Varieties as a Source of Law of One Price Deviations*

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Abstract

The paper analyze a new mechanism for prices to deviate from the Law of One Price. If stores differ in the varieties offered in a given product category, prices diverge more often regardless of distance. A simple extension to the Hotelling (1929) explains this result. We test our prediction using a unique country-level detailed price database. To have one difference in variety in a product category between two stores increases price difference by 0.6-0.8%. Nearly half of the effect is explained by store characteristics, which partially account for the selection

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of varieties. The effect is robust to several controls and alternative specifications and increases as the distance between stores decreases. We offer causal evidence of the varieties-to-prices channel by exploiting an exogenous shock to store demand that change that resulted in a change in the relative number of varieties. The results of the causal effect are in line with the baseline estimations. Our results show that within-store decisions on variety selection could have a large aggregate impact on prices' volatility.

JEL CODE: D4, F40, F41.

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1 Introduction

The convergence of 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, the 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 et al., 2011), the existence of high fixed costs of production for some goods (see Coşar, Grieco and Tintelnot, 2015*a*, Coşar, Grieco and Tintelnot, 2015*a*), 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 in a product category offered by stores. If stores differ in the varieties of goods offer, 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 the different basket of goods across countries (see Gorodnichenko and Tesar, 2009), to the best of our knowledge, no paper explicitly examines the role of differences in varieties 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, some goods offer similar characteristics to the consumer. A variety will be a collection of similar goods: i.e., in the beer market, there

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

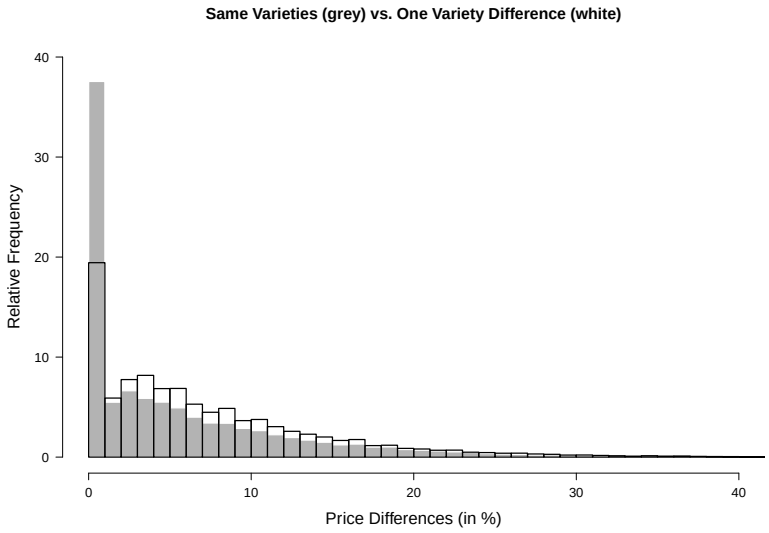
[2] Gopinath et al. (2011) partially addresses this issue by controlling for the markup of firms using cost information.

are 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 et al. (2011), Hong and Li (2017), or Atkin and Donaldson (2015)). We will refer to a specific product as a variety—interchangeably—, and the market to which it belongs as product category.

The idea of price non-convergence due to differences in varieties is as follows. Assume two stores at 100 meters distance from each other, both selling Coke. After controlling for distance, we should expect that Coke's price should be equal between both stores. Assume the same setting as before—two stores selling Coke at 100 meters distance—but one of the stores also has Pepsi available. Now, Coke competes with Pepsi at one store but not at the other store. Coke's equilibrium price shall now not be equal between both stores, even after controlling for distance, because each product faces different competitive conditions within the 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 motivates 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 a one-kilometer distance. In gray is plotted the distribution of price differences for store pairs with 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 prices will converge. This empirical result is also confirmed by our theoretical model in Section 2.

Figure 1: Pooled Price Difference Between Stores Up to One Kilometer.



The paper offers two contributions to the LOP literature. First, we offer a simple extension of the Hotelling (1929) model that accounts for different varieties. We show that a Nash equilibrium exists where stores offer different varieties and charge different prices for common goods. This result holds in an otherwise symmetrical scenario between stores. Also, the model adds to the theoretical literature on price dispersion (see Kaplan et al. (2019)), but does not require asymmetric information for price dispersion to hold, such as in Varian (1980), Burdett and Judd (1983), Preston (1995), among many others. Second, using a detailed price database for Uruguay, a geographically small and economically homogeneous developing country, we present evidence that differences in store varieties in a given category have a significant economic impact on aggregate price dispersion. We propose an estimation for price dispersion in price differences, similar to Engel and Rogers (1996). Roughly, a difference of one variety between two stores adds up to 0.6 percent to price differences, only half of it explained by store characteristics. The effect slightly increases—0.8 percent—when the distance between stores decreases. The result remains robust and significant for different specifications. We also study an exogenous demand shock to varieties that give similar results for price

divergence than the general specifications.

The model, an extension of Hotelling (1929)[3] incorporates two competitive dimensions: the 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, and distance between stores) to show how different varieties at the store explain deviations from the LOP. This formalization is more realistic in capturing the competitive pressure for products, which results from substitution between similar goods—measured by distance—and the availability of substitute varieties at the same store, as measured by the varieties available to consumers. The model allows differences in product markups arising from 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 stores' exact locations, whether they belong to a chain, and on their sizes—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. We compute the number of varieties by counting the number of varieties within a given product category in each store and month.

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 526 kilometers. As a result, no significant deviations from the LOP should be expected. Nevertheless, we found a median price difference of 5%, which increases to 5.6% if stores differ in one variety in a given product category. Also, while the un-

[3]A variation of this model is also used by Gopinath et al. (2011). See also Irmen and Thisse (1998).

conditional probability of two prices being equal when stores have the same number of varieties is one in five, it decreases 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) 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 such unobserved product characteristics.

The paper is organized as follows. The next Section shows that price differences arises 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 tests to check the main results. Section 5 address the causality of the variety to prices. Finally, Section 6 presents the conclusions of the analysis.

