Borders, Local Brands, and Price Convergence*

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Abstract

While the effect of borders on price convergence of traded products is well-documented, the effect of vast product variety discrepancies across regions remains unexplored. Borders hinder price convergence for traded goods between markets while locking local products within markets. We develop a model to show that local products affect the estimated border effect of traded products. Local products are imperfect substitutes for traded goods but closer in distance. The price of traded goods will reflect this trade-off between preferences and distance. Next, we show that not controlling for local products biased the estimation of the border effect. Finally, we review different methods for controlling for local products in empirical analysis.

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1 Introduction

Borders between regions or countries have been one of the most extended explanations for the non-convergence of prices in the trade literature (Engel and Rogers, 1996; Anderson and van Wincoop, 2001; McCallum, 1995; Parsley and Wei, 2001; Gorodnichenko and Tesar, 2009; and more recently Gopinath, Gourinchas, Hsieh, and Li, 2011; Beck, Kotz, and Zabelina, 2020; and Messner, Rumler, and Strasser, 2023). Also, trade costs play a significant role in explaining how goods are moved between different markets (Anderson and van Wincoop, 2003, Anderson and van Wincoop, 2004, Atkin and Donaldson, 2015, Auer, Burstein, and Lein (2021), and Burstein, Lein, and Voguel (2024)).[1]

Geographical regions differ in income and consumer preferences for products. For example, Bronnenberg, Dube, and Gentzkow (2012) showed that preferences are geographically based and time persistent. In such settings, stores may offer varieties that match local preferences. In turn, markets may have different varieties of the same products which may include size, flavor, brand, etc. Interestingly, the overwhelming evidence shows that most retail products are not traded. For example, Broda and Weinstein (2008) established that in "the typical bilateral city/region comparison between the US and Canada only 7.5 percent of the goods are common" (page 11). Gopinath, Gourinchas, Hsieh, and Li (2011) found that only 3.4 percent of 125,048 products were available in the US and Canada, even for the same retail chain. More recently, Messner, Rumler, and Strasser (2023) analyzing transactions at the border between Austria and Germany establishes that "once we restrict the sample to products sold on both sides of the border, we are left with a tenth of products..." (page 8). Finally, Beck, Kotz, and Zabelina (2020) for Belgium, Germany, and Netherlands found less than a tenth of products in both pairs of countries (Table 1).

Borders have two effects. First, it explains why the prices of traded goods differ. Yet, a second issue that has yet to be studied is that borders prevent local products from being traded. While the literature examined the effect of borders on price convergence, if local goods affect the price of traded goods, then the impact of borders may be mismeasured. The idea is simple. On both sides of the border, there is a common—traded—product but different local products on each side. Many local products compete with traded products at the same store, in some cases, meters away on the same shelf. Traded products may compete with each other kilometers away.[2] In terms of gravity, it won't be easy to justify

[1] Other explanations for price divergence include the existence of high fixed costs of production for some goods (Coşar, Grieco, and Tintelnot, 2015a; Coşar, Grieco, and Tintelnot, 2015b), price discrimination of consumers (Haskel and Wolf, 2001, Dvir and Strasser, 2018), a different currency (Cavallo, Neiman, and Rigobon, 2015), or—within countries—sticky prices (Crucini, Shintani, and Tsuruga, 2010, Elberg, 2016).

[2] In the empirical analysis, the distance to the border may include stores of households 60 kilometers Messner, Rumler, and Strasser (2023), 80 kilometers Beck, Kotz, and Zabelina (2020), and reach up to 500 kilometers Gopinath, Gourinchas, Hsieh, and Li (2011) of each side.

that those local brands will not affect the price of traded brands.

In this paper, we provide a simple model to show that the border effect will be biased if local goods are not controlled for. In a previous paper, we showed that variety differences in the same product category between stores explain why prices diverge (Borraz and Zipitría, 2022). This paper presents an extension of the model to include borders. First, we show how borders create price dispersion between traded products in an otherwise symmetrical setting. If border costs shift the indifferent consumer between stores/countries, then prices will diverge. But if borders do not shift the indifferent consumer, we show there is no border at all. Second, we introduce a local brand in one store/country. We derive the new price equilibrium and show that prices diverge, but not by the same value previously found. In the model, the effect on price dispersion of local products confounds with that of the border. Our results show that the price difference for traded products has two components: one due to the effect of the local product in one of the countries and the second one due to the interrelation of the local product with the border.

