The Role of Competition in Explaining Law of One Price Deviations*

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Abstract

The paper shows that differences in competitive conditions are a major source of deviation from the Law of One Price. Using a unique country-level database, we show that if products face different competitors then prices will diverge more often. The result is economically significant and holds even after controlling for other explanatory factors. Likewise, the estimation of the border effect is biased if competition is omitted. A simple extension of the Hotelling (1929) model demonstrates that the availability of different competitive conditions increases price dispersion and biases the estimation of the border effect.

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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 (Haskel and Wolf, 2001, Dvir and Strasser, 2017), or –within countries– sticky prices (see Crucini, Shintani, and Tsuruga, 2010, Elberg, 2016).

The paper offers a novel explanation for the deviations to the LOP: differences in the competitive environments of goods at the retail level. If stores differ in the basket 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 baskets across countries (see Gorodnichenko and Tesar, 2009), to the best of our knowledge there is no paper that explicitly examines competitive effects as a source of LOP deviations.[2]

This paper is developed in three stages. First, we apply an empirical methodology that controls for competition in a standard LOP equation. Second, we apply the methodology using a detailed daily posted price database for all supermarkets in Uruguay,[3] a geographically small and economically homogeneous developing country. Goods are defined at the barcode level to make them comparable across stores, and the exact location of the store is available. Third, the paper offers a simple model that introduces competition into a standard distance model to show its effects on LOP deviations.

The paper proposes a simple exercise for estimating the role of differences in competition across stores in explaining LOP deviations. Using a detailed retail price database for Uruguay, we define markets where international and local brands compete. International brands are defined as those brands also sold in Argentina–Uruguay's neighbor country–while local brands are those sold only in Uruguay. We study LOP convergence for international brands. Local brands are competitors of international brands in the defined markets, and their availability at the store level–measured in our database by the posted price of the local brand–is used to control for potential divergences

[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.

[3] Small groceries with less than 3 cashiers are not in the database.

to the LOP of prices of international brands.

This methodology is inspired by the cross country literature on LOP deviations. The first step in these papers is to define the basket of goods available in all of the countries studied. This implies that local brands–as well as different presentations of international brands, among others goods–are discarded.[4,5] We use this information to control for differences in the competition faced by international brands in each store. One key element of our methodology is that it is easy to implement, requiring only information on prices and distances, which are usually available for analysis.

For each of the defined markets, we analyze deviations of the LOP for international brands, controlling for the availability of local brands at the store level. We construct a dummy variable that takes the value of one if in that retail store, month, and market the price of a local brand is in the database. This information allows us to establish–for each price difference and store pair–whether there are local brands that compete with international brands.

We have access to 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. This detailed information allows us to track the exact same good in stores across the country, avoiding measurement problems due to different products being compared (see Broda and Weinstein (2008)) or the distance between stores being mismeasured (see Head and Mayer (2002)). The papers from Broda and Weinstein (2008), Gopinath, Gourinchas, Hsieh, and Li (2011) also have detailed product information. Nevertheless, to have price series for the exact same good for long periods is not common in the literature.

Another contribution of our paper is that it presents a simple model to shed light on the effects of competition in LOP deviation, vis-a-vis the role of borders. We develop an extension of the Hotelling (1929) model,[6] based on Irmen and Thisse (1998), which incorporates two competitive dimensions: distance between stores for a homogeneous good and variety 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) to show how competition–different numbers of varieties in the store–explains deviations from the LOP. It also explains the potential bias in the estimation of the border effect if competition is not accounted for in the empirical analysis.[7] 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

[4]Gopinath, Gourinchas, Hsieh, and Li (2011) established, "Our first task consist in restricting the initial sample of 125,048 unique products to a set of products that appears on both sides on the border..." (page 2455). Their final database consists on just 4,221 unique products. Nevertheless, Broda and Weinstein (2008) used the whole sample of products; see tables 3 and 4 in their Appendix.

[5]As local goods are not traded outside the country of origin, their border cost is infinite.

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

[7]A similar argument is made in Coşar, Grieco, and Tintelnot (2015a).

varieties at the same store, as measured by the varieties available to consumers. As the model is static in nature, we cannot assess the role of sticky prices in the analysis. Nevertheless, the model is useful for characterizing the different dimensions that affect relative LOP convergence in relation to previous models in the literature.

Our results show that competition has a sizable economic impact in terms of explaining deviations from the LOP, even after controlling for distance, border, and brand characteristics (e.g., different degrees of price stickiness). Our baseline regression indicates that competition explains up to 0.9 percent of price deviation, or up to 14 kilometers (two times the median distance of stores within cities in our sample). At the same time, the role of borders changes when we control for competition. For those goods that do not have local competitors, the size of the border becomes large: they add up to 1.4% of price variation, or 73 kilometers of distance. However, when there are competitors at the store the border becomes negligible.

At this stage two claims should be stated. First, we do not claim competition to be the ultimate force driving price divergence. The availability of different goods in a store could reflect differences in preferences, incomes, population, or other factors. Our interpretation is that the number of competitors is the market equilibrium, whose fundamentals need to be explained in future analyses. Second, we acknowledge a problem of endogeneity due to reverse causality, which does not allow us to claim a causal effect of competition on relative price divergence. It could be that local goods are available in some stores because the prices of international goods differ between stores. Nevertheless, the comparison of goods across countries needs to be performed using the same monetary unit, although the specific exchange rate for each product is usually not know to the analyst, which could be a source of errors in variables.

Our empirical strategy faces a trade-off. On the one hand, this methodology is adequate for avoiding the problems associated with exchange rates, taxes, language, non-price tariffs, differences in institutional settings,[8] and other factors typically associated with cross country analysis. All these forces make it difficult to disentangle the source of deviations to the LOP, which typically are subsumed under the border effect. At the same time, 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.

On the other hand, our methodology is better suited to analyzing the relative dispersion of prices across countries. If an analysis between countries was made, then local goods could be identified for each country. This would help to disentangle how much of the variation observed in the LOP attributed to the border is due to differences in the competitive settings in each country. Additionally, this would also lower the endogeneity problem due to reverse causality at the cost of increasing the problem of errors in variables.

[8]On the impact of the institutional setting see Anderson and Marcouiller (2002).

Our paper adds to different strands of the literature on LOP–either between or within countries–and on the effects of borders on price convergence. Similar to Coşar, Grieco, and Tintelnot (2015b) and Coşar, Grieco, and Tintelnot (2015a), our paper highlights the relevance of local market structure for analyzing price convergence. While these papers emphasize producer markets, we are the first to propose a methodology for measuring market structure at the retail level. At the same time, our methodology address the critique of Gorodnichenko and Tesar (2009), which established that differences in price dispersion between countries could be due to differences in baskets within those countries, which they called the country heterogeneity effect.[9] Our empirical methodology makes it possible to control for differences in the baskets between countries when measuring the relative convergence to the LOP.

We also add to the literature on the role of borders in explaining relative price divergence. This literature started with Engel and Rogers, 1996 and include Parsley and Wei (2001), Gorodnichenko and Tesar (2009), Gopinath, Gourinchas, Hsieh, and Li, 2011, and Coşar, Grieco, and Tintelnot (2015b) among many others. Goldberg and Verboven (2005) shows how the reduction in borders increases the convergence to the LOP.[10] Those papers found a significant impact of borders in terms of explaining the relative price dispersion between countries. Our methodology makes it possible to disentangle the role of competition from the border effect, in an attempt to understand the ultimate sources of price variations between countries.

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 unobserved product characteristics.

Finally, our paper contributes to a new strand of literature that emphasizes the macroeconomic outcomes of differences in the microeconomic environment–i.e., competition. As an example, Hong and Li (2017) and Antoniades and Zaniboni (2016) have studied the impact of different vertical organizations of firms and competitive conditions in the retail market on the pass-through of costs or exchange rate to prices. As the data became more granular and detailed, the microeconomic

[9]The fact that countries will differ in their product basket could be traced back at least to Dixit and Stiglitz (1977).

[10]However, see Dvir and Strasser, 2017 on the role of marketing in consumer price discrimination and in reducing LOP convergence in the European car market.

environment that generates the data could not be separated for understanding aggregated phenomena. Although our empirical model is a reduced form equation usually estimated in the literature, we believe that its microeconomic foundation is a first step to overcoming the problems addressed by Gorodnichenko and Tesar (2009).

The paper is organized as follows. The next section describes the database used to estimate the effect of the availability of substitutes on the estimation of the border effect. Section 3 introduces the equation to be estimated, the econometric results, and the robustness test to check the main results. Section 4 introduces the model and specifies the conditions that allow the prices of goods sold in different places to converge when substitutes are available. Finally, Section 5 presents the conclusions of the analysis.

2 Data

This section offers a detailed explanation of the database used in the empirical section and presents some preliminary results on the relative convergence of prices 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.[11] 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 real 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 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

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

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 international 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.[12]

The three best-selling brands are reported for each market, disregarding the 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 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. First, eliminating supermarkets own brands is key to attaching the competitive effect to products and not to stores. Supermarkets' own brands are not comparable across different chains, confusing the competition effect with a chain effect. Second, due to its construction, the database has the most relevant competitors in each market, simplifying the task of finding them or defining which goods should be considered actual competitors in the market. Although in some cases we lose information on other competitors that could be affecting the pricing decision of international brands, we assume this effect does not invalidate our results.

The 154 products in the database represent 50 markets defined at the product category level (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. The detailed list of goods can be found in Appendix B. The database has a larger number of supermarket chains than in Gopinath, Gourinchas, Hsieh, and Li (2011), who provide information for only one supermarket chain, although they also included daily prices.

For each market, we select only those that have both international and local brands. International brands are defined as those brands also sold in Argentina–Uruguay's neighbor country–while local brands are those sold only in Uruguay. To determine which goods are sold in Argentina, we check whether if each good in our database is in any of the supermarkets in Table 1 of Cavallo (2017), which lists a series of retailers that publish their price information on line. For the five listed retailers in Argentina, two (Easy and Sodimac) do not sell food or cleaning products, and the other two (Coto and Carrefour) do not have information online for all their goods. The only supermarket chain left is WalMart Argentina,[13] so we consider a good as being international if, for a given market, that brand was sold at WalMart Argentina, regardless of the specification. Interestingly, in most markets the main goods sold in Uruguay are not sold Argentina: only 18 of

[12]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.

[13]http://www.walmart.com.ar/

154 goods (12%) were also sold in Argentina. In turn, we discard those markets in which none of the good is sold in Argentina, following the approach of Gopinath, Gourinchas, Hsieh, and Li (2011). Nevertheless, for those markets in which brands sold in Argentina are present, we also keep the prices of the goods sold only in the Uruguayan market. The database has 18 international and 17 local brands. The next table presents details on each market and brand.