2 A Simple Model of LOP Deviations

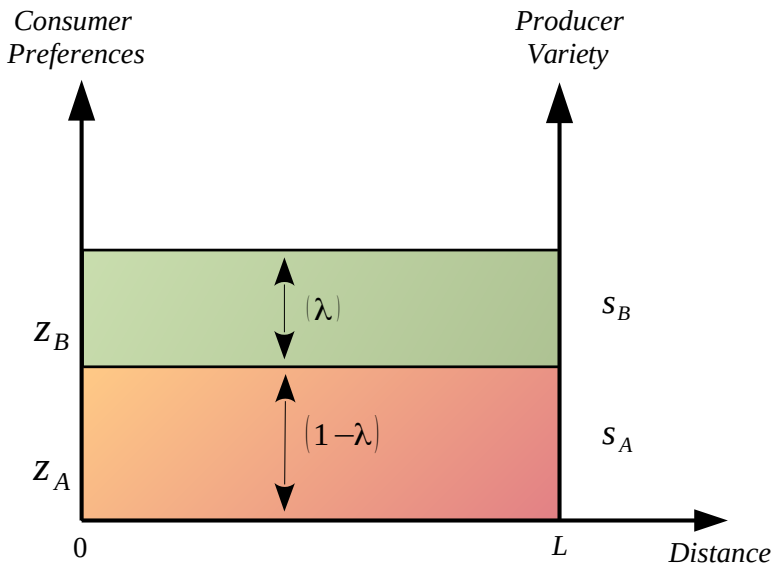
This section presents a simple model to explain sources of deviations from the LOP. We propose an extension of the Hotelling (1929) model, which has previously been used in the literature (see Gopinath et al., 2011), that incor-

porates a two-way horizontal product differentiation.[4] This extension allows to capture trade costs—the distance dimension—, and competition between varieties at the store—the variety dimension. The Hotelling (1929) linear city model of product differentiation could represent either the physical distance between stores, or the variety distance between similar goods. In the model, stores choose 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 an extension of Irmen and Thisse (1998) and assume 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). There are two types of consumers at each point in the line that differ in their preference for varieties $z_i = \{z_A, z_B\}$. This implies 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 who prefer variety z_A, and a mass λ consumers that prefer 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 prefer 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 prefer 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 left y-axis represents the consumers' preferences for variety (z_A, z_B), while the right y-axis depicts the possible varieties sold by stores (s_{Ai}, s_{Bi}).

[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.

Figure 2: The two dimensional model.



The products have a physical—distance—identification (d) and a variety identification (s). Stores are—exogenously—located at one point in the distance dimension and may be sold different varieties of the good in a store. A consumer that prefers variety i and is located at distance j has an—indirect—utility function:

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

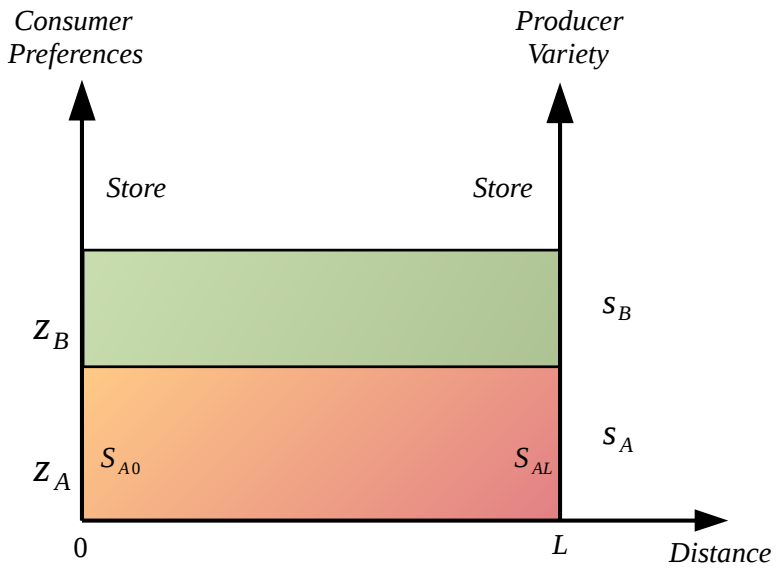
where r is the reservation utility of the consumer—equal for all consumers—, i indicates the variety preference of the consumer ($i.e.,.\, z_i = \{z_A,\, z_B\}$), θ is the cost that a consumer pay if he buys a good of variety s_q that differ from his preferred variety z_i at the store located at d, t is the transport cost the consumer located at j has to pay to buy at the 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

firm's production costs are 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 imposes on the store because of the limited slotting space. Each variety a store chooses to sell will leave less space available for other varieties or products.

This simple setting will allow us to show 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 because having two brands does not increase income for the store but double its fixed costs. Secondly, we show that prices will differ in equilibrium if varieties differ between stores using the previous conditions. Varieties will differ in equilibrium because a store with two varieties will increase its cost and expand the demand at the expense of the store that sold just one brand. On the contrary, although the firm that sold one brand loses market share—and income—it also saves fixed costs.

Suppose two stores sell the same variety $z_A = s_A$. The stores are located on opposite sides of 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, where 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. To find the price equilibrium, as we have assumed that the locations of both stores are exogenously given, the indifferent consumers must be found 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 $r - \theta - t\,|L - x| - p_{AL} \geq 0$ or both, $\forall x \in [0,\, L]$. As consumers with different variety preference differ in θ if the distance is fixed, we can find the indifferent consumer between both stores as:

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

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, $p_{A0} = \frac{p_{AL} + tL}{2}$ 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 it optimal to offer both varieties. Notice that the two varieties problem is symmetrical to the one with one variety, and the indifferent consumer will also be at $\widehat{x}$ for each variety. 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:

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

The above results show that stores will have larger profits by offering only one variety. The assumption of consumers being discrete in their variety dimension explains this result.