Next, we discuss how local products affect the regression discontinuity (RDD) estimation usually applied in the empirical literature. In particular, all other variables should be continuous at the cutoff, i.e., the border. By definition, when there are local products, this is not the case. Some products are on one side of the cutoff, while others are on the other. So, the border effect confounds with local products if not controlled for, biasing the results. We review some ways to address the impact of local products on border estimation.

Our paper relates to other literature that showed ample evidence of the effect of differences in varieties on prices within and between countries. Between countries, Cavallo, Feenstra, and Inklaar (2023) and Beck and Jaravel (2021) show that differences in varieties impact the cost of living. Within countries Handbury and Weinstein (2015) showed how the availability of different varieties between cities in the US biases the estimation of price indexes. Auer, Burstein, and Lein (2021) showed that the appreciation shock to the Swiss Franc has different impacts depending on the share of imported products. While the paper does not address local products, it shows that the impact of an appreciation is different according to local conditions. In Borraz, Carozzi, González-Pampillón, and Zipitría (2024), we showed that after a demand shock in Montevideo, Uruguay, stores increased the number of varieties offered, resulting in a 3% price decrease. In Borraz and Zipitría (2022), we showed that differences in the number of varieties affect price convergence between stores in Uruguay. Finally, in Borraz and Zipitría (2024), we show that changes in varieties correlate with price dispersion in the short and long run. All these papers show evidence of varieties, most in the form of local products, impacting price setting.

The paper is organized as follows. In the next Section, we introduce the model and show the effect of borders on price dispersion. Section 3 derives price dispersion when there are borders and local goods. Section 4 shows how local products bias the estimations in the standard regression discontinuity models used in the literature. It also provides different ways to account for the local product effect in the border estimation.

2 The Border Effect

We assume a linear city model with two stores and a continuum of consumers in a road of distance L. Consumer located at j has utility $U_j = r - t\,|x_j - x_d| - p_d$, where t is the cost per unit of distance to the store located at d. Stores are located at $d = \{0, L\}$, i.e., at the beginning and end of the road, denoted $\{S_0, S_L\}$ respectively. Assume also that costs are zero. In this symmetric setting, prices are tL, and there is no price dispersion between stores. Denote the indifferent consumer from buying the same product between the two stores is $\widehat{x}$.

We introduce a cost for the consumer to cross a hypothetical border between stores.[3] We assume the border is at some place b between both stores. The border implies a fixed cost of β for consumers who cross it to buy from a store on the other side.[4] The utility is now $U_j = r - t\,|x_j - x_d| - \beta \times \mathbb{1}\{c_j \neq c_d\} - p_d$, where $\mathbb{1}\{c_j \neq c_d\}$ is an indicator function that equal one if the country of the consumer j and the store d differ, and 0 otherwise. With a positive border cost, the indifferent consumer shifts from $\widehat{x}$ to x^b. If both are in the same place, then the border does not play any role. The next Lemma shows this result.

Lemma 1. *If the border is at the same place of the indifferent consumer, then the border cost is irrelevant.*

Proof. Assume two consumers, each located at a small ε distance to the border x^b. As the consumer at the left of x^b prefers to buy at S_0, then it must be that $r - t\left(x^b - \varepsilon\right) - p_0 > r - t\left[L - \left(x^b - \varepsilon\right)\right] - p_L + \beta$, and solving for $\left(x^b - \varepsilon\right)$ we obtain $\left(x^b - \varepsilon\right) > \frac{p_L - p_0 + tL}{2t} - \frac{\beta}{2t}$. For the consumer located at the right, as she prefers S_L to S_0 his utility must be such as $r - t\left(x^b + \varepsilon\right) - p_0 + \beta < r - t\left[L - \left(x^b - \varepsilon\right)\right] - p_L$, and solving for $\left(x^b + \varepsilon\right)$ we obtain $\left(x^b + \varepsilon\right) < \frac{p_L - p_0 + tL}{2t} + \frac{\beta}{2t}$. As $\varepsilon \to 0$, we obtain $\frac{p_L - p_0 + tL}{2t} - \frac{\beta}{2t} < x^b < \frac{p_L - p_0 + tL}{2t} + \frac{\beta}{2t}$. Then, $x^b = \frac{p_L - p_0 + tL}{2t}$. □

Lemma 1 says that the border binds only if it shifts consumers from buying from one store to the other. Consumers at the right of the border already prefer to buy at S_L, and those at the left choose to buy at S_0. Assume that the border is to the right of $\widehat{x}$, the

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

[4] See Burstein, Lein, and Voguel (2024) for a model with cross-border shopping and its implication on welfare. Their Fact 1 shows that households close to the border are the ones that made more cross-border shopping. In terms of our model, this implies that the indifferent consumer shifts towards the neighborhood country.

indifferent consumer when no border exists. Now, some consumers who otherwise would have bought at S_L will buy at S_0 due to the border costs. Nevertheless, consumers at the right of the border will continue buying at S_L, as they already prefer that store, and the border cost does not affect their decision. How many consumers will switch from store S_L to S_0 will depend on the magnitude of the cost β.

