Uniform Pricing Within and Across Regions: New Evidence from Argentina

Diego Daruich
FRB of St. Louis

Julian Kozlowski
FRB of St. Louis

March 8, 2019

Abstract

We compile a new database of grocery prices in Argentina, with over 9 million observations per day. Our main novel finding is that product prices almost do not vary within stores of a chain (i.e., uniform pricing). We also find that prices do not change significantly with regional conditions or shocks, particularly so for chains that operate in many regions. To study the impact of uniform pricing on both consumers and firms, this paper uses a tractable model based on the trade literature. Motivated by our empirical findings, each firm has to set the same price in both regions. Relative to a counterfactual in which firms can set different prices across regions (i.e., flexible pricing), uniform pricing reduces firms' profits by 0.4%. Consumers, however, prefer uniform pricing and are willing to give up 6.7% of their income to avoid flexible pricing in the baseline model. The effect on consumers, however, depends on how much uniform pricing limits firms' power to extract consumer surplus and how heterogeneous the regions are.

JEL Classifications: D40, E30, L10, R10.
Keywords: Price Dispersion, Regional Economics.

Contact information: ddaruich@nyu.edu and kozjuli@gmail.com. For helpful comments, we thanks Jaroslav Borovicka, Virgiliu Midrigan, Diego Perez, and Venky Venkateswaran. We thank all the people in the Argentinean *Ministerio de Produccion* that helped us with the data. The views expressed in this paper are solely our responsibility and should not be interpreted as reflecting the views of the Federal Reserve System or the Federal Reserve Bank of St. Louis.

1 Introduction

Price dispersion is known to be a prevalent characteristic in many markets of developed countries with low inflation: The same product is sold at different prices by various stores in the same regional market and time period. This paper makes two main contributions. First, we introduce a new dataset of grocery store prices in Argentina and confirm that large variation in prices is also present in this developing country with high inflation. Our second main contribution is to highlight, however, that conditional on a product, there is little variation in prices across stores of the same chain; i.e., there is *uniform pricing*. Prices almost do not vary within stores of a chain and prices do not change significantly with regional conditions or shocks, particularly so for chains that operate in many regions. Using a simple two-region model, we show that uniform pricing, relative to a counterfactual in which firms can set different prices in each region, has non-trivial implications for firms' profits and consumers' welfare.

Most empirical analysis about micro-price statistics use scanner price data from developed countries with low inflation. We complement this literature by creating a new database for daily prices of grocery stores in Argentina in a high-inflation context. Since May 2016, every day, stores have to report their offline prices (i.e., prices in the store) to the government. The data is processed and posted online in an official price-comparison website, with the objective of providing information to consumers. One of this paper's contributions is the compilation of high-frequency price data from a developing country in a high-inflation (about 30% in 2016) regime. We have about 9 million price observations per day, totaling about 5 billion observations, which allows us to have a large panel on chains, stores, products, and prices.

Our main novel finding is that chains, rather than stores, explain most of the price variation. In other words, prices almost do not vary between particular store locations of a chain (i.e., uniform pricing). This paper presents three pieces of evidence consistent with this fact. First, even though chains have on average over 100 stores across the country, we find that there are on average less than 4 unique prices per product per chain. Second, price changes are also consistent with uniform pricing. Focusing on products that change prices in one store, we compute the probability that other stores change the prices of the same products on the same day. The probability is 5% for stores of *any* chain, but it increases to almost 30% when we focus on stores of the *same* chain. If we focus only on stores in the same province within the chain, this share increases to almost 65%.[1] Third, using a variance decomposition methodology, we find that around two-thirds of the relative price dispersion can be explained by chain-product fixed effects.[2] Hence, only one-third of the price variation can be explained by stores setting different prices within a chain.

[1]The intensive margin of price changes is also similar within chains: The dispersion of these price changes within a chain is less than one-fifth of the one observed in the whole economy.

[2]This decomposition is done using relative prices in order to abstract from differences in product characteristics. For each product in a store and day, we define a relative price as its log-price deviation from the average log-price across stores in the relevant day.

We complement the analysis with information on the location of stores with 2010 Census data in order to study how uniform pricing relates to the characteristics (e.g., education or employment) of each chain's locations. Even though chains with many and more heterogeneous stores tend to display less uniform pricing, we find that the most powerful explanatory variable of uniform pricing seems to be the number of provinces in which a chain operates. Nevertheless, the number of unique prices per product per chain, one measure of uniform pricing, increases by less than one-to-one with the number of provinces in which a chain operates.

One potential implication of uniform pricing is that grocery store prices would not change with regional conditions or shocks, particularly so if chains operate in several regions. We test this hypothesis using monthly employment data at the province level. We show that prices in stores of chains that operate in many regions do not seem to react to local labor market conditions, while stores of chains operating almost exclusively in one region do react to local conditions.

Finally, this paper uses a tractable trade model based on Simonovska (2015), to study the impact of uniform pricing on both consumers and firms and to compare the effects of regional and aggregate income shocks. The model features two regions and a continuum of goods sold by monopolistically competitive firms. Motivated by our findings, each firm has to set a single price in both regions. Consumers have non-homothetic preferences so that regional income shocks can affect prices. Consumers from each region have different preferences over goods so that goods have heterogeneous market shares in each region. We estimate the model to match the fact that firms that operate mostly in one region will react more to local shocks.

Uniform pricing implies that consumption reacts less in response to an aggregate than to a regional income shock because prices adjust more in response to aggregate shocks. The estimated model predicts an almost one-third larger elasticity of consumption to a regional income shock than to an aggregate one. This result highlights that some caution may be necessary when using regional shocks to estimate aggregate elasticities, particularly when the relevant prices are set uniformly across regions.

Comparing our baseline model of uniform pricing to a counterfactual in which firms can set different prices in each region (i.e., flexible pricing), we find that uniform pricing generally reduces firms' profits by 0.4 in our baseline model. Consumers, however, prefer uniform pricing and are willing to give up 6.7 of their income to avoid flexible pricing in the baseline model. There are two main opposing forces behind this result, and their relative importance depends on several model assumptions. On the one hand, uniform pricing limits firms' power to extract consumer surplus. Given the preference heterogeneity across regions, uniform pricing reduces the power of firms to extract surplus from the consumers who like their products the most, as there is another region in which consumers may not like their products as much. On the other hand, if regions have different levels of income, uniform pricing increases consumption inequality. Firms will set prices as if they had a consumer with an income equal to a weighted average of the two regions' incomes, hence leading to higher (lower) prices for the poor (rich) region than under flexible pricing. Finally, given this effect on prices, we evaluate the implications of uniform pricing for the effect of regional income shocks on consumers' welfare. Under flexible pricing, prices would be reduced when income falls. This price reduction, however, is not as salient when there can be only one price for both regions, thus leading to a larger decrease in consumption under uniform than flexible pricing. We interpret this finding to mean that the effect of regional business cycles on consumption may be amplified by uniform pricing.

The rest of the paper is organized as follows. Section 2 discusses the literature. Section 3 introduces our novel price dataset and provides basic descriptive statistics. Section 4 provides our main empirical results regarding uniform pricing. The model and the implications of uniform pricing for consumers and firms are presented in Sections 5 and 6. Finally, Section 7 concludes. The Appendices contain additional details on the data and model.

2 Related Literature

This paper is related to the empirical literature on price-setting behavior in high-inflation countries. Alvarez, Beraja, Gonzalez-Rozada, and Neumeyer (2018) also study micro-price statistics for Argentina, but in a different period (1988 to 1997) and with a smaller sample.[3] Different from previous research, we have larger cross-sectional variation in stores and products, which allows us to control for observable characteristics and uncover novel empirical facts. For example, in Alvarez, Beraja, Gonzalez-Rozada, and Neumeyer (2018) the average number of observations per month is about 81,000, whereas we have about 9 million observations per day. Similarly, they have information on 500 products, whereas we have four times as many products in our final sample selection.[4] This paper is also related to the empirical literature about gathering new data on retail prices in developing countries. Cavallo and Rigobon (2016) provide a summary of this new research agenda. Our contribution is that we obtain information on offline prices (i.e., in the store) instead of online prices as in previous research. Since February 2016, the Argentinean government has created a daily, national, publicly available report of prices (*Sistema Electronico de Publicidad de Precios Argentinos*). To the best of our knowledge, we are the first to collect and analyze this data.

This paper is part of a growing literature that studies price dispersion. Cavallo (2018) and Jo, Matsumura, and Weinstein (2018) highlight a new type of price convergence due to e-commerce. E-retailers typically have a single-price or uniform-pricing strategy independent of the buyer's location. Jo, Matsumura, and Weinstein (2018) show that the introduction of *Rakuten* (the largest Japanese e-retailer) has led to a reduction in price differentials between Japanese offline retailers (of potentially many chains). In the

[3] See also Lach and Tsiddon (1992); Eden (2001); Baharad and Eden (2004) for Israel, Gagnon (2009) for Mexico, and Konieczny and Skrzypacz (2005) for Poland. All of these datasets are much smaller than ours (see data comparisons in Alvarez, Beraja, Gonzalez-Rozada, and Neumeyer, 2018).

[4] An important difference relative to Alvarez, Beraja, Gonzalez-Rozada, and Neumeyer (2018) for our purposes is that we are able to compare the same products (UPC bar code) across stores while they cannot precisely compare products across stores (since products are defined as narrow categories but without bar codes).

US, Cavallo (2018) shows that the introduction of Amazon has led to a reduction in price differentials as well, but his focus is on price dispersion within locations of a single chain (i.e., Walmart). Empirical studies find that many store characteristics are explained by chains. For example, Hwang, Bronnenberg, and Thomadsen (2010) find that assortment gets set at the chain level, and Hwang and Thomadsen (2016) find that a large fraction of the variation of brand sales across stores is also explained at the chain level. We extend the evidence showing that also prices seem to be defined at the chain level. Our empirical findings about price dispersion are more closely related to the analysis in Nakamura, Nakamura, and Nakamura (2011) and Kaplan, Menzio, Rudanko, and Trachter (Forthcoming) for the US. Previous papers used scanner price data, which has the disadvantages of being at weekly frequency and of using transaction prices that mix temporary sales with list prices. A distinct feature of our data is that we observe daily list prices, which allow us to get a more precise definition of prices. Similar to Nakamura, Nakamura, and Nakamura (2011), we find evidence of a large chain component in price setting. Cavallo, Neiman, and Rigobon (2014) highlight that only 21 out of the top 70 US retailers (among those that sell online) potentially have prices that vary by ZIP code, and 13 of these 21 are grocery stores. We show that, at least in the case of Argentina, the price variation between grocery stores of the same chain is relatively small.[5]

Our paper also relates to a growing literature that estimates various elasticities with respect to regional shocks (e.g., Mian and Sufi, 2011; Sufi, Mian, and Rao, 2013; Beraja, Hurst, and Ospina, 2016; Yagan, 2018; Sergeyev and Mehrotra, 2018). We contribute to this literature by exploring the impact of uniform pricing policies on the impact regional shocks have on consumers and firms. Using US data, DellaVigna and Gentzkow (2017) estimate a constant-elasticity model of demand and find that the average chain could increase its profits by 7% under flexible pricing. We build and estimate a tractable two-region model based on the trade literature (Simonovska, 2015) to evaluate the impact on firms and consumers. Differently from DellaVigna and Gentzkow (2017), our structural model allows us to take into account changes in demand elasticity when evaluating the impact of uniform pricing. Similar to Adams and Williams (2019), we find that uniform pricing generally leads to higher consumer welfare since it partially protects consumers from firms exercising monopolistic power. In addition to this market power force highlighted by Adams and Williams (2019), however, in our model this welfare result depends on how different the regions are and the magnitude of the local shocks. Uniform pricing implies that firms do not reduce prices as much when productivity is reduced in a region, and, hence, if local shocks are sizable, uniform pricing may actually reduce consumer welfare.

[5]Regarding price adjustments, Midrigan (2011) uses data on a single chain in the US and finds evidence of price change synchronization *within stores.* We confirm the finding in our data for Argentina. Moreover, we extend the analysis and also find synchronization on the extensive and intensive margins of price changes *within chains.*

3 Data

In February 2016, the Argentinean government passed a normative to build a national, publicly available report of prices (*Sistema Electronico de Publicidad de Precios Argentinos*). The objective of the policy was to reduce inflation by providing information on prices. All large retailers of massively consumed goods have to report daily prices to the government for each of their stores. The requirement was mandatory for a large set of products (typically associated with grocery stores), but retailers were allowed to include non-mandatory products as well. Large fines (of up to 3 million US dollars) are to be applied if stores do not report their prices correctly. Since May 2016, the official website `www.preciosclaros.gob.ar` has provided consumer-friendly access to this price information. On this website, after entering their location, consumers can search for stores and products and compare current prices. This website only contains information about the prices in the stores; i.e., consumers cannot buy online from this website. In this paper, we use data from May 2016 to March 2018.[6]

We obtain information on each store and product. For each store, we know its name (not just an identification code), its chain owner, the type of store, and its precise location (latitude and longitude). Chains may have different types of stores due to having alternative sizes of stores (e.g., Express, Market, and Supermarket) or due to being known under different names in the market. For example, the chain *Jumbo* acquired the chains *Vea* and *Disco*, so the data also includes them as different types of stores. We do not know whether these different types of stores operate as different chains, so in some of our analysis we define "chains" as "chain-types"; i.e., *Jumbo* would be a different chain than *Vea.* For each product (bar code), we know its name, category, and brand. Categories are composed of three levels, with the third level being the most disaggregated. For example, the first-level categories include personal care and non-alcoholic drinks. The second level of the personal care category includes hair care and oral care. Finally, two examples within the third level of hair care are shampoos and conditioners.

The prices posted on the website are the prices of products available at each (offline) store. Given that some products have special sales, we sometimes have several prices for a good in a particular store on a given day. In such cases, we know all available prices. Some of these sales are available only to some consumers—typically a percentage discount for customers with a particular credit card or membership. Some of these sales, however, also refer to discounts available to all consumers—for example, two for the price of one. In addition to the mandatory list price, each store can report one of each of these two types of sale prices. We can differentiate these two types of sales, so we end up with a maximum of three prices per product-store-day.[7] Overall, we have daily data on approximately 9 million product-store observations across the country.

[6] Appendix A.1 shows how the website works.

[7] In this paper we focus on list prices but results are robust to incorporate sales prices. In a companion paper we study the sales data in detail. Around 3.4% of products have sales available to everyone while 43.8% of products have sales for specific customers. Among the latter, stores can have multiple sales for different types of costumers, but it seems that the sale with the largest discount is reported on the website.