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. Assume that at location 0 the store also offers a 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 and consumers that have preference z_A, will prefer to buy the variety s_A. This assumption adds one additional restriction to the model. Consumers located at 0 that have a 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 a 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 for both goods to 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 indifferent consumers 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 $\iff$

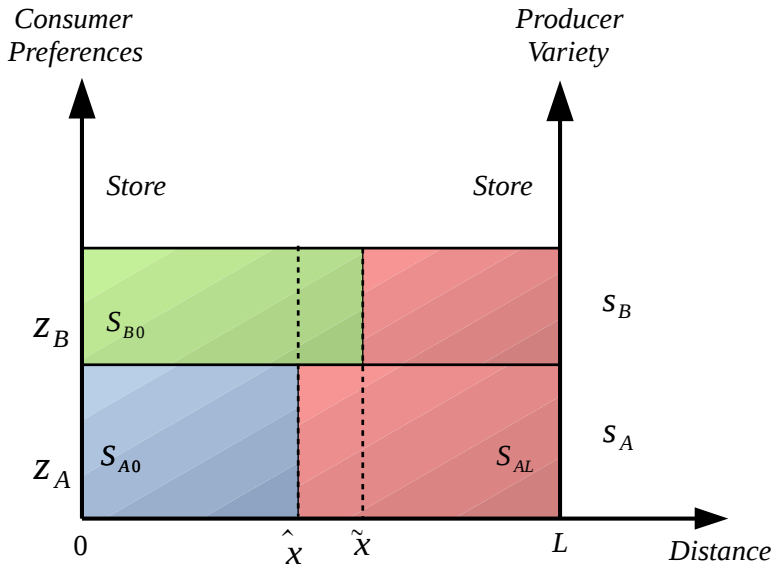
$$r - t\widetilde{x} - p_{B0} = r - \theta - t\,|L - \widetilde{x}| - p_{AL}, \tag{4}$$

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

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

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

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 establishes 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. See Appendix C. □

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

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 $p'_{A0} = p_{A0} - \frac{\lambda\theta}{6}$ while $p'_{A0} = p_{AL} - \frac{\lambda\theta}{3}$. For 2, $p'_{A0} = p'_{AL} \iff \lambda = 0$, which could not hold because there will be no demand for variety z_A, or $\theta = 0$, that is, if there are no costs for consumers to change variety. □

This simple model allows 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. Differences in varieties imply differences in markups for firms. The model is perfectly symmetric and the result relies only on the assumption of positive fixed costs and a discrete number of varieties. The trade-off between markup and fixed costs of varieties is the key for the model to have an asymmetric equilibrium in the number of varieties. As Proposition 2 showed store decision on the number of varieties offered will impact the equilibrium price of the product sold. The price difference between stores in the previous example will be $\left|p'_{A0} - p'_{B0}\right| = \frac{\theta}{2}$ due to the symmetry of the model in terms of distance—and also costs—. Nevertheless, in Section 4 we allow for a more flexible estimation.

3 Data

This section offers a detailed description and descriptive statistics of the database used in the empirical section and 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

[6]This is an updated database from Borraz and Zipitría (2012) and Borraz et al. (2016).

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 value-added tax rates (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 at 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 to mislead customers.

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 product categories 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]

[7]See http://www.precios.uy/sipc2Web/ and Borraz and Zipitría (2012) for a detailed description of the database and an analysis of price stickiness.

The three best-selling brands are reported for each product category, disregarding the supermarket's own brands. Products were selected after a survey of some of the largest supermarket chains in the year 2006. In November 2011, the list of products was updated, including some categories and 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 product categories. 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 product category, 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. Nevertheless, this omission would imply that our results are a lower bound on the effect of varieties, as more varieties should be available at the store.

The 154 products in the database represent 50 product categories (e.g., sunflower oil and corn oil and wheat flour 000 and wheat flour 0000 are different product categories in our analysis). For some of them, the information does not allow identifying of the goods at the UPC level; in the meat and bread product categories, 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 Online Appendix B. The list includes the product category of the good, its presentation, when the product appears for the first time in the database, and the producer for each brand.

For each store in the database, we have detailed information about their exact location given by its Universal Transverse Mercator (UTM) and 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.[8] Figure 7 in Online Appendix A shows the cities in the database and the supermarket distribution for Montevideo, accounting for 54% of all supermarkets in the sample.

For each product and store in the database, 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, and Nakamura and Steinsson, 2013).[9] The inclusion of sales in the analysis will induce spurious deviations related to a 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 8 in Online Appendix A.

Then, for each product, store, and month we calculate the price difference, the difference in the number of varieties, 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 10 in Online Appendix 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 check the results against the year 2011, which has the cross-distribution of varieties that closely mimics the database. Nevertheless, the next subsection shows descriptive statistics for the complete price difference database.

[8] More information is available at http://www.ine.gub.uy/uruguay-en-cifras (in Spanish).

[9] 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.

Our measure of variety is the crucial variable in the empirical analysis. We propose a simple measure to capture the role of different varieties on prices. We count the number of prices for category in each store and month—less one—listed in the database. So if in a given month/store/product category we have two listed prices, our variety measure will take the value of one for both goods in the product category, indicating that there is another variety available to consumers. This simple measure trade-off aggregation *across* product categories with variation *within* product categories. As an example, assume in market Z there are up to three products—as in our database–. Our variety variable will have a value of one if any of the following situations holds: brands A and B are available, brands A and C are available, or brands B and C are available. To have brand A competing with brand B could be a very different competitive setting than brand A competing with brand C. As a result, our measure loses some variation within markets.

On the contrary, our measure allows us to aggregate *between* product categories. Different product categories with a value of one in the variety variable imply that two products are available in each one, or that consumers could choose another variable. If we differentiate within a product category each of the possible combinations of products as previously stated, then we will not be able to aggregate differences between product categories. As a result, to represent each possible combination of products in each product category 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 that variable implies another product is available at the store, whatever the market. Nevertheless, by construction, the variety measure will be noisy. Our variety variable is suited to compare different product categories. All products in the same product categories at a given month and store will have the same value of the variety variable.

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 the number of varieties in the price database and the price difference database. In the price database, most observations are up to two varieties, while a larger number of varieties are for the rice product category only. The price difference database shows that nearly two-thirds of the observations have the 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, and nearly 5% in two varieties.

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

Price Database		Price Difference Database	
# Varieties	Share	△ # Varieties	Share
0	10.6	0	65.5
1	42.4	1	29.3
2	43.9	2	4.5
3	1.2	3	0.5
4	1.7	4	0.2
5	0.2	5	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 supermarket's 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 is not evenly distributed along with the distance. As with the 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.