For every positive border cost β, the indifferent consumer should move from $\widehat{x}$ through x^b. The new indifferent consumer x^b should be at $\widehat{x}+\beta$, as the utility is linear in cost. As a result, $x^b = \widehat{x} + \beta = \frac{p_L - p_0 + tL}{2t} + \beta$, where $\beta \in [0, (b - \widehat{x})]$. If β is larger than $\left(x^b - \widehat{x}\right)$, then Lemma 1 establishes that the demand for store S_0 should be x^b. The demand for store S_0 is $D_0 = \frac{p_L - p_0 + tL + 2t\beta}{2t}$, and the reaction function is $p_0 = \frac{p_L + Lt + 2t\beta}{2}$. Demand for store S_L is $D_L = \frac{p_0 - p_L + tL - 2t\beta}{2t}$, and the reaction function for price p_L is $p_L = \frac{p_0 + Lt - 2t\beta}{2}$. The equilibrium prices are $p_0^b = tL + \frac{2t\beta}{3}$ and $p_L^b = tL - \frac{2t\beta}{3}$. Our second Lemma follows.

Lemma 2. *Borders make price convergence less likely.*

Proof. Now $p_{A0}^b - p_{AL}^b = \frac{4}{3}t\beta$. □

If x^b is at the left of $\widehat{x}$ instead, then the prices p_0^b and p_L^b reverse. We now compute the size of the border by substituting p_0^b and p_L^b in $x^b = \widehat{x} + \beta = \frac{5}{3}\beta + \frac{L}{2}$. As $x^b \in \left[\frac{L}{2}, L\right]$, then $\beta \in \left[0, \frac{3}{10}L\right]$.

Because borders shift demand, prices change with borders, and price convergence becomes more difficult. In the example, as the border is at the right of $\widehat{x}$, consumers at the left of the border cannot buy at store S_L. Then, store S_0 can increase its prices, as the border allows it to increase its market power, while the reverse is true to store S_L. This is the effect of borders on traded goods, being everything else equal. In the next Section, we add a local brand and show it is not.

3 The Border and Local Products

Section 1 showed that countries differ in the varieties of goods offered to consumers. Borders do not just prevent the prices of international brands from converging; they also prevent local brands from being sold in other countries. Traded brands must deal with different local brands between countries, i.e., different competition. What happens when a traded brand—the one sold in both countries—has to compete with a local brand? Following Borraz and Zipitría (2022), we incorporate this asymmetry between countries by adding to our model a local product sold only in one store, that is, in one of the countries. This simple setting allows us to show how price convergence is affected when local brands or local varieties of products are available in different markets and how it affects the estimation of the effect of the border. In what follows, we will use brand and varieties interchangeably to refer to products that can be traded or local.

At each point in the line, there are now two types of consumers who differ in their preference for product variety $z_i = \{z_A, z_B\}$. While the distance dimension is continuous, variety is discrete. Furthermore, a mass $(1-\lambda)$ of consumers prefer variety z_A, and a mass λ of consumers prefer variety z_B. The model could be represented as two lines of distance L, one on top of the other.[5] Stores could offer varieties s_q, with $q = \{A, B\}$, and assume that variety A is available at both stores, the traded one, but variety B is a local product available only at the store located at S_0. That is, we are imposing some brand asymmetry between stores that affect the local pricing decisions of products on both sides of the border, in line with the literature of Section 1.[6]

The consumer utility is now:

$$U_{ij} = r - \theta \times \mathbb{1}\{z_i \neq s_q\} - t\,|x_j - x_d| - \beta \times \mathbb{1}\{c_j \neq c_d\} - p_{qd},$$

Where j is for the consumer's location and i is for its brand preference, θ is a fixed cost the consumer pays if the brand available s_q differs from her preferred one (z_i). The utility function has three costs on consumer utility: one that lowers his utility if his preferred variety is unavailable (θ), one that taxes her for buying in another country (β), and a transport cost for reaching the store regardless of brand preference.