Our dataset has advantages and disadvantages relative to more common scanner price data. There are two main disadvantages. We do not observe prices for grocery stores that are not part of large companies (i.e., those with annual sales over approximately 50 million US dollars). According to survey information available for 2012-2013 (*Encuesta Nacional de Gastos de Hogares*), our data should include between 50 and 85% of grocery sales in Argentina. In that year, grocery sales corresponded to approximately 33% of households' expenditures. More importantly, we do not have purchase quantities or individual product weights. Therefore, our empirical analysis assigns equal weight to each product-store included in the analysis.

Balancing these disadvantages, this data has several advantages. First, scanner price data is not easily available in developing countries, so our data helps fill this gap. Also, because Argentina is a high-inflation (about 30% in 2016) country it provides an interesting scenario. Moreover, having daily (instead of weekly or monthly) price data for all products (not just the ones being sold or bought) is an advantage. Knowing each store's chain provides us with new information that has not been widely exploited before. Similarly, our data has precise location information on each store (not just zip codes), so it potentially allows us to create interesting measures of distance to competition, among others. Finally, we are able to identify both the list price and (possibly many) sales prices, which can be important when describing retailers' pricing strategies.

3.1 Descriptive Statistics

Figure 1 shows all the stores included in the data. Given that most stores are concentrated in the Buenos Aires area, the two bottom figures show in more detail Greater Buenos Aires (GBA) and Buenos Aires City (CABA).[8] We first describe prices in a particular local market, CABA, and then study the pricing evidence from all stores in Argentina.[9]

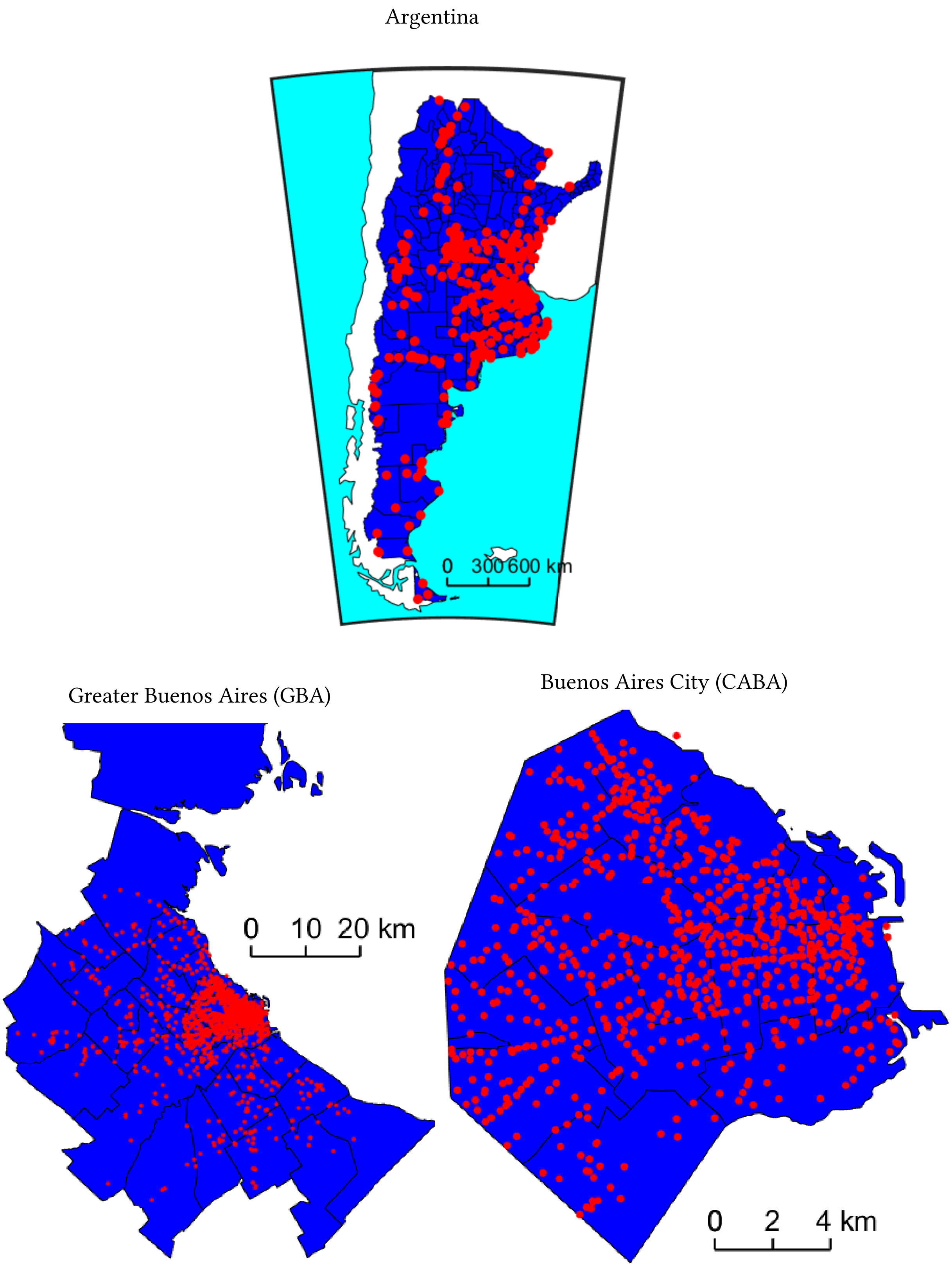
The data includes 2313 stores of 22 chains, with around 50 thousand products. This implies about 9 millions product-store observations per day for 584 days, totaling about 5 billion observations. In order to study price dispersion, we limit our attention to products that are widely sold, as is common in the literature (e.g., Kaplan, Menzio, Rudanko, and Trachter, Forthcoming). In particular, we clean the data such that we keep products that are sold by at least two chains and are present in more than 50% of stores in a given region (i.e., either CABA or Argentina). We also focus on products that are sold most of the time (i.e., we focus on product-store combinations present in over 50% of the weeks). We also drop products in the price-control program *Precios Cuidados* as there is no dispersion on these prices.[10] Table 1 shows some descriptive statistics for the data before and after cleaning, for CABA

[8]Argentina has a population of approximately 44 million people. GBA and CABA account for approximately one-third and one-tenth of the country's population, respectively. The areas of GBA and CABA are 3,830 and 203 km^2, respectively. As a reference, CABA is about twice as large as Manhattan, both in population and area.

[9]Results are robust to choosing other cities (e.g., Cordoba).

[10]The program *Precios Cuidados* consists of price controls for about 300 products. See Aparicio and Cavallo (2018) for a study of this program.

Figure 1: Store Locations



Notes: Each dot refers to a store in either Argentina, Greater Buenos Aires, or Buenos Aires City.

and Argentina. The data cleaning process does not eliminate any store. Even though it does reduce the number of products studied by around 90-95%, the number of observations is reduced by only two-thirds. The products kept are the ones more common across stores, and hence have a larger number of observations.[11] The number of stores per product increases by around 500%, hence allowing us to have enough information to describe price dispersion. Finally, the average prices of the products are around 25% lower in the selected sample. More importantly, the average price dispersion—the cross-sectional standard deviation of the prices at which the same product is sold on the same day and in the same region—in the initial and final samples remains almost constant.

Table 1: Descriptive Statistics Before and After Cleaning

	CABA		**Argentina**	
	Before	**After**	**Before**	**After**
Number of chains	5	5	22	20
Number of stores	806	806	2313	2310
Number of products	26384	1805	50112	1773
Number of days	584	584	584	584
Number of observations per day (M)	2.69	0.90	9.14	2.37
Products per store	3537	1178	4243	1099
Products per chain	9876	1409	7553	1097
Stores per chain	158	158	123	125
Stores per product	102	489	183	1324
Average price (AR $)	61	46	61	45
Price dispersion (%)	6.5	7.0	10.0	9.7

Notes: Price dispersion refers to the average standard deviation of log-standardized prices. This measure is explained in detail in the main text.

Finally, we use the stores' locations to include two additional data sources. First, we use the the 2010 Census to incorporate characteristics such as education and employment of each store's location. Second, we use official data on regional employment to study the response of prices to local shocks.[12]

4 Empirical Results

In this section we study the role of chains (as opposed to stores) on prices. Recent literature has highlighted that price dispersion is a prevalent characteristic in many markets: The same product (defined by the UPC bar code) is sold at different prices by various stores in a local market and time period. We also find large variation in relative prices between chains. We find, however, that conditional on a

[11] It is also possible that some observations have misreported information, which implies that they are less likely to be common across stores. These observations would also be eliminated.

[12] Employment data is available at www.trabajo.gob.ar/estadisticas/oede/estadisticasregionales.asp.

product, there is little variation across stores of the same chain. We use the term "uniform pricing" to refer to this fact, i.e., that product prices do not vary within stores of a chain. The geographic boundary of a chain is not obvious, so we perform our analysis both using only Buenos Aires city data and using all Argentinean data. In both cases, we show that prices as well as price changes are remarkably similar for all stores within a chain.

We then introduce information on the characteristics of store locations and explore which chain characteristics correlate more with uniform pricing. Even though chains with a larger number of stores or with stores in very different locations tend to display less uniform pricing, we find that the most important determinant of uniform pricing is the number of provinces in which a chain operates. Nevertheless, the number of unique prices per product per chain, one measure of uniform pricing, increases by less than one-to-one with the number of provinces in which a chain operates.

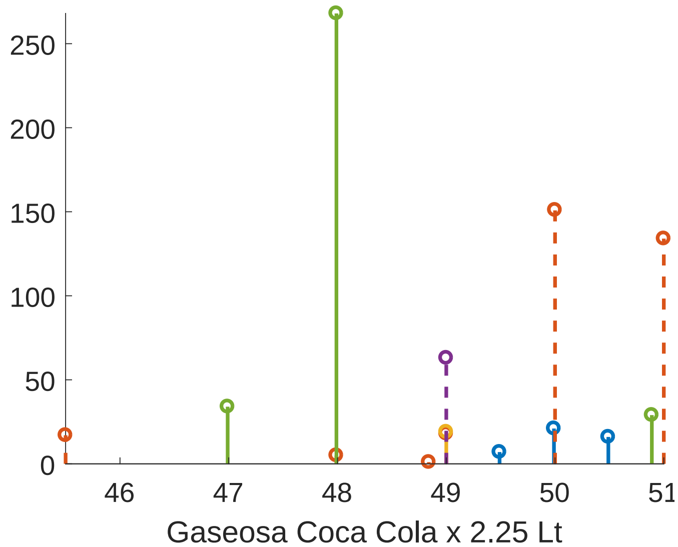
One potential implication of uniform pricing is that grocery store prices would not change with regional conditions or shocks, particularly so if chains operate in several regions. We explore this hypothesis and show that prices in stores of chains that operate in many regions do not seem to react to local labor market conditions, while stores of chains operating almost exclusively in one region do react to local conditions.

4.1 Uniform Pricing

CABA has 806 grocery stores that belong to 5 different chains. The number of stores per chain varies between 17 and 340. The size of the stores, measured by the number of products sold, also varies between approximately 1,200 and 1,800. To obtain some intuition about prices within chains, we first use a case study of the product *Coca-Cola 2.25 Lt.* Figure 2 shows the distribution of prices for this product on a given date, with different colors identifying different chains. Prices are bunched in only a few values and, more importantly, conditional on a chain, there are only a few prices (much fewer prices than the number of stores).[13]

[13] Appendix Figure A2 repeats this exercise for other products.

Figure 2: Uniform Pricing for Coca-Cola



Notes: Each color refers to a different chain.

More formally, Table 2 shows that uniform pricing is a general characteristic of chains in CABA. For each day and product, we define the relative price as the log-price minus the mean log-price across stores for the same product. Product prices are almost unique within chains. The average number of unique prices for each good across stores is between 1 and 4.5 for all chains. Given the number of stores per chain, this implies one price per 55 stores on average. Chains have up to 4 types of stores, and part of the price dispersion within chains is explained by price differences between store types. The average number of unique prices by chain-type is always under 3, implying one price per 81 stores. Moreover, price dispersion in CABA is 7% (see Table 1), while price dispersion within chains is smaller, between 0.7% and 4.7%. If we further control for store type within chains, the price dispersion is even smaller.

The last panel of Table 2 refers to the average price of each chain. The relative price of a store is defined as the average relative price across products in the store for a given day. The relative price of the chain is defined as the average across time and stores of these daily relative prices. Chain I is in general the cheapest, with a relative price 3.3% lower than the average. This contrasts significantly with the Chain V relative price, which is 3.2% higher than the average. This ranking, however, hides significant variation across products. For example, the cheapest chain sets 5% of their prices 4.3% above the market average. Similarly, the most expensive chain sets 5% of their prices 10.6% below the market average.

Table 2: Uniform Pricing in Buenos Aires City

	I	II	III	IV	V
Price dispersion					
Within chain	2.2	4.3	0.7	4.7	3.5
Unique prices by product	2.95	1.89	1.03	4.52	3.85
Price dispersion by Chain-type					
Within chain-type	2.2	1.6	0.7	2.9	1.5
Unique prices by product	2.95	1.11	1.03	1.85	1.84
Prices					
Price rank	1	2	3	4	5
Relative price (%)	-3.3	-3.1	-0.8	2.5	3.2
By product					
Percentile 5	-11.3	-18.4	-9.3	-8.0	-10.6
Percentile 10	-8.8	-12.9	-7.3	-4.4	-7.0
Percentile 25	-5.7	-6.9	-4.0	-0.2	-2.1
Percentile 50	-2.9	-2.4	-1.2	2.8	2.5
Percentile 75	-0.6	1.4	1.5	6.0	8.2
Percentile 90	1.5	6.2	6.0	9.4	14.6
Percentile 95	4.3	9.4	9.5	11.8	19.0

Notes: Price dispersion refers to the average standard deviation of log-standardized prices. This measure is explained in detail in the main text.

Table 3 expands this analysis to all the chains and stores in Argentina, showing that product prices are almost unique within chains not only in CABA but in all Argentina. In order to understand the magnitude, we highlight that the average number of stores per chain is over 100. The geographic boundary of a chain is not clear, so we remark that for most multi-province chains the average number of unique prices is much smaller if we compute unique prices by chain-province.[14]

[14] The average number of provinces in which a chain operates is 5.4. The distribution, however, is right skewed with almost 50% of chains operating in only one province and three chains operating in almost all provinces.