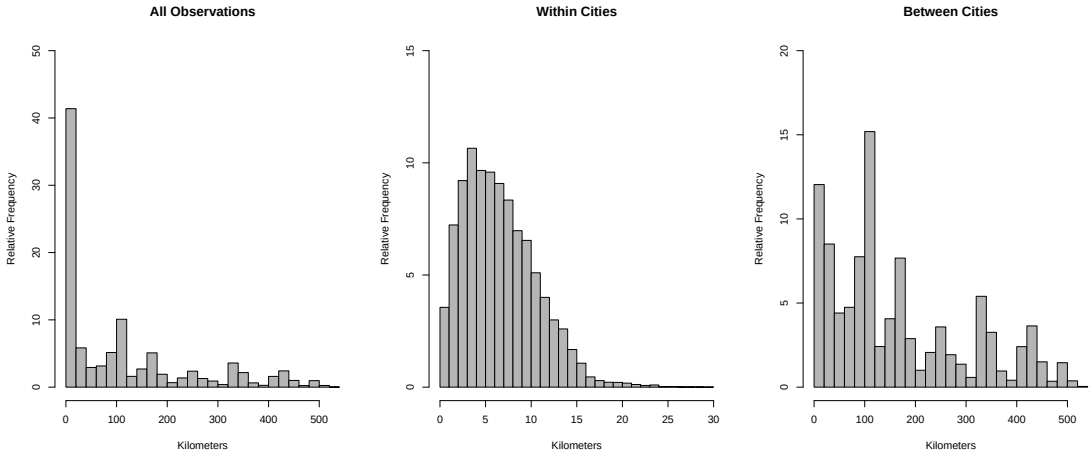


Table 3 below shows summary statistics—median, standard deviation, and the number of exact zeroes—of price differences to illustrate the main message of the paper. The median price difference is about 5% and prices are equal

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 Uruguayan stores 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 to 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 22%. Nevertheless, when products in two stores differ in one variety the median price difference increase by nearly 30%, and the share of equal prices decreases 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 Number of 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 summarizes the paper's main message: 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 variations in the database varieties. It is also interesting to note that the standard deviation of prices is quite the same in the different samples. This is quite relevant after Gorodnichenko and Tesar (2009), who showed that the distribution of prices matters to estimate across the different samples of products.

4 Empirical Strategy

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

$$|p_{ist} - p_{irt}| = \alpha_i + \alpha_t + \beta_1 \times Dist_{sr} + \beta_2 \times DVar_{isrt} +$$

$$+\gamma X_{isr} + \varepsilon_{isrt} \ , \tag{12}$$

where i is 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 time t;[10] $DVar_{isrt} = |Var_{ist} - Var_{irt}|$, is the difference in the number of varieties between stores s, r for product i in time t; α_i is a dummy variable for product i; α_t are time dummies; $Dist_{sr}$ measures the linear 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—and ε_{isrt} is a stochastic error term.

We add different controls, represented by X_{isr}, that include: a dummy variable α_{ch} that takes the value one if stores s, r belong to the same chain; $Border_{sr}$ is a dummy variable that takes the value one if stores s and r are located in different cities; and $\alpha_s + \alpha_r$ are store dummies. 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

[10] The literature also studies the standard deviation of the price difference.

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), and dummies that accounts for uniform prices in chains (DellaVigna and Gentzkow, 2019 for the US, Borraz and Zipitría, 2012 for Uruguay).

Due to the size of the database—273 million observations—and the high number of controls, we take a random sample of 10% of the observations.[11] 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 4 shows the main results for the estimation of Equation 12 for the random sample database and the year 2011. All equations have standard errors clustered by store pair—i.e., store s and r—and time.[12] The estimation uses a within transformation to absorb a large number of fixed effects in the regression.[13]

[11] A sample procedure was also used in DellaVigna and Gentzkow (2019).

[12] Price differences are multiplied by 100. The intercept dummy is omitted in all equations.

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

Table 4: Estimation of LOP Deviation: Varieties.

	Dependent variable: difference in log of prices (times 100)			
	Random Sample		Year 2011	
	(1)	(2)	(3)	(4)
Distance	0.122**	0.374***	0.142**	0.372***
	(0.062)	(0.039)	(0.066)	(0.037)
DVariety	0.624***	0.411***	0.586***	0.380***
	(0.049)	(0.040)	(0.062)	(0.054)
# Observations	27,237,023	27,237,023	49,383,990	49,383,990
Time dummies	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes
Different City Dummy	Yes	No	Yes	No
Same Chain Dummy	Yes	No	Yes	No
Stores s, r Dummies	No	Yes	No	Yes
R square	0.128	0.175	0.153	0.201

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

Both samples show similar results, so we explain the random sample results. One additional variety increases price dispersion—divergence from the LOP—by 0.6 percent. Interestingly, store dummies partially account for the effect of varieties, which seems to be also explained by other factors. In terms of distance, which has been widely used as a comparative for LOP deviations, deviation,[14] to have an additional variety increase price dispersion as to add 2 to 165 kilometers.[15] The large difference in the role of varieties in terms of distance is explained by the decrease in the variety coefficient and by the increase in the distance coefficient when controlling for store effects.[16]

We repeat our exercise to different distances as a robustness check for stores up to 30, 15, and 5 kilometers. These stores should be under similar economic conditions—i.e., transport costs and demand characteristics—, as

[14]See Atalay et al. (2019) for a recent example of distance for measuring transport costs within and between firms.

[15]The calculation are: $2 = exp\,(0.411/0.374) - 1$, and $165 = exp\,(0.624/0.122) - 1$.

[16]See Atkin and Donaldson (2015) for a similar result in the estimation of distance.

the maximum distance within a city is 29 kilometers (see Table 2). Also, the effect should be larger as the stores compete more intensely. Finally, we repeat our estimation for Montevideo, Uruguay's capital city. Montevideo is the largest city in the country with nearly 1.3 million inhabitants and 45% of the supermarkets.[17] Although there are differences in the distribution of the supermarkets across the city and of consumer characteristics, there are fewer barriers to movement within the city than across cities.

[17]The second-largest city is a collection of small urbanizations called "*Ciudad de la Costa*" which has a tenth of Montevideo's population.

Table 5: Estimation of LOP Deviation: Local Effects.

