,265	83.00
Crackers	Maestro Cubano	8.90	17.00	39.50	3.53	16,419	93.00
Cola Drink	Coca Cola	16.10	42.00	68.00	9.28	27,357	99.00
Cola Drink	Nix	15.70	30.00	45.00	3.41	6,404	37.00
Cola Drink	Pepsi	29.90	52.90	70.00	6.09	13,267	97.00
Hamburger	Burgy	10.00	15.90	30.90	2.26	9,825	75.00
Hamburger	Paty	17.90	36.00	46.00	3.89	12,113	82.00
Hamburger	Schneck	13.00	37.00	52.50	4.24	13,326	89.00
Flour (corn)	Gourmet	8.00	13.90	21.90	1.78	4,695	48.00
Flour (corn)	Arcor	6.00	20.00	37.00	3.59	13,905	94.00
Flour (corn)	Puritas	11.00	18.00	41.00	1.88	14,877	99.00
Flour 000 (wheat)	Cañuelas	13.70	22.00	38.00	3.10	9,824	73.00
Flour 000 (wheat)	Cololo	13.00	24.00	33.00	3.06	4,627	38.00
Flour 000 (wheat)	Cañuelas	11.80	24.00	41.00	4.89	21,218	84.00
Flour 000 (wheat)	Cololo	12.50	25.00	39.50	4.20	17,795	87.00
Flour 000 (wheat)	Primor	12.90	22.00	34.00	3.30	7,560	54.00
Ice Cream	Conaprole	79.00	106.50	149.00	12.78	14,438	98.00
Ice Cream	Crufi	59.90	95.00	188.00	11.79	11,243	85.00
Ice Cream	Gebetto	45.00	83.00	103.60	12.78	4,185	70.00
Bleach	Agua Jane	11.90	26.00	47.00	5.79	26,987	99.00
Bleach	Sello Rojo	12.90	22.50	39.00	3.96	23,832	98.00
Bleach	Solucion Cristal	9.00	20.00	34.40	4.56	11,652	60.00
Eggs	El Jefe	23.00	33.00	38.00	2.27	3,676	47.00
Eggs	Prodhin	11.50	23.00	36.00	5.41	12,645	60.00
Eggs	Super Huevo	14.90	29.00	39.00	4.66	7,028	51.00
Soap	Astral Plata	12.00	20.00	29.20	3.04	15,052	99.00
Soap	Palmolive	9.90	17.00	47.50	3.23	25,001	99.00
Soap	Rexona	13.33	21.00	52.00	2.36	4,775	74.00
Laundry Soap	Drive	25.00	48.00	99.00	6.10	23,736	97.00
Laundry Soap	Nevex	18.50	59.50	99.00	8.68	25,982	99.00
Laundry Soap	Skip	50.00	76.50	136.00	10.37	21,667	97.00
Laundry Soap (in bar)	Bull Dog	11.90	22.00	40.00	4.80	26,844	99.00
Laundry Soap (in bar)	Nevex	8.70	15.20	29.00	3.80	27,083	99.00
Laundry Soap (in bar)	Primor	7.90	12.00	23.90	1.24	7,776	60.00
Butter	Calcar	15.90	34.00	65.00	8.20	18,150	85.00
Butter	Conaprole	13.50	41.90	69.30	7.95	26,919	96.00
Butter	Kasdorf	21.60	42.00	56.70	3.10	11,655	77.00
Margarine	Doriana	11.60	36.00	81.00	9.57	24,915	98.00
Margarine	Flor	14.90	20.90	35.70	2.11	4,351	50.00
Margarine	Primor	8.90	25.00	69.00	5.45	17,773	93.00
Mayonnaise	Fanacoa	14.50	32.90	67.00	6.95	21,556	96.00
Mayonnaise	Hellmans	19.90	52.90	89.00	11.12	26,582	99.00
Mayonnaise	Uruguay	9.90	31.00	52.00	5.34	12,794	56.00
Peach Jam	Dulciora	14.50	32.00	53.00	7.11	17,744	77.00
Peach Jam	El Hogar	26.00	43.00	64.00	5.32	10,215	75.00
Peach Jam	Los Nietitos	14.50	43.00	68.00	6.22	25,796	96.00
Bread Loaf	Los Sorchantes	29.00	46.00	68.00	7.97	14,126	93.00
Bread Loaf	Bimbo	31.00	49.00	71.00	7.47	13,198	91.00
Bread Loaf	Pan Catalan	20.00	39.00	61.00	8.96	9,153	68.00
Toilet Paper	Eite	16.90	43.00	60.00	5.74	13,820	97.00
Toilet Paper	Higienol	11.00	29.00	59.90	7.55	25,497	100.00
Toilet Paper	Sin Fin	11.50	37.00	62.00	10.32	25,514	99.00
Toothpaste	Colgate	20.90	33.00	52.00	4.96	15,388	100.00
Toothpaste	Kolynos	16.00	28.00	56.00	3.83	14,281	97.00
Toothpaste	Pico Jenner	19.00	26.00	52.00	3.66	8,576	63.00

