# Macroeconomic Implications of Uniform Pricing (Online Appendix)

**By: Diego Daruich (University of Southern California) and Julian Kozlowski (FRB of St. Louis)**

This material is for a separate, online appendix and not intended to be printed with the paper.

# C Data Appendix

## C.1 Website Example

The left panel of Figure C1 shows an example in which we use the website 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.

The right panel of Figure C1 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).[68]

## C.2 Data Validation

The data are self-reported by the chains, but we have several motives to believe that it actually represents the real prices. First, large fines (of up to 3 million US dollars) are applied if stores do not report their prices correctly. Second, micro-price statistics are consistent with the international evidence for countries with annual inflation around 30%. For example, the monthly frequency of price changes is 0.84 and the dispersion of relative prices is 9.7%, both of which are similar to the findings in Alvarez, Beraja, Gonzalez-Rozada, and Neumeyer (2018). Third, we observe a (small) variation in prices for a specific product (barcode) across stores of the same chain and chain type, implying that retailers are not uploading exactly the same price list for all their stores. Fourth, the number of stores by province is consistent with official statistics (see *Encuesta de Supermercados*). Finally, the level of price changes is consistent with official statistics for monthly inflation. This evidence leads us to believe that the self-reported prices are the real ones and that there are no mistakes in the database.

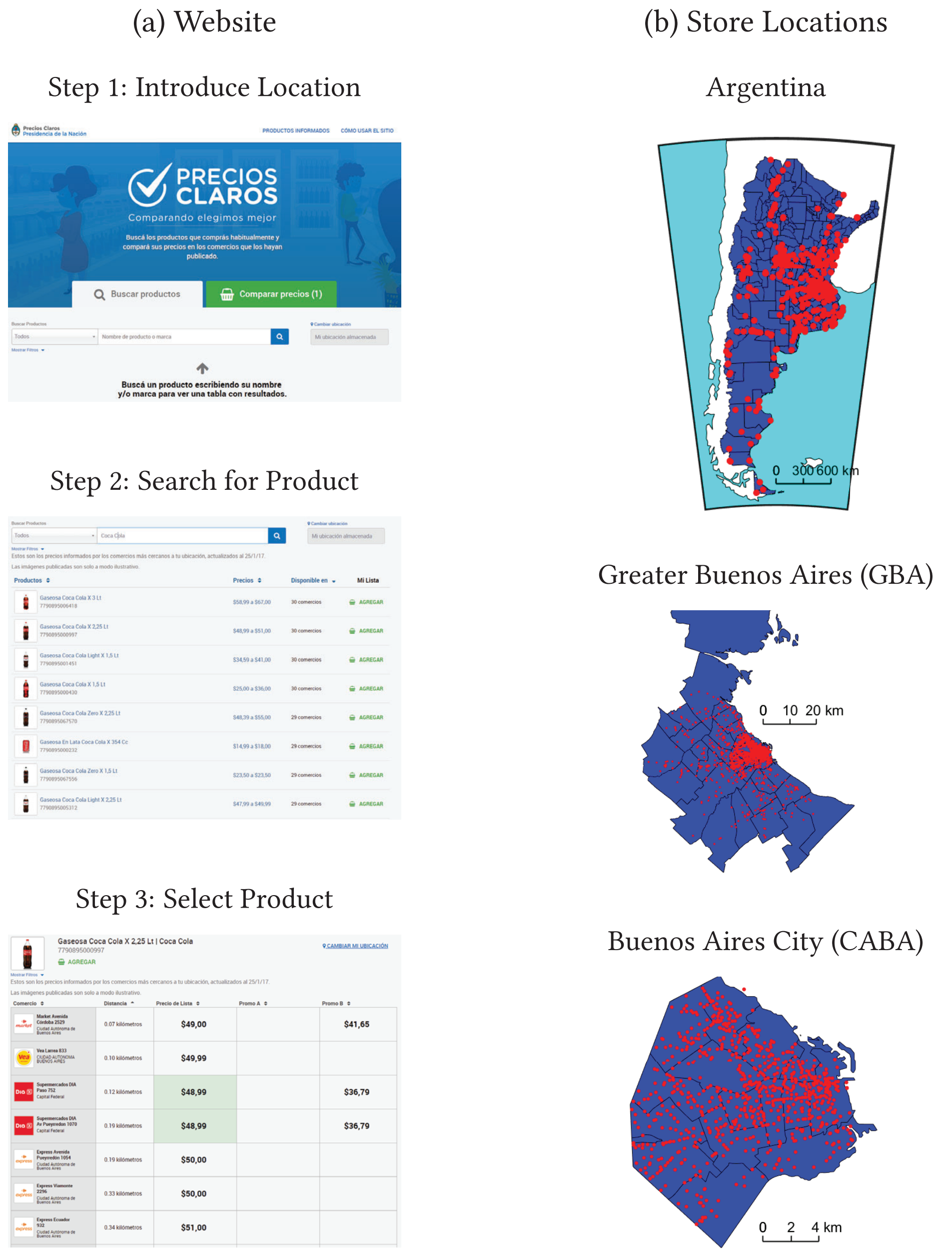
## C.3 Uniform Pricing

Figure C2 shows the distribution of prices for several products, with different colors identifying each chain's distribution. 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).

Table C1 shows that uniform pricing is a general characteristic of chains in CABA. For each day-product-store observation, we define the relative price as the log-price minus the mean log-price

[68] 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.