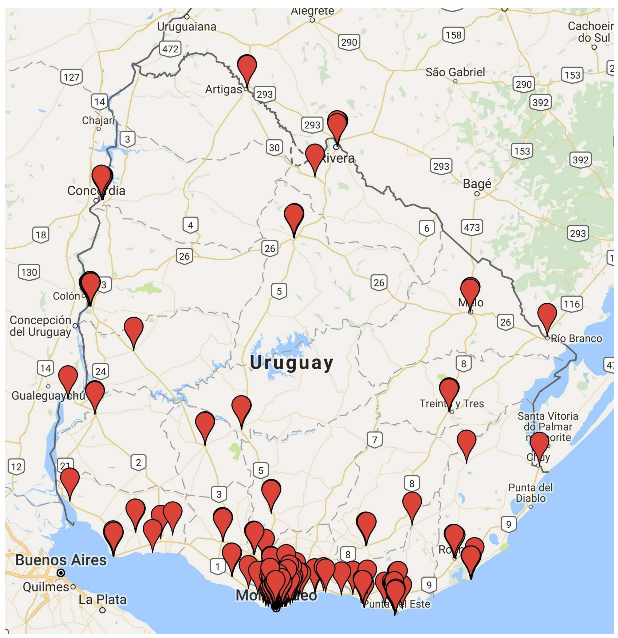
Table 1: Products in the database.

Market	**Brand**	**Presentation**	**International / Local**
Soft Drinks	Coke	1.5 liters	*International*
Soft Drinks	Pepsi	1.5 liters	*International*
Soft Drinks	Nix	1.5 liters	Local
Mayonnaise	Hellmans	0.5 kilos	*International*
Mayonnaise	Fanacoa	0.5 kilos	Local
Mayonnaise	Uruguay	0.5 kilos	Local
Tea	Hornimans	Box (10 units)	Local
Tea	La Virginia	Box (10 units)	*International*
Tea	Lipton	Box (10 units)	Local
Shampoo	Fructis	0.35 liters	Local
Shampoo	Sedal	0.35 liters	*International*
Shampoo	Suave	0.93 liters	*International*
Soap	Astral	0.125 kilos	Local
Soap	Palmolive	0.125 kilos	*International*
Soap	Suave	0.125 kilos	*International*
Peach jam	Dulciora	0.5 kilos	*International*
Peach jam	Limay	0.5 kilos	Local
Peach jam	Los Nietitos	0.5 kilos	Local
Laundry soap	Drive	0.8 kilos	*International*
Laundry soap	Nevex	0.8 kilos	Local
Laundry soap	Skip	0.8 kilos	*International*
Toilet paper	Higienol Export	4 units (25 meters each)	*International*
Toilet paper	Personal	4 units (25 meters each)	*International*
Toilet paper	Sin Fin	4 units (25 meters each)	Local
Bread	Los Sorchantes	0.330 kilos	Local
Bread	Bimbo	0.330 kilos	*International*
Bread	Pan Catalan	0.330 kilos	Local
Toothpaste	Pico Jenner	0.09 kilos	Local
Toothpaste	Colgate Total	0.09 kilos	*International*
Toothpaste	Kolynos	0.09 kilos	*International*
Wheat Flour 000	Canuelas	1 kilo	*International*
Wheat Flour 000	Cololo	1 kilo	Local
Wheat Flour 0000	Puritas	1 kilo	Local
Wheat Flour 0000	Canuelas	1 kilo	*International*
Wheat Flour 0000	Cololo	1 kilo	Local

Source: based on DGC information and author's online search.

For each supermarket we have detailed information about the exact location given by its Universal Transverse Mercator (UTM) as well as about whether it belongs to a chain. This information allows us to avoid measurement problems due to mismeasurement of the distance between stores (see Head and Mayer (2002)). 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 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.[14] The following figure shows the cities in the database and the supermarket distribution for Montevideo, which accounts for 54% of all supermarkets in the sample.

Figure 1: Cities covered in the sample and distribution of supermarkets.



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

Our database has 18,188,568 daily observations for the 35 goods in the twelve markets defined. We check for outliers in the sample by filtering each series to exclude those observations above three times (or a third) the daily median price.[15] After deleting outliers, 18,186,880 observations remain, so we lose less than 0.01% of the data. For each brand 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, and Nakamura and Steinsson, 2013). The inclusion of sales in the analysis will induce spurious deviations related to producer or retail

[14]More information is available at http://www.ine.gub.uy/uruguay-en-cifras.

[15]This is similar to Borraz, Cavallo, Rigobon, and Zipitría (2016) and more stringent than Klenow and Kryvtsov (2008), which excludes prices 10 times larger (see page 867).

commercial policies that introduce noise in the analysis of deviations of prices to the LOP. We also tested the robustness of the results using the monthly median and the average, although the latter is more sensible to sales. We obtain 599,059 monthly observations after the reduction procedure. We lose another 2,397 observations due to lack of information about one supermarket in the database. Finally, as in the Soap market local brands started reporting prices in November 2010, and so we discard the price information for international brands before that date. The final database contains 585,390 monthly observations. Our left hand variable in the analysis will be the absolute price difference for each product and month between all stores in the sample.

2.1 Descriptive statistics

All descriptive statistics in this section are calculated using the monthly mode price. We first show some statistics for the products in the database and then for the supermarkets. The following table describes the products in each category: if it is local or international, the month/year when the sample begins–all sample ends at September 2014–, the number of observations in each database (price and price differences), the share of supermarkets in which the product is available,[16] and the share of zero price differences. The Annex A shows additional information for each product (descriptive statistics for the monthly price in Table 9), for supermarket chains (Table 10), and for Uruguayan states (Table 11).

[16] We count a supermarket if the product is available at that supermarket at least one month in the sample.

Table 2: Sample information of the database.

				Price database		*Price diff. database*	
Market	**Brand**	**Intern./ Local**	**Sample Start**	**# Observations**	**% Supermarkets**	**# Observations**	**% Zeroes**
Soft Drinks	Coke	*International*	2007/04	27,197	99	4,138,327	32
Soft Drinks	Nix	Local	2007/04	6,365	37	—	—
Soft Drinks	Pepsi	*International*	2010/11	13,095	97	1,846,893	19
Mayonnaise	Fanacoa	Local	2007/04	21,463	96	—	—
Mayonnaise	Hellmans	*International*	2007/04	26,497	99	3,930,531	12
Mayonnaise	Uruguay	Local	2007/07	12,649	56	—	—
Tea	Hornimans	Local	2007/04	26,859	99	—	—
Tea	La Virginia	*International*	2007/04	21,257	82	2,521,377	27
Tea	President	Local	2010/11	12,976	89	—	—
Shampoo	Fructis	Local	2007/04	17,938	85	—	—
Shampoo	Sedal	*International*	2007/04	21,640	99	2,667,262	11
Shampoo	Suave	*International*	2007/04	21,309	97	2,661,978	11
Soap*	Astral	Local	2010/11	14,840	99	—	—
Soap*	Palmolive	*International*	2007/04	13,583	96	1,968,329	11
Soap*	Suave	*International*	2012/12	4,645	74	495,916	15
Peach jam	Dulciora	*International*	2007/04	17,708	77	1,811,549	29
Peach jam	Limay	Local	2010/11	10,028	75	—	—
Peach jam	Los Nietitos	Local	2007/04	25,611	96	—	—
Laundry soap	Drive	*International*	2007/04	23,677	97	3,165,237	12
Laundry soap	Nevex	Local	2007/04	25,902	99	—	—
Laundry soap	Skip	*International*	2007/04	21,623	97	2,962,445	9
Toilet paper	Elite	*International*	2010/11	13,607	97	1,985,337	9
Toilet paper	Higienol Export	*International*	2007/04	25,267	100	3,576,168	10
Toilet paper	Sin Fin	Local	2007/04	25,286	99	—	—
Bread	Los Sorchantes	Local	2010/11	13,976	93	—	—
Bread	Bimbo	*International*	2010/11	13,086	91	1,830,266	16
Bread	Pan Catalan	Local	2010/11	9,015	68	—	—
Toothpaste	Colgate Herbal	*International*	2010/11	15,235	100	2,469,580	16
Toothpaste	Kolynos Triple acción	*International*	2010/11	14,117	97	2,125,720	12
Toothpaste	Pico Jenner	Local	2010/11	8,436	63	—	—
Wheat Flour 000	Canuelas	*International*	2010/11	9,759	73	1,021,638	20
Wheat Flour 000	Cololo	Local	2010/11	4,524	38	—	—
Wheat Flour 0000	Canuelas	*International*	2007/04	21,156	84	2,515,242	17
Wheat Flour 0000	Cololo	Local	2007/04	17,643	87	—	—
Wheat Flour 0000	Primor	Local	2010/11	7,421	54	—	—
Total	-	-	-	585,390	-	43,693,795	16

*Except for Sample Start, information for the adjusted sample–2010/11–to match local brand availability.
Source: author's calculation.

Two conclusions arise from the previous table. First, the absolute LOP do not hold even in a small country such as Uruguay. On average, less than one in six price differences are equal in our database. This result leaves room for explaining the factors that relate to these differences. Second, there is variation in the maximum share of stores that sell local brands, with a minimum of 37% in the Soft Drink market and a maximum of 99% in the Toilet Paper and Laundry Soap markets. This variation will be used to identify the effect of competition in the same way as distance is usually used to identify transport costs (see Atkin and Donaldson, 2015).

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.