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Market	Brand	Minimum	Median	Maximum	Standard Deviation	N	Share Stores (%)
Tomato Pulp	Conaprole	24.50	41.90	62.00	5.71	26,810	97.00
Tomato Pulp	De Ley	17.50	34.90	49.00	4.50	19,243	94.00
Tomato Pulp	Gourmet	29.00	41.00	58.00	3.81	12,356	83.00
Grated Cheese	Artesano	21.00	38.00	57.00	6.28	2,859	22.00
Grated Cheese	Conaprole	12.80	33.90	56.00	7.06	24,984	95.00
Grated Cheese	Milky	11.90	36.50	61.40	6.92	11,594	65.00
Salt	Sal Sek	9.60	18.90	39.40	3.87	17,054	84.00
Salt	Torrevieja	6.90	17.90	30.00	4.13	8,038	35.00
Salt	Urusal	10.90	18.00	33.00	3.53	12,927	59.00
Te	Hornimans	4.80	15.00	26.00	2.25	27,015	99.00
Te	La Virginia	7.90	13.00	26.00	2.08	21,324	82.00
Te	President	14.90	23.00	32.00	2.50	13,140	89.00
Wine	Faisan	35.90	57.00	75.10	4.62	10,733	72.00
Wine	Santa Teresa	23.50	57.90	78.00	8.36	26,724	99.00
Wine	Tango	21.50	49.00	67.00	7.80	21,091	90.00
Yerba	Baldo	59.90	76.00	157.00	26.09	14,846	97.00
Yerba	Canarias	34.80	68.00	166.00	24.76	27,468	100.00
Yerba	Del Cebador	31.90	67.50	175.00	25.17	25,686	99.00
Yogurt	Calcar	26.60	39.00	73.00	4.97	9,711	68.00
Yogurt	Bio Top	32.00	42.00	73.00	5.09	14,644	95.00
Yogurt	Parmalat	22.80	39.00	60.00	5.06	12,605	92.00
TOTAL	-	-	-	-	-	2,096,310	-

Source: author's calculation.

Table 12: Price Difference Database Descriptive Statistics.

Market	Brand	Minimum	Median	Maximum	Standard Deviation	N	Exact Zeroes (%)
Sunflower Oil	Optimo	0	4.46	121.40	5.38	4,243,083	12.00
Sunflower Oil	Rio de la Plata	0	5.94	78.39	7.71	601,857	20.00
Sunflower Oil	Uruguay	0	4.83	79.06	5.27	1,480,029	8.00
Corn Oil	Delicia	0	4.96	62.98	5.76	2,306,349	13.00
Corn Oil	Rio de la Plata	0	5.64	73.45	6.84	1,724,741	14.00
Corn Oil	Salad	0	0.04	70.87	7.43	74,983	49.00
Soybean Oil	Condesa	0	5.26	87.84	6.07	2,987,108	14.00
Soybean Oil	Rio de la Plata	0	5.72	66.45	7.49	1,176,822	21.00
Soybean Oil	Salad	0	3.08	50.88	7.42	117,470	32.00
Sparkling Water	Matutina	0	4.45	91.63	5.48	3,502,297	31.00
Sparkling Water	Nativa	0	3.51	55.73	5.79	1,769,043	36.00
Sparkling Water	Salus	0	0.00	70.19	3.77	4,105,926	51.00
Rice	Blue Patna	0	5.88	113.54	7.40	3,009,720	17.00
Rice	Green Chef	0	5.61	71.98	6.49	2,842,015	16.00
Rice	Saman	0	6.45	65.63	7.64	1,773,185	20.00
Rice	Aruba	0	5.26	82.50	7.65	2,093,020	21.00
Rice	Pony	0	4.88	65.54	7.23	766,118	31.00
Rice	Vidarroz	0	4.45	92.63	8.00	813,347	32.00
Peas	Campero	0	10.54	81.83	11.07	52,441	18.00
Peas	Cololo	0	7.12	97.29	8.49	1,164,240	16.00
Peas	Nidemar	0	10.18	69.31	12.58	315,091	20.00
Sugar	Azucarlito	0	0.37	72.18	3.99	2,999,800	43.00
Sugar	Bella Union	0	0.98	76.00	3.94	3,608,445	41.00
Coffee	Aguila	0	3.13	70.42	4.54	3,587,543	16.00
Coffee	Chana	0	4.53	96.14	5.00	3,824,719	12.00