Table 3: Uniform Pricing in Argentina

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Price dispersion																				
Within chain	0.4	0.5	0.0	0.0	0.0	0.0	2.4	3.7	0.0	6.1	0.0	5.3	2.9	7.0	1.8	3.6	8.0	7.7	3.2	5.4
Unique prices by product	1.01	1.01	1.00	1.00	1.00	1.00	1.11	3.73	1.00	9.08	1.00	3.44	1.13	2.26	2.09	5.40	15.29	18.25	1.37	6.68
Price dispersion by Chain-Province																				
Within chain-prov	0.4	0.5	0.0	0.0	0.0	0.0	2.3	2.6	0.0	3.8	0.0	5.0	2.9	4.3	1.2	2.8	4.1	5.6	3.2	3.7
Unique prices by product	1.01	1.01	1.00	1.00	1.00	1.00	1.10	2.72	1.00	2.10	1.00	2.74	1.13	1.40	1.10	3.22	3.52	5.36	1.37	2.35
Price dispersion by Chain-Province-Type																				
Within Chain-prov-type	0.4	0.5	0.0	0.0	0.0	0.0	2.0	2.6	0.0	2.5	0.0	2.4	2.5	0.9	1.2	2.8	2.6	3.4	3.2	3.6
Unique prices by product	1.01	1.01	1.00	1.00	1.00	1.00	1.09	2.72	1.00	1.32	1.00	2.17	1.09	1.04	1.10	3.22	1.88	2.30	1.37	2.16
Prices																				
Price rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Relative price (%)	-15.7	-10.0	-8.6	-6.8	-6.4	-5.6	-5.1	-3.1	-2.6	-2.3	-2.2	-2.0	-1.5	-0.6	0.1	0.7	1.7	2.2	3.6	4.4
By product																				
Percentile 5	-37.8	-35.0	-30.6	-23.9	-31.8	-28.6	-31.5	-11.6	-14.1	-18.2	-26.8	-29.3	-28.4	-24.7	-8.2	-22.0	-14.8	-13.8	-19.6	-13.0
Percentile 10	-32.4	-27.4	-22.6	-17.9	-25.6	-21.3	-22.2	-8.9	-12.3	-12.7	-21.1	-20.8	-22.2	-17.8	-6.0	-14.1	-9.8	-8.1	-12.0	-7.4
Percentile 25	-23.3	-17.6	-13.0	-11.7	-14.3	-12.6	-12.3	-5.8	-8.6	-5.9	-11.0	-9.2	-11.4	-6.4	-2.9	-3.7	-3.4	-2.1	-2.6	-0.7
Percentile 50	-15.1	-8.5	-7.1	-6.1	-4.4	-5.3	-4.0	-2.7	-3.9	-1.6	-1.8	0.1	-1.5	0.5	-0.2	2.2	1.6	2.9	4.6	5.2
Percentile 75	-7.6	-1.1	-2.0	-0.7	2.0	1.5	3.4	0.0	3.3	2.4	7.5	7.2	9.2	6.9	2.9	7.5	7.2	7.7	11.2	10.5
Percentile 90	-0.6	5.1	2.2	4.2	8.2	8.7	10.9	2.9	7.7	7.0	16.0	13.8	18.0	13.3	6.9	12.5	13.3	11.9	18.0	15.2
Percentile 95	3.2	9.5	5.0	7.6	13.4	13.7	16.1	5.1	12.4	10.2	20.5	17.3	25.0	17.4	9.7	15.8	17.4	14.7	22.4	18.3

Notes: Price dispersion refers to the average standard deviation of log-standardized prices. This measure is explained in detail in the main text.

Table 4: Uniform Price Changes

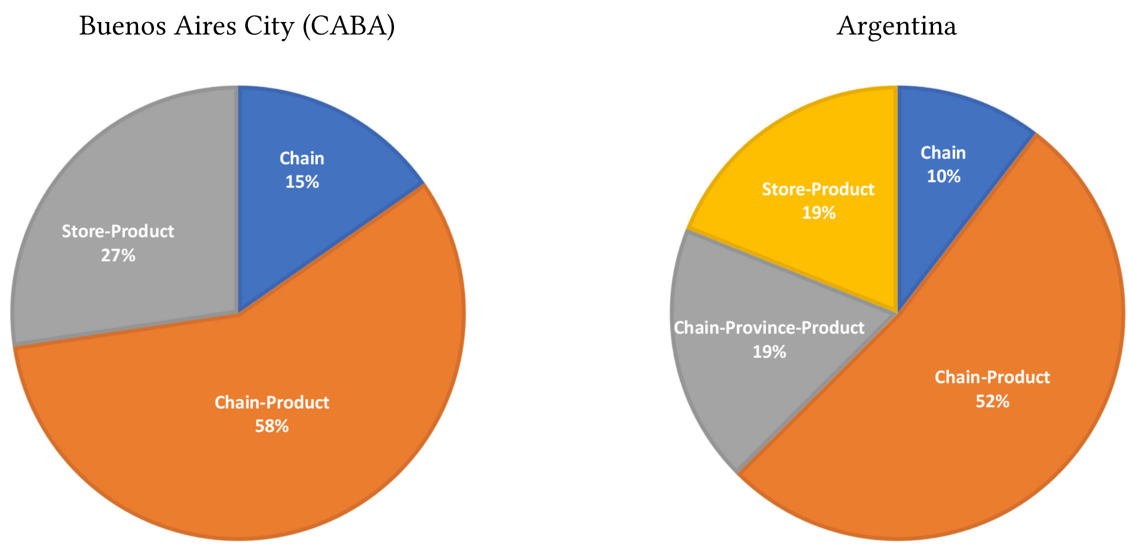
	CABA	**Argentina**
Price changes: Unconditional		
Share with change	2.72%	2.88%
Share increase	1.80%	1.84%
Share decrease	0.92%	1.04%
Std. deviation of price change	11.92%	14.92%
Price changes: Category synchronization		
Changed other products of same category, chain level	11.82%	11.40%
Changed other products of same category, store level	27.53%	29.00%
Price changes: Chain synchronization		
Changed in other stores of any chain	13.04%	5.53%
Std. deviation of price change	2.32%	5.66%
Changed in other stores of same chain	37.27%	29.93%
Std. deviation of price change	1.84%	3.25%
Changed in other stores of same type and chain	60.01%	38.27%
Std. deviation of price change	1.32%	2.85%
Changed in other stores of same province and chain	37.27%	64.96%
Std. deviation of price change	1.84%	1.23%

Notes: Statistics are in daily frequency. For example, 2.65% of prices are changed everyday in CABA. "Price changes by store" refers to the share of prices that were changed by stores that changed the price of at least one product.

Price Changes: Table 4 studies the intensive and extensive margin of price changes in CABA and Argentina, highlighting the large level of synchronization in price changes across stores of the same chain. Around 2.8% of prices are changed every day, with approximately two-third of these changes being price increases and one-third being decreases. Midrigan (2011) highlights that price changes tend to occur at similar times for products of the same category in the US. This is also true in our data. Among products that change prices in CABA, only 13% of other stores in any chain change prices. For products that change prices, we observe that around 27% of other products in the same level-3 category (the most narrowly defined) change prices in the same store. We notice, however, that price-change coordination seems stronger across chains than categories. Among products that change prices, we observe that 30−37% of other stores in the same chain change the price of the same product in the same day. The standard deviation of these price changes is approximately one-sixth of the unconditional standard deviation of price changes. Moreover, if we focus only on stores of the same type (for CABA) or in same province (for Argentina) within the chain, the share of stores that change prices increases to over 60%, with an even smaller dispersion of changes. This evidence suggests that chains coordinate their price changes across stores.

Variance decomposition: In Appendix B we introduce a statistical model to perform a variance decomposition of prices and formally highlight the role of chains in pricing. Figure 3 shows that in CABA, 15% of the price variation is driven by some chains being generally more expensive than others. Once we control for average prices of products by chain, 73% (15% + 58%) of the price dispersion is explained. Similarly for Argentina, average chain prices per product explain 62% (10% + 52%) of price variation. Controlling for price differences across provinces by chain explains another 19%. In other words, consistent with Table 2 and 3, price variation across stores within chains is small, driving only 27% and 19% of the total relative price dispersion for CABA and Argentina, respectively.

Figure 3: Variance Decomposition of Prices



Notes: We perform a variance decomposition of prices to formally highlight the role of chains relative to stores in pricing. See details in Appendix B.

4.2 Correlation with Chain Characteristics

We merge information on the location of stores with 2010 Census data to describe the characteristics of each chain's locations. We use the most precise definition of a location in the Census data (i.e., *departamentos*, *partidos* or *comunas,* depending on the region), with a total of 528 locations. These locations are generally large, on average 7,300km^2 in size with a population of 79,000 people. The median location in which stores are located, however, is smaller in size and more densely populated (186 km^2 with 190,000 people).[15] More importantly, we are able to obtain information on the education, employment and home characteristics of the people living in those areas.

Table 5 performs a simple OLS regression of our different measures of uniform pricing on different chain characteristics. The number of unique prices increases with the number of stores, but this becomes insignificant once we control for the number of provinces in which a chain operates. One potential hypothesis is that chains with greater variance in store location characteristics will have higher incen-

[15] Means are approximately 3,W500km^2 and 310,000 individuals.

tives to set different prices. We find that the the number of unique prices does increase with variance in store location characteristics (either education or distance to competition) but, once again, becomes insignificant once we control for the number of provinces in which a chain operates. The second panel of Table 5 shows that the results are qualitatively similar if we use the standard deviation of relative prices as the measure of dispersion instead of the number of unique prices.

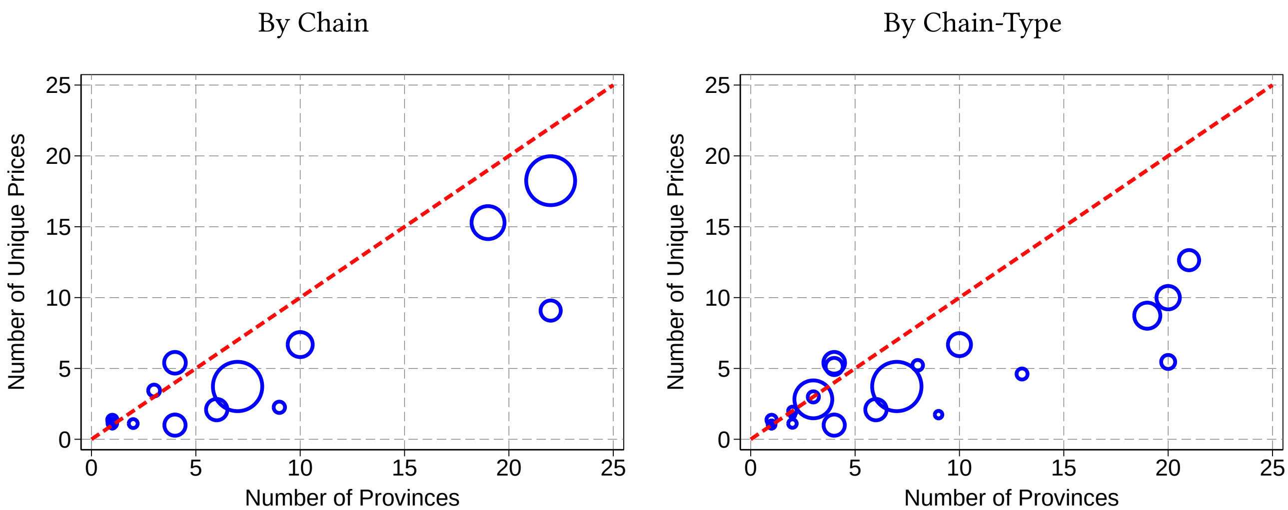
Table 5: Uniform Pricing and Chain Characteristics

	(1)	(2)	(3)	(4)	(5)
		Log(Number of Unique Prices)			
Log(Number of stores)	0.477***	0.0812			0.151
	(0.0843)	(0.120)			(0.165)
Log(Number of provinces)		0.660***			0.691***
		(0.170)			(0.181)
Var(Log(education) within chain)			57.47***		-13.99
			(15.17)		(17.62)
Var(Log(distance) within chain)				0.584***	-0.0180
				(0.181)	(0.160)
Observations	20	20	20	20	20
R-squared	0.640	0.810	0.444	0.366	0.817
		Std. Dev. of Relative Prices			
Log(Number of stores)	1.208***	-0.0206			0.329
	(0.282)	(0.425)			(0.553)
Log(Number of provinces)		2.049***			2.235***
		(0.602)			(0.607)
Var(Log(education) within chain)			131.0**		-91.31
			(49.11)		(58.95)
Var(Log(distance) within chain)				1.588***	0.139
				(0.530)	(0.535)
Observations	20	20	20	20	20
R-squared	0.505	0.706	0.283	0.333	0.749

*Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

The left panel of Figure 4 plots the relation between uniform pricing and the number of provinces in which a chain operates. The relation is positive but lower than one-to-one. The number of stores, shown by the size of each circle, does not seem to affect the number of unique prices. The right panel of Figure 4 plots the same relation but defines chains in a more strict way, i.e., according to chain-types. In this case, the relation between uniform pricing and the number of provinces becomes weaker, suggesting that chains may use subdivisions within the chain to partially discriminate prices. Once that is done, price differentiation between locations is not as strong.

Figure 4: Uniform Pricing and Number of Provinces



Notes: Each circle refers to a chain or a chain-type. The size of the circle increases with the number of stores in the chain or chain-type.

Table 6: Relative Dispersion of Chain Location Characteristics

	Average	Std. Dev.
Years of education	0.33	0.39
Home characteristics	0.41	0.40
Number of children	0.30	0.40
House ownership	0.40	0.46
Age	0.44	0.46

Notes: We compute the variance of the log of alternative characteristics for locations in which a chain operates relative to the unconditional variance. This table reports the average and standard deviations of these measures across chains.

Store locations are not exogenous, so we might expect that chains tend to operate stores in locations with similar characteristics (e.g., for reputation or customer demand reasons). To study this hypothesis, we compute the variance of the log of alternative characteristics for locations in which a chain operates relative to the unconditional variance. Table 6 shows that the averages across chains for alternative characteristics (e.g., education, number of children, or age of the head of household) are always under one-half, confirming that chains locate their stores in relatively similar places.