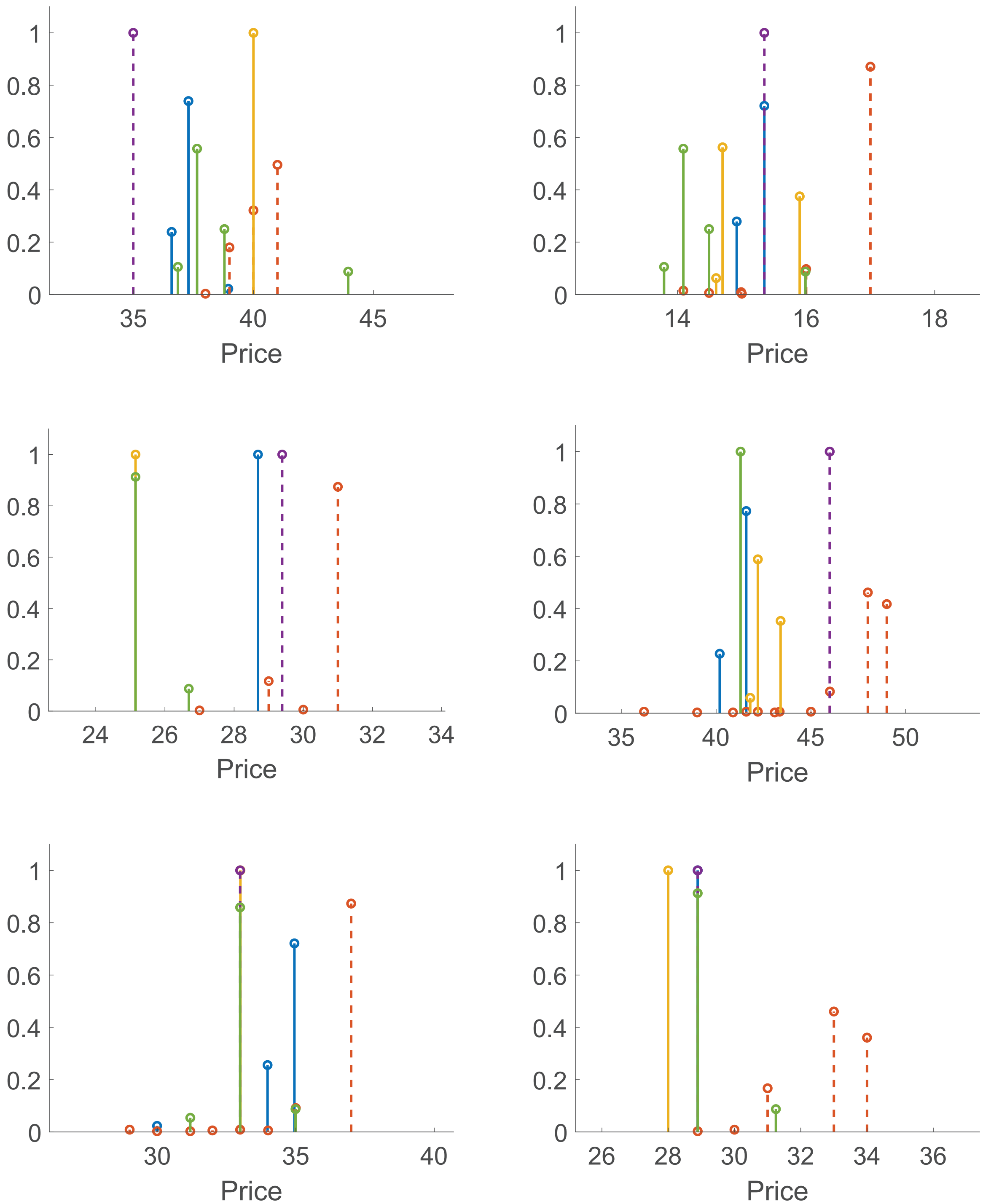
Figure C1: Precios Claros




*Notes: The left panel shows an example in which the website is used to search for Coca Cola soda. The last figure shows (a subset of) the different stores and prices (including sales) available nearby. The right panel shows the location of the stores, with each dot referring to a store in the given region.*

across stores for the same day-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

Figure C2: Examples of Uniform Pricing




*Source: Precios Claros.* Each color refers to a different chain. Data are for particular products (barcodes) on a particular day (December 1, 2016).

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.

Table C1: 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 relative (i.e., log-standardized) prices. This measure is explained in detail in the main text.*

The last panel of Table C1 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 C2 repeats the analysis of Table C1, but for all national chains, and shows that uniform pricing is a general characteristic of chains in Argentina.

## C.4 Price Change Synchronization

Table C3 shows that price-change coordination at the chain level also holds when looking at weekly or biweekly data.

Table C2: 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 relative (i.e., log-standardized) prices. This measure is explained in detail in the main text.*

Table C3: Uniform Price Changes

| | **Period of analysis** | | |
|---|---|---|---|
| | 1 day | 1 week | 2 weeks |
| Changed in other stores of any chain | 5.53% | 17.65% | 27.82% |
| Std. deviation of price change | 5.66% | 9.39% | 9.46% |
| Changed in other stores of same chain | 29.93% | 47.57% | 58.89% |
| Std. deviation of price change | 3.25% | 4.33% | 3.97% |
| Changed in other stores of same type and chain | 38.27% | 52.95% | 63.13% |
| Std. deviation of price change | 2.85% | 3.91% | 3.70% |
| Changed in other stores of same province and chain | 64.96% | 75.23% | 81.25% |
| Std. deviation of price change | 1.23% | 1.86% | 1.96% |

*Notes: Statistics are in daily, weekly and biweekly frequency. For example, out of all products that changed prices in one store in a given week, prices also changed in 17.65% of other stores of any chain.*

## C.5 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., *departamento*s, *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).[69] More importantly, we are able to obtain information on the education, employment, and home characteristics of the people living in those areas.

Table C4 performs a simple OLS regression of uniform pricing (measured using the standard deviation of relative prices within each chain) on different chain characteristics. The standard deviation of relative price increases with the number of stores, but this becomes insignificant once we control for the number of provinces in which a chain operates. The number of types of stores is also correlated with the amount of price dispersion, diminishing the explanatory power of the number of provinces. One potential hypothesis is that chains with greater variance in store-location characteristics will have higher incentives to set different prices. We find that the standard deviation of relative 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 types of stores and number of provinces in which a chain operates.

The left panel of Figure C3 plots the relation between uniform pricing and the number of provinces in which a chain operates. The relation is positive but relatively flat. The number of stores, shown by the size of each circle, does not seem to affect the standard deviation of relative prices.

[69] Means are approximately 3,500km$^2$ and 310,000 individuals.

Table C4: Uniform Pricing and Chain Characteristics

| VARIABLES | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Log(Numb of Stores) | 0.477*** | 0.0812 | | | 0.151 |
| | (0.0843) | (0.120) | | | (0.165) |
| Log(Numb 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 |

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

*Notes: Uniform pricing is measured using the standard deviation of relative (i.e., log-standardized) prices within each chain. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.*

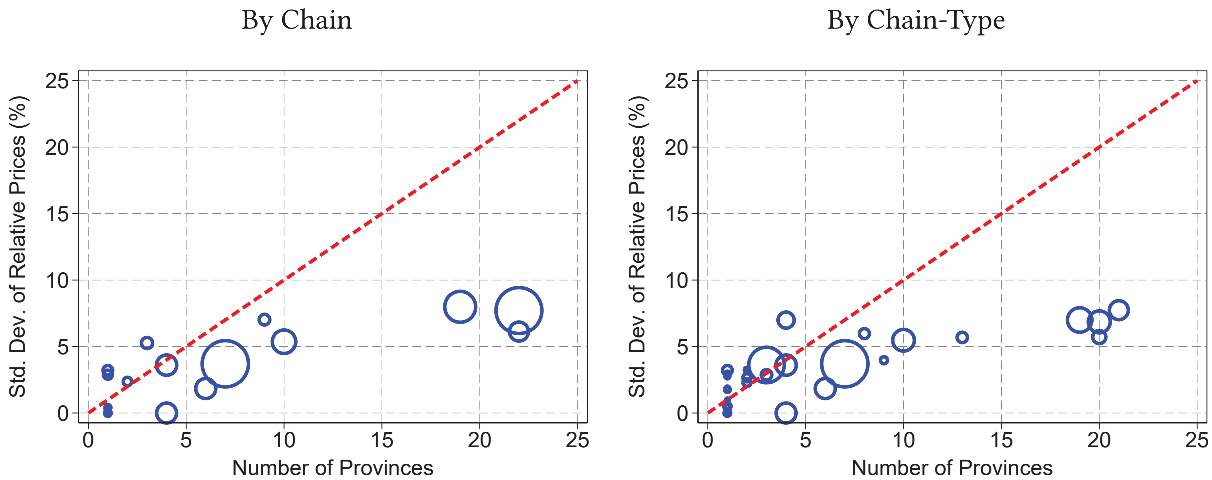
The right panel of Figure C3 plots the same relation but defines chains in a stricter way, i.e., according to chain-types. In this case, the relation between uniform pricing and the number of provinces is even weaker, suggesting that chains may use subdivisions within the chain to partially discriminate prices. Once that is done, price differentiation between locations is not as strong.[70]

## C.6 Uniform Pricing with Discount Prices

The paper documents two main empirical facts using list prices. This appendix shows that both results also hold if we take temporary discounts into account. An advantage of the data is that we can easily identify discount prices without relying on any *sales filter*. We observe up to three different prices for the same store and product. First, we always observe the list price. Second, we sometimes observe discounts, labeled as sale I, and/or sale II. The top panel of Table C6 shows that we have about 5% of observations with sale I, with an average discount of about 25%, and about 18% with sale II, with an average discount of about 15%.