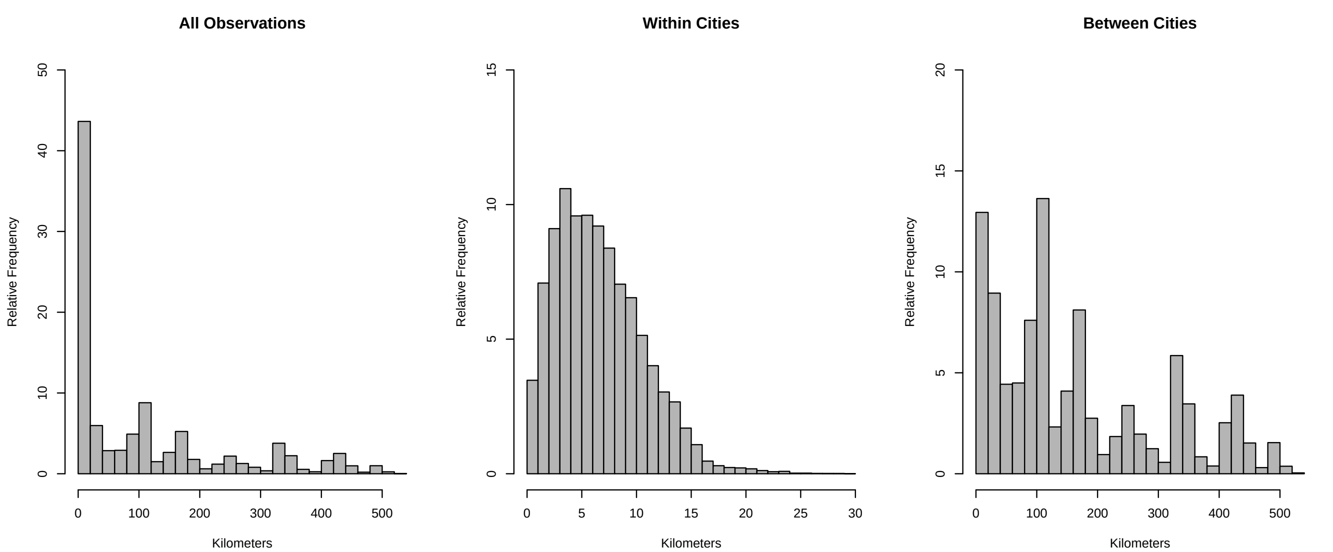
Table 3: Descriptive statistics for distance between supermarkets (in kilometers).

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

Source: author's calculation.

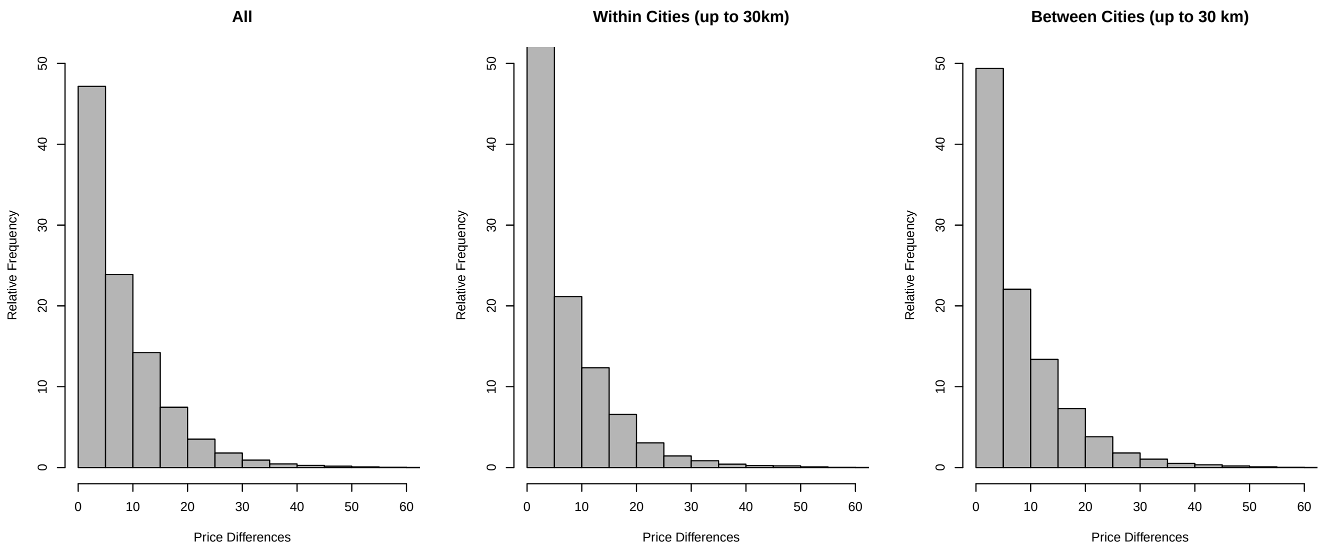
Figure 2 plots the distribution of observations in the price difference database by distance in the sample. The first histogram (left) shows the distribution of observations for the whole sample, while the second (center) and third (right) show histograms of observations by distance within and between 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 2: Observations by distance in the sample.



Next, we show the distribution of price differences, associated with the three main sources of deviation from the LOP: distance, borders, and competition. First, 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.

Figure 3: Distribution of price differences.



Second, we plot the price differences taking into account variations in competitive conditions. When there is one local competitor at the store, price differences tend to be less equal, in comparison to price differences when there are no local competitors. The figure below plots the density of price differences according to alternative competitive conditions. When there is no local competitor, the density is more peaked at zero than price differences when one store has a local competitor.

Figure 4: Density of price differences by competitive conditions.

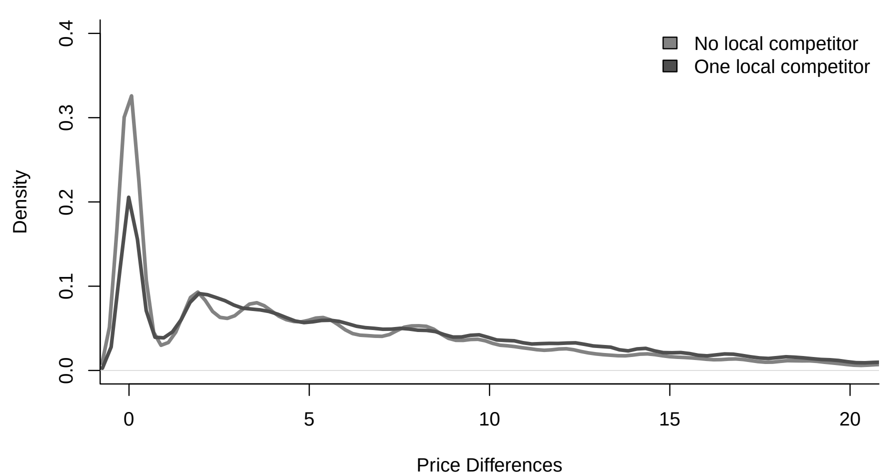


Table 4 shows summary statistics of price differences to illustrate the main message of the paper. We show the median, standard deviation, and number of exact zeroes of price differences for the pooled sample of international goods for different configurations. The median price differences between cities is 6.1%, 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.

It is interesting to note that the median price difference within and between cities is very similar to the median price difference if the store has no or only one competitor, as show in Table 4. The median price difference is 35% larger between cities in relation to the price difference within cities, and 41% larger for stores that have no competition for international brands in relation to price differences for store pairs that have a local competitor in one store. The raw analysis shows that the competitive effect of local brands results in larger deviations from the LOP than the border effect of stores being in different cities. Nevertheless, this calculation does not have controls for trade costs, i.e., distance.

More interestingly, the data allow us to compute the exact number of price coincidences or the number of times the absolute version of the LOP version holds in the sample. For the whole sample, nearly a sixth of the prices are equal. This number increases for stores within cities and for international brands that do not have competition to one in five. These figures are nearly twice what is found in situations where stores are in different cities or there is competition for international brands. This descriptive evidence shows a role for borders and competition in explaining LOP divergences.

Table 4: Deviations of Law of One Price under different configurations.

	Median	**St. dev.**	**% Exact Zeroes**	**# of obs.**
Total	5.4	7.9	16.0	43,693,795
Between cities	6.0	7.9	12.2	28,195,843
Within cities	4.4	7.8	23.0	15,497,952
No local competitor	4.5	7.9	23.0	8,521,907
Local competitor at one store	6.0	8.2	11.8	11,811,649

Source: author's calculation.

The next section presents the main estimation strategy to disentangle the effects of borders and local competitive conditions on relative prices. We exploit the previous variation in both dimensions to show how local competitive conditions affect the estimation of the border effect.

3 Estimation Strategy

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, 2017, Engel and Rogers, 1996, Goldberg and Knetter, 1997, and–with some differences–Coşar, Grieco, and Tintelnot (2015b), among others). Our base estimation for LOP deviation–adapted from Engel and Rogers (1996)–as follows:

$$|p_{ist} - p_{irt}| = \sum \alpha_i + \alpha_{ch} + \gamma \times T + \beta_1 \times Dist_{sr} + \beta_2 \times Border_{sr} + \varepsilon_{isrt}, \tag{1}$$

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 logs of the price of good i between stores s, r at moment t;[17] 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; T is a time trend; $Dist_{sr}$ 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 actually 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, 2017 for the US, Borraz and Zipitría, 2012 for Uruguay), and a time trend that accounts for the long-term convergence of prices.

Our analysis proposes a simple modification of equation 1, which we introduce in two steps. As detailed in Section 2, our database makes it possible to establish whether a local brand is available at each store and market. Therefore, for each month and good we compute a binary variable that takes the value of one if a local competitor is present at one or both stores. When price differences are calculated, three situations are possible: both stores have local competitors, neither store has local competitors, or there are competitors at only one of the two stores. As the effect on relative prices could be different in the three situations, we introduce two new dummies to control for the availability of local brands at each store.

Nevertheless, the model in Section 4 shows that the effects of competition could be more complex if stores are in different cities. If there are differences in competition between stores as well as a border, then both effects could bias the estimation if interactions are omitted. As a result, we also add an interaction between border and competition to disentangle both effects.

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

Now, equation 1 transforms into the following:

$$|p_{ist} - p_{irt}| = \sum \alpha_i + \alpha_{ch} + \gamma \times T + \beta_1 \times Dist_{sr} + \beta_2 \times Border_{sr} + \alpha_1 \times OneLocal_{isrt} + \alpha_2 \times BothLocal_{isrt}$$

$$+\beta_4 \times OneLocal_{isrt} \times Border_{sr} + \beta_5 \times BothLocal_{isrt} \times Border_{sr} + \varepsilon_{isrt} \ , \tag{2}$$

where *OneLocal* takes the value of one–at time t–if either store (s, r) sold the local brand that competes with good i, and *BothLocal* takes the value of one if–at time t–both stores (s, r) sold the local brand that competes with good i. Equation 2 corrects for the direct effect of local competitors on price dispersion as well as for its effect on the estimation of the border effect.

This methodology could be easily adapted to the case when more than one country is studied. Assume that we are studying the LOP deviations between the US and Canada. In this case, *OneLocal* could be transformed into "US local competitors" to measure product competitors that are only available in the US, and *BothLocal* could be transformed into "Canadian local competitors" to measure product competitors that are only available in Canada. This simple transformation could also help us to understand which country adds to price dispersion (see Gorodnichenko and Tesar, 2009)

Table 5 shows the main results for the estimation of equations 1 and 2 for the international products in our database.[18]

[18] Price differences are multiplied by 100. The intercept dummy is omitted in all equations. We do not cluster the standard errors because there is neither clustering in the sample nor in the assignment (see Abadie, Athey, Imbens, and Wooldridge, 2017).

Table 5: Estimation of LOP deviation (baseline regression).