In Borraz and Zipitría (2022), if there is no border (i.e., $\beta = 0$), we found that the price of the traded product is $p_{A0} = tL - \frac{\delta\theta}{6}$ and $p_{AL} = tL - \frac{\delta\theta}{3}$, and prices do not converge due to different competitive conditions at the store. Also, in this setting, there are two indifferent consumers: the "location" consumer, who is indifferent between buying the traded product in either store/country $(\widehat{x})$, and the "local" consumer, who is indifferent between buying at S_0 the B local product instead of reaching store S_L and buying the A non-preferred traded variety (x^v).[7] We also showed that the indifferent consumer for the local variety (x^v) should be at the right of the indifferent consumer for location $(\widehat{x})$. The intuition is simple. The indifferent consumer for local products has two penalties: one for buying the—non-preferred—traded brand and another for moving to another store. Then, compared to consumers who only need to move to the other store to buy their preferred variety, a larger number of those who switch variety consumers will stick to their preferred brand because it is unavailable at the other store. Assume that the border is far to the right from both indifferent consumers. Figure 1 below depicts the setting.

We assume the border b is at the right of x^v and $\widehat{x}$.[8]As $\widehat{x} \neq x^v$, the effect of the border

[5]See Borraz and Zipitría (2022) figure 2.

[6]Why should there be consumers in other country preferring a foreign local brand? As we will show later, this assumption does not change the problem at hand and simplifies the process of determining where the exact border is to restrict the line of local consumers.

[7](Borraz and Zipitría, 2022) call the second indifferent consumer $\widetilde{x}$.

[8]This assumption is consistent with the brand being local. Assuming the border at the left of x^v will

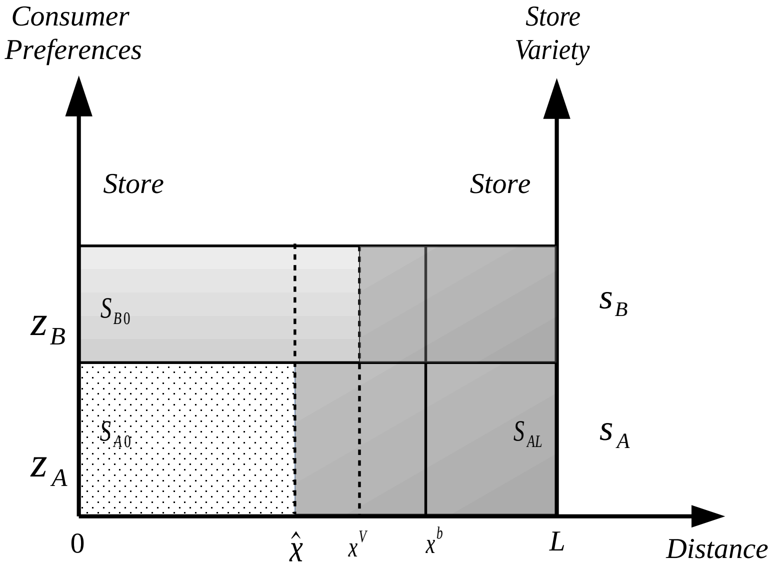

Figure 1: A Linear City with Varieties and Border.

will be different for the consumers of a local product B than for consumers of the traded product A.

The indifferent "location" consumer $\widehat{x}'$, the one that prefers the traded brand, has utility: $r - t\,|\widehat{x} - 0| - p_{A0} = r - t\,|\widehat{x} - L| - p_{AL} - \beta$, then $\widehat{x}' = \widehat{x} + \widehat{\beta} = \frac{p_{AL} - p_{A0} + tL}{2t} + \widehat{\beta}$. The indifferent "local" consumer $x^{b\prime}$, the one that switches brands and stores, has utility: $r - t\,|\widehat{x} - 0| - p_{B0} = r - t\,|\widehat{x} - L| - p_{AL} - \theta - \beta$, then $x^{b\prime} = x^b + \beta^b = \frac{p_{AL} - p_{B0} + tL + \theta}{2t} + \beta^b$, where $\widehat{\beta} \in [0,\,(b - \widehat{x})]$ and $\beta^b \in \left[0,\,\left(b - x^b\right)\right]$ and $\beta^b \leq \widehat{\beta}$.