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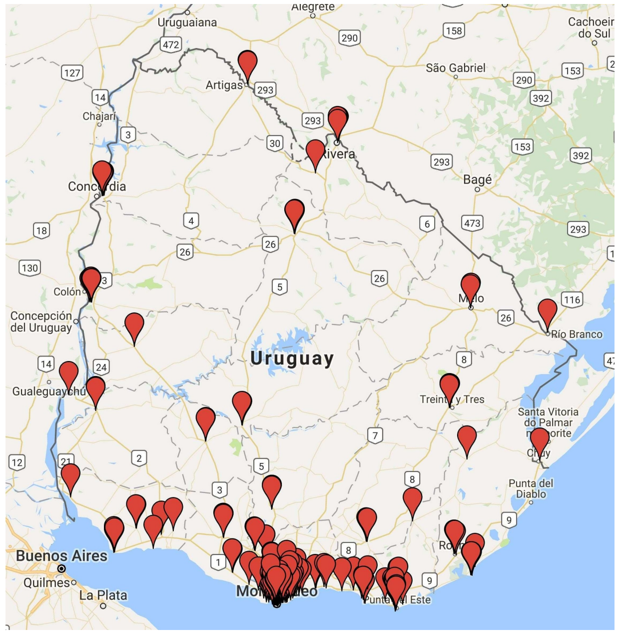
Market	Brand	Minimum	Median	Maximum	Standard Deviation	N	Exact Zeroes (%)
Coffee	Saint	0	8.49	97.10	13.02	321,851	10.00
Beer	Patricia	0	1.94	61.14	3.49	4,209,560	36.00
Beer	Pilsen	0	2.15	50.21	3.68	4,207,370	32.00
Beer	Zillertal	0	1.71	42.55	3.59	2,306,851	28.00
Shampoo	Fructis	0	5.98	116.73	7.47	1,841,510	14.00
Shampoo	Sedal	0	5.88	119.10	7.49	2,694,728	11.00
Shampoo	Suave	0	6.54	122.73	8.79	2,710,586	11.00
Cacao	Copacabana	0	4.41	135.52	5.22	3,691,390	10.00
Cacao	Vascolet	0	5.78	102.72	6.18	3,599,107	12.00
Deodorant	Axe Musk	0	7.90	49.13	7.68	2,442,879	13.00
Deodorant	Dove	0	7.18	82.16	8.28	2,384,323	12.00
Deodorant	Rexona	0	6.90	53.73	7.94	2,327,191	12.00
Dishwashing Detergent	Deterjane	0	7.02	79.35	6.78	2,596,608	12.00
Dishwashing Detergent	Hurra Nevex	0	6.06	117.12	6.23	4,253,674	12.00
Dishwashing Detergent	Protergente	0	8.34	88.12	10.39	993,622	14.00
Dulce de Leche	Conaprole	0	3.92	113.09	4.93	3,944,439	12.00
Dulce de Leche	Los Nietitos	0	4.32	136.41	5.79	3,461,011	14.00
Dulce de Leche	Manjar	0	3.35	92.85	5.30	3,684,604	13.00
Noodles	Adria	0	3.94	106.01	4.84	3,473,718	16.00
Noodles	Cololo	0	5.72	76.12	6.31	1,627,630	16.00
Noodles	Las Acacias	0	4.47	126.54	7.16	2,728,963	19.00
Semolina Pasta	Adria	0	3.92	93.39	10.27	1,272,218	30.00
Semolina Pasta	Las Acacias	0	4.45	88.63	9.70	2,414,009	22.00
Semolina Pasta	Puritas	0	3.39	110.70	11.91	171,149	48.00
Crackers	Famosa	0	3.49	126.69	7.55	2,554,714	33.00
Crackers	Maestro Cubano	0	8.56	138.38	15.16	1,523,436	20.00
Cola Drink	Coca Cola	0	2.53	92.99	5.95	4,188,627	32.00
Cola Drink	Nix	0	5.13	93.52	10.54	232,643	20.00
Cola Drink	Pepsi	0	4.08	82.16	5.63	1,901,584	19.00
Hamburger	Burgy	0	11.46	107.16	10.58	1,030,180	13.00
Hamburger	Paty	0	5.95	65.03	7.90	1,559,491	14.00
Hamburger	Schneck	0	8.00	112.39	7.97	1,888,688	14.00
Flour (corn)	Gourmet	0	8.84	85.44	12.25	234,912	26.00
Flour (corn)	Arcor	0	6.31	116.11	8.34	2,056,773	18.00
Flour (corn)	Puritas	0	5.47	100.55	6.02	2,354,097	19.00
Flour 000 (wheat)	Cañuelas	0	8.70	86.50	8.77	1,035,182	20.00
Flour 000 (wheat)	Cololo	0	4.01	69.31	9.14	225,978	24.00
Flour 000 (wheat)	Cañuelas	0	6.57	97.23	8.09	2,531,227	17.00
Flour 000 (wheat)	Cololo	0	7.55	76.12	8.59	1,767,500	15.00
Flour 000 (wheat)	Primor	0	5.72	66.59	8.06	608,866	17.00
Ice Cream	Conaprole	0	4.55	59.72	5.22	2,218,302	11.00
Ice Cream	Crufi	0	3.39	78.40	5.60	1,354,563	23.00
Ice Cream	Gebetto	0	7.87	69.31	14.95	315,252	19.00
Bleach	Agua Jane	0	4.42	92.20	7.83	4,070,785	15.00
Bleach	Sello Rojo	0	6.67	105.37	7.15	3,274,677	13.00
Bleach	Solucion Cristal	0	9.84	93.39	11.96	779,560	22.00
Eggs	El Jefe	0	2.99	46.37	6.03	305,435	33.00
Eggs	Prodhin	0	0.44	73.57	5.80	928,768	46.00
Eggs	Super Huevo	0	4.08	71.91	5.86	529,487	24.00
Soap	Astral Plata	0	9.10	73.54	8.96	2,412,373	11.00
Soap	Palmolive	0	8.65	130.35	8.72	3,491,878	13.00
Soap	Rexona	0	9.10	136.12	9.87	525,073	15.00
Laundry Soap	Drive	0	5.04	100.55	6.45	3,180,105	12.00
Laundry Soap	Nevex	0	5.34	115.13	5.42	3,775,676	12.00
Laundry Soap	Skip	0	4.83	78.85	6.12	2,966,113	9.00