4.3 Effects of Regional Shocks

We have reported consistent evidence that firms' pricing decisions almost do not vary with store characteristics; that is most chains tend to have a single price per product across their stores. One potential implication of this fact is that grocery store pricing will not change with local conditions or shocks. In this section we introduce evidence on monthly employment levels for each province to evaluate whether average store prices fluctuate with local labor market conditions.[16]

Given the evidence presented on uniform pricing, we expect that prices in stores of chains that operate in many regions will not react to local labor market conditions, while stores of chains operating almost exclusively in one region will react to local conditions. For each store s we define three measures. First, for prices, let $\Delta p_{s,t}$ be the annual change in the average relative price in store s and month t. Second, we measure the relative importance of a province for a chain with the local share. Let $c(s)$ refer to the chain of store s and $prov(s)$ the province of store s. We define the chain's local share $local_{s,t}$ as the share of stores of chain $c(s)$ that belong to province $prov(s)$ in month t. Third, for local conditions, let $\Delta e_{prov(s),t}$ be the annual change in log employment in the province $prov(s)$ of store s in month t. Table 7 evaluates how $\Delta p_{s,t}$ relates to $\Delta e_{prov(s),t}$ and, more importantly, how that relation depends on the local share $local_{s,t}$.

The first column of Table 7 shows that average-price growth per store is not significantly related to employment growth. In all our analysis, we control for store fixed effects in order to control for trends in either store or local characteristics. Once we split the sample by local share, however, columns (2) and (3) show that the relation is significantly positive for stores with a local share above the median (i.e., above one-third approximately) but not for those below.

Next, we do a more formal analysis of the role of the local share by including the interaction between $local_{s,t}$ and $\Delta e_{prov(s),t}$. We estimate

$$\Delta p_{s,t} = \alpha_s + \gamma_t + \delta\, local_{s,t} + \rho\, \Delta e_{prov(s),t} + \beta\, local_{s,t} \times \Delta e_{prov(s),t} + \epsilon_{s,t}.$$

The coefficient of interest is the interaction term β. Columns (4) and (5) show that the interaction term is significant and positive, even after controlling for time fixed effects. Figure 5 plots the marginal effect of employment growth $\Delta e_{prov(s),t}$ on store price growth $\Delta p_{s,t}$ for store with different levels of local shares $local_{s,t}$, showing that prices in stores with larger local shares covary more with local conditions. This means that a 1 percent change in employment growth ($\Delta e_{prov(s),t}$) implies a 0.5 percent change in prices ($\Delta p_{s,t}$) for chains with a local share of 100%, but almost no change for chains with a local share below 25%.

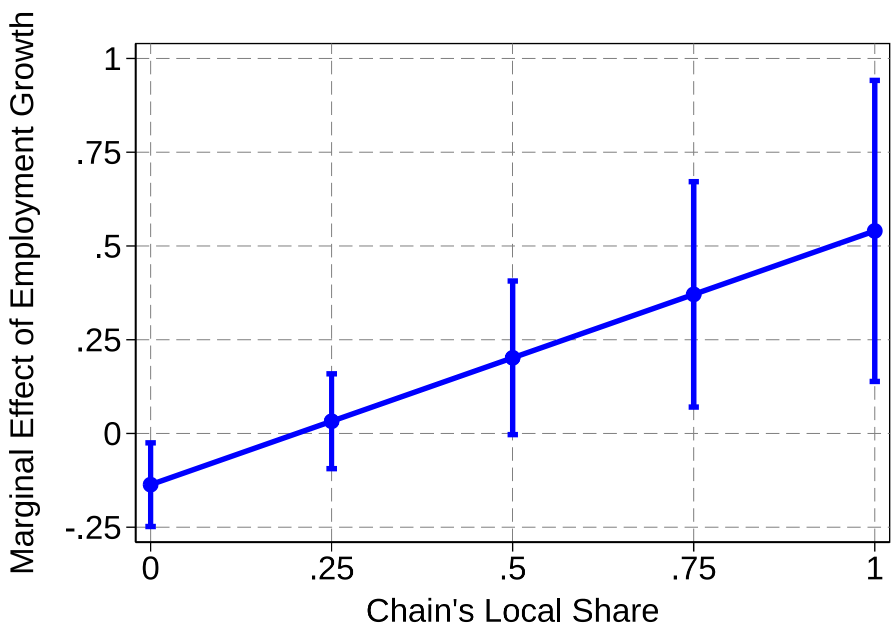
[16] We would like to have more precise definitions of labor market conditions, but we are limited by data availability.

Table 7: Regional Shocks and Store Prices

	(1) All	(2) Local Share < Median	(3) Local Share > Median	(4) All	(5) All
Emp. Growth $\left(\Delta e_{prov(s),t}\right)$	-0.0197	-0.124**	0.490***	-0.137**	-0.174***
	(0.0625)	(0.0538)	(0.157)	(0.0569)	(0.0582)
Local Share $(local_{s,t})$				-0.269	-0.237
				(0.189)	(0.144)
Emp. Growth × Local Share				0.677***	0.454**
				(0.216)	(0.199)
Observations	24,626	12,372	12,253	24,626	24,626
R-squared	0.463	0.537	0.425	0.472	0.488
Store FE	YES	YES	YES	YES	YES
Time FE	NO	NO	NO	NO	YES

Notes: Robust standard errors in parentheses. *** *p<0.01,* ** *p<0.05,* * *p<0.1.*

Figure 5: Marginal Effect of Regional Shocks on Store Prices



Notes: This figure reports the marginal effect of employment growth on price growth for different levels of a chain's local share, as obtained from Column (4) in Table 7. The vertical lines refer to the 95% confidence intervals.

5 Model

We build and estimate a tractable model consistent with our empirical findings to evaluate the consequences of uniform pricing. We compare the responses of prices and quantities for regional versus aggregate shocks and study who are the winners and losers of uniform pricing. The model has the minimal ingredients such that it is consistent with the data and is also tractable, allowing us to easily identify the key trade-offs across alternative pricing schemes. We describe the main ingredients of the model and relegate the solution details to Appendix C.

Time is discrete and infinite, $t = 0, \ldots, \infty$. There are two cities $j = 1, 2$ and a continuum of differentiated goods $\omega \in [0, 1]$. Each product is sold by a national monopolistic firm that chooses to sell in either one or both cities. Throughout the analysis, we interpret city 1 as the local economy and city 2 as the rest of the economy. We take wages as given, but each product market ω clears. Section 6.6 extends the analysis to a general equilibrium framework.

5.1 Households

There is a representative consumer in each city with period utility

$$u_{j,t} = \int_{\omega \in \Omega_{j,t}} s_j(\omega) \log\left(q_{j,t}(\omega) + \bar{q}_j\right) d\omega, \tag{1}$$

where $\Omega_{j,t}$ is the set of goods consumed in city j and period t, $q_{j,t}(\omega)$ is the individual consumption of variety ω in city j and period t, and $\bar{q}_j > 0$ is a city-specific constant. There are city-specific tastes, $s_j(\omega)$, such that the demand functions are heterogeneous across goods and cities. We assume that $\frac{\partial s_1(\omega)}{\partial \omega} \geq 0$ and $\frac{\partial s_2(\omega)}{\partial \omega} \leq 0$. Hence, city $j = 1$ prefers goods closer to $\omega = 1$, while city $j = 2$ prefers goods close to $\omega = 0$.

Preferences are non-homothetic, so the demand elasticity changes with income, as in Simonovska (2015). We assume these preferences so that the model can be consistent with the empirical findings in Section 4 showing that prices change with income shocks.[17] Moreover, the presence of heterogeneous tastes and non-homotheticity implies that in equilibrium some goods are sold only in city 1, some goods only in city 2, and some in both cities. This characterization is important to capture the empirical finding that some chains are national (i.e., sell in many cities), while others are local (sell only in one city) and can have different responses to regional shocks.

The representative household has an exogenous labor supply normalized to $L_{j,t}$. The household's prob-

[17] With CES preferences, firms prices equal to a constant markup over the marginal cost and therefore prices do not react to income shocks. For more general preferences, see Jung, Simonovska, and Weinberger (2019) or Arkolakis, Costinot, Donaldson, and Rodríguez-Clare (2019) among others.

lem reads

$$U^{j}=\max_{q_{j,t}(\omega)}\sum_{t=0}^{\infty}\beta^{t}u\left(u_{j,t}\right)\qquad\text{s.t.}\quad\int_{\omega\in\Omega_{j,t}}p_{j,t}\left(\omega\right)q_{j,t}\left(\omega\right)\leq w_{j,t}L_{j,t}\quad\forall t.$$

The demand for variety ω in city j at period t is given by

$$q_{j,t}\left(\omega\right)=\max\left\{0,\frac{s_{j}\left(\omega\right)}{\bar{S}_{j,t}}\frac{y_{j,t}+P_{j,t}\bar{q}_{j}}{p_{j,t}\left(\omega\right)}-\bar{q}_{j}\right\},\tag{2}$$

where $y_{j,t}=w_{j,t}L_{j,t}$, $\bar{S}_{j,t}=\int_{\omega\in\Omega_{j,t}}s_{j}\left(\omega\right)d\omega$, and $P_{j,t}=\int_{\omega\in\Omega_{j,t}}p_{j,t}\left(\omega\right)d\omega$. The marginal utility from consuming a variety ω is bounded from above at any level of consumption. Hence, a consumer may not have positive demand for all varieties.

5.2 Firms

Firms have a linear technology in local labor to produce goods in each city. The cost of producing one unit of good in city j in period t is $c_{j,t}=\frac{w_{j,t}}{z_{j}}$.

We compare the solution of two alternative price settings: *uniform* and *flexible pricing*. Under uniform pricing, the firm has to set the same price in both cities; i.e., $p_{1,t}\left(\omega\right)=p_{2,t}\left(\omega\right)=p_{t}\left(\omega\right)$. Alternatively, under flexible pricing, producers can set different prices in each city.

5.2.1 Flexible Pricing

In the case of flexible pricing, firms can set different prices in each city. The problem of the firm is

$$\max_{p_{j,t}(\omega)}\sum_{j=1}^{J}\left(p_{j,t}\left(\omega\right)-c_{j,t}\right)q_{j,t}\left(\omega\right)$$

taking the demand function 2 as given. The solution is

$$p_{j,t}\left(\omega\right)=\left[c_{j,t}\frac{s_{j}\left(\omega\right)}{\bar{S}_{j,t}}\left(\frac{y_{j,t}}{\bar{q}_{j}}+P_{j,t}\right)\right]^{1/2}.\tag{3}$$

Given the demand function 2 and pricing 3, we can find the set of goods consumed in each city. It is easy to show that this set is characterized by a threshold such that $q_{j,t}\left(\omega\right)\geq0$ if and only if $s_{j}\left(\omega\right)\geq\underline{s}_{j,t}$.[18]

[18]To see this, replace the equilibrium price 3 on the demand function 2 and note that it is increasing in $s_{j}\left(\omega\right)$.

The threshold is defined as the taste such that consumption is equal to zero; that is

$$\underline{s}_{j,t} \equiv \frac{\overline{S}_{j,t}\overline{q}_j c_{j,t}}{w_{j,t} + P_{j,t}\overline{q}_j}. \tag{4}$$

Recall that $s_1(\omega)$ is increasing in ω. Hence, there exists $\underline{\omega}_t \in [0,1]$ such that $q_{1,t}(\omega) \geq 0$ if and only if $\omega \geq \underline{\omega}_t$ and $\underline{\omega}_t = s_1\left(\underline{s}_{1,t}\right)^{-1}$. Similarly, as $s_2(\omega)$ is decreasing in ω, there exists $\overline{\omega}_t \in [0,1]$ such that $q_{2,t}(\omega) \geq 0$ if and only if $\omega \leq \overline{\omega}_t$ and $\overline{\omega}_t = s_2\left(\underline{s}_{2,t}\right)^{-1}$.

5.2.2 Uniform Pricing

Under uniform pricing, each variety ω has the same price in both cities. Therefore, each seller has to choose whether to sell only in city 1, only in city 2, or in both locations. If the seller chooses to sell only in one location, the price function is the same as with flexible pricing. If he sells in both locations, the problem is

$$\max_{p_t(\omega)} \sum_{j=1}^{J} q_{j,t}(\omega)\left(p_t(\omega) - c_{j,t}\right)$$

taking the demand functions 2 as given. The solution is

$$p_t(\omega) = \left[\sum_{j=1}^{2} c_{j,t}\frac{s_j(\omega)}{\bar{S}_{j,t}}\left(\frac{y_{j,t}}{\bar{q}_j} + P_{j,t}\right)\right]^{1/2}. \tag{5}$$

Individual prices are increasing in the taste preference s_j regardless of whether a variety is sold in either one or both cities. This implies that in equilibrium there are thresholds $\underline{s}_{j,t}$ such that in city j the consumption of variety ω is positive if and only if $s_j(\omega) \geq \underline{s}_{j,t}$. Moreover, $s_1(\omega)$ increasing implies that there exists $\underline{\omega}_t$ such that $\Omega_{1,t} = \left[\underline{\omega}_t, 1\right]$. Similarly, as $s_2(\omega)$ is decreasing, then $\Omega_{2,t} = [0, \overline{\omega}_t]$. As a result, the price of variety ω is

$$p_t(\omega) = \begin{cases} \left[c_{2,t}\frac{s_2(\omega)}{\bar{S}_{2,t}}\left(\frac{y_{2,t}}{\bar{q}_2} + P_{2,t}\right)\right]^{1/2} & \text{if } \omega \leq \underline{\omega}_t \\ \left[\sum_{j=1}^{2} c_{j,t}\frac{s_j(\omega)}{\bar{S}_{j,t}}\left(\frac{y_{j,t}}{\bar{q}_j} + P_{j,t}\right)\right]^{1/2} & \text{if } \underline{\omega}_t \leq \omega \leq \overline{\omega}_t \\ \left[c_{1,t}\frac{s_1(\omega)}{\bar{S}_{1,t}}\left(\frac{y_{1,t}}{\bar{q}_1} + P_{1,t}\right)\right]^{1/2} & \text{if } \omega \geq \overline{\omega}_t \end{cases}.$$

Finally, the thresholds are defined by

$$\frac{s_1\left(\underline{\omega}_t\right)}{\bar{S}_{1,t}}\frac{y_{1,t} + P_{1,t}\bar{q}_1}{p_t\left(\underline{\omega}_t\right)} = \bar{q}_1 \qquad \text{and} \qquad \frac{s_2\left(\overline{\omega}_t\right)}{\bar{S}_{2,t}}\frac{y_{2,t} + P_{2,t}\bar{q}_2}{p_t\left(\overline{\omega}_t\right)} = \bar{q}_2.$$

6 Quantitative Exploration

In this section we quantitatively evaluate the implications of uniform versus flexible pricing for firms and households.