	Eq. 1	Eq. 2
Distance	0.358***	0.321***
	(0.004)	(0.001)
Border	0.205***	1.382***
	(0.004)	(0.006)
One Local		0.878***
		(0.006)
Both Local		-0.588***
		(0.006)
One Local ×Border		-1.607***
		(0.007)
Both Local ×Border		-1.348***
		(0.006)
# Observations	43,693,795	43,693,795
Time dummy	Yes	Yes
Product dummies	Yes	Yes
Same Chain Dummy	Yes	Yes
R square	0.082	0.087

*** $p < 0.01$. Standard errors in parentheses.

As is typical in the literature, we will show the results of competition and border in terms of equivalent distance. Consistent with the literature, the results of the estimation of equation 1 show a role for trade cost in explaining LOP deviations. Every 15 kilometers of distance between stores adds 1% of variation to prices,[19] after controlling for product characteristics and for stores belonging to the same chain.[20] This result implies a price difference of 0.4 percent for the median distance between two stores within a city and a 7.8 percent price difference for the median distance between two stores between cities. [21] The impact of borders is more limited: buying in different cities add a 0.2% of variation to prices. In terms of equivalent distance, crossing to a different city equates to adding 0.8 kilometers.[22]

The estimation of equation 2 shows a very different picture. First, note that the distance parameter is not highly affected by the correction of competition. This interesting result shows that, at least in our sample, factors that affect trade costs are not related to other variables, particularly to competition. Second, for those goods that do not have a local competitor–i.e.,

[19] As price differences are listed as percentages, a 1% difference in prices accounts to $exp\,(1/0.358) - 1 = 15.3$ kilometers.

[20] Although not reported in Table 5, it is interesting to note that if stores belong to the same chain, price dispersion is reduced by 3%. This result is in line with DellaVigna and Gentzkow (2017).

[21] According to Table 3, the median distance between two stores within a city is 6 kilometers, and it is 119 kilometers for two stores between two cities.

[22] The distance equivalent measure of distance is calculated as $\beta_2 = \beta_1 \times \ln(d+1)$. In this case, $0.8 = exp\,(0.205/0.358) - 1$.

dummies *OneLocal* and *BothLocal* are zero–the size of the border increase substantially. Thus, now the border add 1.4% to price variation, equivalent to 73 kilometers of distance between stores.[23] As the median distance between two stores in different cities is 119 kilometers, the previous result implies that the price difference increases by nearly 60% due to borders.[24] To put it differently, when products do not face competition, price discrimination, that is, different prices in different cities, is large.

Third, the effect of competition is large. To add a competitor to a store increases price dispersion by 0.9%. As this effect is independent of distance, the result is sizable. It is equivalent to 14 kilometers of distance in transport costs, which is nearly two times larger than the median distance between two stores within a city. At the same time, adding a competitor to a store actually reduces the variation induced by the border by -0.2%.[25] In other words, the border decreases the variability of prices induced by transport costs when one store introduces a local competitor. As section 4, shows the effect of the border could go in the opposite direction to the effect of competition.

Fourth, to add a local competitor in each store reduces price dispersion by 0.6% in relation to a pair of stores that do not sell local products. We do not expect any particular result in the comparison of relative price dispersion whether both stores have local brands or neither store has a local brand. On the one hand, this reinforces the idea that the comparison of different baskets in different stores has a huge impact on price dispersion. On the other hand, if our intuition a priori is that the relative price dispersion induced by competition should be similar to that related to not having competition, this result could point to measurement error in the local competitor variable. The database has information on just three goods in each market. As a result, in some of them we could be missing information from other competitors that could be introducing variability in the price difference while not being captured by our competition dummy. Finally, note that in this case the estimated border is nearly zero.

To summarize, we found a large effect of competition on price dispersion. Adding a competitor to a store increases price dispersion by 0.9%. The estimation of trade costs is not affected by the inclusion of competition. Nevertheless, the border appears relevant when there are no competitors for international brands at the store. Price discrimination by producers could be an explanation for this fact. In the next section, we perform robustness checks for our results.

3.1 Robustness

This section shows several robustness checks for our main results. First, we estimate equations 1 and 2 using other measures of central tendency (e.g., monthly average and median price). The

[23]The performed calculation is $73 = exp\,(1.382/0.321) - 1$.

[24]The calculation is 119 kilometers of median distance plus 46 kilometers of the estimated border over 119 kilometers.

[25]The difference between 1.382, the coefficient of the border, and 1.607, the interaction between the border and *OneLocal*.

results–see table 12 in the Appendix–do not show significant changes in sign or magnitude. As expected, the results using the mean monthly price are somewhat larger in magnitude due to the fact that they are affected by sales.

Second, as shown in Table 11, Montevideo (the capital city of Uruguay) accounts for nearly half of the supermarkets and observations in the sample. Thus, we run regressions 1 and 2, adding a dummy that takes a value of one if any supermarket is located in Montevideo (i.e., we estimate the Montevideo border). Again, the results do not differ from those previously found.

Table 6: Estimation of LOP deviation (controlling for Montevideo city).

	Eq. 1	Eq. 2
Distance	0.340***	0.326***
	(0.001)	(0.001)
Border	0.189***	1.363***
	(0.004)	(0.006)
Montevideo	-0.292***	-0.269***
	(0.003)	(0.003)
One Local		0.879***
		(0.006)
Both Local		-0.585***
		(0.006)
One Local ×Border		-1.601***
		(0.007)
Both Local ×Border		-1.344***
		(0.006)
# Observations	43,693,795	43,693,795
Time dummies	Yes	Yes
Product dummies	Yes	Yes
Same Chain Dummy	Yes	Yes
R square	0.082	0.087

*** $p < 0.01$. Standard errors in parentheses.

Third, we allow a different definition of border. Uruguay is a centralized country. Taxes, such as VAT, are set at the country level. However, Uruguay has nineteen states, called "departamentos." States have some power to set rules locally, such as public transport policies or allowing entry by new supermarkets. These policies could be the same for cities in the same state. As a result, we use states as an alternative to cities as a definition of geographical region. More information about states can be found in Table 11 in the Appendix A. Again, the results are not significantly different from those previously found.

Table 7: Estimation of LOP deviation (using state).

	Eq. 1	Eq. 2
Distance	0.363***	0.347***
	(0.001)	(0.001)
Border	0.185***	1.382***
	(0.004)	(0.006)
One Local		0.873***
		(0.006)
Both Local		-0.602***
		(0.006)
One Local ×Border		-1.644***
		(0.006)
Both Local ×Border		-1.367***
		(0.006)
# Observations	43,693,795	43,693,795
Time dummies	Yes	Yes
Product dummies	Yes	Yes
Same Chain Dummy	Yes	Yes
R square	0.082	0.087

*** $p < 0.01$. Standard errors in parentheses.

Fourth, as distance increases, the economic conditions that underlie the analysis could also change, even for a small homogeneous country such as Uruguay. In order to account for omitted variables that could bias the results, we restrict distance to more homogeneous economic conditions.[26] We estimate equation 1 and equation 2 for 20, 30, and 40 kilometers. Table 3 shows that the maximum distance between two stores within a city in our sample is 29 kilometers, so we take a third less and a third more than that distance. Nevertheless, the distance is less than the 500 kilometers proposed by Gopinath, Gourinchas, Hsieh, and Li (2011).

As distance decreases, we expect more homogeneous prices–i.e., less price dispersion–and lower estimated coefficients. The distance coefficient decreases to a third, the border coefficient doubles in the estimation of equation 1, and it decreases by half in the estimation of equation 2. The competition coefficient for *OneLocal* also decreases by a half in the estimation of equation 2, and the interaction with border became negative. Nevertheless, in relative terms the results remain consistent.

Moreover, the economic effect is much larger than the one found in the baseline regression. Consider the case of 20 kilometers. The effect of competition in explaining price dispersion is economically significant–nearly half a percentage point–and equivalent to 167 kilometers in terms of trade costs.[27] The explanation power of trade costs decreases much faster as distance decreases,

[26]We are grateful to Roberto Rigobon for suggesting this robustness check to us.
[27]The performed calculation is $176 = exp\,(0.559/0.108) - 1$.

Table 8: Estimation of LOP deviation (for 20, 30, and 40 kilometers)

	20 kilometers		**30 kilometers**		**40 kilometers**	
	Eq. 1	Eq. 2	Eq. 1	Eq. 2	Eq. 1	Eq. 2
Distance	0.127***	0.117***	0.132***	0.119***	0.120***	0.110***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Border	0.509***	0.602***	0.462***	0.553***	0.458***	0.555***
	(0.005)	(0.010)	(0.005)	(0.009)	(0.005)	(0.009)
One Local		0.405***		0.413***		0.419***
		(0.006)		(0.006)		(0.006)
Both Local		-1.443***		-1.435***		-1.426***
		(0.007)		(0.006)		(0.006)
One Local ×Border		-0.334***		-0.261**		-0.254***
		(0.011)		(0.011)		(0.010)
Both Local		-0.001		-0.027***		-0.040***
×Border		(0.011)		(0.010)		(0.009)
# Observations	19,062,097	19,062,097	21,125,466	21,125,466	21,669,886	21,669,886
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes	Yes	Yes
Same Chain Dummy	Yes	Yes	Yes	Yes	Yes	Yes
R square	0.130	0.136	0.129	0.134	0.128	0.133

*** $p < 0.01$, ** $p < 0.05$. No asterisk means no significant. Standard errors in parentheses.

but competition much slower. The economic value of the border also increases and accounts for an added distance of 138 kilometers.[28] When more homogeneous conditions are studied, the effect of competition and borders is larger.

To summarize, the robustness test performed reinforces the relevance of competition in explaining deviations from the LOP. The next section offers a microeconomic-based model to explain the role of competition in LOP deviations. Moreover, it helps to explain how competition and price discrimination–borders–interact and the possible bias that can arise.

4 A Simple Model of LOP Deviations

This section offer a simple model to explain sources of deviations from the LOP. As the empirical analysis has changed its source of data by refining the analysis to specific products and stores the model need to encompass these specific and distinct environment. Our model is designed to capture more realistically the competitive setting of retailers, which include basket of goods for the consumer to choose. This setting makes substitution of products within stores easy for consumers.

We propose a simple 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.[29] This extension allows to capture trade costs –the distance dimension–, but also competition 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. The model also incorporate borders as a source of relative price divergence between stores. To disentangle the sources of price variations we will decompose the source of deviations from the LOP in three: variety, borders, and both variety and borders. As the model is static in nature the role of sticky prices will not be introduced in the analysis.