Continued on next page

Market	Brand	Minimum	Median	Maximum	Standard Deviation	N	Exact Zeroes (%)
Laundry Soap (in bar)	Bull Dog	0	6.67	69.31	6.95	4,035,897	14.00
Laundry Soap (in bar)	Nevex	0	5.72	80.71	6.48	4,108,829	15.00
Laundry Soap (in bar)	Primor	0	8.70	103.38	9.59	648,293	22.00
Butter	Calcar	0	8.29	118.60	10.73	1,940,699	14.00
Butter	Conaprole	0	4.88	71.29	5.23	4,047,868	13.00
Butter	Kasdorf	0	4.08	72.73	4.90	1,443,391	19.00
Margarine	Doriana	0	7.64	168.07	8.62	3,474,331	10.00
Margarine	Flor	0	6.74	80.88	8.23	212,062	13.00
Margarine	Primor	0	8.34	156.35	11.38	1,780,292	11.00
Mayonnaise	Fanacoa	0	6.97	107.36	7.34	2,663,703	11.00
Mayonnaise	Hellmans	0	6.16	91.21	6.48	3,957,463	12.00
Mayonnaise	Uruguay	0	7.52	110.53	7.84	956,546	6.00
Peach Jam	Dulciora	0	3.16	88.55	8.76	1,819,721	29.00
Peach Jam	El Hogar	0	7.85	90.08	9.80	1,107,398	15.00
Peach Jam	Los Nietitos	0	4.77	123.79	6.04	3,739,500	13.00
Bread Loaf	Los Sorchantes	0	3.33	47.75	4.53	2,122,642	18.00
Bread Loaf	Bimbo	0	3.51	56.35	5.12	1,861,109	16.00
Bread Loaf	Pan Catalan	0	5.54	64.51	7.41	897,944	20.00
Toilet Paper	Eite	0	6.75	98.60	8.02	2,045,690	9.00
Toilet Paper	Higienol	0	6.28	106.44	8.10	3,640,465	10.00
Toilet Paper	Sin Fin	0	7.14	101.71	7.35	3,665,841	10.00
Toothpaste	Colgate	0	8.46	84.08	9.11	2,519,109	16.00
Toothpaste	Kolynos	0	7.47	104.95	10.22	2,175,216	12.00
Toothpaste	Pico Jenner	0	7.70	96.05	10.23	783,813	18.00
Tomato Pulp	Conaprole	0	5.28	61.70	5.73	4,013,016	12.00
Tomato Pulp	De Ley	0	5.84	85.14	8.28	2,125,708	11.00
Tomato Pulp	Gourmet	0	6.54	67.58	7.15	1,625,433	11.00
Grated Cheese	Artesano	0	8.70	71.08	9.83	86,801	6.00
Grated Cheese	Conaprole	0	6.60	108.17	7.94	3,492,344	12.00
Grated Cheese	Milky	0	6.80	121.23	7.82	772,477	17.00
Salt	Sal Sek	0	8.66	141.20	9.40	1,667,943	13.00
Salt	Torrevieja	0	3.70	104.98	10.22	356,014	36.00
Salt	Urusal	0	6.76	79.51	9.50	938,777	19.00
Te	Hornimans	0	6.67	126.46	7.49	4,088,459	16.00
Te	La Virginia	0	5.27	102.81	8.59	2,538,170	27.00
Te	President	0	8.10	64.85	8.29	1,834,506	16.00
Wine	Faisan	0	3.45	61.13	4.46	1,192,638	23.00
Wine	Santa Teresa	0	3.89	85.73	4.88	4,006,714	13.00
Wine	Tango	0	4.51	74.40	5.81	2,495,152	20.00
Yerba	Baldo	0	1.29	69.97	3.26	2,344,120	37.00
Yerba	Canarias	0	0.15	69.60	3.37	4,223,912	47.00
Yerba	Del Cebador	0	3.87	86.90	5.42	3,821,864	12.00
Yogurt	Calcar	0	7.41	82.47	8.48	1,003,687	17.00
Yogurt	Bio Top	0	4.65	66.61	5.60	2,281,480	17.00
Yogurt	Parmalat	0	4.74	62.40	6.64	1,692,864	23.00
TOTAL	-	-	-	-	-	272,370,229	-

Source: author's calculation.

Figure 7: Cities covered in the sample and distribution of supermarkets.



Note: Each dot represents a store location across the 19 Uruguayan states.

Table 13: Chain description.