	Dependent variable: difference in log of prices (times 100)							
Stores:	up to 30 kms.		up to 15 kms.		up to 5 kms.		Montevideo City	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Distance	0.157	0.169***	0.150	0.145***	-0.147	0.094	0.190*	0.147***
	(0.095)	(0.038)	(0.102)	(0.038)	(0.097)	(0.061)	(0.110)	(0.043)
DVariety	0.855***	0.380***	0.868***	0.408***	0.885***	0.409***	0.884***	0.414***
	(0.078)	(0.053)	(0.079)	(0.056)	(0.089)	(0.061)	(0.083)	(0.058)
# Observations	125,170,128	125,170,128	99,983,886	99,983,886	37,538,472	37,538,472	89,655,896	89,655,896
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Different City Dummy	Yes	No	Yes	No	Yes	No	No	No
Same Chain Dummy	Yes	No	Yes	No	Yes	No	Yes	No
Stores s, r Dummies	No	Yes	No	Yes	No	Yes	No	Yes
R square	0.148	0.205	0.152	0.205	0.167	0.223	0.154	0.205

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

Odd (even) columns show the results when (not) controlling for stores dummies. Results for even columns are relatively similar and show nearly a fifty percent increase in the coefficient of the variety parameter. On the other side, odd columns show that nearly half of the value of the variety parameter can be explained by store decisions. The distance parameter is insignificant in the even columns and significantly lower in odd columns. The distance equivalent of an additional variety equals 15 kilometers, roughly half the distance between stores in Montevideo.

5 Causality

A potential concern in the analysis results from endogeneity, mainly through two channels: measurement error in our variety variable and reverse causality. Measurement errors arise due to our database's restricted number of varieties and from the procedure to construct the variety variable. Our database is restricted to the three most selling brands in each product category, disregarding supermarkets' own brands. Then, there could be more differences not accounted in the database as some varieties are not included in the analysis. Also, as the construction of the variety variable is detailed in Section 3, we treat different situations as similar (e.g., store 1 having varieties A and B in a product category are equal to store 2 having varieties A and C).

Nevertheless, both scenarios tend to bias downward the effect of varieties as there is less variability in the variety variable. Our baseline of both stores having the same number of varieties could be less frequent in the database, and there could be situations where there is variability in varieties but assigned to both stores having the same number of varieties. As a result, there could be much variety in the baseline scenario of both stores having the same number of varieties that are not captured by our variety measure.

The problem of reverse causality is a more serious concern. There will always be some store pairs for which there will potentially be reverse causality of prices to varieties. If stores choose the set of varieties to be sold based on total expected sales, which is a function of marginal costs, then the variable

$\triangle$Varieties would be correlated with the marginal cost in the error. This correlation will bias our estimators. Therefore, for a causal interpretation of the results, it is necessary to generate some exogenous variation for the number of varieties offered. One approach is to use the instrumental variable estimator with the distance between the plant's location producing the good and each supermarket to instrument for the availability of a variety from producers. However, it is not possible to apply this instrumental geography variable in our environment because our endogenous variable is not the number of varieties offered by a supermarket but the difference in the number of varieties between two supermarkets. We propose two alternative ways to address reverse causality.

First, we add multiple fixed effects to the regression model to estimate the causal effect of varieties on prices. However, Anderson, Rebelo and Wong (2018) provides direct empirical evidence on markups in the retail industry. They find that markups are acyclical. There is regional dispersion where rich regions pay higher markups than poor regions, but goods common to both regions have the same markups. Despite these facts, they conclude that markups are relatively stable over time. Therefore, there is no clear evidence in favor of variable markups across time. Our empirical strategy of a full set of time dummies—supermarket pairs dummies, and store pairs year fixed effect and variety-store pairs fixed effects—can address the endogeneity of varieties. Therefore, we expand our baseline estimations with the incorporation of store pairs year fixed effect and variety-store pairs fixed effects to partially account for unobserved changes in marginal cost that impact varieties in stores over time. The table 6 below shows results in line with Tables 4 and 5. Adding additional controls does not change the statistical significance of the parameters or the value of the coefficients.

Table 6: Estimation of LOP deviation: Robustness.

	Dependent variable: difference in log of prices (times 100)					
	Random Sample		Year 2011		Stores up to 5 kms.	
	(1)	(2)	(3)	(4)	(5)	(6)
Distance	0.361***	0.373***	0.351**	0.371***	0.096	0.090
	(0.037)	(0.039)	(0.035)	(0.037)	(0.058)	(0.060)
DVariety	0.464***	0.413***	0.504***	0.379***	0.472***	0.419***
	(0.040)	(0.040)	(0.047)	(0.054)	(0.058)	(0.062)
# Observations	27,237,023	27,237,023	49,383,990	49,383,990	37,538,472	37,538,472
Product dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Stores s, r Dummies	Yes	Yes	No	Yes	Yes	Yes
Chain s, r ×Product Dummies	Yes	Yes	No	Yes	Yes	Yes
Chain s, r ×Time Dummies	No	Yes	No	Yes	No	Yes
R square	0.249	0.181	0.314	0.204	0.312	0.229

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

Secondly, we exploit an exogenous demand shock to some supermarkets due to an exogenous shift in the spatial distribution of the construction activity in the city of Montevideo, which we and coauthors study in Borraz et al. (2021). In that paper, we exploit the 2011 passing of Law 18,795, entitled *Ley de Acceso a la Vivienda de Interés Social* (which roughly translates to Access to Housing of Social Interest Law), that gives place-based tax benefits for new constructions. 540 projects were promoted between December 2011 and December 2019, with a total investment of 1.5% of the average 2011-2019 Uruguayan GDP. In Montevideo, the law defined an exogenous border dividing the city into places that benefit from the tax exemption policy—promoted areas in the northern part of the city—and places that do not benefit—non-promoted areas in the south of the city, close to the coast.[18] Most approved projects were close to the exogenous border, on the northern non-subsidized zone of the city. Although the law was passed in 2011, until year 2014 less

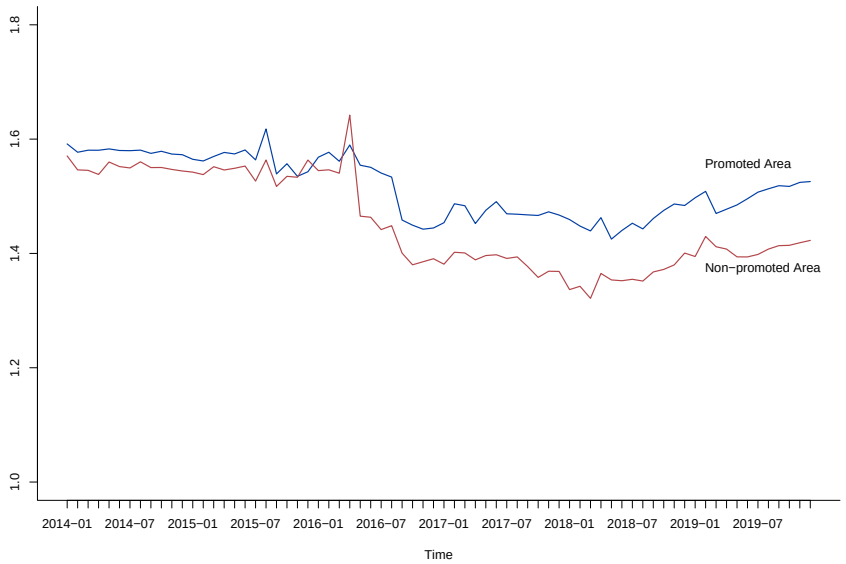
[18]For more detailed information, see Borraz et al. (2021).

than 5% of the approved projects were built, 40% by 2016, and 80% by 2017.