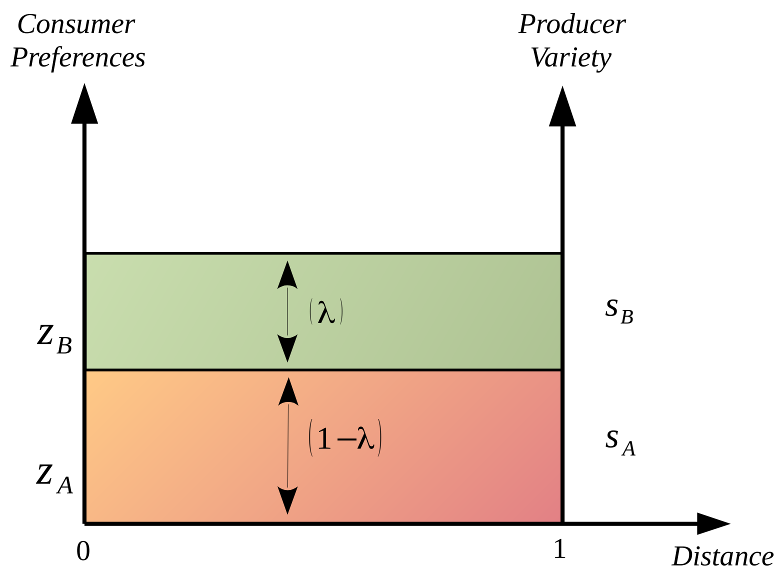
The main setting is a road that has two types of consumers uniformly located, and at each store two varieties of a given product can be sold; i.e., at a given location, two possible varieties of a good are available to consumers, say Coke and Pepsi. More formally, we propose a modification of Irmen and 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 λ of consumers that prefers variety z_A, and a mass $1 - \lambda$ consumers that prefers variety z_B. The model could be represented

[28] The performed calculation is $138 = exp\,(0.538/0.108) - 1$.

[29] A previous version of this paper offer 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.

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 λ, and the total mass of consumers is $L \times \lambda$. The second line is for consumers that prefers variety z_B, its thickness is $(1-\lambda)$, and there is a total mass of consumers of $L \times (1-\lambda)$. Figure 5 below depicts the main setting of the model. The left y axis represent the consumers preferences for variety $(z_A,\ z_B)$, while the right y axis depict the possible varieties sold by firms $(s_A,\ s_B)$. To link our model with the empirical analysis assume that variety s_A represents an international brand and variety s_B represents a local brand.

Figure 5: The two dimensional model.



Products have a physical –distance– identification (d) but also a variety identification (s). Producers 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:

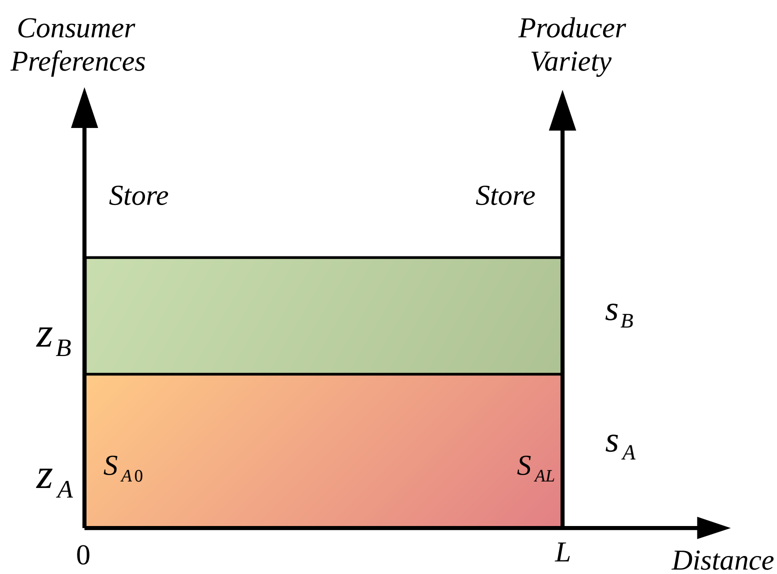
$$U_{ij} = r - \theta \left\{ if \ z_i \neq s_q \right\} - t \left| x_j - x_d \right| - p_{qd},$$

where r is the reservation utility of the consumer –equal for all consumers–, i indicates the variety preference of the consumer $(ie.\ z_i = \{z_A,\ z_B\})$, 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.

First, we derive the equilibrium conditions for two goods of the same variety (i,e., the traditional Hotelling problem), and then we add a third good that differs in variety and derive the pricing equilibrium conditions. We assume that each good is sold by a different producer/store.

Suppose there are two stores that sell the same variety $z_A = s_A$ of the good. The stores are located in opposite places on the street. The first store is located at 0 and the second store at L, therefore L is also the distance between the stores. We label both stores 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. The situation is depicted in Figure 6.

Figure 6: The model with two stores.



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 $r - \theta - t\,|L - x| - p_{AL} \geq 0$ 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:[30]

$$r - t\widehat{x} - p_{A0} = r - t\,|L - \widehat{x}| - p_{AL}, \tag{3}$$

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

$$\widehat{x} = \frac{p_{AL} - p_{A0} + tL}{2t}. \tag{4}$$

The demand for store S_{A0} 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 $\Pi_{A0} = p_{A0} \times D_{A0}$ and $\Pi_{AL} = p_{AL} \times D_{AL}$, as we have assumed that cost are zero. 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, $L/2$–.

4.1 Variety

In this simple model prices will diverge if the symmetry between stores is broken. We accomplish this by introducing a second variety at one of the extremes of the road. Specifically, assume that at location 0 there is another store that sell variety s_B to consumers. This store also has zero production cost. As the model is continuous in the distance dimension but not on the variety dimension, we need to introduce additional assumptions in order to consumers buying product s_B. We will 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 guarantees consumption for both goods, or entry of the new brand.

These assumptions add one additional restriction to the model. Consumers located at 0 that have preference for variety z_A will prefer to buy brand s_A at store S_{A0} if $r - p_{A0} > r - \theta - p_{B0} \iff p_{A0} - p_{B0} < \theta$. Consumers located at 0 that have preference for variety z_B will prefer to buy brand s_B at store S_{B0} 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 stores S_{A0} and S_{B0} in order to both goods have demand:

$$|p_{A0} - p_{B0}| < \theta. \tag{5}$$

Now we find the consumers who are indifferent about buying from stores S_{B0} and S_{AL}. Take

[30] Note that the same reasoning applies for the s_B consumer.

the case of a consumer located at $\widetilde{x}$ that prefers variety z_B. She will be indifferent between buying variety s_B at store S_{B0} or variety s_A at store $S_{AL} \iff$

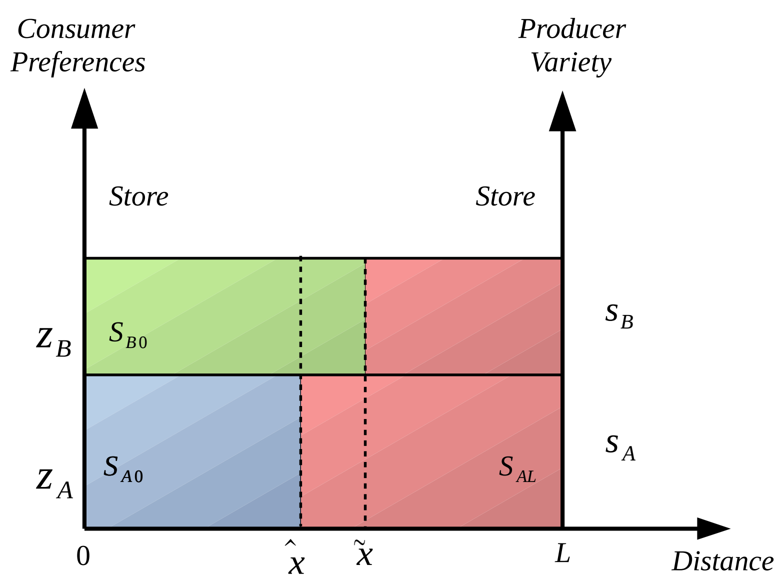
$$r - t\widetilde{x} - p_{B0} = r - \theta - t\,|L - \widetilde{x}| - p_{AL}, \tag{6}$$

and

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

A comparison of equations 4 and 7 shows that $\widetilde{x} > \widehat{x} \iff p_{A0} - p_{B0} < \theta$. If instead we assume that $\widetilde{x} < \widehat{x}$, then equations 4 and 7 imply that $\theta < p_{B0} - p_{A0}$, and this result violate inequality 5. Figure 7 depicts the possible location of $\widetilde{x}$ for a given location of $\widehat{x}$ and the demand for each store.

Figure 7: Possible equilibrium values of $\widetilde{x}$ and $\widehat{x}$. 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 brand/store, taking into account the previous results. Demand for firm S_{A0} is: $D_{A0} = (1-\lambda)\,\widehat{x} = (1-\lambda)\,\frac{p_{AL}-p_{A0}+tL}{2t}$. Profits are $\Pi_{A0} = p_{A0} \times D_{A0}$. The first order constraint of the problem is $\frac{\partial \Pi_{A0}}{\partial p_{A0}} = 0 = \frac{(1-\lambda)}{2t}\left[p_{AL} - 2p_{A0} + tL\right]$, therefore the reaction function is

$$p_{A0} = \frac{p_{AL} + tL}{2}. \tag{8}$$

Note that the reaction function of store S_{A0} selling brand depends –increasingly– only on the price of firm S_{AL}, but not on the price of store S_{B0}. This result holds because of the discrete nature of the variety dimension.

For firm S_{AL}, as $\widetilde{x} > \widehat{x}$, its demand is affected by the entry of firm S_{B0}, that 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: $\Pi_{AL} = p_{AL}\left[\left(\frac{p_{A0}-p_{AL}+tL}{2t}\right) - \lambda\left(\frac{\theta+p_{A0}-p_{B0}}{2t}\right)\right] = p_{AL}\left(\frac{(1-\lambda)p_{A0}-p_{AL}+\lambda p_{B0}-\lambda\theta+tL}{2t}\right)$. From the FOC we obtain:

$$p_{AL} = \frac{(1-\lambda)\, p_{A0} + \lambda p_{B0} - \lambda\theta + tL}{2}. \tag{9}$$

The reaction function of store S_{AL} is increasing in p_{A0} and p_{B0} as they are both substitutes.