Chain	**# Stores**	**# Stores in Montevideo**	**# Cities**	**# States**	**Average Cashier p/Store**	**# Observations**
Devoto	24	17	6	3	12	169,646
Disco	27	20	5	3	11	189,100
El Clon	12	8	5	4	4	24,154
El Dorado	38	0	20	6	4	187,283
Frigo	6	6	1	1	4	39,748
Géant	2	1	2	2	48	7,491
Iberpark	6	5	2	2	1	10,781
La Colonial	6	6	1	1	1	30,564
Los Jardines	4	2	3	2	4	13,524
Macromercado	7	4	3	3	18	38,848
Micro Macro	10	5	4	4	3	63,129
MultiAhorro	48	38	8	8	6	321,525
Red Market	12	9	3	2	3	53,044
Super XXI	4	0	2	1	3	24,628
Super Star	4	0	1	1	7	27,705
TATA	43	12	25	19	7	245,469
Tienda Inglesa	10	7	4	3	16	56,174
Ubesur	19	19	1	1	3	91,626
None	104	49	27	14	4	501,871
TOTAL	386	173	-	-	6	2,096,310

Table 14: Uruguayan States information.

	# Cities	**# Stores**	**Average Stores per City**
Artigas	1	2	2
Canelones	15	47	3
Cerro Largo	2	4	2
Colonia	6	12	2
Durazno	1	4	4
Flores	1	4	4
Florida	1	5	5
Lavalleja	1	4	4
Maldonado	8	36	4
Montevideo	1	209	209
Paysandú	1	7	7
Río Negro	2	3	1
Rivera	2	6	3
Rocha	5	14	3
Salto	1	9	9
San José	3	9	3
Soriano	1	2	2
Tacuarembó	1	5	5
Treinta y Tres	1	4	4
TOTAL	54	386	7

B List of Products

Product	Brand	Specification*	% Share in CPI	Sample Start	Owner (/merger)	Class Code
Beer	Pilsen	0.96 L	0.38	2007/04	FNC	021^A
Beer	Zillertal	1 L	0.38	2010/11	FNC	021^A
Wine	Faisán	1 L	0.80	2007/04	Grupo Traversa	021^A
Wine	Santa Teresa	1 L	0.80	2007/04	Santa Teresa SA	021^A
Wine	Tango	1 L	0.80	2007/04	Almena SA	021^A
Cola Drink	Coca Cola	1.5 L	1.12	2007/04	Coca Cola	0122
Cola Drink	Nix	1.5 L	1.12	2007/04	Milotur (CCU)	0122
Cola Drink	Pepsi	1.5 L	1.12	2010/11	Pepsi	0122
Sparkling water	Matutina	2 L	0.81	2007/04	Salus	0122
Sparkling water	Nativa	2 L	0.81	2007/04	Milotur	0122
Sparkling water	Salus	2.25 L	0.81	2007/04	Salus	0122
Bread Loaf	Los Sorchantes	0.33 Kg	0.06	2010/11	Bimbo / Los Sorchantes	0111
Bread Loaf	Bimbo	0.33 Kg	0.06	2010/11	Bimbo	0111
Bread Loaf	Pan Catalán	0.33 Kg	0.06	2010/11	Bimbo	0111
Brown eggs	Super Huevo	1/2 dozen	0.46	2010/11	Super Huevo	0114
Brown eggs	El Jefe	1/2 dozen	0.46	2010/12	El Jefe	0114
Brown eggs	Prodhin	1/2 dozen	0.46	2007/07	Prodhin	0114
Butter	Calcar	0.2 Kg	0.23	2007/04	Calcar	0115
Butter	Conaprole (no salt)	0.2 Kg	0.23	2007/04	Conaprole	0115
Butter	Kasdorf	0.2 Kg	0.23	2010/11	Conaprole	0115
Cacao	Copacabana	0.5 Kg	0.08	2007/04	Nestlé	0121
Cacao	Vascolet	0.5 Kg	0.08	2007/06	Nestlé	0121
Coffee	Aguila	0.25 Kg	0.14	2007/04	Nestlé	0121
Coffee	Chana	0.25 Kg	0.14	2007/04	Nestlé	0121
Coffee	Saint	0.25 Kg	0.14	2010/11	Saint Hnos.	0121
Corn Oil	Delicia	1 L	n/i	2010/11	Cousa	0115^B
Corn Oil	Río de la Plata	1 L	n/i	2010/11	Soldo	0115^B
Corn Oil	Salad	1 L	n/i	2010/11	Nidera	0115^B
Dulce de leche	Conaprole	1 Kg	0.14	2007/04	Conaprole	0118
Dulce de leche	Los Nietitos	1 Kg	0.14	2007/04	Los Nietitos	0118
Dulce de leche	Manjar	1 Kg	0.14	2007/04	Manjar	0118
Flour (corn)	Gourmet	0.4 Kg	n/i	2010/11	Barraca Deambrosi	0111^C
Flour (corn)	Presto Pronta Arcor	0.5 Kg	n/i	2010/11	ARCOR	0111^C