In Borraz et al. (2021) , we estimate the effect of the demand shock to supermarkets at a distance of up to two kilometers on both sides of the border.[19] In Borraz et al. (2021) we found that prices decreased by 2% between 2010 and 2019, mainly due to a relative increase in the total number of varieties offered by stores in the promoted areas. Further, using annual data, we found that the effect of varieties starts roughly in 2016, while the effect on prices in 2018. That is, the effect of varieties precede the effect on prices. Nevertheless, in Borraz et al. (2021) we do not explore the effect of varieties within a product category but on aggregate.

We exploit the exogenous demand shock of construction to analyze if the number of varieties affects prices. Using the database in Borraz et al. (2021)—an extended database of the one used in the present paper—we construct price and variety differences for stores up to two kilometers from the border. The following Figure plot the evolution of the average category number of varieties in the promoted and non-promoted areas.

Figure 6: Evolution of the Average Number of Varieties per Category.



[19] A similar methodology is used in Handbury and Moshary (2021).

The Figure shows that until the beginning of 2016, the average number of varieties was nearly similar between the promoted and non-promoted areas. Nevertheless, starting in 2016, the number of varieties departed between areas. We now proceed to estimate Equation 12 in a difference-in-difference setting for 2014 and 2019.[20] We select those store pairs where one store is in the treated area while the other is in the control area. The estimated equation is the difference in varieties' interaction with a year fixed effect. The following Table shows the results for the whole sample and the restricted sample of stores in both 2014 and 2019.

Table 7: Estimation of LOP deviation: Exogenous Shift in Demand.

Dependent variable: difference in log of prices (times 100)		
Sample	Full	Restricted
DVariety	0.112	0.114
	(0.143)	(0.163)
Year 2019	2.469***	2.518***
	(0.318)	(0.313)
DVariety×Year2019	0.748***	0.643***
	(0.189)	(0.220)
# Observations	3,872,542	2,921,949
Month dummies	Yes	Yes
Product dummies	Yes	Yes
Stores s, r Dummies	Yes	Yes
R square	0.238	0.248

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

Results show a significant increase in price dispersion between 2014 and 2019. Nearly 0.7 percent is explained by a change in the number of varieties between the promoted and non-promoted areas. While other factors may

[20] We also run a regression with year-fixed effects for 2014 to 2019. We found all interaction between $DVarieties$ and year significant, at 5 percent level for 2015 and 1 percent level for years 2016 to 2019.

explain the full result of the increase in price dispersion, the difference in the number of varieties seems to have a causal effect on prices. Considering the exogenous demand shock and controlling for years' fixed effects, we find evidence of a causal effect of varieties on prices.

6 Conclusions

The literature has shown deviations from the LOP across or within countries, offering different sources for this phenomenon. We present a new source of relative price divergence: the difference in the varieties offered by stores in a product category. We show that price dispersion arises in equilibrium if stores differ in the number of varieties, even with symmetric information. We provide evidence that price volatility increases by 0.6-0.8 percent for each additional difference in varieties between stores. Store characteristics explain up to half of this value. The variety effect is robust to several controls and different specifications.

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A Online Appendix: Additional Tables

Table 8: 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

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Market	Brand	Minimum	Median	Maximum	Standard Deviation	N	Share Stores (%)
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
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

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Market	Brand	Minimum	Median	Maximum	Standard Deviation	N	Share Stores (%)
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
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 10: 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
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

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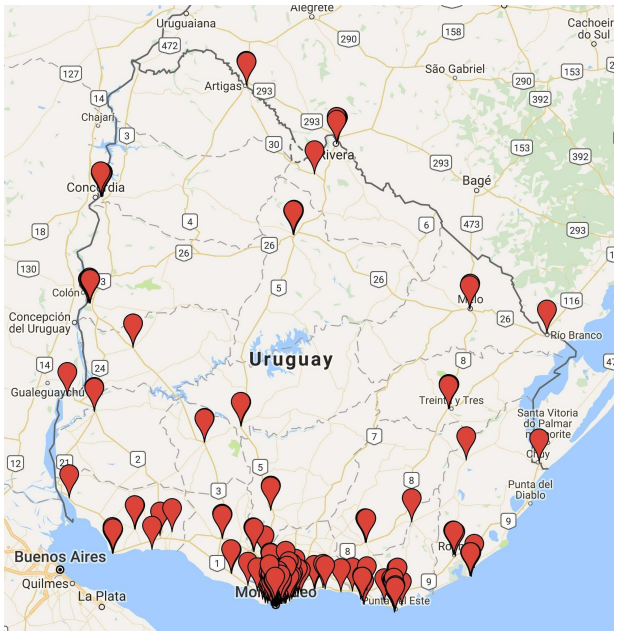
Market	Brand	Minimum	Median	Maximum	Standard Deviation	N	Exact Zeroes (%)
Noodles	Cololo	0	5.72	76.12	6.31	1,627,630	16.00
Noodles	Las Acacias	0	4.47	126.54	7.16	2,728,963	19.00
Semolina Pasta	Adria	0	3.92	93.39	10.27	1,272,218	30.00
Semolina Pasta	Las Acacias	0	4.45	88.63	9.70	2,414,009	22.00
Semolina 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
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

Continued on next page

Market	Brand	Minimum	Median	Maximum	Standard Deviation	N	Exact Zeroes (%)
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 12: 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 13: 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 Online Appendix: List of Products