6.1 Calibration

Given that our empirical evidence suggests uniform pricing, we calibrate the economy to the uniform pricing case in steady state. We assume cities are symmetric, so we normalize $L_1 = L_2 = 1$ and set $\bar{q} = \bar{q}_1 = \bar{q}_2$ and $z = z_1 = z_2$. Also, we set the taste parameters $s_1(\omega) = (\omega)^{\alpha}$ and $s_2(\omega) = (1-\omega)^{\alpha}$ and we normalize the wage $w_1 = w_2 = 1$.

There are three parameters to calibrate: productivity z and the preference parameters α and $\bar{q}$. We target three moments from the empirical results. First, in the data, 4% of stores sell only in one province. In the model, city 1 consumes varieties $\Omega_1 = [\underline{\omega}, 1]$ out of which varieties $[\overline{\omega}, 1]$ are sold only in city 1. Hence, we target this moment as $0.04 = (1-\overline{\omega}) / (1-\underline{\omega})$.

Section 4.3 shows that prices of firms with a lower local share react less to regional shocks. In the model we define the local share as $local(\omega) = q_1(\omega) / (q_1(\omega) + q_2(\omega))$. We shock the economy with an exogenous increase in income for city 1—we increase L_1 by 1.7%, which corresponds to one standard deviation in the data. We target the response of a firm with a local share of 0.5 and the differential effect between a firm with a local share of 1 versus one with 0.5. Despite its simplicity, the model does a good job at matching the three target moments. Table 8 shows the estimated parameters and target moments.

Table 8: Estimated Parameters and Moments

Parameter	Value	Description	Moment	Data	Model
z	15.48	Productivity	Local share	4.0	4.0
α	0.89	Taste curvature	Price response p50	0.2	0.2
$\bar{q}$	0.20	Demand constant	Price response p100	0.5	0.5

Notes: The data of price responses and local shares is based on the estimtes of Section 4.3.

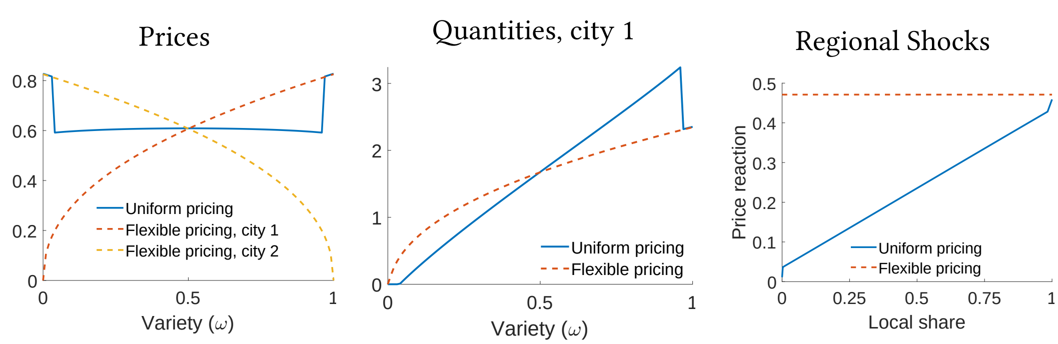
Validation: We validate the calibration looking at price dispersion, which is a non-targeted moment. The total price dispersion (i.e., across varieties ω) is equal to 8.2% in the model. To map the dispersion to the data, we have to specify what chains, stores, and products are in the model. Depending on the mapping, the relevant price dispersion in the data can be as high as 9.5%. Our preferred interpretation is that each ω corresponds to a product in a chain for which there is one representative store in each city. Under this interpretation, the corresponding price dispersion in the data is equal to the chain plus the chain-product component of price dispersion in Argentina, which is equal to 5.89% (see Table 1 and the decomposition of Figure 3). Note that the uniform-pricing model is very close to the data, while the flexible-pricing model predicts much higher price dispersion (44.27%).

6.2 Uniform versus Flexible Pricing

How do prices change across varieties? Focusing on city 1, products close to $\omega = 1$ have a larger demand relative to products close to $\omega = 0$. If sellers can set different prices across cities, then $p_1(\omega)$ is monotonically increasing in ω (the red dashed line on the left panel of Figure 6). However, under uniform pricing, sellers have to set the same price in both cities. For those products very close to $\omega = 1$, sellers prefer to set a relatively high price and sell only in city 1, while for most of the products they set an intermediate price such that there is positive demand in both markets.[19] Hence, price dispersion is smaller under uniform than flexible pricing.

The second panel of Figure 6 shows the quantity demanded of each variety in city 1. In the uniform-pricing model, households do not consume goods below $\underline{\omega}$. Goods above $\overline{\omega}$ are sold only in city 1 at a high price, so the quantity demanded is relatively small. Note that there is more dispersion across quantities in the uniform- than in the flexible-pricing model because there is less price dispersion across varieties.

Figure 6: Uniform vs Flexible Pricing



Notes: The first figure shows the prices under uniform and flexible pricing. The second figure shows the quantity demanded in city 1. The third figure shows the response of prices to regional shocks in city 1. We shock the economy with an exogenous increase in income for city 1, we increase L_1 by 1.7%, which corresponds to one standard deviation in the data.

Response to regional shocks: In the calibration we target the response of prices to regional shocks for firms with a local share of 50% and 100%. We now compare the response for uniform versus flexible pricing. The third panel of Figure 6 shows the response of prices to income shocks as a function of the local share. In the economy with flexible pricing, the response of prices is equal to 0.47 for all varieties.

[19]Recall that the value of the thresholds $\underline{\omega}$ and $\overline{\omega}$ are a calibration target to match a 4% share of only local sellers.

In the uniform pricing, economy firms have to set the same price across cities. Hence, when the local share is relatively small, the total demand for that product does not change much. As a result, the price has a small reaction to income shocks. On the other hand, when the local share is high, prices react more to income shocks in city 1. The patterns of price reactions in the uniform-pricing economy resemble the empirical findings of Figure 5, while those in the flexible-pricing model do not.

6.3 Regional versus Aggregate Shocks

Prices react more to regional shocks under flexible than uniform pricing, providing consumers with a form of insurance and making them better off. Figure 7 shows the impulse responses of the price index (defined as $P_{j,t}^{index}$ such that $w_{j,t}L_{j,t} = P_{j,t}^{index} \int_0^1 q_{jt}(\omega)\, d\omega$) and individual prices for firms with local shares of 10%, 50%, or 90%. In the flexible-pricing economy, the response of individual prices is the same regardless of the local share. Under uniform pricing, the size of the response is increasing on the local share. The total effect is reflected in the price index: Prices decrease more in the flexible- than in the uniform-pricing economy.

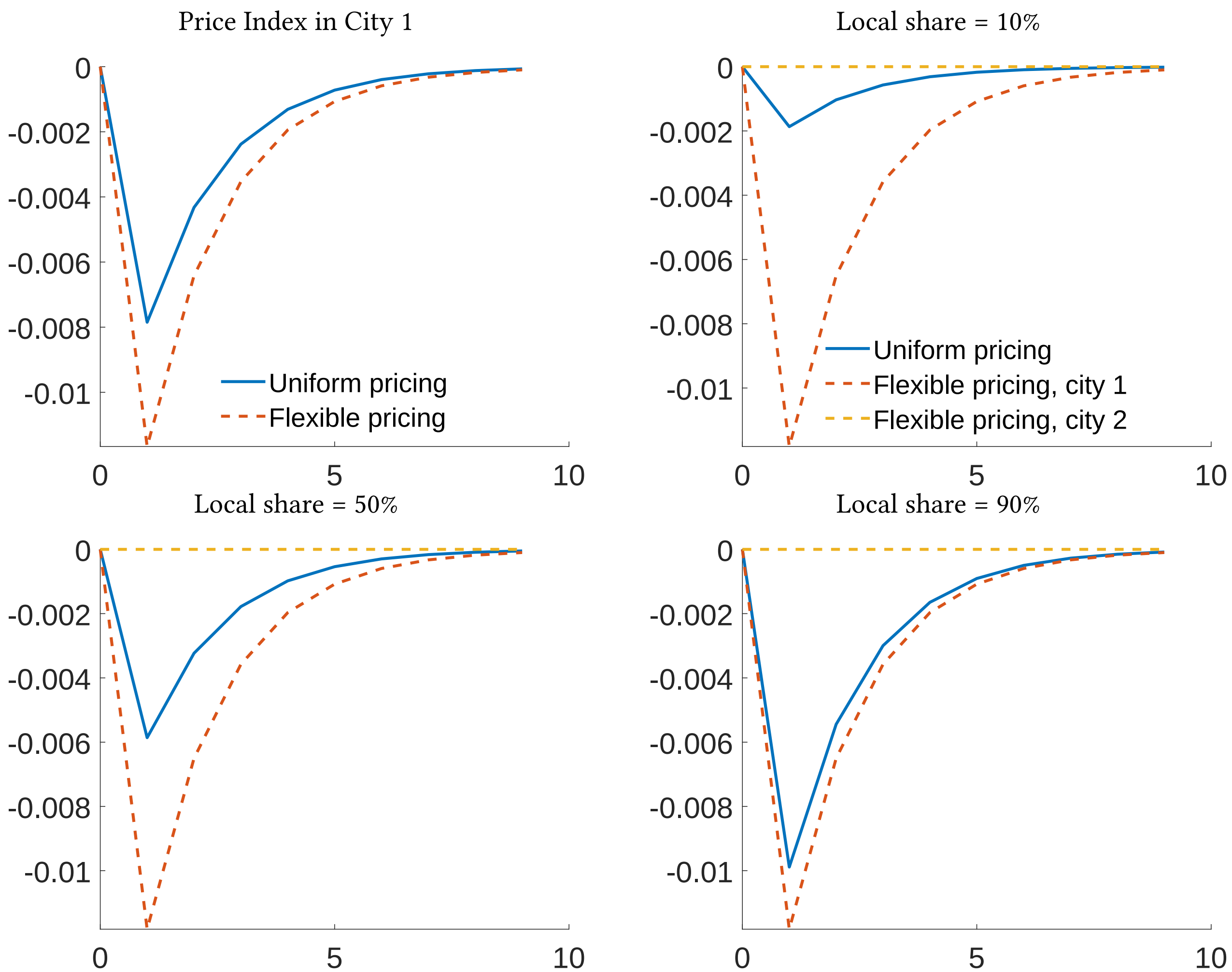
Aggregate shocks: Under uniform pricing, prices react more to aggregate than to regional shocks, which implies an smaller reaction of total consumption to aggregate than to regional shocks. Table 9 shows that the response of regional and aggregate shocks are the same with flexible pricing: Prices increase by 4.6% and consumption by 5.3% when household income increases by 10%. Under uniform pricing, however, prices react less to a regional than to an aggregate shock. Consumption, thus, reacts more to regional than to aggregate shocks. The estimated model predicts an almost one-third larger elasticity of consumption to a regional income shock than to an aggregate one. This result implies that using regional heterogeneity to infer aggregate elasticities may lead to an upward-bias due to uniform pricing.

Table 9: Regional versus Aggregate Shocks

	Prices	**Quantities**
Uniform pricing		
Regional shock	0.31	0.68
Aggregate shock	0.46	0.53
Flexible pricing		
Regional shock	0.46	0.53
Aggregate shock	0.46	0.53

Notes: The table compare the elasticity of the price index and quantities consumed to regional and aggregate shocks, in the uniform- and flexible-pricing economy.

Figure 7: Uniform- and Flexible-Pricing Responses to a Regional Shock



Notes: Impulse response of the price index as well as individual prices to a regional shock in city 1.

6.4 Winners and Losers: Steady-State Analysis

In this section we quantify the welfare gains of households and firms moving from uniform to flexible pricing.

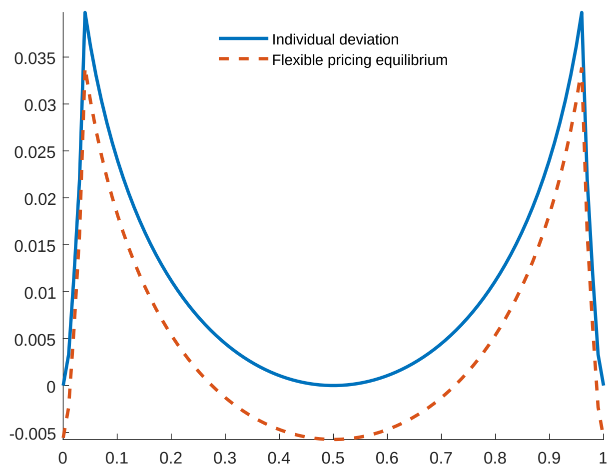
6.4.1 How costly is the uniform-pricing constraint for firms?

Firms generally prefer the flexible-pricing model, but the gains are quite modest on average. The average profit under flexible pricing is 0.4% higher than under uniform pricing (second column of Table 10). The effect is, however, heterogeneous across firms and some firms prefer the uniform-pricing economy.

To understand this heterogeneity, we compute the change in profits for an individual firm after we remove its uniform-pricing constraint but keep it for all other firms. The firm cannot be worse off because it can always set the same prices in both cities. More interestingly, the blue line of Figure 8 shows that those firms close to the thresholds $\underline{\omega}$ and $\overline{\omega}$ have the largest gains, with 4% higher profits. On the other hand, firms close to the corners of $\omega = 0$ or $\omega = 1$ or around $\omega = 0.5$ have no gains. Intuitively, firms close to the corners sell only in one city under uniform pricing. When we remove the constraint, they start selling in the other city. The demand in the other city, however, is relatively small, so, despite entering a new market, profits do not increase much. Firms close to the middle have the same demand in both cities, so in equilibrium they choose to set the same prices and have no gains.

When all firms move to the flexible-pricing equilibrium, the gains can be different due to equilibrium effects. With our baseline calibration, we find that gains are smaller for all firms (red dotted line in Figure 8), particularly due to a reduction in the demand function. Taking into account equilibrium effects, some firms are actually worse off and prefer the uniform-pricing equilibrium to the flexible one.

Figure 8: Profits Gains Under Flexible Pricing



Notes: The figure shows the percentage increase in profits for a firm to move from uniform to flexible pricing both as an individual deivation and in the new equilibrium..