Product	Brand	Specification*	% Share in CPI	Sample Start	Owner (/merger)	Class Code
Beer	Patricia	0.96 L	0.38	2007/04	FNC	021^{A}
Flour (corn)	Puritas	0.45 Kg	n/i	2010/11	Molino Puritas	0111^{C}
Flour 000 (wheat)	Cañuelas	1 Kg	0.21	2010/11	Molino Cañuelas	0111
Flour 000 (wheat)	Cololó	1 Kg	0.21	2010/11	Distribuidora San José	0111
Flour 0000 (wheat)	Cañuelas	1 Kg	0.21	2007/04	Molino Cañuelas	0111
Flour 0000 (wheat)	Cololó	1 Kg	0.21	2007/04	Distribuidora San José	0111
Flour 0000 (wheat)	Primor	1 Kg	0.21	2010/11	Molino San José	0111
Grated Cheese	Conaprole	0.08 Kg	0.16	2007/04	Conaprole	0114
Grated Cheese	Artesano	0.08 Kg	0.16	2010/11	Artesano	0114
Grated Cheese	Milky	0.08 Kg	0.16	2007/04	Milky	0114
Hamburger	Burgy	0.2 Kg	n/i	2010/11	Schneck	0112
Hamburger	Paty	0.2 Kg	n/i	2010/11	Sadia Uruguay	0112
Hamburger	Schneck	0.2 Kg	n/i	2010/11	Schneck	0112
Ice Cream	Conaprole	1 Kg	0.22	2010/11	Conaprole	0118
Ice Cream	Crufi	1 Kg	0.22	2010/11	Crufi	0118
Ice Cream	Gebetto	1 Kg	0.22	2010/11	Conaprole	0118
Margarine	Flor	0.2 Kg	n/i	2010/11	COUSA	0115^{D}
Margarine	Doriana nueva	0.25 Kg	n/i	2007/04	Unilever	0115^{D}
Margarine	Primor	0.25 Kg	n/i	2007/04	COUSA	0115^{D}
Mayonnaise	Fanacoa	0.5 Kg	0.21	2007/04	Unilever	0119
Mayonnaise	Hellmans	0.5 Kg	0.21	2007/04	Unilever	0119
Mayonnaise	Uruguay	0.5 Kg	0.21	2007/04	COUSA	0119
Noodles	Cololo	0.5 Kg	0.43	2007/04	Distribuidora San José	0111
Noodles	Adria	0.5 Kg	0.43	2007/04	La Nueva Cerro	0111
Noodles	Las Acacias	0.5 Kg	0.43	2007/04	Alimentos Las Acacias	0111
Peach Jam	Dulciora	0.5 Kg	n/i	2007/04	ARCOR	0118
Peach Jam	El Hogar	0.5 Kg	n/i	2010/11	Libafel SA	0118
Peach Jam	Los Nietitos	0.5 Kg	n/i	2007/04	Los Nietitos	0118
Peas	Campero	0.3 Kg	0.09	2010/11	Regional Sur	0117
Peas	Cololó	0.3 Kg	0.09	2010/11	Distribuidora San José	0117
Peas	Nidemar	0.3 Kg	0.09	2010/11	Nidera	0117
Rice	Aruba tipo Patna	1 Kg	0.38	2007/04	Saman	0111
Rice	Blue Patna	1 Kg	0.38	2007/04	Coopar	0111

Product	Brand	Specification*	% Share in CPI	Sample Start	Owner (/merger)	Class Code
Beer	Patricia	0.96 L	0.38	2007/04	FNC	021^{A}
Rice	Green Chef	1 Kg	0.38	2007/04	Coopar	0111
Rice	Pony	1 Kg	0.38	2010/11	Saman	0111
Rice	Vidarroz	1 Kg	0.38	2008/05	Coopar	0111
Rice	Saman Blanco	1 Kg	0.38	2010/11	Saman	0111
Crackers	Famosa	0.14 Kg	0.28	2007/04	Mondelez	0111
Crackers	Maestro Cubano	0.12 Kg	0.28	2007/04	Bimbo	0111
Salt	Sek	0.5 Kg	0.09	2007/04	Barraca Deambrosi	0119
Salt	Torrevieja	0.5 Kg	0.09	2007/04	Torrevieja	0119
Salt	Urusal	0.5 Kg	0.09	2007/04	UruSal	0119
Semolina Pasta	Adria	0.5 Kg	0.43	2007/04	La Nueva Cerro	0111
Semolina Pasta	Las Acacias	0.5 Kg	0.43	2007/04	Alimentos Las Acacias	0111
Semolina Pasta	Puritas	0.5 Kg	0.43	2007/04	Molino Puritas	0111
Soybean oil	Condesa	0.9 L	0.11	2008/05	Cousa	0115
Soybean oil	Río de la Plata	0.9 L	0.11	2010/11	Soldo	0115
Soybean oil	Salad	0.9 L	0.11	2010/11	Nidera	0115
Sugar	Azucarlito	1 Kg	0.35	2007/04	Azucarlito	0118
Sugar	Bella Union	1 Kg	0.35	2007/04	ALUR	0118
Sunflower Oil	Optimo	0.9 L	0.37	2007/04	Cousa	0115
Sunflower Oil	Uruguay	0.9 L	0.37	2007/04	Cousa	0115
Sunflower Oil	Río de la Plata	0.9 L	0.37	2010/11	Soldo	0115
Tea	Hornimans	Box (10 units)	0.08	2007/04	Jose Aldao	0121
Tea	La Virginia	Box (10 units)	0.08	2007/04	La Virginia	0121
Tea	President	Box (10 units)	0.08	2010/11	Carrau	0121
Tomato Pulp	Conaprole	1 L	0.16	2007/04	Conaprole	0117
Tomato Pulp	De Ley	1 L	0.16	2007/04	Barraca Deambrosi	0117
Tomato Pulp	Gourmet	1 L	0.16	2010/11	Barraca Deambrosi	0117
Yerba	Canarias	1 Kg	0.64	2007/04	Canarias	0121
Yerba	Del Cebador	1 Kg	0.64	2007/04	Molino Puritas	0121
Yerba	Baldo	1 Kg	0.64	2010/11	Canarias	0121
Yogurt	Conaprole	0.5 Kg	0.13	2010/11	Conaprole	0114
Yogurt	Parmalat (Skim)	0.5 Kg	0.13	2010/11	Parmalat	0114
Yogurt	Calcar (Skim)	0.5 Kg	0.13	2010/11	Calcar	0114
Bleach	Agua Jane	1 L	0.16	2007/04	Electroquímica	0561
Bleach	Sello Rojo	1 L	0.16	2007/04	Electroquímica	0561
Bleach	Solucion Cristal	1 L	0.16	2007/04	Vessena SA	0561
Deodorant	Axe Musk	0.105 Kg	0.34	2010/11	Unilever	1213
Deodorant	Dove Original	0.113 Kg	0.34	2010/11	Unilever	1213