Product	Brand	Specification*	% Share in CPI	Sample Start	Owner (/merger)
Beer	Pilsen	0.96 L	0.38	2007/04	FNC
Beer	Zillertal	1 L	0.38	2010/11	FNC
Wine	Faisán	1 L	0.80	2007/04	Grupo Traversa
Wine	Santa Teresa	1 L	0.80	2007/04	Santa Teresa SA
Wine	Tango	1 L	0.80	2007/04	Almena SA
Cola Drink	Coca Cola	1.5 L	1.12	2007/04	Coca Cola
Cola Drink	Nix	1.5 L	1.12	2007/04	Milotur (CCU)
Cola Drink	Pepsi	1.5 L	1.12	2010/11	Pepsi
Sparkling water	Matutina	2 L	0.81	2007/04	Salus
Sparkling water	Nativa	2 L	0.81	2007/04	Milotur
Sparkling water	Salus	2.25 L	0.81	2007/04	Salus
Bread Loaf	Los Sorchantes	0.33 Kg	0.06	2010/11	Bimbo / Los Sorchantes
Bread Loaf	Bimbo	0.33 Kg	0.06	2010/11	Bimbo
Bread Loaf	Pan Catalán	0.33 Kg	0.06	2010/11	Bimbo
Brown eggs	Super Huevo	1/2 dozen	0.46	2010/11	Super Huevo
Brown eggs	El Jefe	1/2 dozen	0.46	2010/12	El Jefe
Brown eggs	Prodhin	1/2 dozen	0.46	2007/07	Prodhin
Butter	Calcar	0.2 Kg	0.23	2007/04	Calcar
Butter	Conaprole (no salt)	0.2 Kg	0.23	2007/04	Conaprole
Butter	Kasdorf	0.2 Kg	0.23	2010/11	Conaprole
Cacao	Copacabana	0.5 Kg	0.08	2007/04	Nestlé
Cacao	Vascolet	0.5 Kg	0.08	2007/06	Nestlé
Coffee	Aguila	0.25 Kg	0.14	2007/04	Nestlé
Coffee	Chana	0.25 Kg	0.14	2007/04	Nestlé
Coffee	Saint	0.25 Kg	0.14	2010/11	Saint Hnos.
Corn Oil	Delicia	1 L	n/i	2010/11	Cousa
Corn Oil	Río de la Plata	1 L	n/i	2010/11	Soldo

Product	Brand	Specification*	% Share in CPI	Sample Start	Owner (/merger)
Beer	Patricia	0.96 L	0.38	2007/04	FNC
Corn Oil	Salad	1 L	n/i	2010/11	Nidera
Dulce de leche	Conaprole	1 Kg	0.14	2007/04	Conaprole
Dulce de leche	Los Nietitos	1 Kg	0.14	2007/04	Los Nietitos
Dulce de leche	Manjar	1 Kg	0.14	2007/04	Manjar
Flour (corn)	Gourmet	0.4 Kg	n/i	2010/11	Barraca Deambrosi
Flour (corn)	Presto Pronta Arcor	0.5 Kg	n/i	2010/11	ARCOR
Flour (corn)	Puritas	0.45 Kg	n/i	2010/11	Molino Puritas
Flour 000 (wheat)	Cañuelas	1 Kg	0.21	2010/11	Molino Cañuelas
Flour 000 (wheat)	Cololó	1 Kg	0.21	2010/11	Distribuidora San José
Flour 0000 (wheat)	Cañuelas	1 Kg	0.21	2007/04	Molino Cañuelas
Flour 0000 (wheat)	Cololó	1 Kg	0.21	2007/04	Distribuidora San José
Flour 0000 (wheat)	Primor	1 Kg	0.21	2010/11	Molino San José
Grated Cheese	Conaprole	0.08 Kg	0.16	2007/04	Conaprole
Grated Cheese	Artesano	0.08 Kg	0.16	2010/11	Artesano
Grated Cheese	Milky	0.08 Kg	0.16	2007/04	Milky
Hamburger	Burgy	0.2 Kg	n/i	2010/11	Schneck
Hamburger	Paty	0.2 Kg	n/i	2010/11	Sadia Uruguay
Hamburger	Schneck	0.2 Kg	n/i	2010/11	Schneck
Ice Cream	Conaprole	1 Kg	0.22	2010/11	Conaprole
Ice Cream	Crufi	1 Kg	0.22	2010/11	Crufi
Ice Cream	Gebetto	1 Kg	0.22	2010/11	Conaprole
Margarine	Flor	0.2 Kg	n/i	2010/11	COUSA
Margarine	Doriana nueva	0.25 Kg	n/i	2007/04	Unilever
Margarine	Primor	0.25 Kg	n/i	2007/04	COUSA
Mayonnaise	Fanacoa	0.5 Kg	0.21	2007/04	Unilever
Mayonnaise	Hellmans	0.5 Kg	0.21	2007/04	Unilever
Mayonnaise	Uruguay	0.5 Kg	0.21	2007/04	COUSA
Noodles	Cololo	0.5 Kg	0.43	2007/04	Distribuidora San José
Noodles	Adria	0.5 Kg	0.43	2007/04	La Nueva Cerro
Noodles	Las Acacias	0.5 Kg	0.43	2007/04	Alimentos Las Acacias

