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Why Do Prices Differ Across Stores? Differential Competition Environments and Their Price Impacts

Abstract

Our study provides empirical insights into the extent to which differential market demographics and differential competition environments affect product prices. Using big data, we find that price variations are caused mainly by differential competitive environments. More specifically, we find that *Brand Competition Within Stores* exerts the largest downward pressure on prices. A 10 percent increase in the number of brands reduces prices by about 10 percent. *Product Competition Within Stores* exerts the second-largest price effect, followed by *Store Competition Within Local Markets*. Moreover, retailers operating multiple stores in a local market coordinate prices to attenuate competitive downward pressure on prices.

JEL-Codes: D400, D900, L100, L200, M200.

Keywords: anti-inflammatory drugs, competition, market determinants, price effects, pain killers.

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1) Introduction

The evaluation of price effects and consumer welfare effects plays a central role in economic and business decision making. The recent availability of big data provides opportunities to examine the extent of price variations of identical products. Several studies find large price dispersions of the same product across stores and markets (see for example Nakamura (2008), Eden (2014), Kaplan and Menzio (2015), Dubois and Perrone (2015), and Hitsch, et al. (2021). Moreover, DellaVigna and Gentzkow (2019) find price dispersions across stores and between different chains. They also find that price dispersions are far lower across stores within chains, resulting in uniform or nearly uniform prices.

The aim of this study is to empirically explain the extent to which differential market determinants (such as different market demographics and differential competition environments) affect product prices. We place special attention on differential competition environments such as product and brand competition within and across stores, as well as competition across stores within local markets.

To make good economic and business decisions, managers and policy makers must have a good understanding of how market characteristics affect consumer welfare and prices (see Federal Trade Commission (2010)). This pertains especially to decisions involving market entry, product launches, mergers, and collusion, among others. A big part of these analyses is devoted to competition, which plays a relevant role for society; it imposes downward pressure on prices so goods are offered at affordable prices.³ There is wide consensus that competitive downward pressure on prices can be large, which is one reason why competition and antitrust policies place so much attention on it.

Competition is a powerful economic concept that starts when consumers are offered choices. Consumers have the opportunity to purchase a competitor's product, often

 $^{^{3}}$ Competition also plays a relevant role for evaluating management performances (see Bloom and Van Reenen (2007)) and firm survival (see Bloom et al. (2013).

resulting in downward pressure on prices (see Lancaster (1966), Baumol (1967), and Boone (2008)).

Competition can be caused by different environmental situations, such as competition between firms, between stores, between brands, and between products. Scholars need to examine more thoroughly the extent to which these different competition layers reduce prices. This topic is especially relevant for managers and policy makers so they can learn to prioritize specific competition environments when evaluating economic and other business events.

The retail market is one classical example that is characterized by different competition environments.⁴ When facing competition with other stores in a local market, retailers must decide on the number of stores they will operate. Retailers also offer a certain number of products and brands that compete with each other in their stores. Prices are then dependent on the number of other stores offering the same product in a local market, as well as the number of brands and products offered within a store. Moreover, prices are dependent on further market demographics. For example, prices can be set higher (lower) in high-income (low-income) areas, and they can vary depending on other population demographics. In general, retailers have opportunities to engage in price discrimination---that is, they alter prices of identical products across stores and local markets as market conditions change.⁵

 $^{^4}$ Thomassen et al. (2017) and Heimeshoff and Klein (2024) show that consumer patterns such as one-stopshopping behavior can exert differential effects on competition.

⁵ The analysis of price discrimination and price variation has attracted much attention in the economics literature, especially with the availability of big data. Examples are Eden (2014), Dubois and Perrone (2015), and Eizenberg et al. (2021), with a focus on soft drinks (McMillan (2007)), movie tickets (Orbach and Einav (2007)), rental cars (Cho and Rust (2010)), online music (Shiller and Waldfogel (2011)) and the retail market (Stroebel and Vavra (2019), among many others. Chevalier and Kashyap (2019) consider intertemporal discounts as a mean of price discrimination. Similar to the cited literature, we also use big data. However, our study differs from their work as we observe price variation across regional markets and empirically evaluate the extent to which price and market environments affect prices.