6.4.2 Do households prefer uniform or flexible pricing?

In the benchmark calibration, households prefer uniform pricing. This result, however, depends on the exact configuration of the economy. There are four key forces at play, with different effects: *competition*, *entry of new varieties*, *response to regional shocks*, and *city heterogeneity*. First, competition stands for the fact that with uniform pricing, firms face more competition—in the form of heterogeneous demands—which pushes down prices and makes households prefer uniform to flexible pricing. In the benchmark calibration this force is the strongest, so households prefer uniform pricing. Second, under flexible pricing there is entry of new varieties. Third, prices provide more insurance against regional shocks under flexible than uniform pricing. The second and third mechanisms make consumers better off in the flexible-pricing economy. Fourth, if cities are heterogeneous (e.g., in income or size), results can go either way and be heterogeneous across households. As we show in Section 6.5, the total effect of these forces depends on the configuration of the economy.

To evaluate the effect on households, we use the equivalent variation measure. We compute the change in household income such that the agent can attain the level of utility of the alternative economy under the prices of the uniform-pricing economy. Thus, a negative value indicates that the household prefers uniform pricing to the alternative economy. The third row of Table 10 shows that the change in welfare of moving from uniform to flexible pricing is equivalent to an income reduction of 6.7%. The key force is the competition mechanism: For those goods for which city 1 has a relatively high taste, city 2 has a low taste. Hence, uniform pricing generates a force towards setting relatively low prices for those goods that agents value the most (recall the pricing choices of Figure 6). Uniform pricing acts as an increase in competition and makes consumers better off. The size of this channel depends on many assumptions such as heterogeneity in tastes across cities.

In equilibrium, the demand function changes for two reasons. First, the budget constraint has to hold and, because preferences are non-homothetic, this changes the demand elasticity. Moreover, under flexible pricing there is entry of new varieties. We decompose the cost of moving to flexible pricing for these two effects. The first row of Table 10 considers the case in which an individual firm can set different prices across cities. This exercise corresponds to a partial equilibrium in which we allow the firm to charge different prices but keep the demand function and set of products from the uniform pricing economy. For this counterfactual, the equivalent variation is -6.7%, almost the same as the total effect.

The second row of Table 10 shows the results when we keep the set of varieties constant but allow the demand function to adjust to the new equilibrium. In this case, the equivalent variation reduces by an additional 0.2% relative to the partial-equilibrium scenario. Finally, we interpret the difference between this result and the total effect (0.2%) as the welfare gains due to the entry of new varieties in the flexible-pricing equilibrium. Hence, the force of entry of new varieties is quite modest in the benchmark economy, while the effect of competition is larger and makes consumers better off in the uniform-pricing economy.

Response to Regional Shocks: The total effect on household welfare depends on the volatility of regional shocks, the intertemporal elasticity of substitution, and the discount factor. We estimate an AR(1) process for $\log L_{1,t}$ using the employment data from Section 4.3. We estimate a persistent parameter of 0.974 and a standard deviation of 0.021. We assume CRRA preferences $u = \frac{c^{1-\sigma}}{1-\sigma}$ with $\sigma = 2$ and set the monthly discount factor $\beta = 0.96^{1/12}$. The last row of Table 10 shows that relative to the steady state economy, the income equivalent has to be 0.4% higher. Hence, the business cycle adjustments of flexible pricing make consumers relatively better off, but quantitatively the competition effect dominates in the baseline calibration.[20]

[20] Firms are risk neutral, so the presence of local shocks does not generate any additional effect on firms profits.

Table 10: Winners and Losers of Uniform Pricing

Flexible Pricing	**Demand Adjusts**	**Entry of Varieties**	**Regional Shocks**	**Households**	**Firms**
Yes	No	No	No	-6.7	0.9
Yes	Yes	No	No	-6.9	0.5
Yes	Yes	Yes	No	-6.7	0.4
Yes	Yes	Yes	Yes	-6.3	0.4

Notes: The "Households" column computes the equivalent variation of moving from the uniform-pricing to the alternative economy. A negative value indicates that the household prefers the uniform-pricing economy. The "Firms" column computes the average profit gains for firms under the alternative economy.

6.5 Alternative City Configurations

Do firms and households prefer the uniform- or flexible-pricing economy? The quantitative answer depends on several assumptions. In this section we consider alternative setups to study the quantitative importance of each assumption. We evaluate several cases: City 1 is poorer; city 1 is smaller; goods are homogeneous in city 2; volatility is higher; and the intertemporal elasticity of substitution is lower. These alternative assumptions matter for household preferences for uniform over flexible pricing but not so much for firms. The additional benefit of flexible pricing for households when taking into account regional shock depends mostly on the volatility of the shocks as well as the intertemporal elasticity of substitution.

City 1 is poor: When a city is poor, the value of flexible pricing increases for households in the poor city. We calibrate city 1 to be poorer than city 2. We set $L_1 = 0.61$, which corresponds to the income per capita of a province at the 25th percentile. Now households in city 1 prefer flexible pricing rather than uniform pricing, as in the benchmark scenario. The second row of Table 11 shows that the equivalent variation increases from -6.73% to 1.16% when we move away from symmetric cities. The intuition is that under uniform pricing, the seller takes into account the demand in city 2 and therefore sets relatively high prices. Instead, when they can price-discriminate across cities, prices in city 1 diminish and consumers are better off.

City 1 is small: When a city is small, the value of uniform pricing increases for households in that city. We set the number of representative households to be M_j and normalize $M_1 + M_2 = 1$. In the benchmark model we had set $M_1 = M_2 = 0.5$, while in this exercise we consider $M_1 = 0.25$. Under uniform pricing, sellers pay more attention to the demand in city 2 than city 1. Given the heterogeneity in preferences for goods across cities, the difference in city size will lead to even lower prices in the uniform-pricing economy than in the flexible one for the goods preferred by city 1. Thus, the third row of Table 11 shows that the equivalent variation is reduced from -6.73% to -16.03%.

Homogeneous goods in city 2: When the two cities have more similar preferences, the value of uniform pricing is reduced. To study the role of product heterogeneity, we set $s_2(\omega) = 1$ while keeping $s_1(\omega) = \omega^\alpha$. Hence, we have heterogeneous demand in city 1 but not in city 2. In this case the welfare gains of uniform pricing reduces to 3.06%. The intuition is that for products close to $\omega = 1$, there is high demand in city 1 but not particularly low demand in city 2. Hence, in the uniform-pricing equilibrium, the prices of those goods will be higher than in the benchmark economy with $s_2(\omega) = (1-\omega)^\alpha$. As a result, the cost of moving to flexible pricing is lower.

Higher volatility: The additional value of flexible pricing increases with the volatility of the shocks. When we double the volatility, the additional value of flexible prices due to business cycles increases by a factor of three (from 0.44 to 1.31). Recall that with flexible pricing, prices are more procyclical, hence providing more insurance to consumers. Hence, when the volatility increases, so do the gains from this channel. However, note that even if we duplicate the volatility of the shocks, the net effect is still negative: Consumers prefer uniform pricing, and the total income equivalent is -5.42.

Intertemporal Elasticity of Substitution: When agents have a lower intertemporal elasticity of substitution, they put more value on smoothing consumption and, hence, increase the value of flexible pricing. If we set $\sigma = 10$, the additional value of flexible pricing increases to 1.28. Again, note that this increase is not enough to overcome the steady-state effects and the total effect remains negative.

Table 11: Alternative City Configurations

	Moving to Price to Market		**Additional value of business cycles**	
	Households	**Firms**	**Households**	**Firms**
Benchmark	-6.73	0.43	0.44	0.00
City 1 poor	1.16	0.50	0.72	0.00
City 1 small	-16.03	0.35	1.31	0.00
Goods homogeneous in city 2	-3.06	0.15	0.65	0.00
Higher volatility	-6.73	0.43	1.31	0.01
Lower IES	-6.68	0.43	1.28	0.00

Notes: City 1 poor has $L_1 = 0.61$. City 1 small has $M_1 = 0.25$ and $M_2 = 0.75$. When goods are homogeneous in city 2, we assume $s_2(\omega) = 1$. With higher volatility, we duplicate the volatility of regional shocks. With Lower IES, we set $\sigma = 10$.

6.6 General Equilibrium

We compare the flexible- and uniform-pricing economies when there is endogenous labor supply, labor markets clear, and households of each city are the owners of firms. The representative household of city j solves

$$\max_{\left\{q_{j,t}(\omega),L_{j,t}^{S}\right\}} \sum_{t=0}^{\infty} \frac{\beta^t}{1-\sigma} \left(C_{j,t} - \zeta \frac{\left(L_{j,t}^{S}\right)^{1+\gamma}}{1+\gamma} \right)^{1-\sigma}$$

subject to

$$\begin{aligned} P_{C,j,t} C_{j,t} &= w_{j,t} L_{j,t}^{S} h_{j,t} + \Pi_{j,t} \\ C_{j,t} &= \int_{\Omega_{j,t}} s_j(\omega) \log\left(q_{j,t}(\omega) + \bar{q}_j\right) d\omega \\ P_{C,j,t} C_{j,t} &= \int_{\Omega_{j,t}} p_{j,t}(\omega)\, q_{j,t}(\omega)\, d\omega \end{aligned}$$

where $L_{j,t}^{S}$ is the labor supply and $h_{j,t}$ are the efficiency units. The agent consumes $C_{j,t}$ —a bundle of varieties ω— with price $P_{C,j,t}$. The representative household in city j is the owner of $\Pi_{j,t}$; i.e., firms' profits in city j

$$\Pi_{j,t} = \int_{\Omega_{j,t}} \left(p_{j,t}(\omega) - \frac{w_{j,t}}{z_j} \right) q_{j,t}(\omega)\, d\omega.$$

The demand for variety ω is similar to equation 2 with total income equal to $y_{j,t} = w_{j,t} L_{j,t}^{S} h_{j,t} + \Pi_{j,t}$.

Labor market: Labor demand and supply are

$$L_{j,t}^{D} = \frac{1}{z_j} \int_{\Omega_{j,t}} q_{j,t}(\omega)\, d\omega \qquad\qquad L_{j,t}^{S} = \left(\frac{w_{j,t} h_{j,t}}{\zeta P_{C,j,t}} \right)^{1/\gamma}$$

and the wage $w_{j,t}$ clears the labor market.

Results: We set the Frisch elasticity of labor supply $1/\gamma$ to 1 (as in Kaplan, Moll, and Violante 2018 or Blundell, Pistaferri, and Saporta-Eksten 2016), the weight on the labor supply component of utility, ζ, is set so that hours worked are equal to one-third in steady state, and calibrate the same parameters as before (productivity z, and preference parameters $\bar{q}$, and α) to match the same target moments as in the previous calibration.[21] Table 12 compares the solutions under uniform and flexible pricing.

Profits are higher under flexible than uniform pricing, as in partial equilibrium, but now there are feedbacks to households' income due to general-equilibrium effects. In partial equilibrium, firms are better off under flexible than uniform pricing because they are less constrained. Table 12 shows that this force is also present in general equilibrium: Profits are slightly higher (about 0.7%) under flexible pricing. In general equilibrium, the representative household is the owner of firms' local profits. Hence, the profits component of households' income is higher under flexible pricing which increases the total income of households.

Households prefer uniform pricing, as in partial equilibrium, but are willing to give up less income

[21] To compute the response to local shocks we introduce shocks to local efficiency units $h_{j,t}$.

to avoid flexible pricing under general equilibrium. The equivalent variation goes down from 6.7% in partial equilibrium to 0.9% in general equilibrium. The main reason is that the representative household is also the owner of profits which are higher in the flexible-pricing economy. This result hinges on the assumption of how profits are distributed across households. In a model with household heterogeneity in ownership shares, we expect households with low ownership shares will be willing to give up more income to avoid flexible pricing than those with high ownership shares.

Table 12: Model in General Equilibrium

	Moving to Flexible Pricing
Firms' profits	0.7%
Equivalent variation	-0.9%
Consumption (C)	-0.5%
Labor supply	-1.3%
Real wage	-1.3%

Notes: Compare flexible to uniform pricing equilibrium.

7 Conclusion

This paper introduces a new database of grocery prices in Argentina, with over 9 million observations per day, to study the importance of chains relative to stores for prices. We show that conditional on a product, there is little variation across stores of the same chain; i.e., there is *uniform pricing*. Prices almost do not vary within stores of a chain and prices do not change significantly with regional conditions or shocks, particularly so for chains that operate in many regions.

Using a simple two-region model, we show that uniform pricing has non-trivial implications for firms' profits and consumers' welfare. Relative to a counterfactual in which firms can set different prices across regions (i.e., flexible pricing), uniform pricing reduces firms' profits by 0.7%. Consumers, however, prefer uniform pricing and are willing to give up 3.8% of their income to avoid flexible pricing in the baseline model. The effect on consumers, however, depends on how much uniform pricing limits firms' power to extract consumer surplus and how heterogeneous the regions are.

The model also has relevant implications for consumption inequality when chains operate in multiple locations with heterogeneous levels of income or locations subject to local shocks. Under uniform pricing, chains set prices as if they have a consumer with an income equal to a weighted average of the two regions' income, hence leading to higher (lower) prices for the poor (rich) location than under flexible pricing. Following this same line of thought, negative local income shocks would lead to smaller price reductions when there can be only one price for multiple regions, thus leading to a larger decrease in consumption under uniform than flexible pricing. We interpret this finding to mean that the effect of regional business cycles on consumption may be amplified by uniform pricing.

Why would firms set uniform prices instead of customizing prices to local customers? Traditional explanations typically focus on the cost of discriminating, including operation as well as reputation costs. Dobson and Waterson (2008) provide a different reason more closely related to collusion. They show that firms may be better off under uniform pricing even if they have larger market power in some regions. This policy, if applied by all firms under commitment, will soften competition in other markets and may sufficiently raise firm profits overall (at the cost of some local profits). Our paper does not explore this question. Instead, using the model, we take uniform pricing as an exogenous constraint and evaluate its consequences for consumers and firms. We highlight, nevertheless, that the returns to price discrimination for firms in our baseline estimation are low, less than 2% of profits on average. Hence, we interpret this to mean that the costs of price discrimination may not need to be as large as one may imagine to justify uniform pricing.

References

ADAMS, B., AND K. R. WILLIAMS (2019): "Zone Pricing in Retail Oligopoly," *American Economic Journal: Microeconomics*, 11(1), 124–56.

ALVAREZ, F., M. BERAJA, M. GONZALEZ-ROZADA, AND P. A. NEUMEYER (2018): "From Hyperinflation to Stable Prices: Argentina's Evidence on Menu Cost Models," *The Quarterly Journal of Economics*, 134(1), 451–505.