Product	Brand	Specification*	% Share in CPI	Sample Start	Owner (/merger)	Class Code
Beer	Patricia	0.96 L	0.38	2007/04	FNC	021[A]
Deodorant	Rexona Active Emotion	0.100 Kg	0.34	2010/11	Unilever	1213
Dishwashing Detergent	Deterjane	1.25 L	0.13	2007/04	Clorox Company	0561
Dishwashing Detergent	Hurra Nevex Limon	1.25 L	0.13	2007/04	Unilever	0561
Dishwashing Detergent	Protergente	1.25 L	0.13	2010/11	Electroquímica	0561
Laundry Soap	Drive	0.8 Kg	0.45	2007/04	Unilever	0561
Laundry Soap	Nevex	0.8 Kg	0.45	2007/04	Unilever	0561
Laundry Soap	Skip, Paquete azul	0.8 Kg	0.45	2007/04	Unilever	0561
Laundry Soap, in bar	Bull Dog	0.3 Kg (1 unit)	n/i	2007/04	Unilever	0561[E]
Laundry Soap, in bar	Nevex	0.2 Kg (1 unit)	n/i	2007/04	Unilever	0561[E]
Laundry Soap, in bar	Primor	0.2 Kg (1 unit)	n/i	2010/11	Soldo	0561[E]
Shampoo	Fructis	0.35 L	0.36	2007/04	Garnier	1213
Shampoo	Sedal	0.35 L	0.36	2007/04	Unilever	1213
Shampoo	Suave	0.93 L	0.36	2007/04	Unilever	1213
Soap	Astral	0.125 Kg	0.16	2010/11	Colgate	1213
Soap	Palmolive	0.125 Kg	0.16	2007/04	Colgate	1213
Soap	Rexona	0.125 Kg	0.16	2012/12	Unilever	1213
Toilet paper	Higienol Export	4 units (25 M each)	0.24	2007/04	Ipusa	1213
Toilet paper	Elite	4 units (25 M each)	0.24	2010/11	Ipusa	1213
Toilet paper	Sin Fin	4 units (25 M each)	0.24	2007/04	Ipusa	1213
Toothpaste	Pico Jenner	0.09 Kg	0.19	2010/11	Colgate	1213
Toothpaste	Colgate Herbal	0.09 Kg	0.19	2010/11	Colgate	1213
Toothpaste	Kolynos	0.09 Kg	0.19	2010/11	Colgate / Abarly	1213

* Kg = kilograms; L = liters; M = meters. n/i - No information.
A. Wine and beer are a class in itself. Nevertheless, both belong to the same group "Alcoholic beverages".
B. Not in CPI. We classify it as oil.

C. Not in CPI. We classify it as flour.

D. Not in CPI. We classify it as butter.

E. Not in CPI. We classify it as laundry soap.

C Proof of Proposition 1

To find a Nash equilibrium we must show that store S_0 prefers to sell two brands when store S_L sells one to sell just one brand, and that store S_L prefers to sell one brand when store S_0 sells two, rather than sell also two brands. We first present the main results of the analysis to be used in the proof. If each store sold one variety, then $p_{A0} = p_{AL} = tL$ and demand is $L/2$. Profits are $\Pi_i^{11} = \frac{tL^2}{2} - F$. If both stores sold one both varieties instead, then we have that $\Pi_i^{22} = \frac{tL^2}{2} - 2F$.

For the case when store 0 sell two varieties and store L just one, we have that $\widehat{x} = \frac{L}{2} - \frac{\lambda\theta}{12t}$ and $\widetilde{x} = \frac{L}{2} + \frac{(3-\lambda)\theta}{12t}$, and prices are $p_{A0} = tL - \frac{\lambda\theta}{6}$, $p_{B0} = tL + \frac{(3-\lambda)\theta}{6}$, $p_{AL} = tL - \frac{\lambda\theta}{3}$.

Lets start the analysis for store S_L selling one brand.