[70] 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 C5 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.

Figure C3: 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 C5: 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.*

The second and third panel of Table C6 show that there is uniform pricing even if we take sales into account. Once we have multiple prices we have to take a stand on what is the price paid by consumers. We consider four alternative definitions based on the minimum price between the list and/or sale prices, and show that in all of them prices are uniform across stores of the same chain.

Our second empirical finding is also robust to using sale prices. Table C7 shows that prices tend to react relatively little to local conditions, particularly so for firms that operate in multiple regions. We show here only the results with our broadest definition of sales, but it is robust to using the other two alternatives from Table C6. This result is consistent with the discount literature. For example, Kryvtsov and Vincent (2020) finds little evidence that sales co-vary with unemployment across U.K. regions, a finding that they attribute to uniform pricing strategies by large retailers (even though they are not able to observe prices at multiple stores of the same chain). Our results, which do rely on direct observation of sale prices at all stores, confirm their intuition.

Table C6: Uniform Pricing Including Sales

| | **Mean** | **Standard deviation** | **P25** | **P50** | **P75** |
|---|---|---|---|---|---|
| **Chain characteristics** | | | | | |
| Number of Stores | 113.4 | 181.4 | 10.5 | 27.5 | 116.6 |
| Products with sale I (%) | 4.6 | 5.4 | 0.0 | 2.5 | 7.7 |
| Size sale I (%) | 25.7 | 11.4 | 14.2 | 28.4 | 34.2 |
| Products with sale II (%) | 18.8 | 29.9 | 0.0 | 0.1 | 34.4 |
| Size sale II (%) | 14.7 | 8.2 | 9.2 | 13.9 | 17.9 |
| **Unique prices by chain** | | | | | |
| List price | 3.9 | 5.0 | 1.0 | 1.2 | 4.6 |
| Min(list, sale I) | 4.0 | 5.1 | 1.0 | 1.2 | 4.6 |
| Min(list, sale II) | 4.1 | 5.4 | 1.0 | 1.2 | 4.6 |
| Min(list, sale I, sale II) | 4.1 | 5.5 | 1.0 | 1.2 | 4.6 |
| **Unique prices by chain-type** | | | | | |
| List price | 2.5 | 2.1 | 1.0 | 1.2 | 4.0 |
| Min(list, sale I) | 2.6 | 2.2 | 1.0 | 1.2 | 4.2 |
| Min(list, sale II) | 2.6 | 2.1 | 1.0 | 1.2 | 4.1 |
| Min(list, sale I, sale II) | 2.6 | 2.2 | 1.0 | 1.2 | 4.2 |

*Notes: The database has up to three reported prices. All products have a list price, while a subgroup also include up to two sale prices (i.e., sale I, and/or sale II).*

Table C7: Regional Shocks and Store Prices Including Sales

| | (1) All | (2) Local share < Median | (3) Local share > Median | (4) All | (5) All |
|---|---|---|---|---|---|
| Emp. growth $(\Delta e_{prov(s),t})$ | -0.0410 | -0.186*** | 0.715*** | -0.226*** | -0.258*** |
| | (0.0769) | (0.0707) | (0.227) | (0.0781) | (0.0835) |
| Local share $(local_{s,t})$ | | | | -0.218 | -0.192 |
| | | | | (0.217) | (0.186) |
| Emp. growth × Local share | | | | 1.066*** | 0.923*** |
| | | | | (0.271) | (0.250) |
| 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. We define the price as the minimum between the list and sales I and II.*

## C.7 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 component $\alpha_g$, a chain component $\beta_c$, a chain-product component $\gamma_{g,c}$, 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 $\mathbb{E}[\beta_c] = 0$, such that $\alpha_g$ 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 a particular soda vs a 750 milliliter bottle of a shampoo).[71] We also assume that $\mathbb{E}\left[\gamma_{g,c}|c\right] = 0$, such that $\beta_c$ 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 the covariance terms are zero. The estimation of $\alpha_g$, $\beta_c$, and $\gamma_{g,c}$ can be done by conditional sample means:

$$\hat{\alpha}_g = \frac{1}{N_g}\sum_{s,c} p_{g,s,c}, \qquad \hat{\beta}_c = \frac{1}{N_c}\sum_{g,s}\left(p_{g,s,c} - \hat{\alpha}_g\right),$$

$$\hat{\gamma}_{g,c} = \frac{1}{N_{g,c}}\sum_{s}\left(p_{g,s,c} - \hat{\alpha}_g - \hat{\beta}_c\right), \qquad \hat{\epsilon}_{g,s,c} = p_{g,s,c} - \hat{\alpha}_g - \hat{\beta}_c - \hat{\gamma}_{g,c},$$

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 observations) 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 $\alpha_g$ and study dispersion in relative prices. We decompose relative price variation in a chain component, a chain-product component, and the residual:

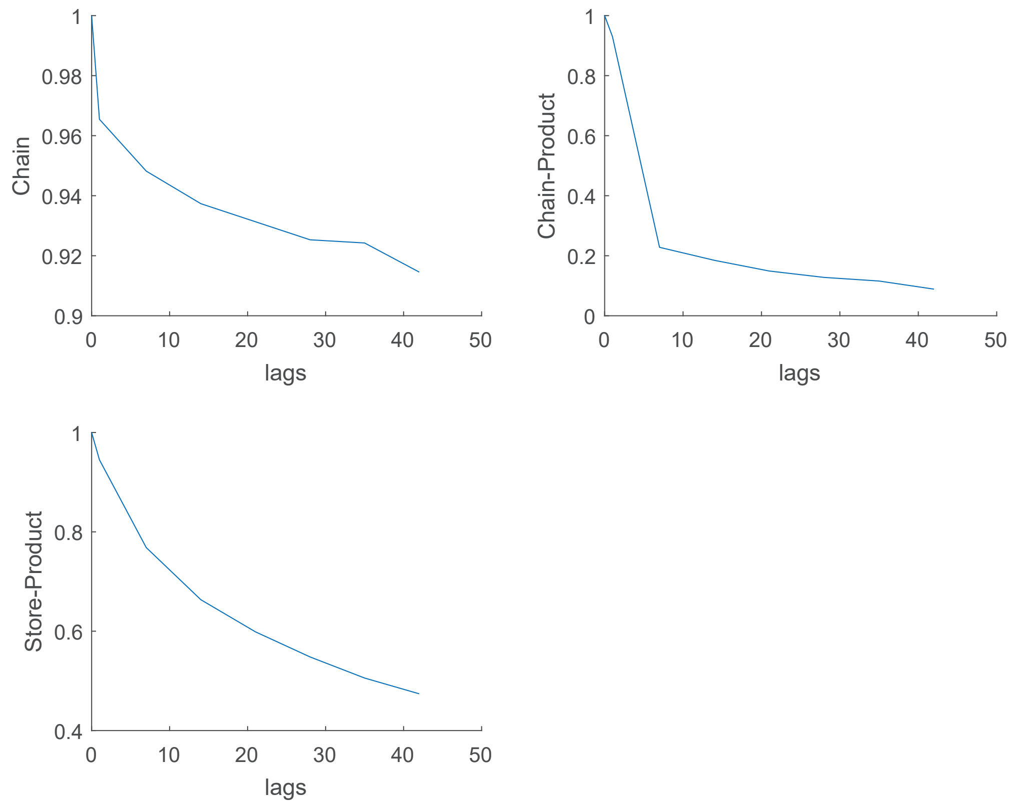
$$\mathrm{Var}\left(p_{g,s,c} - \hat{\alpha}_g\right) = \mathrm{Var}\left(\hat{\beta}_c\right) + \mathrm{Var}\left(\hat{\gamma}_{g,c}\right) + \mathrm{Var}\left(\hat{\epsilon}_{g,s,c}\right).$$