Store S_0 sells the traded variety A and the local variety B, so its profits are $\pi_0 = p_{A0} \times \lambda\widehat{x}' + p_{B0} \times (1-\lambda)x^{b\prime} = p_{A0} \times \lambda(\frac{p_{AL} - p_{A0} + tL}{2t} + \widehat{\beta}) + p_{B0} \times (1-\lambda)(\frac{p_{AL} - p_{B0} + tL + \theta}{2t} + \beta^b)$. Maximizing in p_{A0} and p_{B0} we obtain $p_{A0} = \frac{p_{AL} + Lt + 2t\widehat{\beta}}{2}$ and $p_{B0} = \frac{p_{AL} + tL + \theta + 2t\beta^b}{2}$.

Store S_L sells only the traded variety A to both consumers, so its profits are $\pi_L = p_{AL} \times \left[(1-\lambda) \times (L - \widehat{x}') + \lambda \times (L - x^{b\prime})\right]$ $= p_{AL} \times \left[(1-\lambda)(L - (\frac{p_{AL} - p_{A0} + tL}{2t} + \widehat{\beta})) + \lambda(L - (\frac{p_{AL} - p_{B0} + tL + \theta}{2t} + \beta^b))\right]$. Maximizing in p_{AL} we obtain $p_{AL} = \frac{(1-\lambda)p_{A0} + \lambda p_{B0} + Lt - \lambda\theta - 2t\left[\widehat{\beta} + \lambda\left(\beta^b - \widehat{\beta}\right)\right]}{2}$.

Substituting reaction functions, we obtain:

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

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

imply that some consumers in the country L will prefer the local brand in the country 0. In some cases, it could be a reasonable assumption. Nevertheless, we skip this result for simplicity.

For completion, $p^{bv}_{B0} = Lt + \frac{(3-\lambda)\theta}{6} + \frac{t\left[(3-\lambda)\widetilde{b}-(1-\lambda)\widehat{b}\right]}{3}$. Next proposition show the main result of the analysis.

Proposition 1. *The availability of local brands affects the estimation of the border effect.*

Proof. Lemma 2, showed that the border coefficient is $\frac{4}{3}\beta$. Price difference is now $p^{bv}_{A0} - p^{bv}_{AL} = \frac{\lambda\theta}{6} + \frac{t\left[4\widehat{\beta}-\lambda\left(\widehat{\beta}-\beta^b\right)\right]}{3}$. □

When there are local brands, the estimation of the border differs. First is the effect of local varieties within countries $\frac{\lambda\theta}{6}$. This effect is due to the border creating local brands in the country 0. In turn, this will affect the price of the traded brand in that country and create price dispersion. Second, the term $\frac{\left[4\widehat{b}-\lambda\left(\widehat{b}+3\widetilde{b}\right)\right]}{3}$ in absolute terms. Second, there is a local brand effect in Lemma 1 that, if not accounted for, will be in the border coefficient. In addition to the border coefficient, the term $\frac{\lambda\theta}{6}$ catches the interaction of local brands and the border.

4 Econometric Analysis

We showed that the price difference of traded products when there are borders ($\frac{4}{3}\beta$) differ of the actual value of the price difference when there are local varieties ($\frac{\lambda\theta}{6} + \frac{t\left[4\widehat{\beta}-\lambda\left(\widehat{\beta}-\beta^b\right)\right]}{3}$). By how much they differ will depend on the substitutions between brands (θ), and where the indifferent consumers are located.

Most of the papers' empirical analyses were made by applying—non-parametric sharp—regression discontinuity designs (RDD). At a distance small enough on both sides of the border, everything should be equal except the price of the traded goods. Then, the border causes prices to diverge, and the effect can be measured. Nevertheless, the data in all the papers reviewed in Section 1 showed that not everything on both sides is equal: most products are local, that is, are on one side or the other, but not on both. Assume the impact of the border on prices is measured according to the following equation:

$$p^h_i = \alpha_i + \beta B + \theta D^h + \psi D^h B + \gamma^h X^h + \varepsilon^h_i, \tag{1}$$

Where i is for good, h is the unit of analysis (store as in Gopinath, Gourinchas, Hsieh, and Li (2011), or household as in Beck, Kotz, and Zabelina (2020)) B is a dummy variable that takes the value one if the store or household is not in the reference country, say in Canada vs. being in the US, D^h is the distance of the unit of analysis—store, household—to the border, and X^h are observable characteristics of the unit of analysis—income, age, size of the store, etc.—. Note the similarity between the paper's empirical equation and our theoretical model and how the model can adopt an empirical estimation strategy. The parameter of interest is β, and the identifying assumption is that the error term ε^h_i is uncorrelated to the border dummy variable B, i.e., $E[\varepsilon^h_i|B] = 0$.