Profits are $\Pi_L^{12} = (1-\lambda)(L - \widehat{x})\, p_{AL} + \lambda (L - \widetilde{x})\, p_{AL} - F$ which could be rewriten as $\Pi_L^{12} = (L - \widetilde{x})\, p_{AL} + (1-\lambda)(\widetilde{x} - \widehat{x})\, p_{AL} - F = p_{AL}\left[L - \widehat{x} - \lambda(\widetilde{x} - \widehat{x})\right] p_{AL} - F$. Substituting we obtain $\Pi_L^{12} = \left(tL - \frac{\lambda\theta}{3}\right)\left[L - \frac{L}{2} + \frac{\lambda\theta}{12t} - \lambda\right($ $F = \left(tL - \frac{\lambda\theta}{3}\right)\left[\frac{L}{2} - \frac{\lambda\theta}{6t}\right] - F \Rightarrow \Pi_L^{12} = \frac{tL^2}{2} - \frac{\lambda\theta L}{3} - \frac{(\lambda\theta)^2}{18t} - F$.

Now we check that the incentive compatibility condition holds: $\Pi_L^{12} \geq \Pi_L^{22} \iff \frac{tL^2}{2} - \frac{\lambda\theta L}{3} - \frac{(\lambda\theta)^2}{18t} - F \geq \frac{tL^2}{2} - 2F$, which holds if and only if $F - \frac{\lambda\theta L}{3} - \frac{(\lambda\theta)^2}{18t} \geq 0$. Rearranging terms we obtain

$$\frac{3F}{\theta\lambda} - \frac{\lambda\theta}{6t} \geq L. \tag{16}$$

Now we turn to store S_0 which sells two brands. Instead of finding the profits and then postulate the incentive compatibility condition, we will start by this condition.

Profits if store S_0 sell both varieties are $\Pi_0^{12} = (1-\lambda)\,\widehat{x}p_{0A} + \lambda\widetilde{x}p_{0B} - 2F$, while if it sells only one variety profits could be written as $\Pi_0^{11} = (1-\lambda)\frac{tL^2}{2} + \lambda\frac{tL^2}{2} - F$. Then, we can write the incentive compatibility condition as $\Pi_0^{12} \geq \Pi_0^{11} \iff \triangle\Pi = (1-\lambda)\left(\underbrace{\widehat{x}p_{0A} - \frac{tL^2}{2}}_{(*)}\right) + \lambda\left(\underbrace{\widetilde{x}p_{0B} - \frac{tL^2}{2}}_{(\square)}\right) - F \geq 0.$

We can write (*) as $\left[\left(\frac{L}{2} - \frac{\lambda\theta}{12t}\right)\left(tL - \frac{\lambda\theta}{6}\right) - \frac{tL^2}{2}\right]$ and $(\square)$ as $\left[\left(\frac{L}{2} - \frac{\lambda\theta}{12t} + \frac{3\theta}{12t}\right)\left(tL - \frac{\lambda\theta}{6} + \frac{3\theta}{6}\right) - \frac{tL^2}{2}\right]$. Now, noting that (*) is in $(\square)$, rearranging terms we obtain that $(\square) = (*) + \frac{3\theta}{6}\left(L + \frac{3\theta}{6t} - \frac{\lambda\theta}{6t}\right)$.

Now, we plug all the previous result into $\triangle\Pi$ and obtain $\triangle\Pi = (1-\lambda)(*) + \lambda\left((*) + \frac{3\theta}{6}\left(L + \frac{3\theta}{6t} - \frac{\lambda\theta}{6t}\right)\right) - F$, and now we have that $\triangle\Pi = (*) + \frac{3\theta\lambda}{6}\left(L + \frac{3\theta}{6t} - \frac{\lambda\theta}{6t}\right) - F$. Now, operating in (*) we obtain $(*) = \frac{\lambda\theta}{6}\left[\frac{\lambda\theta}{12t} - L\right]$ and plugging back into $\triangle\Pi$, we obtain $\triangle\Pi = \frac{\lambda\theta}{6}\left[\frac{\lambda\theta}{12t} - L\right] + \frac{3\theta\lambda}{6}\left(L + \frac{3\theta}{6t} - \frac{\lambda\theta}{6t}\right) - F$. Simplifying again, we obtain

$$\triangle\Pi = \frac{\lambda\theta}{6}\left[2L + \frac{\theta}{6t}\left(9 - \frac{5}{2}\lambda\right)\right] - F \geq 0.$$

Condition for existence of equilibrium reduces to

$$L \geq \frac{3F}{\lambda\theta} - \frac{\theta}{12t}\left(9 - \frac{5}{2}\lambda\right). \tag{17}$$

From equations 16 and 17, we obtain that a Nash equilibrium exist $\iff$

$$\frac{3F}{\lambda\theta} - \frac{\theta}{12t}\left(9 - \frac{5}{2}\lambda\right) \leq L \leq \frac{3F}{\theta\lambda} - \frac{\lambda\theta}{6t},$$

and this equations holds $\iff$ $\frac{\theta}{12t}\left(9 - \frac{5}{2}\lambda\right) \geq \frac{\lambda\theta}{6t}$, which holds $\iff$ $\lambda \leq 2$. As $\lambda \in [0, 1]$, the previous inequality always hold.