APARICIO, D., AND A. CAVALLO (2018): "Targeted Price Controls on Supermarket Products," Working Paper 24275, National Bureau of Economic Research.

ARKOLAKIS, C., A. COSTINOT, D. DONALDSON, AND A. RODRÍGUEZ-CLARE (2019): "The Elusive Pro-Competitive Effects of Trade," *The Review of Economic Studies*, 86(1), 46–80.

BAHARAD, E., AND B. EDEN (2004): "Price rigidity and price dispersion: Evidence from micro data," *Review of economic dynamics*, 7(3), 613–641.

BERAJA, M., E. HURST, AND J. OSPINA (2016): "The Aggregate Implications of Regional Business Cycles," Working Paper 21956, National Bureau of Economic Research.

BLUNDELL, R., L. PISTAFERRI, AND I. SAPORTA-EKSTEN (2016): "Consumption Inequality and Family Labor Supply," *American Economic Review*, 106(2), 387–435.

CAVALLO, A. (2018): "More Amazon Effects: Online Competition and Pricing Behaviors," Working Paper 25138, National Bureau of Economic Research.

CAVALLO, A., B. NEIMAN, AND R. RIGOBON (2014): "Currency Unions, Product Introductions, and the Real Exchange Rate," *The Quarterly Journal of Economics*, 129(2), 529–595.

CAVALLO, A., AND R. RIGOBON (2016): "The Billion Prices Project: Using online prices for measurement and research," *The Journal of Economic Perspectives*, 30(2), 151–178.

DELLAVIGNA, S., AND M. GENTZKOW (2017): "Uniform Pricing in US Retail Chains," Working Paper 23996, National Bureau of Economic Research.

DOBSON, P., AND M. WATERSON (2008): "Chain-Store Competition: Customized vs. Uniform Pricing," The warwick economics research paper series (twerps), University of Warwick, Department of Economics.

EDEN, B. (2001): "Inflation and Price Adjustment: An Analysis of Microdata," *Review of Economic Dynamics*, 4(3), 607–636.

GAGNON, E. (2009): "Price setting during low and high inflation: Evidence from Mexico," *The Quarterly Journal of Economics*, 124(3), 1221–1263.

Hwang, M., B. J. Bronnenberg, and R. Thomadsen (2010): "An Empirical Analysis of Assortment Similarities Across U.S. Supermarkets," *Marketing Science*, 29(5), 858–879.

Hwang, M., and R. Thomadsen (2016): "How Point-of-Sale Marketing Mix Impacts National-Brand Purchase Shares," *Management Science*, 62(2), 571–590.

Jo, Y. J., M. Matsumura, and D. E. Weinstein (2018): "Estimating the Welfare Gains from E-Commerce: A Price Arbitrage Approach," Working paper.

Jung, J. W., I. Simonovska, and A. Weinberger (2019): "Exporter heterogeneity and price discrimination: A quantitative view," *Journal of International Economics*, 116, 103–124.

Kaplan, G., G. Menzio, L. Rudanko, and N. Trachter (Forthcoming): "Relative price dispersion: Evidence and theory," *American Economic Journal: Microeconomics*.

Kaplan, G., B. Moll, and G. L. Violante (2018): "Monetary Policy According to HANK," *American Economic Review*, 108(3), 697–743.

Konieczny, J. D., and A. Skrzypacz (2005): "Inflation and price setting in a natural experiment," *Journal of Monetary Economics*, 52(3), 621–632.

Lach, S., and D. Tsiddon (1992): "The Behavior of Prices and Inflation: An Empirical Analysis of Disaggregated Price Data," *Journal of Political Economy*, 100(2), 349–389.

Mian, A., and A. Sufi (2011): "House Prices, Home Equity-Based Borrowing, and the US Household Leverage Crisis," *American Economic Review*, 101(5), 2132–56.

Midrigan, V. (2011): "Menu costs, multiproduct firms, and aggregate fluctuations," *Econometrica*, 79(4), 1139–1180.

Nakamura, A. O., E. Nakamura, and L. I. Nakamura (2011): "Price dynamics, retail chains and inflation measurement," *Journal of Econometrics*, 161(1), 47–55.

Sergeyev, D., and N. Mehrotra (2018): "Financial Shocks, Firm Credit and the Great Recession," Working paper.

Simonovska, I. (2015): "Income Differences and Prices of Tradables: Insights from an Online Retailer," *The Review of Economic Studies*, 82(4), 1612–1656.

Sufi, A., A. Mian, and K. Rao (2013): "Household Balance Sheets, Consumption, and the Economic Slump," *The Quarterly Journal of Economics*, 128(4), 1687–1726.

Yagan, D. (2018): "Employment Hysteresis from the Great Recession," *Journal of Political Economy*, Forthcoming.

A Data Appendix

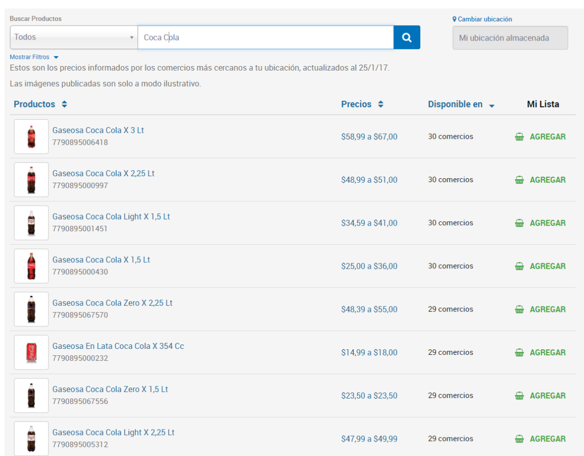
A.1 Website Example

Figure A1 shows an example in which this website is used to search for *Coca-Cola* soda. The second figure shows that after searching for *Coca-Cola*, many varieties of the product are available. The prices in the nearby stores are reported. After selecting one particular product (e.g., *Gaseosa Coca-Cola X 2,25Lt*), we obtain the list of stores and their prices. Note that these prices include list and sale prices.

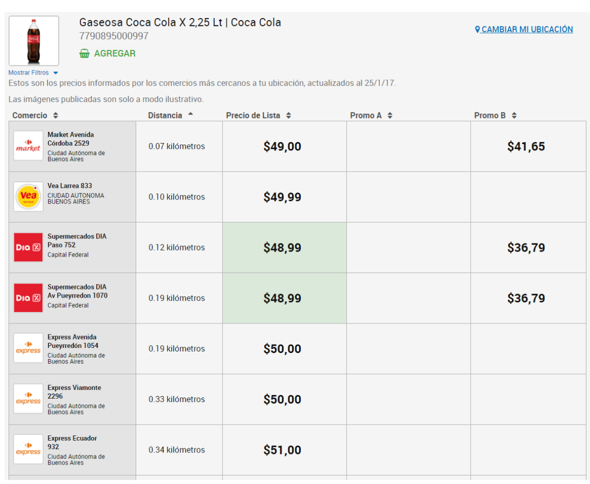
Figure A1: Precios Claros Website

Step 1: Introduce Location

Step 2: Search for Product

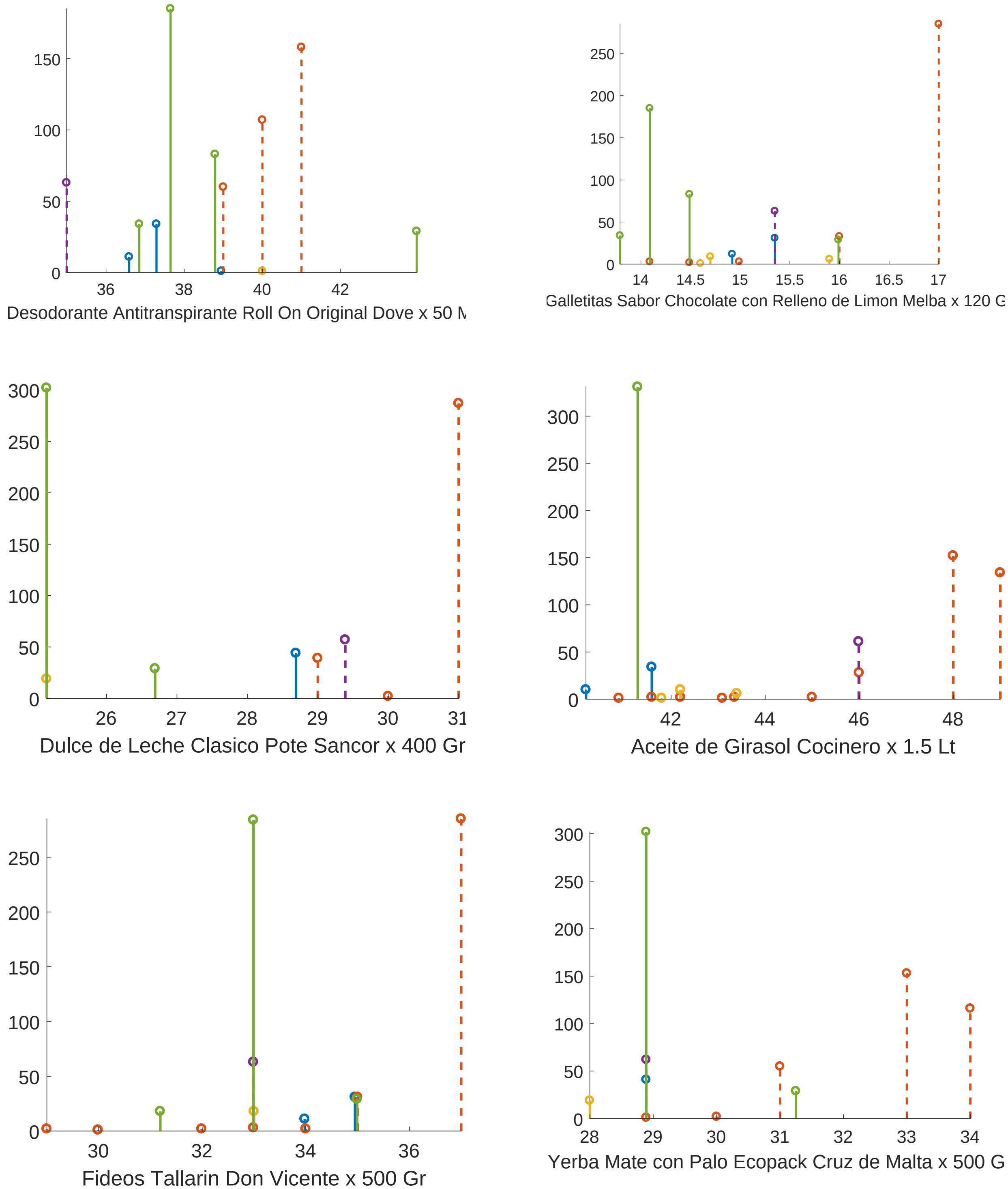


Step 3: Select Product



Notes: We show here an example in which the website is used to search for Coke (Coca-Cola) soda. The last figure shows (a subset of) the different stores and prices (including sales) available nearby.

Figure A2: Examples of Uniform Pricing



Source: Precios Claros. Each color refers to a different chain.

B Statistical Model of Price Dispersion

We use a statistical model to do a variance decomposition of prices and formally highlight the role of chains behind price setting. We implement this analysis separately for each day, so the variation studied here is not related to prices changing over time—and we do not need to control for time factors. We then report average results over time as well as the autocorrelation of the different estimated components.

We propose that the log-price $p_{g,s,c}$, of good g in store s of chain c, can be summarized by a product fixed-effect α_g, a chain fixed-effect β_c, a chain-product fixed-effect $\gamma_{g,c}$, and a residual $\epsilon_{g,s,c}$. The variation in $\epsilon_{g,s,c}$ comes from different stores of the same chain setting different prices for the same product:

$$p_{g,s,c} = \alpha_g + \beta_c + \gamma_{g,c} + \epsilon_{g,s,c}.$$

In our estimation, we assume that the conditional mean $\mathbb{E}\left[\beta_c + \alpha_g | g\right] = 0$, such that α_g absorbs the average price effect. This standardizes prices, facilitating the comparison of prices of different goods that may be more expensive due to their characteristics (e.g., a 2.25 liter bottle of *Coca-Cola* vs a 750 milliliter bottle of *Pantene* shampoo).[22] We also assume that $\mathbb{E}\left[\gamma_{g,c} | c\right] = 0$, such that β_c absorbs the average chain effect. This controls for some chains being on average more expensive, possibly due to their particular amenities. These assumptions simplify the estimation, which is particularly important given the size of our sample and guarantee that covariance terms are zero. The estimation of α_g, β_c, and $\gamma_{g,c}$ can be done by conditional sample means:

$$\begin{aligned}
\hat{\alpha}_g &= \frac{1}{N_g} \sum_{s,c} p_{g,s,c} \\
\hat{\beta}_c &= \frac{1}{N_c} \sum_{g,s} \left(p_{g,s,c} - \hat{\alpha}_g\right) \\
\hat{\gamma}_{g,c} &= \frac{1}{N_{g,c}} \sum_{s} \left(p_{g,s,c} - \hat{\alpha}_g - \hat{\beta}_c\right) \\
\hat{\epsilon}_{g,s,c} &= p_{g,s,c} - \hat{\alpha}_g - \hat{\beta}_c - \hat{\gamma}_{g,c},
\end{aligned}$$

where (with a slight abuse of notation) N_g refers to the number of stores selling good g, N_c the number of price observations (i.e., good-stores) of chain c, and $N_{g,c}$ the number of stores selling good g in chain c.

We then abstract from the price variation due to product characteristics α_g and study dispersion in relative prices. We decompose relative price variation in a chain component, a chain-product component, and the residual:

[22] This is equivalent to analyzing "relative prices," as in Kaplan, Menzio, Rudanko, and Trachter (Forthcoming).