**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 (2019) highlight that a large share of price dispersion comes from each store selling different sets of

[71] This is equivalent to analyzing "relative prices," as in Kaplan, Menzio, Rudanko, and Trachter (2019).

goods cheaper while charging similar prices on average. This situation suggests that an information problem might make consumers buy in a store selling more goods 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 C4 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 C4: Price Dispersion Persistence




**Alternative Decomposition** The left panel of Table C8 shows the role of goods categories and store provinces on the variance of relative prices for Argentina. Regarding categories, 51% of the variance is explained by chains setting different relative prices across goods. Variation across categories explains 16% of the variance, while variation within goods of the same category explains the remaining 35%. Moreover, 38% of the variance of relative prices is explained by stores of the same chain setting different prices for the same good. The province of the store explains 19% of that variance, while the other 19% corresponds to different prices in stores of the same province. Finally, the right panel of Table C8 shows that 19% of the variance of relative prices is explained by stores setting different prices across goods. Chains explain 11% of that variance, and different prices at stores of the same chain explain the additional 8%.

Table C8: Alternative Decomposition

Categories and Provinces

| | I | II | III |
|---|---|---|---|
| **Chain** | 11 | 11 | 11 |
| **Goods** | | | |
| Chain-good | 51 | | 51 |
| Chain-category | | 16 | |
| Chain-category-good | | 35 | |
| **Stores** | | | |
| Chain-good-store | 38 | 38 | |
| Chain-good-province | | | 19 |
| Chain-good-province-store | | | 19 |
| Total | 100 | 100 | 100 |

Stores

| | IV | V |
|---|---|---|
| **Chain & Stores** | | |
| Store | 19 | |
| Chain | | 11 |
| Chain-store | | 8 |
| **Goods** | | |
| Store-good | 81 | |
| Chain-store-good | | 81 |
| Total | 100 | 100 |

*Notes: Left panel shows the roles of goods' categories and stores' provinces. Right panel shows the role of stores versus chains.*

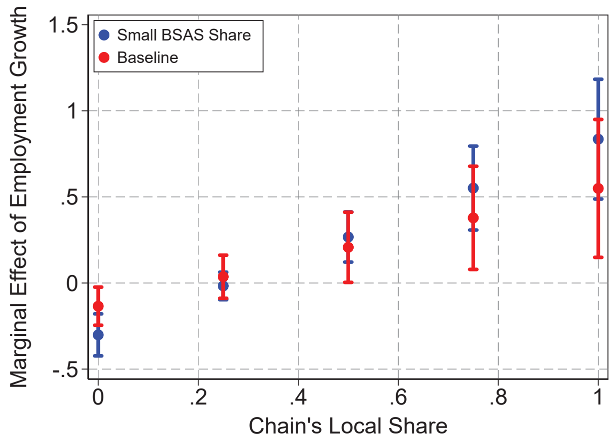
## C.8 Effects of Regional Shocks: Role of Buenos Aires

In Section 3.2, we showed that prices tend to react relatively little to local conditions (based on employment data at the province level), particularly so for chains that operate in multiple regions. In particular, prices in stores of chains operating almost exclusively in one region do react to local conditions, while stores of chains that operate in many regions do not seem to react to local conditions. Given that almost 40% of Argentineans live in Buenos Aires province and 29% of the stores are in Buenos Aires, we want to confirm that our results are not driven exclusively by Buenos Aires. For this, we extend our regression equation (1) to allow for the share of the chain's stores that are in Buenos Aires, $bsas_{c(s),t}$, to have an effect:

$$\begin{aligned}\Delta p_{s,t} =& \alpha_s + \gamma_t + \beta_1\ local_{s,t} + \beta_2 \Delta e_{prov(s),t} + \beta_3 local_{s,t} \times \Delta e_{prov(s),t} + \\ &+ \beta_4\ local_{s,t} \times bsas_{c(s),t} + \beta_5\ \Delta e_{prov(s),t} \times bsas_{c(s),t} + \\ &+ \beta_6\ local_{s,t} \times \Delta e_{prov(s),t} \times bsas_{c(s),t} + \epsilon_{s,t}.\end{aligned} \tag{10}$$

In addition to the baseline results from 4, Figure C5 plots the marginal effect of employment growth $\Delta e_{prov(s),t}$ on store price growth $\Delta p_{s,t}$ for chains with low participation in Buenos Aires, i.e., at the 10th percentile ($bsas_{c(s),t} = 0.12$). We do not find any statistically significant differences between the baseline results and the ones focused on chains with low participation in Buenos Aires. Thus, the results are valid for the whole country and not only for Buenos Aires.

Figure C5: 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. The baseline results are those from Figure 4, while the alternative is based on the estimates from equation (10) evaluating the Buenos Aires share, $bsas_{c(s),t}$ at its 10th percentile (i.e., 0.12). The vertical lines refer to the 95% confidence intervals.*

## C.9 Effects of Regional Shocks: An IV approach

Our main evidence regarding the differential effect of regional shocks on stores with different local shares is not to be interpreted as causal. Our model in Section 4 is useful to overcome this limitation since we use the model to generate and properly evaluate the causal effects of exogenous regional and aggregate shocks—estimating the same regression and showing that it is in line with this empirical findings. As an alternative approach, we also evaluate here an instrumental variable approach akin to Guren, McKay, Nakamura, and Steinsson (2021)—though ours is more limited since we do not have as much regional information as they do. In particular, we estimate the elasticity of our local employment variable (i.e., at the province level) to supra-provincial employment:

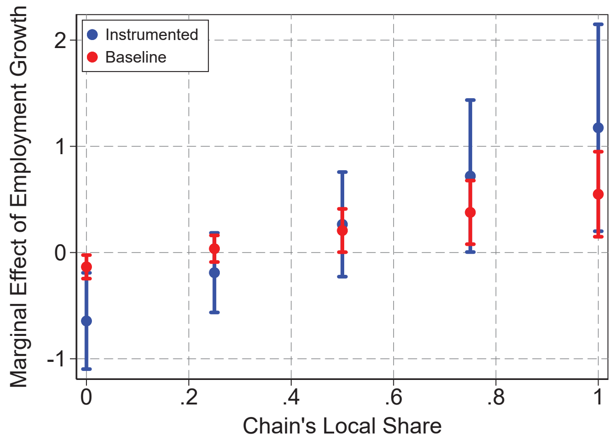
$$\Delta e_{prov,z,t} = \alpha_{prov} + \beta_{prov}\Delta E_{z,t} + \delta_{prov}\Delta\tilde{E}_t + \varepsilon_{prov,z,t}, \tag{11}$$

where $\Delta e_{prov,z,t}$ is the growth rate of employment in province $prov$ (which is in zone $z$) in period $t$, $\Delta E_{z,t}$ is the growth rate of employment in zone $z$ in period $t$, and $\Delta\tilde{E}_t$ is the country-wide growth rate of employment in period $t$. Thus, as in Guren, McKay, Nakamura, and Steinsson (2021), coefficients $\beta_{prov}$ and $\delta_{prov}$ may be interpreted as capturing the province-specific sensitivity to employment variation at the zone and national level.[72] Thus, after estimating equation (11), we use $x_{prov,z,t} = \hat{\beta}_{prov}\Delta E_{z,t} + \hat{\delta}_{prov}\Delta\tilde{E}_t$ as an instrument for $\Delta e_{prov,z,t}$. Figure C6 shows the main result of interest for our purpose based on this approach, as well as our baseline result from Column

[72]We follow the standard geographical definition of regions in Argentina, which splits all provinces into 6 zones.

(4) in Table 5. While the instrumental approach is noisier, our baseline results lie within the 95% confidence interval of the instrumented results. Thus, this evidence suggests that our result that prices in stores with larger local shares covary more with local conditions is robust to introducing sources of plausibly exogenous variation.

Figure C6: Marginal Effect of Regional Shocks on Store Prices: An IV Approach




*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 5 as well as our instrumental variable approach based on Guren, McKay, Nakamura, and Steinsson (2021). The vertical lines refer to the 95% confidence intervals.*

# D Quantitative Results

## D.1 Validation Regressions

Table D1 shows that the validation regressions using the model-generated data do a good job in replicating the empirical results, particularly the interaction term between employment growth and the local share.

Table D1: Validation

| | Without Time FE | | With Time FE | |
|---|---|---|---|---|
| | Data | Model | Data | Model |
| Emp. Growth | -0.137 | -0.037 | -0.174 | -0.025 |
| | (0.0569) | (0.0054) | (0.0582) | (0.0055) |
| Local Share | -0.269 | -0.000 | -0.237 | -0.000 |
| | (0.1890) | (0.0000) | (0.1440) | (0.0000) |
| Emp. Growth x Local Share | 0.677 | 0.377 | 0.454 | 0.430 |
| | (0.2160) | (0.0132) | (0.1990) | (0.0133) |

*Notes: We shock the simulated model with an exogenous increase in price of exports for each region one by one; we increase $P_r^*$ by 4.43%, which corresponds to 1 standard deviation in the data. We then estimate (1) as in the data. In particular, we include store fixed effects as in Figure 4 and column 5 of Table 5. The table compares the estimates in the model to those in column 5 of Table 5.*

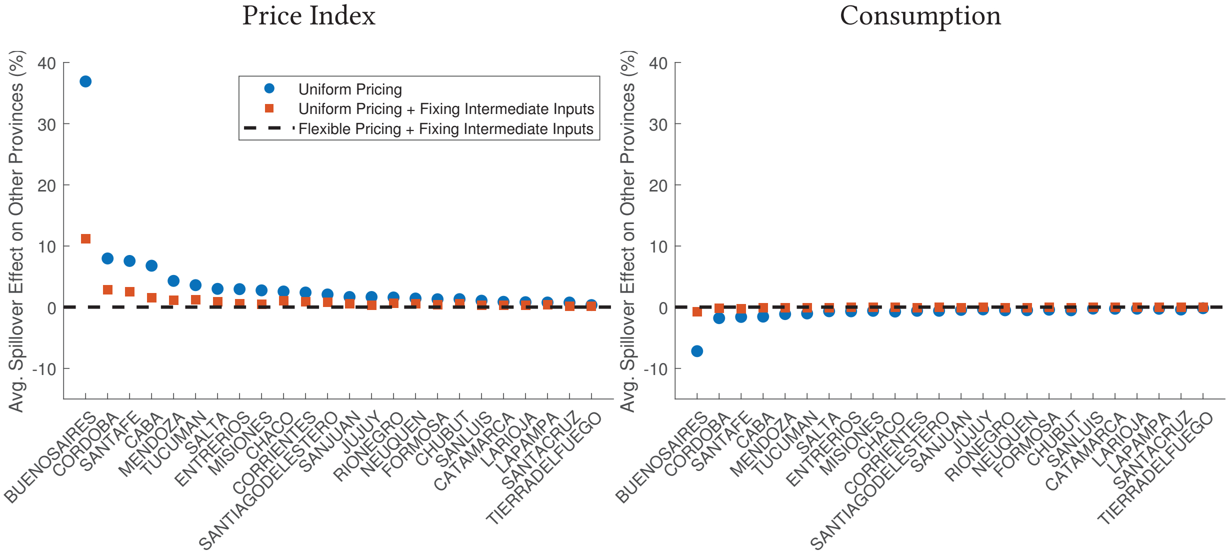
## D.2 Spillovers

Uniform pricing also implies that shocks in one region have spillover effects on other regions. As firms set the same price in all regions, a shock in one region will lead to a price change in all regions. To demonstrate this, we separately simulate regional shocks in each region as before but, instead, look at the effect on other regions. Figure D1 shows the average effects of a shock in each region on the price index and total consumption of other regions, all relative to the effects from an aggregate shock.

The average spillover effect on prices is 4.0%, while the one on consumption is -0.9% (always relative to the effect from an aggregate shock). But results are very heterogeneous depending on where the shock takes place. A shock in Buenos Aires, the largest region, leads to an average increase in prices of approximately 37% (relative to the aggregate shock) in the other regions. This then causes an average decrease in consumption of 7% (relative to the consumption increase observed with an aggregate shock). Similar qualitative spillover effects on prices and consumption are observed when the shock takes place in other provinces. However, the magnitudes of the spillover effects are much smaller since the shocks are taking place in much smaller regions. Bigger regions have a larger impact on prices, hence leading to larger spillover effects.