Standard theories show that optimal prices are dependent on multiple factors including: (1) differential costs, (2) differential market demographics, and (3) differential competition environments related to other products offered within stores and other stores and retailers found within the same local markets.⁶ Few scholars have empirically examined the extent to which these factors affect prices.

It is frequently observed that product prices of the same product vary to different degrees. This raises the question: who is setting prices? In some circumstances, prices are determined at the local store level. In other cases, retailers determine product prices often within manufacturer guidelines.⁷ Depending on the level at which prices are being determined, this has implications on competitive forces and price variations. Furthermore, the level of aggregation and number of product categories included in the analysis may have different implications on price variations.

Since the main focus of the study is to disentangle the impact of competition environments on prices, it is important to choose a product category that (1) provides sufficient information on product characteristics to control for product differentiation,⁸ (2) provides detailed information of different competition environments such as competition within stores, across brands and stores, (3) abstracts from influences of private labels on prices since these impose large downward pressure on prices and eliminating large parts of potential price variations.

For these reasons, we concentrate our analysis on one product category: antiinflammatory drug products (or pain killers). The pain killer market is an appropriate market for our purposes since pain killer products and their associated brands are

 $^{^{6}}$ See Ma and Siebert (2024) and Bonnet et al. (2022).

⁷ Retailers usually engage in legal agreements with manufacturers, who determine guidelines regarding the minimum and maximum price for a product. Pricing guidelines are intended to protect retailers and manufacturers by providing fair opportunities to generate sales.

⁸ Exemplary product categories are breakfast cereals (Nevo 2001, Chidmi and Lopez, 2007) and Yoghurt (Draganska et al. 2009).

established and well-known among consumers. Pain killer products are offered at various types of stores, including small and large retail stores, grocery stores, gas stations, etc. Hence, consumers can purchase pain killers at a variety of stores and retailers within and across markets. Many people from all demographic backgrounds purchase pain killers. The market is characterized by a large variety of products and brands. A major strength of our database is that it includes a large number of drug products and purchase transactions across a large number of retail stores in the U.S. This allows us to explore price variations of the same product across stores and markets. We are able to consider a large set of explanatory variables related to cost, market demographics, and competition. Finally, our focus on pain killers helps us avoid heterogeneities across product categories, which could have an influence on institutional features that would impact and cause distortion in evaluating various competitive and market environments across local markets.

We use a set of big data that encompasses detailed U.S. scanner transaction information from 2018 stemming from a large number of retail stores across local markets covering more than 80 percent of all existing retail stores in the U.S.⁹

One crucial advantage of the dataset is that it includes highly disaggregate information on local markets across the U.S., including the number of retailers and stores, as well as store-level number of products and brands, product prices, and sales volumes. The detailed product information provides an excellent setting for examining the price effects of market and competition characteristics across local stores and markets.

Our final dataset contains detailed sales information on more than 1,200 different pain killer products (measured at the universal product level), stemming from more than

⁹ The Kilts Center at the University of Chicago provided the NielsenIQ Retail Scanner (RMS) and NielsenIQ Consumer Panel (Homescan).

71 million purchase transactions and more than 46 thousand stores located across 879 regional markets.

Summary statistics show a large degree of price variations, which are explained mostly by variations across stores and local markets rather than by price fluctuations over time. We conduct regression analyses to examine the extent to which market determinants explain most of the price variations. The empirical model addresses endogeneity concerns following DellaVigna and Gentzkow (2019) and using an instrumental variable strategy related to Hausman (1996) and Nevo (2000).

Our regression results show that a large majority of price variations is explained by differential competition environments. More specifically, we find that *Competition* across Brands within Stores has the largest effect on prices. An increase of 10 percent in the number of pain killer brands offered in stores reduces prices by around 10 percent. The second-largest downward pressure on prices is caused by Store Competition within Local Markets. A 10 percent increase in the number of stores within a local market reduces prices by approximately one percent. It is noteworthy that retailers operating multiple stores within a local market are able to internalize competitive externalities imposed on their own stores within the local market. This pricing strategy attenuates price competition.

Remaining market characteristics (such as market size, as well as income, age, and unemployment rates) have smaller effects on prices. Income has the largest effect, where a 10 percent income increase results in a 1 percent price increase.

Overall, our study provides empirical evidence that competition across brands and competition across stores exerts the highest downward pressure on prices. In contrast, competition across products and stores belonging to the same retailer (as well as remaining market characteristics) have small effects on prices.