Lastly, the demand for store S_{B0} is $D_{B0} = \lambda\widetilde{x} = \lambda\frac{p_{AL}-p_{B0}+\theta+tL}{2t}$. Profits are $\Pi_{B0} = p_{B0} \times \left[\lambda\frac{p_{AL}-p_{B0}+\theta+tL}{2t}\right]$. The first order constraint is $\frac{\partial\Pi_{B0}}{\partial p_{B0}} = 0 = \frac{\lambda}{2t}(p_{AL} - 2p_{B0} + \theta + tL)$. The reaction function for store S_{B0} is

$$p_{B0} = \frac{p_{AL} + \theta + tL}{2}. \tag{10}$$

The solution to the three equations system is:

$$p'_{A0} = tL - \frac{\lambda\theta}{6}, \tag{11}$$

$$p'_{AL} = tL - \frac{\lambda\theta}{3}, \tag{12}$$

$$p'_{B0} = tL + \frac{(3-\lambda)\,\theta}{6}. \tag{13}$$

The results show that the prices of stores S_{A0} and S_{AL} are now lower than if store S_{B0} is not in place. As competition increase, prices decrease. Also, in this model, the effect of variety is independent of the effect of distance.[31] The next Proposition summarizes the effect of variety on pricing.

Proposition 1. *Introducing variety into the distance model:*

1. *Decreases the price of goods of the same variety;*
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. □

Although the reaction function of the price of store S_{A0} does not depend on the price of store S_{B0}, it has an effect through the reaction function of price of store S_{AL}. As store S_{B0} induces the price of store S_{AL} to decrease, this affects the price of store S_{A0} in equilibrium. The effect of competition is more intense for store S_{AL}. In the next section, a border is added between the stores, and its effect on price convergence is evaluated.

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

4.2 Borders

Now we return to the original setting –one variety– and introduce the role of borders in the model. We introduce a cost for the consumer to cross a hypothetical border between stores.[32] This border cost could be language, the use of different paper money, paying a tax, etc. We assume that any of these factors imposes a cost on the utility of consumers, which they avoid by not crossing the border. We also assume that the border is between both stores, at point z. The border imposes a cost b for consumers that cross it in order to buy from a store located on the other side. Formally:

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

and δ equals 1 if the consumer located at j needs to cross the border to buy at a store located d, and 0 otherwise. To understand the effect of the border, we return for a moment to the model with just one variety. Assume in that model a border located at point $\widehat{x}$, that is, where consumers are indifferent about which store they will buy from. Imposing a border implies that there is not one indifferent consumer but two: one located at the left of the border and the other at its right. In turn, this implies that the border does not play any role if it is located where the indifferent consumer is.

Lemma 1. *If the border is located at the same point where the indifferent consumer is, then the border cost is not relevant in the analysis.*

Proof. Assume two consumers, each one located at ε of the border $\widehat{x}$. For the consumer at the left, his utility for buying in stores S_{A0} and S_{AL} is

$$r - t\,(\widehat{x} - \varepsilon) - p_{A0} > r - t\,[L - (\widehat{x} - \varepsilon)] - p_{AL} + d,$$

and solving for $(\widehat{x} - \varepsilon)$ we obtain $(\widehat{x} - \varepsilon) > \frac{p_{AL} - p_{A0} + tL}{2t} - \frac{d}{2t}$. For the consumer located at the right, his utility is

$$r - t\,(\widehat{x} + \varepsilon) - p_{A0} + d < r - t\,[L - (\widehat{x} - \varepsilon)] - p_{AL},$$

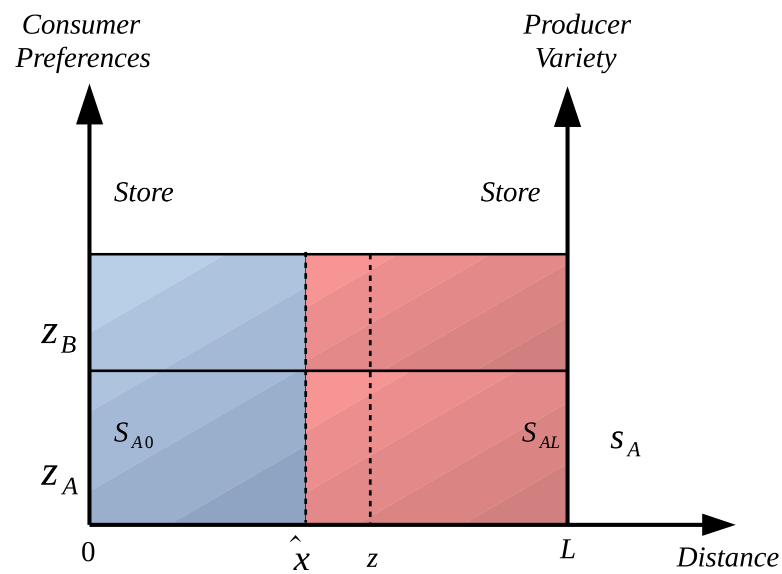
and solving for $(\widehat{x} + \varepsilon)$ we obtain $(\widehat{x} + \varepsilon) < \frac{p_{AL} - p_{A0} + tL}{2t} + \frac{d}{2t}$. As $\varepsilon \to 0$, we obtain $\frac{p_{AL} - p_{A0} + tL}{2t} - \frac{d}{2t} < \widehat{x} < \frac{p_{AL} - p_{A0} + tL}{2t} + \frac{d}{2t}$. Then, $\widehat{x} = \frac{p_B - p_A + tL}{2t}$. □

Lemma 1 says that the border is relevant only if it shifts consumers from buying in one store to buying in the other store. If consumer choice is not affected by the border then there is not border at all. But when the border shift the indifferent consumer, this movement has a limit equal to the location of the border itself. When the location of the border is reached, Lemma 1 establishes that no further displacement of the indifferent consumer occurs.

[32] A similar assumption is made in Gopinath, Gourinchas, Hsieh, and Li (2011).

Now we return to the original setting where there is only one variety (s_A) and introduce a border between stores. Assume also that the border is at z to the right of $\widehat{x}$, as the next figure shows.

Figure 8: A border at the right of $\widehat{x}$.



For every positive border cost, the indifferent consumer should move from $\widehat{x}$ through z. The new indifferent consumer $\widehat{x}^{'}$ should be equal to $\widehat{x}+b$, as the utility is lineal in cost. As a result, $\widehat{x}^{'}=\widehat{x}+b=\frac{p_{AL}-p_{A0}+tL}{2t}+b$, where $b\in[0,\,(z-\widehat{x})]$. If b is bigger than $(z-\widehat{x})$, then Lemma 1 establishes that the demand for store S_{A0} should be z. Now $D_{A0}=\frac{p_{AL}-p_{A0}+tL+2tb}{2t}$, and the new reaction function is $p_{A0}=\frac{p_{AL}+Lt+2tb}{2}$. Demand for store S_{AL} is $D_{AL}=\frac{p_{A0}-p_{AL}+tL-2tb}{2t}$, and the reaction function for price p_{AL} is $p_{AL}=\frac{p_{A0}+Lt-2tb}{2}$. The new equilibrium prices are:

$$p^b_{A0}=tL+\frac{2tb}{3}, \tag{14}$$

$$p^b_{AL}=tL-\frac{2tb}{3}, \tag{15}$$

Lemma 2. *Borders make price convergence more difficult.*

Proof. Now $p^b_{A0}-p^b_{AL}=\frac{4}{3}tb$. □

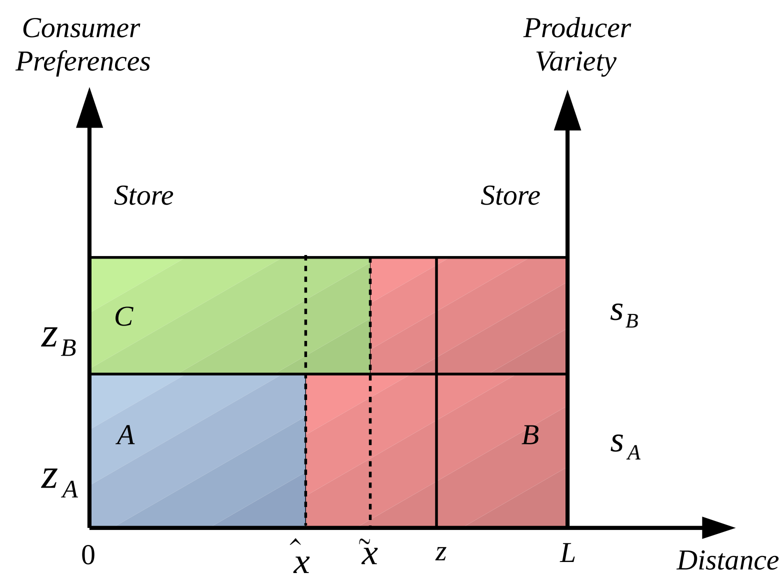
If z is at the left of $\widehat{x}$, then the sign of the border coefficients in equations 14 and 15 reverse, but the Lemma remains unchanged by simply reversing the price difference. We now compute the size of the border by substituting p^b_{A0} and p^b_{AL} in $\widehat{x}^{'}=\widehat{x}+b=\frac{5}{3}b+\frac{L}{2}$. As $\widehat{x}^{'}\in\left[\frac{L}{2},\,L\right]$, then $b\in\left[0,\,\frac{3}{10}L\right]$.

Borders shift demand, therefore prices change with borders and price convergence becomes more difficult. This is the standard result found in the literature, where borders increase price variability in relation to the volatility of prices within countries. The main point is to show that price non-convergence in this case is due to a border, while in the previous section is due to differences in store competition due to different varieties, as shown in Proposition 1.

4.3 Variety and Border

Now we incorporate both variety and borders to analyze its effects on LOP convergence. This setting is also interesting to show the interrelation between both variables. As the empirical analysis does not usually control for the competition effect, it will also allow to understand the effects on the estimation of the border effect. We incorporate a second variety at the beginning of the road and analyze the case where the border z is at the right of $\widetilde{x}$, and show the results for the case where the border z is at the left of $\widehat{x}$.[33] As $\widehat{x} \neq \widetilde{x}$, the effect of the border will be different for the consumers of variety s_A than for consumers of variety s_B. The next figure shows the case.

Figure 9: A border at the right of $\widehat{x}$ and $\widetilde{x}$ when there are two varieties.