Product	Brand	Specification*	% Share in CPI	Sample Start	Owner (/merger)
Beer	Patricia	0.96 L	0.38	2007/04	FNC
Peach Jam	Dulciora	0.5 Kg	n/i	2007/04	ARCOR
Peach Jam	El Hogar	0.5 Kg	n/i	2010/11	Libafel SA
Peach Jam	Los Nietitos	0.5 Kg	n/i	2007/04	Los Nietitos
Peas	Campero	0.3 Kg	0.09	2010/11	Regional Sur
Peas	Cololó	0.3 Kg	0.09	2010/11	Distribuidora San José
Peas	Nidemar	0.3 Kg	0.09	2010/11	Nidera
Rice	Aruba tipo Patna	1 Kg	0.38	2007/04	Saman
Rice	Blue Patna	1 Kg	0.38	2007/04	Coopar
Rice	Green Chef	1 Kg	0.38	2007/04	Coopar
Rice	Pony	1 Kg	0.38	2010/11	Saman
Rice	Vidarroz	1 Kg	0.38	2008/05	Coopar
Rice	Saman Blanco	1 Kg	0.38	2010/11	Saman
Crackers	Famosa	0.14 Kg	0.28	2007/04	Mondelez
Crackers	Maestro Cubano	0.12 Kg	0.28	2007/04	Bimbo
Salt	Sek	0.5 Kg	0.09	2007/04	Barraca Deambrosi
Salt	Torrevieja	0.5 Kg	0.09	2007/04	Torrevieja
Salt	Urusal	0.5 Kg	0.09	2007/04	UruSal
Semolina Pasta	Adria	0.5 Kg	0.43	2007/04	La Nueva Cerro
Semolina Pasta	Las Acacias	0.5 Kg	0.43	2007/04	Alimentos Las Acacias
Semolina Pasta	Puritas	0.5 Kg	0.43	2007/04	Molino Puritas
Soybean oil	Condesa	0.9 L	0.11	2008/05	Cousa
Soybean oil	Río de la Plata	0.9 L	0.11	2010/11	Soldo
Soybean oil	Salad	0.9 L	0.11	2010/11	Nidera
Sugar	Azucarlito	1 Kg	0.35	2007/04	Azucarlito
Sugar	Bella Union	1 Kg	0.35	2007/04	ALUR
Sunflower Oil	Optimo	0.9 L	0.37	2007/04	Cousa
Sunflower Oil	Uruguay	0.9 L	0.37	2007/04	Cousa
Sunflower Oil	Río de la Plata	0.9 L	0.37	2010/11	Soldo
Tea	Hornimans	Box (10 units)	0.08	2007/04	Jose Aldao
Tea	La Virginia	Box (10 units)	0.08	2007/04	La Virginia
Tea	President	Box (10 units)	0.08	2010/11	Carrau

Product	Brand	Specification*	% Share in CPI	Sample Start	Owner (/merger)
Beer	Patricia	0.96 L	0.38	2007/04	FNC
Tomato Pulp	Conaprole	1 L	0.16	2007/04	Conaprole
Tomato Pulp	De Ley	1 L	0.16	2007/04	Barraca Deambrosi
Tomato Pulp	Gourmet	1 L	0.16	2010/11	Barraca Deambrosi
Yerba	Canarias	1 Kg	0.64	2007/04	Canarias
Yerba	Del Cebador	1 Kg	0.64	2007/04	Molino Puritas
Yerba	Baldo	1 Kg	0.64	2010/11	Canarias
Yogurt	Conaprole	0.5 Kg	0.13	2010/11	Conaprole
Yogurt	Parmalat (Skim)	0.5 Kg	0.13	2010/11	Parmalat
Yogurt	Calcar (Skim)	0.5 Kg	0.13	2010/11	Calcar
Bleach	Agua Jane	1 L	0.16	2007/04	Electroquímica
Bleach	Sello Rojo	1 L	0.16	2007/04	Electroquímica
Bleach	Solucion Cristal	1 L	0.16	2007/04	Vessena SA
Deodorant	Axe Musk	0.105 Kg	0.34	2010/11	Unilever
Deodorant	Dove Original	0.113 Kg	0.34	2010/11	Unilever
Deodorant	Rexona Active Emotion	0.100 Kg	0.34	2010/11	Unilever
Dishwashing Detergent	Deterjane	1.25 L	0.13	2007/04	Clorox Company
Dishwashing Detergent	Hurra Nevex Limon	1.25 L	0.13	2007/04	Unilever
Dishwashing Detergent	Protergente	1.25 L	0.13	2010/11	Electroquímica
Laundry Soap	Drive	0.8 Kg	0.45	2007/04	Unilever
Laundry Soap	Nevex	0.8 Kg	0.45	2007/04	Unilever
Laundry Soap	Skip, Paquete azul	0.8 Kg	0.45	2007/04	Unilever
Laundry Soap, in bar	Bull Dog	0.3 Kg (1 unit)	n/i	2007/04	Unilever
Laundry Soap, in bar	Nevex	0.2 Kg (1 unit)	n/i	2007/04	Unilever
Laundry Soap, in bar	Primor	0.2 Kg (1 unit)	n/i	2010/11	Soldo
Shampoo	Fructis	0.35 L	0.36	2007/04	Garnier
Shampoo	Sedal	0.35 L	0.36	2007/04	Unilever
Shampoo	Suave	0.93 L	0.36	2007/04	Unilever
Soap	Astral	0.125 Kg	0.16	2010/11	Colgate
Soap	Palmolive	0.125 Kg	0.16	2007/04	Colgate

Product	**Brand**	**Specification***	**% Share in CPI**	**Sample Start**	**Owner (/merger)**
Beer	Patricia	0.96 L	0.38	2007/04	FNC
Soap	Rexona	0.125 Kg	0.16	2012/12	Unilever
Toilet paper	Higienol Export	4 units (25 M each)	0.24	2007/04	Ipusa
Toilet paper	Elite	4 units (25 M each)	0.24	2010/11	Ipusa
Toilet paper	Sin Fin	4 units (25 M each)	0.24	2007/04	Ipusa
Toothpaste	Pico Jenner	0.09 Kg	0.19	2010/11	Colgate
Toothpaste	Colgate Herbal	0.09 Kg	0.19	2010/11	Colgate
Toothpaste	Kolynos	0.09 Kg	0.19	2010/11	Colgate / Abarly

* Kg = kilograms; L = liters; M = meters. n/i - No information.

C Online Appendix: 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 $\Pi_L^{12} = \left(tL - \frac{\lambda\theta}{3}\right)\left[L - \frac{L}{2} + \frac{\lambda\theta}{12t} - \lambda\left(\frac{L}{2} + \frac{(3-\lambda)\theta}{12t} - \frac{L}{2} + \frac{\lambda\theta}{12t}\right)\right] - F = \left(tL - \frac{\lambda\theta}{3}\right)\left[\frac{L}{2} - \frac{\lambda\theta}{6t}\right] - F \Rightarrow \Pi_L^{12} = \frac{tL^2}{2} - \frac{\lambda\theta L}{3} - \frac{(\lambda\theta)^2}{18t} - F$.

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

$$\frac{3F}{\theta\lambda} - \frac{\lambda\theta}{6t} \geq L. \tag{13}$$

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

$$L \geq \frac{3F}{\lambda\theta} - \frac{\theta}{12t}\left(9 - \frac{5}{2}\lambda\right). \tag{14}$$

From equations 13 and 14, 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.