Spillovers occur because of uniform prices as well as intermediate inputs that are nationally produced. The dashed line of Figure D1 shows that when these two elements are shut down (i.e., prices are flexible, and the cost of as well as labor demand for intermediate inputs are fixed to their baseline values), there are no spillover effects. To evaluate the importance of uniform pricing relative to intermediate inputs, Figure D1 also shows the spillover effects with uniform pricing but fixed intermediate inputs. While uniform pricing explains all of the negative consumption spillover effects, it only explains about one-fourth of the total price spillovers: the average price

Figure D1: Regional versus Aggregate Shocks




*Notes: We shock the economy with an exogenous increase in price of exports for each region one by one; we increase $P_r^*$ by 4.43%, which corresponds to 1 standard deviation in the data. The first figure shows the average spillover effect on prices of other regions, relative to an aggregate shock. The second figure shows the consumption spillover, also relative to an aggregate shock. Regions are sorted by size.*

spillover effect is now 1.2% instead of 4.0%.[73]

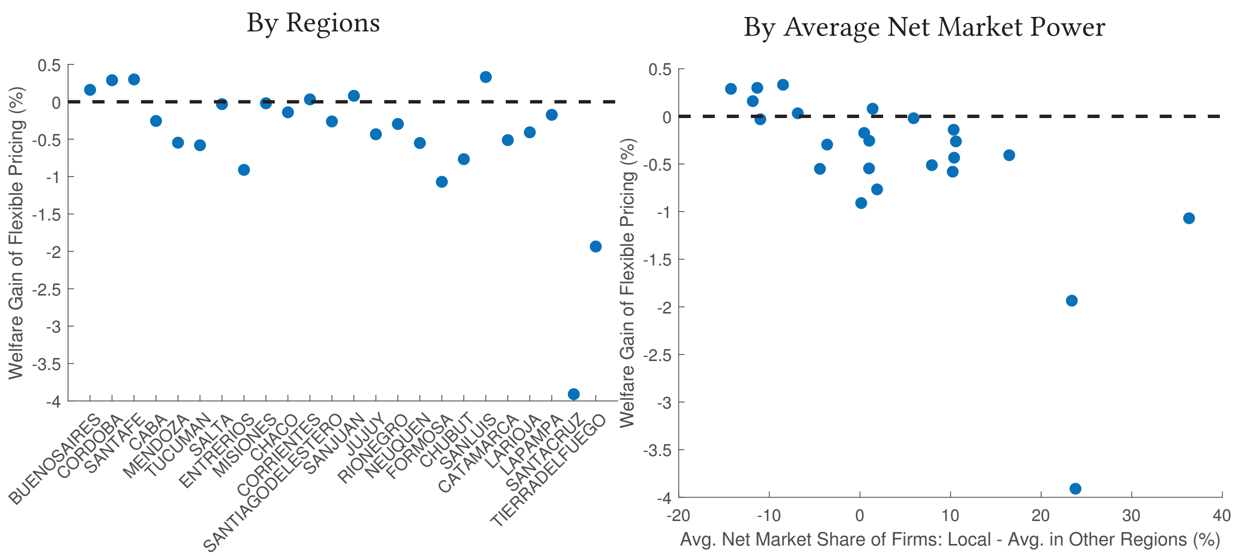
## D.3 Welfare Implications of Uniform Pricing

We evaluate the welfare implications of uniform pricing. We compute the consumption equivalent units of moving from uniform to flexible pricing for each region. The left panel of Figure D2 shows that households tend to lose when moving to flexible pricing (average loss of 0.5%), but welfare effects are highly heterogeneous, ranging from losses of 3.9% to gains of 0.3%.

A large driver of the heterogeneity of welfare effects has to do with the firms' heterogeneous market power. Households care about what prices would be if firms, instead of setting a uniform price, were able to set different prices in each region. In our model, equation 7 shows that firms set higher prices when they have higher market power. Thus, if firms have heterogeneous levels of market power across the regions, they would want to increase (decrease) prices in regions where they have more (less) market power. To capture this, we calculate the net market power of firm $f$ in region $r$ as the market power of firm $f$ in region $r$ ($s_{rf}^n$ in the model) minus the average

[73] The existence of intermediate inputs that are nationally produced implies that when one region receives a positive export price shock, its wages increase and a larger share of intermediate inputs is now produced in other regions. This increases the income in other regions, leading to an increase in consumption that partially compensates the decrease generated by the increase in prices.

Figure D2: Welfare Effects of Moving from Uniform to Flexible Pricing




*Notes: The figure shows the welfare gains for each region of moving from uniform pricing to flexible pricing. The left panel plots the gains for each region, ordered by population size. The right panel shows the welfare gains according the average net market power that chains in sector one have in each region. The net market power of each chain-region is calculated as the market power of a chain in a region minus the average market power of such chain in other regions in which it operates.*

market power of such chain in other regions in which it operates,

$$\hat{s}^n_{rf} = s^n_{rf} - \frac{\sum_{r' \neq r, r' \in \Omega^n_{gf}} s^n_{r'f}}{\sum_{r' \neq r, r' \in \Omega^n_{gf}} 1}.$$

The average, within region, net market power is, therefore, a summary statistic that explains the direction in which prices would move. The right panel of Figure D2 shows, as expected, that regions where firms would have more market power under flexible pricing tend to prefer uniform pricing. For these regions, uniform pricing is a way of reducing prices. In line with Adams and Williams (2019), chains that operate in low-competition regions need to take into account that increasing prices may increase local profits, but would also lead to large profit losses in high-competition regions.

# E Alternative Model

The baseline model in Section 4 has price changes due to variations on marginal costs. Our main conclusions also hold when prices change due to demand shocks that affect the demand elasticity (due to non-homothetic preferences and income shocks). We find the same qualitative results as in our baseline model: (i) firms setting uniform prices weigh each region according to their sales share, (ii) regional price elasticities are smaller than aggregate price elasticities, and (iii) regional elasticities are more biased measures of aggregate ones when regions are smaller or firms' sales are more equally distributed across regions.

This alternative model has the fewest possible components such that while it is consistent with the data it is also tractable, allowing us to easily identify the key trade-offs across alternative pricing schemes. We extend the standard model of monopolistically competitive firms with a continuum of goods in three key dimensions. First, we add non-homothetic preferences so that prices change with income shocks. We assume preferences similar to Simonovska (2015), as this preference structure allows for analytical tractability. Second, we include multiple regions and variation in market shares across varieties. We assume there are two regions with heterogeneous preferences across varieties to generate variation on market shares. Third, we assume that there is uniform pricing, i.e., the seller has to set the same price in both markets.[74]

Time is discrete and infinite, $t = 0, \ldots, \infty$. There are two cities $j = 1, 2$ with population size $M_j$ 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.

## E.1 Households

There is a representative consumer in each city with period utility

$$u_{j,t} = \int_{\omega \in \Omega_{j,t}} s_j(\omega) \log\left(q_{j,t}(\omega) + \bar{q}_j\right) d\omega, \tag{12}$$

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 $\omega$ 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. Without loss of generality we assume that $\frac{\partial s_1(\omega)}{\partial \omega} \geq 0$ and $\frac{\partial s_2(\omega)}{\partial \omega} \leq 0$ . Thus, consumers in City 1 prefer goods closer to $\omega = 1$, while those in City 2 prefer goods closer to $\omega = 0$.

Preferences are non-homothetic, so the demand elasticity changes with income, as in Simonovska (2015). With these preferences the model can be consistent with the empirical findings in Section 3, which show that prices change with income shocks.[75] 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

[74] The model is studied here in partial equilibrium. Our results are robust to extending the model to general equilibrium, with endogenous labor supply and the disutility of labor being the source of shocks (available upon request).

[75] With CES preferences, prices are 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 Rodriguez-Clare (2019), among others.

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 or aggregate shocks.

The household's problem reads

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

The demand for variety $\omega$ in city $j$ and period $t$ is given by

$$q_{j,t}(\omega) = \max\left\{0, \frac{s_j(\omega)}{\bar{S}_{j,t}} \frac{y_{j,t} + P_{j,t}\bar{q}_j}{p_{j,t}(\omega)} - \bar{q}_j\right\}, \tag{13}$$

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

## E.2 Firms

Firms have a linear technology with marginal cost $c_{j,t}$. 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., $p_{1,t}(\omega) = p_{2,t}(\omega) = p_t(\omega)$. Alternatively, under flexible pricing, producers can set different prices in each city.