The new indifferent consumers will be

$$\widehat{x}' = \widehat{x} + \widehat{b} = \frac{p_{AL} - p_{A0} + tL}{2t} + \widehat{b}, \tag{16}$$

[33]The case where z is between both $\widehat{x}$ and $\widetilde{x}$ cancel out, as the analysis below shows.

$$\widetilde{x}^{'} = \widetilde{x} + \widetilde{b} = \frac{p_{AL} - p_{B0} + tL + \theta}{2t} + \widetilde{b}, \tag{17}$$

where $\widehat{b} \in [0, (z - \widehat{x})]$ and $\widetilde{b} \in [0, (z - \widetilde{x})]$ and $\widetilde{b} \leq \widehat{b}$.[34] The border coefficient will be subtracted if the border z is at the left of $\widehat{x}$. The reaction function for store S_{A0} is the same as in the previous subsection: $p_{A0} = \frac{p_{AL}+Lt+2t\widehat{b}}{2}$. Demand for store S_{AL} will now be $D_{AL} = (1-\lambda) \times \left(L - \widehat{x}^{'}\right) + \lambda \times \left(L - \widetilde{x}^{'}\right)$ and substituting equations 16 and 17 and rearranging terms we obtain $D_{AL} = \frac{(1-\lambda)p_{A0}-p_{AL}+\lambda p_{B0}+Lt-\lambda\theta-2t\left[\widehat{b}-\lambda\left(\widehat{b}-\widetilde{b}\right)\right]}{2t}$.[35] Now the reaction function for firm S_{AL} is

$$p_{AL} = \frac{(1-\lambda)\, p_{A0} + \lambda p_{B0} + Lt - \lambda\theta - 2t\left[\widehat{b} + \lambda\left(\widetilde{b} - \widehat{b}\right)\right]}{2}.$$

Demand for store S_{B0} is $D_{B0} = \lambda\widetilde{x}^{'} = \lambda\left[\frac{p_{AL}-p_{B0}+tL+\theta+2t\widetilde{b}}{2t}\right]$,[36] and the new reaction function is

$$p_{B0} = \frac{p_{AL} + tL + \theta + 2t\widetilde{b}}{2}.$$

Substituting reaction functions we obtain:

$$p_{A0}^{bv} = tL - \frac{\lambda\theta}{6} + \frac{t\left[2\widehat{b} + \lambda\left(\widehat{b} - \widetilde{b}\right)\right]}{3},$$

$$p_{AL}^{bv} = tL - \frac{\lambda\theta}{3} - \frac{2t\left[\widehat{b} - \lambda\left(\widehat{b} - \widetilde{b}\right)\right]}{3},$$

$$p_{B0}^{bv} = Lt + \frac{(3-\lambda)\,\theta}{6} + \frac{t\left[(3-\lambda)\,\widetilde{b} - (1-\lambda)\,\widehat{b}\right]}{3}.$$

If the border z is at the left of $\widehat{x}$, the sign of the last term in the three price equations is reversed. This implies that the border coefficient could either be positive or negative, dependent upon where the border is displaced. As a result, the border effect could either reinforce or hinder the variety effect.

Lemma 3. *The border could diminish or augment the variety effect.*

Proof. Price difference $p_{A0}^{bv} - p_{AL}^{bv} = \frac{\lambda\theta}{6} + \frac{t\left[4\widehat{b}-\lambda\left(\widehat{b}-\widetilde{b}\right)\right]}{3}$ if the border z is at the right of $\widetilde{x}$. For the second case, if the border z is at the left of $\widehat{x}$, we have $p_{A0}^{bv} - p_{AL}^{bv} = \frac{\lambda\theta}{6} - \frac{t\left[4\widehat{b}-\lambda\left(\widehat{b}-\widetilde{b}\right)\right]}{3}$. □

When there are variety differences, the border effect always reinforces the variety effect. The main point of this section is twofold. First, the border coefficient changes when there is a com-

[34] The inequality is reversed if the border z is at the left of $\widehat{x}$.

[35] If border z is at the left of $\widehat{x}$, then the border coefficients will be subtracting. Thus, we obtain $D_{AL} = \frac{(1-\lambda)p_{A0}-p_{AL}+\lambda p_{B0}+Lt-\lambda\theta+2t\left[\widehat{b}-\lambda\left(\widehat{b}-\widetilde{b}\right)\right]}{2t}$

[36] Accordingly, $D_{B0} = \lambda\left[\frac{p_{AL}-p_{B0}+tL+\theta-2t\widetilde{b}}{2t}\right]$ if the border z is at the left of $\widehat{x}$.

petition –variety– effect. A comparison between price differences in Lemmas 2 and 3 shows that border coefficients change due to the variety effect. In Lemma 2, the border coefficient is $\frac{4}{3}b$ while in Lemma 3 it is $\frac{\left[4\widehat{b}-\lambda\left(\widehat{b}+3\widetilde{b}\right)\right]}{3}$ in absolute terms. Second, there is a variety effect in Lemma 3 that, if not accounted for, could bias the estimation of the border coefficient. In addition to the border coefficient, the term $\frac{\lambda\theta}{6}$ in Lemma 3 will be added to the border if not accounted for in the estimation. These results are shown in the paper's main proposition.

Proposition 2. *The availability of competitive –variety– substitutes bias the estimation of the border effect through two channels*

1. *A direct effect bias* $\left(e.g.,.\ \frac{4}{3}b\ vs.\ \frac{t\left[4\widehat{b}-\lambda\left(\widehat{b}-\widetilde{b}\right)\right]}{3}\right)$
2. *An indirect effect bias* $\left(\frac{\lambda\theta}{6}\right)$ *due to the availability of different varieties*

The model presented in this section has shown that competition is a source of relative price divergence between stores. We also show that the interplay between competition and the border effect is more complex than previously thought, as they are intertwined and their directions could be offset or reinforced. The conclusions of the model gave a reasonable underpinning for our empirical analysis.

5 Conclusions

Several papers have shown deviations from the LOP either across or within countries. The literature offers different sources of this phenomena. This paper presents a new source of relative price divergence: difference in competition across stores and, potentially, countries. We extend the literature on LOP deviations by estimating the effect of competition on price differences. Our results show a sizable effect of competition in explaining LOP deviations, even after controlling for product fixed effect, stores belonging to the same chain, and border effect.

Our baseline specification shows that competition increases price dispersion up to 0.9%, equivalent to 14 kilometers in terms of trade costs (more than two times the median distance of two stores within cities in Uruguay). Controlling for competition also allows us to uncover a more subtle role of borders. When there are no local competitors, borders add up to 1.4 percent of price variation, equivalent to 73 kilometers of distance between stores. However, when there are local competitors, borders become negligible or even negative. This result shows that borders are used to price discriminate consumers.

Our proposed estimation could be easily modified to encompass the analysis of different countries. If two countries "A" and "B" are under study, two dummies that control for local competitors in country "A" and country "B" could be created. This could also help to partially control for differences in baskets of goods across countries (see Gorodnichenko and Tesar, 2009).

The paper also introduces a model to explain the role of competition in price variation. The effect of competition is more blurry when there are borders between stores. In such cases, the border could diminish or augment the competition–variety–effect. The model is a starting point for analyzing other effects that could induce price deviations between stores.

Finally, we do not claim that competition is the ultimate force driving price divergence. Several other explanations could underlie the differences in competitive conditions in markets across stores or countries, such as preferences, income, population, infrastructure (i.e., roads), marketing, and distribution channels. In the same vein, further research is needed to disentangle the ultimate sources that express themselves into differences in competition. The availability of more detailed databases allows us to perform finer analyses on individual markets to uncover aggregate effects.

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A Additional Tables

Table 9: Descriptive statistics for each product in the database.

			Price database				*Price difference database*			
Market	**Brand**	**Intern./ Local**	**Minimum**	**Median**	**Maximum**	**SD**	**Minimum**	**Median**	**Maximum**	**SD**
Soft Drinks	Coke	*International*	13.0	42.0	68.0	9.2	0.0	2.5	93.0	6.0
Soft Drinks	Pepsi	*International*	30.0	52.0	70.0	6.2	0.0	4.1	82.2	5.6
Mayonnaise	Hellmans	*International*	17.5	52.5	89.0	11.1	0.0	6.2	97.2	6.5
Tea	La Virginia	*International*	7.9	13.0	26.0	2.1	0.0	5.2	102.8	8.6
Shampoo	Sedal	*International*	31.0	80.0	165.0	16.3	0.0	5.9	119.1	7.5
Shampoo	Suave	*International*	20.0	60.0	111.0	18.9	0.0	6.5	122.7	8.6
Soap*	Palmolive	*International*	12.0	19.6	48.0	2.9	0.0	9.5	80.2	9.0
Soap*	Suave	*International*	13.3	21.0	52.0	2.3	0.0	9.5	136.1	10.0
Peach jam	Dulciora	*International*	14.5	32.0	53.0	7.1	0.0	3.2	88.6	8.8
Laundry soap	Drive	*International*	25.0	48.0	99.0	6.1	0.0	5.0	100.6	6.5
Laundry soap	Skip	*International*	50.0	76.5	136.0	10.3	0.0	4.8	78.8	6.1
Toilet paper	Elite	*International*	17.0	42.4	60.0	5.8	0.0	6.8	98.6	8.0
Toilet paper	Higienol Export	*International*	10.5	29.0	60.0	7.5	0.0	6.2	106.4	8.1
Bread	Bimbo	*International*	31.0	49.0	71.0	7.5	0.0	3.5	56.3	5.1
Toothpaste	Colgate Herbal	*International*	19.0	33.6	52.0	5.0	0.0	8.5	84.1	9.2
Toothpaste	Kolynos Triple acción	*International*	16.9	28.0	56.5	3.8	0.0	7.6	104.6	10.2
Wheat Flour 000	Canuelas	*International*	13.7	22.0	38.0	3.1	0.0	8.7	86.5	8.6
Wheat Flour 0000	Canuelas	*International*	10.0	24.0	41.0	4.9	0.0	6.6	97.2	8.1

*All data for the adjusted sample to 2010/11 to match local brand availability.

Table 10: Chain description.

Chain	# Stores	# Stores in Montevideo	# Cities	# States	# Cashiers (Total)	Average size	# observations
Devoto	24	17	6	3	288	12	46,551
Disco	27	20	5	3	307	11	52,300
El Clon	12	8	5	4	59	4	7,164
El Dorado	38	0	20	6	158	4	46,755
Frigo	6	6	1	1	26	4	10,084
Géant	2	1	2	2	96	48	2,044
Iberpark	6	5	2	2	6	1	3,174
La Colonial	6	6	1	1	8	1	7,490
Los Jardines	4	2	3	2	17	4	4,076
Macromercado	7	4	3	3	127	18	11,162
Micro Macro	10	5	4	4	31	3	17,484
MultiAhorro	48	38	8	8	281	6	91,023
None	104	49	27	14	458	4	145,777
Red Market	12	9	3	2	38	3	15,249
Super XXI	4	0	2	1	12	3	7,683
Super Star	4	0	1	1	29	7	7,920
TATA	43	12	25	19	301	7	68,756
Tienda Inglesa	10	7	4	3	164	16	13,916
Ubesur	19	19	1	1	59	3	26,782
TOTAL	386	173	-	-	2,454	6	585,390

Table 11: 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	385	7

Table 12: Estimation of distance and border effect using Average and Median monthly price.