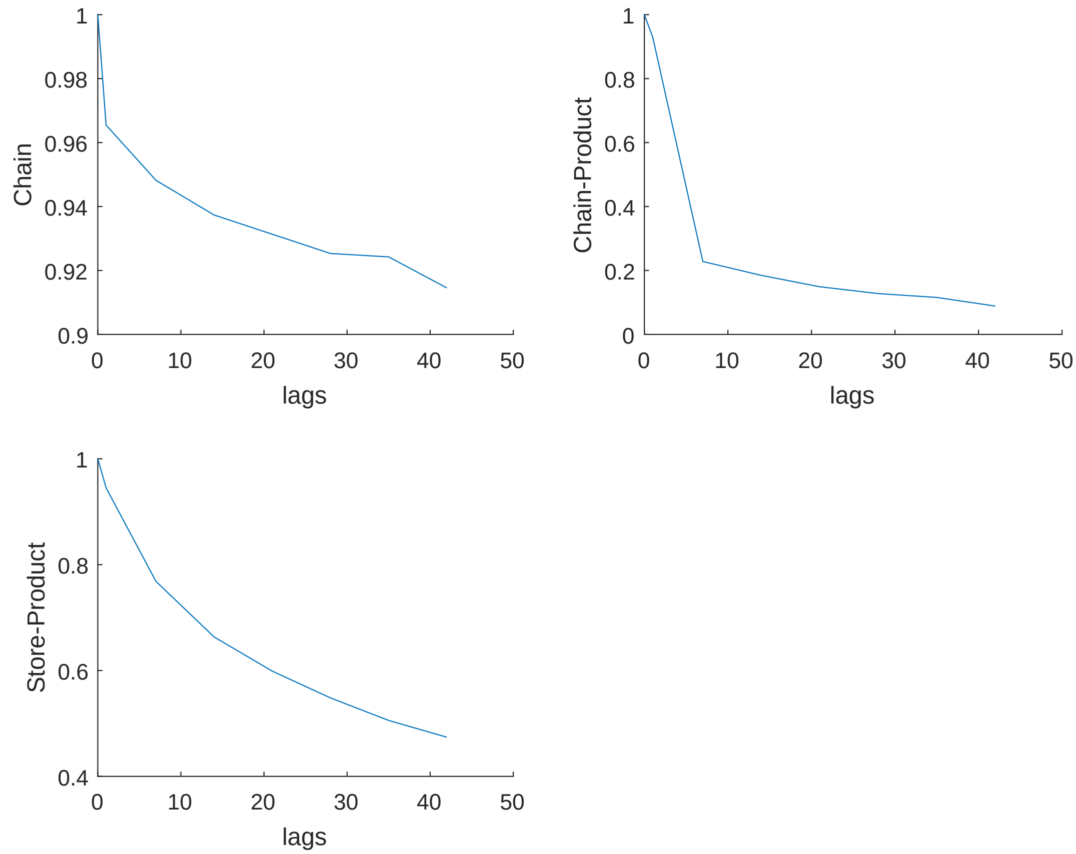
$$\underbrace{\mathrm{Var}\left(p_{g,s,c} - \hat{\alpha}_g\right)}_{\text{Relative Price}} = \underbrace{\mathrm{Var}\left(\hat{\beta}_c\right)}_{\text{Chain}} + \underbrace{\mathrm{Var}\left(\hat{\gamma}_{g,c}\right)}_{\text{Chain-Product}} + \underbrace{\mathrm{Var}\left(\hat{\epsilon}_{g,s,c}\right)}_{\text{Residual}}.$$

Figure 3 in the main text shows that in CABA 15% of the price variation is driven by some chains being generally more expensive than others. Once we control for average prices of products by chains, 73% (15% + 58%) of the price dispersion is explained. For the Argentinean case, we also estimate the importance of prices in chains at the province-product level. In this case, average chain prices per product explain 62% (10% + 52%) of price variation. Controlling for price differences across provinces by chain explains another 19%. In other words, consistent with Tables 2 and 3, price variation across stores within chains is small, driving only 27% and 19% of the total relative price dispersion for CABA and Argentina, respectively.

Alvarez, Beraja, Gonzalez-Rozada, and Neumeyer (2018) estimate price dispersion in Argentina using a longer time series of price data from 1988 to 1997, covering a range of monthly inflation between 0 and 200%. They have, however, only 500 products that cannot be precisely compared across stores (since products are defined as narrow categories and don't have bar codes). Our dataset contains a substantially larger number of goods that can be precisely compared across stores since we observe their UPC bar code. Our estimates for the standard deviation of relative prices is approximately 7% and 10% for CABA and Argentina, respectively. These estimates are near but below the estimates reported by Alvarez, Beraja, Gonzalez-Rozada, and Neumeyer (2018) in periods with inflation levels close to the ones from our time period. One potential explanation for this difference is that we are actually comparing the same products (UPC bar code) across stores, while they may be comparing different products.

Autocorrelation: Understanding the origin of this price dispersion is important to understanding store price setting as well as consumer choices. Kaplan, Menzio, Rudanko, and Trachter (Forthcoming) highlight that a large share of price dispersion comes from each store selling different sets of goods cheaper while charging similar prices on average. This situation suggests that an information problem might make consumers buy in a store selling goods more at higher prices since it is costly (or not possible) to find lower prices. If chains are the only drivers of price dispersion, the information problem seems more limited, as long as price differences between chains are persistent. Figure B3 shows the autocorrelation of the estimated components $\hat{\beta}_c$, $\hat{\gamma}_{g,c}$, and $\hat{\epsilon}_{g,s,c}$ at different lags of days.

Figure B3: Price Dispersion Persistence



C Model Appendix

In this appendix we derive the solution of the model.

C.1 Household's problem

The first-order condition reads

$$\frac{s_j(\omega)}{q_{j,t}(\omega)+\bar{q}_j} \leq \lambda_{j,t} p_{j,t}(\omega)$$

,where $\lambda_{j,t}$ is the Lagrange multiplier of the budget constraint. Hence, the demand for varieties with positive consumption is

$$q_{j,t}(\omega) = \frac{s_j(\omega)}{\lambda_{j,t} p_{j,t}(\omega)} - \bar{q}_j.$$

Using the budget constraint, we solve for $\lambda_{j,t}$ as

$$\frac{1}{\lambda_{j,t}} = \frac{w_{j,t}L_{j,t} + P_{j,t}\bar{q}_j}{\bar{S_{j,t}}},$$

where

$$\bar{S}_{j,t} = \int_{\omega\in\Omega_{j,t}} s_j(\omega)\, d\omega$$
$$P_{j,t} = \int_{\omega\in\Omega_{j,t}} p_{j,t}(\omega)\, d\omega.$$

The demand for variety ω with positive consumption is

$$q_{j,t}(\omega) = \frac{s_j(\omega)}{\bar{S}_{j,t}} \frac{y_{j,t} + P_{j,t}\bar{q}_j}{p_{j,t}(\omega)} - \bar{q}_j,$$

where $y_{j,t} = w_{j,t}L_{j,t}$.

C.2 Firm's Problem: Flexible Pricing

The first-order condition is

$$q_{j,t}(\omega) + (p_{j,t}(\omega) - c_{j,t}) \frac{\partial q_{j,t}(\omega)}{\partial p_{j,t}(\omega)} = 0.$$

The demand elasticity is

$$\frac{\partial q_{j,t}(\omega)}{\partial p_{j,t}(\omega)} = -\frac{s_j(\omega)}{\bar{S}_{j,t}} \frac{y_{j,t} + P_{j,t}\bar{q}_j}{(p_{j,t}(\omega))^2}.$$

After a few substitutions we get

$$p_{j,t}(\omega) = \left(c_{j,t} \frac{s_j(\omega)}{\bar{S}_{j,t}} \frac{(y_{j,t} + P_{j,t}\bar{q}_j)}{\bar{q}_j}\right)^{1/2}.$$

C.2.1 Algorithm

This algorithm describes how we compute the equilibrium of the model.

1. Initiate guess P_j^{guess}.
2. Solve for equilibrium prices:
   (a) Given P_j^{guess}, solve for thresholds:

i. Solve for $\underline{s}$:

$$\underline{s} = \frac{c_1 \bar{q} \bar{S_1}}{\left(y_1 + P_1^{guess} \bar{q}\right)}$$
$$\underline{\omega} = s_1^{-1}\left(\underline{s}\right)$$
$$\bar{S_1} = \int_{\underline{\omega}}^{1} s_1\left(\omega\right) d\omega.$$

ii. Solve for $\bar{s}$:

$$\bar{s} = \frac{c_2 \bar{q} \bar{S_2}}{\left(y_2 + P_2^{guess} \bar{q}\right)}$$
$$\overline{\omega} = s_2^{-1}\left(\bar{s}\right)$$
$$\bar{S_2} = \int_{0}^{\overline{\omega}} s_2\left(\omega\right) d\omega.$$

(b) Solve for new P_j^{new} using

$$p_1\left(s_1\right) = \left(c_1 \frac{s_1}{\bar{S_1}} \frac{\left(y_1 + P_1^{guess} \bar{q}\right)}{\bar{q}}\right)^{1/2}$$
$$P_1^{new} = \int_{\underline{\omega}}^{1} p_1\left(s_1\left(\omega\right)\right) d\omega$$

and

$$p_2\left(s_2\right) = \left(c_2 \frac{s_2}{\bar{S_2}} \frac{\left(y_2 + P_2^{guess} \bar{q}\right)}{\bar{q}}\right)^{1/2}$$
$$P_2^{new} = \int_{0}^{\overline{\omega}} p_2\left(s_2\left(\omega\right)\right) d\omega.$$

(c) Iterate until P_j^{guess} is close enough to P_j^{new}.

C.3 Firm's Problem: Uniform Pricing

If the firm sells in both locations, the problem is

$$max_{p_t(\omega)} \sum_{j=1}^{J} q_{j,t}\left(\omega\right)\left(p_t\left(\omega\right) - \left(\frac{w_{j,t}}{z_j}\right)\right).$$

The first-order condition is

$$\sum_{j=1}^{J} q_{j,t}(\omega) + \sum_{j=1}^{J} \frac{\partial q_{j,t}(\omega)}{\partial p_t(\omega)} \left(p_t(\omega) - \left(\frac{w_{j,t}}{z_j} \right) \right) = 0.$$

After some substitutions we get

$$p_t(\omega) = \left(\sum_{j=1}^{2} \left(\frac{w_{j_t}}{z_j} \right) \frac{s_j(\omega)}{\bar{S}_{j,t}} \frac{y_{j,t} + P_{j,t}\bar{q}_j}{\bar{q}_j} \right)^{1/2}.$$

C.3.1 Algorithm

This algorithm describes how we compute the equilibrium of the model.

1. Initiate guess P_1^{guess}, P_2^{guess}.
2. Solve for equilibrium prices:
   (a) Given P_j^{guess} solve for thresholds:
      i. Initiate guess $\underline{s}^{guess}, \overline{s}^{guess}$.
      ii. Compute

$$\underline{\omega} = s_1^{-1}\left(\underline{s}^{guess}\right)$$
$$\bar{S}_1 = \int_{\underline{\omega}}^{1} s_1(\omega)\, d\omega$$

$$\overline{\omega} = s_2^{-1}\left(\overline{s}^{guess}\right)$$
$$\bar{S}_2 = \int_{0}^{\overline{\omega}} s_2(\omega)\, d\omega.$$

      iii. Use price function to update thresholds:
         A. If $\underline{s}^{guess} \leq \overline{s}^{guess}$, use

$$p(\omega) = \left(\frac{1}{\bar{q}} \right)^{1/2} \left(\frac{s_1(\omega)}{\bar{S}_1} \left(\frac{w_1}{z_1} \right) \left(y_1 + P_1^{guess}\bar{q} \right) + \frac{s_2(\omega)}{\bar{S}_2} \left(\frac{w_2}{z_2} \right) \left(y_2 + P_2^{guess}\bar{q} \right) \right)^{1/2}.$$

         B. If $\underline{s}^{guess} > \overline{s}^{guess}$, use flexible-pricing solutions for each threshold.

C. Thresholds:

$$\underline{s}^{new} = \frac{\bar{q}\bar{S}_1 p\left(s_1^{-1}\left(\underline{s}^{new}\right)\right)}{y_1 + P_1^{guess}\bar{q}}$$
$$\bar{s}^{new} = \frac{\bar{q}\bar{S}_2 p\left(s_2^{-1}\left(\bar{s}^{new}\right)\right)}{y_2 + P_2^{guess}\bar{q}}.$$

iv. Iterate until $\underline{s}^{guess}$,$\bar{s}^{guess}$ are close enough to $\underline{s}^{new}$,$\bar{s}^{new}$.

(b) Solve for new P_j^{new}:

i. Individual prices

$$p(\omega) = \begin{cases} \left[c_2 \frac{s_2(\omega)}{\bar{S}_2}\left(\frac{y_2}{\bar{q}_2} + P_2^{guess}\right)\right]^{1/2} & \text{if } \omega \leq \underline{\omega} \\ \left[\sum_{j=1}^{2} c_j \frac{s_j(\omega)}{\bar{S}_j}\left(\frac{y_j}{\bar{q}_j} + P_j^{guess}\right)\right]^{1/2} & \text{if } \underline{\omega} \leq \omega \leq \overline{\omega} \\ \left[c_1 \frac{s_1(\omega)}{\bar{S}_1}\left(\frac{y_1}{\bar{q}_1} + P_1^{guess}\right)\right]^{1/2} & \text{if } \omega \geq \overline{\omega} \end{cases}.$$

ii. In $j = 1$, we have that

$$P_1^{new} = \int_{\underline{\omega}}^{1} p_1(\omega)\, d\omega.$$

iii. In $j = 2$, we have that

$$P_2^{new} = \int_{0}^{\overline{\omega}} p_2(\omega)\, d\omega.$$

(c) Iterate until P_1^{guess}, P_2^{guess} is close enough to P_1^{new}, P_2^{new}.

C.4 General Equilibrium: Algorithm

For each city j we have 4 unknowns: (i) the threshold for the set of products, (ii) The average price of varieties, (iii) the real wage, (iv) and the total profits. In the flexible pricing economy the equilibrium of each city is solved independently while in the uniform price economy the 8 unknowns are solve simultaneously. Below we describe the extended algorithm to solve the equilibrium.

1. Normalize $w_1 = w_2 = 1$.
2. Initiate guess $P_{C,1}^{\text{guess}}, P_{C,2}^{\text{guess}}, \Pi_1^{\text{guess}}, \Pi_2^{\text{guess}}$.
3. Given the guess of real wage solve for labor supply.
4. Apply algorithms C.2.1 or C.3.1 (depending on flexible or uniform pricing) and obtain labor demand and total profits in each city.
5. Use excess supply on labor market and difference in total profits in each city to get $P_{C,j}^{\text{new}}$ and Π_j^{new}.

6. Iterate until $P_{C,j}^{\text{guess}}, \Pi_j^{\text{guess}}$ is close enough to $P_{C,j}^{\text{new}}$ and Π_j^{new}.