### E.2.1 Flexible Pricing

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

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

taking the demand function (13) as given. The solution is

$$p_{j,t}(\omega) = \left[c_{j,t} \frac{s_j(\omega)}{\bar{S}_{j,t}} \left(\frac{y_{j,t}}{\bar{q}_j} + P_{j,t}\right)\right]^{1/2}. \tag{14}$$

Given the demand function (13) and pricing (14), 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 $q_{j,t}(\omega) \geq 0$ if and only if $s_j(\omega) \geq \underline{s}_{j,t}$.[76] The threshold is defined as the taste such that consumption is equal to zero; that is,

$$\underline{s}_{j,t} \equiv \frac{\bar{S}_{j,t}\bar{q}_j c_{j,t}}{w_{j,t} + P_{j,t}\bar{q}_j}. \tag{15}$$

[76]To see this, replace the equilibrium price (14) on the demand function (13) and note that it is increasing in $s_j(\omega)$.

Recall that $s_1(\omega)$ is increasing in $\omega$. 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 $\omega$, 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 $\overline{\omega}_t = s_2\left(\underline{s}_{2,t}\right)^{-1}$.

### E.2.2 Uniform Pricing

Under uniform pricing, each variety $\omega$ 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

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

taking the demand functions (13) as given. The solution is

$$p_t(\omega) = \left[\sum_{j=1}^{2} \frac{M_j}{M_1 + M_2} c_{j,t} \frac{s_j(\omega)}{\bar{S}_{j,t}} \left(\frac{y_{j,t}}{\bar{q}_j} + P_{j,t}\right)\right]^{1/2}. \tag{16}$$

To solve for the set of goods consumed in each city, note that 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 $\omega$ 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 $\omega$ is

$$p_t(\omega) = \begin{cases} \left[c_{2,t} \frac{s_2(\omega)}{\bar{S}_{2,t}} \left(\frac{y_{2,t}}{\bar{q}_2} + P_{2,t}\right)\right]^{1/2} & \text{if } \omega \leq \underline{\omega}_t \\ \left[\sum_{j=1}^{2} \frac{M_j}{M_1+M_2} c_{j,t} \frac{s_j(\omega)}{\bar{S}_{j,t}} \left(\frac{y_{j,t}}{\bar{q}_j} + P_{j,t}\right)\right]^{1/2} & \text{if } \underline{\omega}_t \leq \omega \leq \overline{\omega}_t \\ \left[c_{1,t} \frac{s_1(\omega)}{\bar{S}_{1,t}} \left(\frac{y_{1,t}}{\bar{q}_1} + P_{1,t}\right)\right]^{1/2} & \text{if } \omega \geq \overline{\omega}_t \end{cases}.$$

Finally, the thresholds are defined by

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

## E.3 Quantitative Exploration

In this section we quantitatively evaluate the implications of uniform versus flexible pricing.

### E.3.1 Calibration

We calibrate the model with uniform pricing in steady state, assuming that City 1 is a representative province of our data and City 2 is the rest of the country. To measure the relative size of a representative province, we use information on the number of stores by provinces. We estimate that the average share of stores that a chain has in a province is 20%. We interpret this as $M_1 = 0.2$ and $M_2 = 0.8$ since those estimates reflect the relative size of the different markets available to a typical chain. We further assume consumers in each city are symmetric, so we set $y_1 = y_2 = 1$ and $\bar{q} = \bar{q}_1 = \bar{q}_2$, and without loss of generality we normalize $c_1 = c_2 = 1$. Moreover, we set the taste parameters $s_1(\omega) = (\omega)^{\alpha}$ and $s_2(\omega) = (1-\omega)^{\alpha}$ . In Section E.5 we evaluate the role of some of these assumptions in our results.

We calibrate the two preference parameters $\alpha$ and $\bar{q}$ targeting three moments from the empirical results. First, in the data, on average, 7% of stores that sell in a province sell only in that province. In the model, City 1 consumes varieties $\Omega_1 = \left[\underline{\omega}, 1\right]$ out of which varieties $[\overline{\omega}, 1]$ are sold only in City 1. Hence, we target this moment as $(1-\overline{\omega}) / \left(1-\underline{\omega}\right) = 0.07$.

Section 3.2 shows that prices of firms with a lower local share react less to regional shocks. In the model we define the local share as $local(\omega) = M_1 q_1(\omega) / (M_1 q_1(\omega) + M_2 q_2(\omega))$.[77] We shock the economy with an exogenous increase in income for City 1—we increase $y_1$ by 1.7%, which corresponds to one standard deviation in the data. We target the response of firms with local shares of 0.5 and 1. Despite its simplicity, the model does a good job at matching the three target moments. Table E1 shows the estimated parameters and target moments.

Table E1: Estimated Parameters and Moments

| Parameter | Value | Description | Moment | Data | Model |
|---|---|---|---|---|---|
| $\alpha$ | 1.23 | Taste curvature | Local share | 7.0 | 7.0 |
| $\bar{q}$ | 0.01 | Demand constant | Price response p50 | 0.2 | 0.2 |
| | | | Price response p100 | 0.5 | 0.5 |

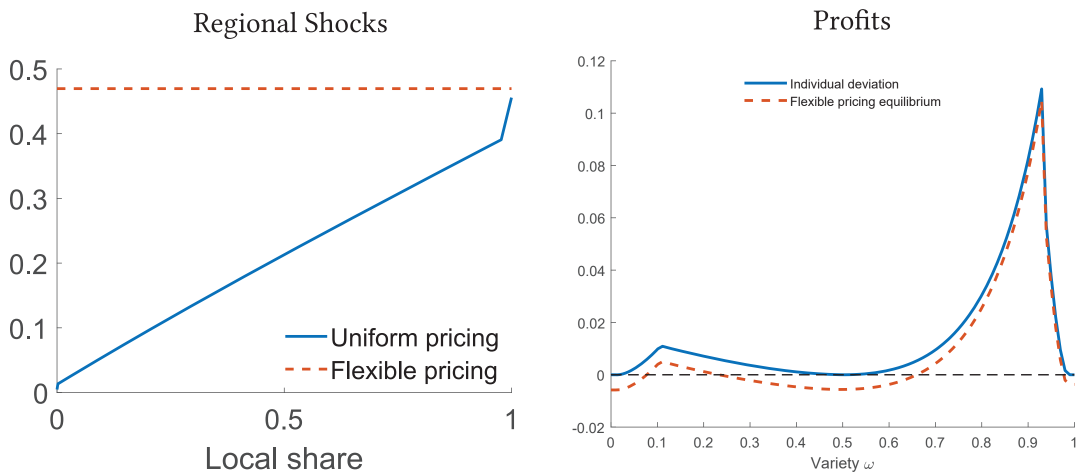
*Notes: The data of price responses and local shares are based on the estimates of Section 3.2.*

**Response to regional shocks** In the calibration we target the response of prices to regional shocks for firms with a local share of 50% or 100%. We now compare the response for uniform versus flexible pricing. The first panel of Figure E1 shows the responses 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 products regardless of the local share. In the uniform pricing economy, firms have to set the same prices across cities. Hence, when the local share is relatively small, the

[77] In the data, we restrict the set of products such that we compare the price of similar goods across stores. Similarly, in the model, we interpret each variety $\omega$ as a similar basket sold by different stores.

total demand for that product does not change much. As a result, prices have 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 4, while those in the flexible-pricing model do not.