	Median Monthly Price		**Average Monthly Price**	
	Eq. 1	Eq. 2	Eq. 1	Eq. 2
Distance	0.350***	0.336***	0.307***	0.291***
	(0.001)	(0.001)	(0.001)	(0.001)
Border	0.219***	1.397***	0.227***	1.462***
	(0.004)	(0.006)	(0.004)	(0.006)
One Local		0.895***		0.913***
		(0.006)		(0.006)
Both Local		-0.555***		-0.545***
		(0.006)		(0.005)
One Local ×Border		-1.601***		-1.658***
		(0.006)		(0.006)
Both Local		-1.354***		-1.428***
×Border		(0.006)		(0.006)
# Observations	43,693,795	43,693,795	43,693,795	43,693,795
Time dummies	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes
Same Chain Dummy	Yes	Yes	Yes	Yes
R square	0.081	0.086	0.077	0.082

*** $p < 0.01$. Standard errors in parentheses.

B List of Products

Product	Brand	Specification*	% Share in CPI
Beer	Pilsen	0.96 L	0.38
Beer	Zillertal	1 L	0.38
Wine	Faisán	1 L	0.80
Wine	Santa Teresa Clasico	1 L	0.80
Wine	Tango	1 L	0.80
Cola	Coca Cola	1.5 L	1.12
Cola	Nix	1.5 L	1.12
Cola	Pepsi	1.5 L	1.12
Cola	Coca Cola	2 L	1.12
Cola	Pepsi	2 L	1.12
Sparkling water	Matutina	2 L	0.81
Sparkling water	Nativa	2 L	0.81
Sparkling water	Salus	2.25 L	0.81
Beef (peceto)	No brand	1 Kg	0.16
Beef (nalga)	With bone, no brand	1 Kg	0.32
Beef (nalga)	Boneless, no brand	1 Kg	0.32
Beef (aguja)	With bone, no brand	1 Kg	0.23
Beef (aguja)	With bone, no brand	1 Kg	0.23
Beef (paleta)	With bone, no brand	1 Kg	0.20
Beef (paleta)	Boneless, no brand	1 Kg	0.20
Beef (rueda)	With bone, no brand	1 Kg	n/i
Mince	Up to 20 percent fat	1 Kg	0.98
Mince	Up to 5% fat	1 Kg	0.14
Bread	No brand	1 unit (≈ 0.215 Kg)	1.14
Bread Loaf	Los Sorchantes	0.33 Kg	0.06
Bread Loaf	Bimbo	0.33 Kg	0.06
Bread Loaf	Pan Catalán	0.33 Kg	0.06
Brown eggs	Super Huevo	1/2 dozen	0.46
Brown eggs	El Jefe	1/2 dozen	0.46
Brown eggs	Prodhin	1/2 dozen	0.46
Butter	Calcar	0.2 Kg	0.23
Butter	Conaprole sin sal	0.2 Kg	0.23
Butter	Kasdorf	0.2 Kg	0.23
Cacao	Copacabana	0.5 Kg	0.08

Product	Brand	Specification*	% Share in CPI
Beer	Patricia	0.96 L	0.38
Cacao	Vascolet	0.5 Kg	0.08
Cheese	Cerros del Este	1 Kg	0.23
Cheese	Dispnat	1 Kg	0.23
Chicken	Avicola del Oeste	1 Kg	0.64
Chicken	Tenent	1 Kg	0.64
Coffee	Aguila	0.25 Kg	0.14
Coffee	Chana	0.25 Kg	0.14
Coffee	Saint	0.25 Kg	0.14
Corn Oil	Delicia	1 L	n/i
Corn Oil	Río de la Plata	1 L	n/i
Corn Oil	Salad	1 L	n/i
Dulce de leche	Conaprole	1 Kg	0.14
Dulce de leche	Los Nietitos	1 Kg	0.14
Dulce de leche	Manjar	1 Kg	0.14
Fish	No brand	1 Kg	0.11
Flour (corn)	Gourmet	0.4 Kg	n/i
Flour (corn)	Presto Pronta Arcor	0.5 Kg	n/i
Flour (corn)	Puritas	0.45 Kg	n/i
Flour 000 (wheat)	Cañuelas	1 Kg	0.21
Flour 000 (wheat)	Cololó	1 Kg	0.21
Flour 0000 (wheat)	Cañuelas	1 Kg	0.21
Flour 0000 (wheat)	Cololó	1 Kg	0.21
Flour 0000 (wheat)	Primor	1 Kg	0.21
Frankfurters	Centenario	8 units (≈ 0.340 Kg)	0.23
Frankfurters	Ottonello	8 units (≈ 0.340 Kg)	0.23
Frankfurters	Schneck	8 units (≈ 0.340 Kg)	0.23
Grated cheese	Conaprole	0.08 Kg	0.16
Grated cheese	Artesano	0.08 Kg	0.16
Grated cheese	Milky	0.08 Kg	0.16
Deodorant	Axe Musk	0.105 Kg	0.34
Deodorant	Dove Original	0.113 Kg	0.34
Deodorant	Rexona Active Emotion	0.100 Kg	0.34
Ham	Ottonello	1 Kg	0.16
Ham	La Constancia	1 Kg	0.16
Ham	Schneck	1 Kg	0.16

Product	Brand	Specification*	% Share in CPI
Beer	Patricia	0.96 L	0.38
Ham (cooked)	Ottonello	1 Kg	0.44
Ham (cooked)	Cattivelli	1 Kg	0.44
Hamburger	Burgy	0.2 Kg	n/i
Hamburger	Paty	0.2 Kg	n/i
Hamburger	Schneck	0.2 Kg	n/i
Ice Cream	Conaprole	1 Kg	0.22
Ice Cream	Crufi	1 Kg	0.22
Ice Cream	Gebetto	1 Kg	0.22
Margarine	Flor	0.2 Kg	n/i
Margarine	Doriana nueva	0.25 Kg	n/i
Margarine	Primor	0.25 Kg	n/i
Mayonnaise	Fanacoa	0.5 Kg	0.21
Mayonnaise	Hellmans	0.5 Kg	0.21
Mayonnaise	Uruguay	0.5 Kg	0.21
Noodles	Cololo	0.5 Kg	0.43
Noodles	Adria	0.5 Kg	0.43
Noodles	Las Acacias	0.5 Kg	0.43
Peach jam	Dulciora	0.5 Kg	n/i
Peach jam	El Hogar	0.5 Kg	n/i
Peach jam	Los Nietitos	0.5 Kg	n/i
Peas	Campero	0.3 Kg	0.09
Peas	Cololó	0.3 Kg	0.09
Peas	Nidemar	0.3 Kg	0.09
Poultry	Avicola del Oeste	1 Kg	0.83
Poultry	Tenent	1 Kg	0.83
Poultry	Tres Arroyos	1 Kg	0.83
Quince Jam	Los Nietitos	0.4 Kg	0.13
Rice	Aruba tipo Patna	1 Kg	0.38
Rice	Blue Patna	1 Kg	0.38
Rice	Green Chef	1 Kg	0.38
Rice	Pony	1 Kg	0.38
Rice	Vidarroz	1 Kg	0.38
Rice	Saman Blanco	1 Kg	0.38
Crackers	Famosa	0.14 Kg	0.28
Crackers	Maestro Cubano	0.12 Kg	0.28

Product	**Brand**	**Specification***	**% Share in CPI**
Beer	Patricia	0.96 L	0.38
Salt	Sek	0.5 Kg	0.09
Salt	Torrevieja	0.5 Kg	0.09
Salt	Urusal	0.5 Kg	0.09
Sausage	Cattivelli	1 Kg	0.37
Sausage	Centenario	1 Kg	0.37
Sausage	La Familia	1 Kg	0.37
Semolina pasta	Adria	0.5 Kg	0.43
Semolina pasta	Las Acacias	0.5 Kg	0.43
Semolina pasta	Puritas	0.5 Kg	0.43
Soybean oil	Condesa	0.9 L	0.11
Soybean oil	Río de la Plata	0.9 L	0.11
Soybean oil	Salad	0.9 L	0.11
Sugar	Azucarlito	1 Kg	0.35
Sugar	Bella Union	1 Kg	0.35
Sunflower oil	Optimo	0.9 L	0.37
Sunflower oil	Uruguay	0.9 L	0.37
Sunflower oil	Río de la Plata	0.9 L	0.37
Tea	Hornimans	Box (10 units)	0.08
Tea	La Virginia	Box (10 units)	0.08
Tea	President	Box (10 units)	0.08
Tomato paste	Conaprole	1 L	0.16
Tomato paste	De Ley	1 L	0.16
Tomato paste	Gourmet	1 L	0.16
Yerba	Canarias	1 Kg	0.64
Yerba	Del Cebador	1 Kg	0.64
Yerba	Baldo	1 Kg	0.64
Yogurt	Conaprole	0.5 Kg	0.13
Yogurt	Parmalat (Skim)	0.5 Kg	0.13
Yogurt	Calcar (Skim)	0.5 Kg	0.13
Bleach	Agua Jane	1 L	0.16
Bleach	Sello Rojo	1 L	0.16
Bleach	Solucion Cristal	1 L	0.16
Dishwashing detergent	Deterjane	1.25 L	0.13
Dishwashing detergent	Hurra Nevex Limon	1.25 L	0.13
Dishwashing detergent	Protergente	1.25 L	0.13

Product	**Brand**	**Specification***	**% Share in CPI**
Beer	Patricia	0.96 L	0.38
Laundry soap	Drive	0.8 Kg	0.45
Laundry soap	Nevex	0.8 Kg	0.45
Laundry soap	Skip, Paquete azul	0.8 Kg	0.45
Laundry soap, in bar	Bull Dog	0.3 Kg (1 unit)	n/i
Laundry soap, in bar	Nevex	0.2 Kg (1 unit)	n/i
Laundry soap, in bar	Primor	0.2 Kg (1 unit)	n/i
Shampoo	Fructis	0.35 L	0.36
Shampoo	Sedal	0.35 L	0.36
Shampoo	Suave	0.93 L	0.36
Soap	Astral	0.125 Kg	0.16
Soap	Palmolive	0.125 Kg	0.16
Soap	Rexona	0.125 Kg	0.16
Toilet paper	Higienol Export	4 units (25 M each)	0.24
Toilet paper	Elite	4 units (25 M each)	0.24
Toilet paper	Sin Fin	4 units (25 M each)	0.24
Toothpaste	Pico Jenner	0.09 Kg	0.19
Toothpaste	Colgate Herbal	0.09 Kg	0.19
Toothpaste	Kolynos	0.09 Kg	0.19

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