In Section 3, we showed that prices are affected by local products. Auer, Burstein, and Lein (2021) reach the same conclusion when they find that prices of local and imported products have strategic complementarities, i.e., the price of local products reacts to changes in the price of imported products. We incorporate local products into Equation 1 by adding two terms: X_{ij}^{h-} for product i at unit h at the left of the border $h-$, and X_{ij}^{h} for product i at unit h at the right of the border h, the convention for the reference country, and where j refers to local products in the same product category of product i.

Noting that X_{ij}^{h-} and X_{ij}^{h} can be written as $X_{ij}^{h-}(1-B)$ and $X_{ij}^{h}B$, we add both terms to Equation 1 and rewrite it as:

$$p_i^h = \alpha_i + \left[\beta + \left(\delta_1 X_{ij}^h - \delta_2 X_{ij}^{h-}\right)\right] B + \delta_2 X_{ij}^{h-} \theta D^h + \psi D^h B + \gamma^h X^h + u_i^h, \tag{2}$$

Two conclusions can be reached from Equations 1 and 2. First, ε_i^h in Equation 1 is correlated with B due to the omitted variable bias. Formally, $\varepsilon_i^h = \left(\delta_1 X_{ij}^h - \delta_2 X_{ij}^{h-}\right) B + u_i^h$, which is correlated with the border. Secondly, we can rearrange again Equation 2 to isolate the effect of local varieties from the estimation of the border, as with the interaction of the distance parameter:

$$p_i^h = \alpha_i + \beta B + \delta_1 X_{ij}^h B + \delta_2 X_{ij}^{h-}(1-B) + \theta D^h + \psi D^h B + \gamma^h X^h + u_i^h, \tag{3}$$

Papers have applied corrections to account for local product differences- or, more generally, varieties- between countries. First, some papers have counted UPCs in a given product category, as in (Borraz and Zipitría, 2022), or by sectors, as in (Cavallo, Feenstra, and Inklaar, 2023). Both count the number of brands in each store or sector to control for differences between markets. In particular, Cavallo, Feenstra, and Inklaar (2023) showed that differences in varieties with the US are the primary source of explanation for the increased cost of living. While this approach is easy to collect and compute, it also has limitations. For example, in Borraz and Zipitría (2022), we calculate differences in the number of varieties in a given product category as a regressor for price differences between the same products. Nevertheless, the measure will assign the same value to very different competitive settings: a product that is hardly sold will count the same as a most-selling brand and, thus, will have the same effect.

Alternatively, in Borraz and Zipitría (2024), we analyze short and long-run price dispersion and use an entropy index to measure product differences in a given product category between markets. In this setting, an entropy index will measure how sparse products are between markets and will be larger the more different countries are in terms of varieties offered, where local brands abound. Also, as the border variable is a dummy, there will not be collinearity problems between both variables.

Lastly, Auer, Burstein, and Lein (2021) proposed a method to correct the impact of traded products on the exchange rate pass-through in Switzerland. They provide shares of the proportion of traded products to traded and local products by categories to control for the impact of the appreciation of the Swiss Franc in 2015. This could also be used to correct the presence of local products when estimating the effect of borders on prices and to isolate its impact.

The corrections will depend on the information available. For example, Auer, Burstein, and Lein (2021) has information on purchases but not on the other products that were not consumed at the store. This limits the possibility of controlling for actual restrictions on the purchase options of the consumers and the price decisions of stores. On the other hand, Borraz and Zipitría (2022) has information on prices for products sold at the same store but not actual purchases. While this information is suitable for better controlling local brands, if not complemented with purchases, it won't be easy to weigh the relevance of each product (θ).

5 Conclusions

The paper highlights a crucial factor affecting the border effect estimations: differences in product varieties across regions. While borders affect the price convergence of traded products, they also create local products. In turn, local products affect the price of traded products. Our simple theoretical model shows that the dispersion in traded product prices created by the border is affected by local products. Local products increase price dispersion, which is uncorrelated with the border. Local products are fully correlated with the border, so their effect will confound unless controlled. We then show how the RDD strategy does not control for local products, which will bias the estimation of the border effect. Lastly, we propose measures from other papers that can be adapted to provide an unbiased estimation of the border effect.

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