Figure E1: Uniform vs Flexible Pricing




*Notes: The left panel 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 1 standard deviation in the data. The right panel shows the change in profits when the economy moves from uniform to flexible pricing.*

**Uniform versus flexible pricing** We model uniform pricing as an exogenous constraint to the firm for tractability. We can quantify how costly this constraint is by comparing the profits of firms in this economy with firms in the flexible-pricing economy. The second panel of Figure E1 shows the change in profits when we move from the uniform to the flexible pricing economy. First, the blue solid line shows the change in profits for an individual deviation of only a specific variety $\omega$. In this case the firm can only be better off. Note that for varieties close to $\omega = 0$ and $\omega = 1$ the gains are almost zero. Similarly, at $\omega = 0.5$ the demand elasticities are equivalent in City 1 and 2 and, therefore, there are no gains for firms. The red dotted line shows the change in profits when all firms move to the flexible-pricing equilibrium, and so the demand functions also change. In this case there are some winners, those close to the thresholds $\underline{\omega}$ and $\overline{\omega}$ because for those firms the constraint is more costly, while there are some losers, those away from the thresholds. On average, however, the increase in profits is only about 0.35%.

## E.4 Aggregate Shocks

We study the responses of prices and consumption to aggregate versus regional income shocks. We define total consumption in city $j$ as $Q_{jt} = \int_0^1 q_{jt}(\omega)\, d\omega$ and a price index $P_{j,t}^{index}$ such that

$P_{j,t}^{index} Q_{jt} = \int_0^1 p_{j,t}(\omega)\, q_{jt}(\omega)\, d\omega$. With this decomposition an increase in income $y_j$ is accounted by changes in $Q_{jt}$ and $P_{j,t}^{index}$. We define the elasticities as

$$\varepsilon_{P,j} = \frac{\Delta P_{j,t}^{index}}{\Delta y_{j,t}} \qquad \varepsilon_{Q,j} = \frac{\Delta Q_{j,t}}{\Delta y_{j,t}}$$

and note that $\varepsilon_{P,j} + \varepsilon_{Q,j} = 1$. With flexible pricing, regional and aggregate shocks have similar effects on prices and quantities. Table E2 shows that the elasticity of prices and consumption are 0.46 and 0.53, respectively, regardless of the type of shock being regional or aggregate.

Under uniform pricing, however, regional and aggregate shocks have different effects. An aggregate shock has almost the same effect as in the flexible-pricing economy. A regional shock, however, has a lower effect on prices and a larger effect on quantities in the uniform-pricing economy. The intuition is that under uniform pricing prices are set accordingly to the total demand of the aggregate economy. If there is a regional shock, the aggregate demand will not change much, and, as a result, prices will be sticky to regional shocks. Consumption, therefore, will react more in the region of the shock than under an aggregate shock in which prices do adjust more. Table E2 shows that when household income increases only in City 1, prices increase by 0.28, while prices increase by 0.44 for an aggregate shock. Thus, consumption increases by 0.71 from a regional shock, while it increases only by 0.55 from an aggregate shock. 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 E2: Regional versus Aggregate Shocks in City 1

| | **Price index** | **Consumption** |
|---|---|---|
| **Uniform pricing** | | |
| Regional shock | 0.28 | 0.71 |
| Aggregate shock | 0.44 | 0.55 |
| Elasticity ratio | 0.64 | 1.29 |
| **Flexible pricing** | | |
| Regional shock | 0.46 | 0.53 |
| Aggregate shock | 0.46 | 0.53 |
| Elasticity ratio | 1.00 | 1.00 |

*Notes: The table compares the elasticity of the price index and quantities consumed to regional and aggregate shocks in City 1, in the uniform- and flexible-pricing economies. We define the elasticity ratio as elasticity to regional relative to aggregate shocks.*

## E.5 Alternative City Configurations

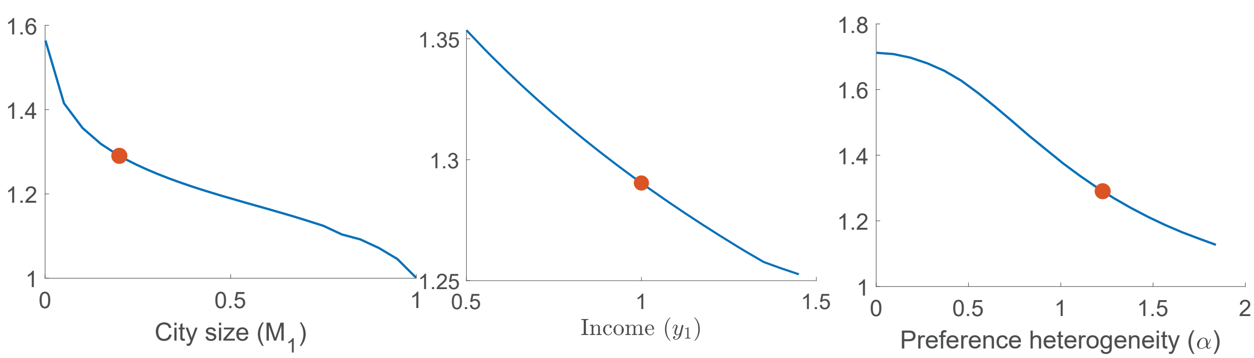
We consider alternative setups to study the quantitative importance of each assumption. We evaluate the effects of city sizes, income, and preferences. We find that the amplification of the response of consumption to regional relative to aggregate shocks is robust to all the alternative specifications.

**City Sizes** As City 1 becomes larger, prices will follow more the demand of City 1 and the response of regional and aggregate shocks will become more similar. Figure E2 shows the ratio of the elasticity of consumption to a regional relative to an aggregate shock. In the limit, when $M_1 = 1$ and $M_2 = 0$, the ratio is equal to 1. However, the figure shows that for a wide range of values the ratio is between 1.2 and 1.4 and that when $M_1$ is sufficiently small the ratio can be as high as 1.6. We model the economy as two regions, while in the real world there are many regions, so each city looks like a small region. Hence, this exercise shows that the results would likely be stronger in a larger model that takes geographical heterogeneity into account.

**Heterogeneous Income** When City 1 becomes richer the elasticity ratio increases. We vary $y_1$, which proxy for the income in City 1. The intuition is that under uniform pricing, the seller takes the demand in the richer city more into account and therefore react less to shocks in the poor city. Hence, prices react more to regional shocks in richer than in poorer cities, which decreases the elasticity ratio.

**Preference Heterogeneity** When both cities have more similar preferences (lower $\alpha$), the elasticity ratio increases. The intuition is that for products close to $\omega = 1$ (those with higher preference in region one), the demand from City 1 increases when $\alpha$ decreases. Hence, the prices of those goods will react less to a regional shock, which increases the elasticity ratio.

Figure E2: Alternative City Configurations




*Notes: The figure shows the change in the ratio of the elasticity of consumption to regional relative to aggregate shocks under alternative parameter configurations.*