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The study is structured as follows: The next section provides thorough insights into the market and summary statistics on price and market determinant variations across local markets. Section 3 introduces the empirical model. Section 4 discusses the estimation results and offers further insights on competitive effects on prices and price-cost margins. Section 5 concludes.

2) The Data

2.a) The Datasets

Our empirical analysis builds on several datasets. The Kilts Center at the University of Chicago provided the NielsenIQ Retail Measurement Services (RMS) retail scanner data and the NielsenIQ Homescan consumer panel data. The RMS dataset records product-level revenue and sales information for more than 47 thousand U.S. retail stores (including grocery stores, mass merchandisers, drug stores, convenience stores, and gas stations).

We focus on one product category, the anti-inflammatory drug market (pain killers), which allows us to concentrate fully on multiple competition environments. Pain killer products are defined using "universal product codes" (UPCs), which are identical across stores. Products are classified by brands, package sizes, dosages, and form of administration (tablets, capsules, caplets, etc.). For each product, we observe weekly sales and weekly revenues generated at every retail store. Each store's product assortment is defined by its completed weekly transactions. The retailers carry unique IDs that allow us to cross-link retailers across stores and local markets. Localities of retail stores are identified at the three-digit zip code level, which is the smallest geographic unit provided in the Kilts-NielsenIQ RMS data. Hence, in accordance with most of the studies cited earlier, we define the geographic market as the designated market area (DMA) at the three-digit zip code level.

The original scanner information stems from more than 85 million pain killer sales transactions that were conducted across U.S. retail stores in 2018. The scanner data represent almost 80 percent of all U.S. retail revenue in pain killers, such that extensive selection concerns are attenuated. We remove outliers by deleting the top and bottom 5 percent of observations of the product price distributions and the top 5 percent of the product sales distributions. We remove price promotions as defined by store-specific price changes that exceed more than 5 percent from one week to another. This procedure has been adapted frequently in marketing studies (see Hitsch et al. (2021)). After cleaning the data, our analysis encompasses information from more than 71 million sales transactions conducted in more than 46 thousand stores across 879 local markets. The dataset encompasses 84 brands, 143 retailers, and 46,933 stores, as well as prices and sales information of more than 1,200 different pain killer products.

To provide an example of the terminology being used in this study, we consider retailers (retailer A, retailer B, etc.) and their corresponding stores (e.g., a store by a specific retailer in a specific local market as defined by a three-digit zip code) that offer brands (Advil, Tylenol, etc.) and specific products (Tylenol 500 mg caplets, 100 pack).¹⁰

Drugs are sold at different dosages, which contain different amounts of the active ingredients. For example, Tylenol is sold in dosages of 325 mg, 500 mg, etc. They are also sold in different package sizes---containing 50 units, 100 units, etc. Our empirical analysis accounts for variations across dosage amounts and package sizes to avoid artificial price variations.¹¹

¹⁰ We refer to retailer A, retailer B, etc. to comply with the data provider's data policy to not disclose specific identities of retailers.

¹¹ We use two price measures to account for this. First, we use the price per pill product-specific weekly price per pill sold in a retail store (calculated using weekly product-specific revenues at the store level

We collect demographic information at the local market level from the Census Data Household Survey. This information includes county population, median age, and unemployment rate. We retrieve income data from the statistic of income office, which uses individual income tax returns (Forms 1040) filed with the Internal Revenue Service.

We retrieve information on wholesale prices from the IBM Micromedex Database.¹² This database provides information identified by the National Drug Code matched manually with the UPC.¹³

2.b) An Example for Price Variations across Stores and Markets

We begin the data descriptives by providing an illustrative example to motivate the existence of price variations across stores. (Later, we provide large-scale evidence from our big data that prices for the same products vary within and across local markets.) We focus on two cities or local markets in Indiana---West Lafayette and Lafayette. The two local markets lie adjacent to each other, separated only by the Wabash River (see Figure 1). These two cities differ in their demographics. For example, in West Lafayette 44.9 thousand people reside in West Lafayette (most are associated with Purdue University), the median age is 21.4, and the median household income is \$30,317 (as of 2022). Lafayette has a population of 70.8 thousand people (many working in the manufacturing industry), the median age is 33, and the median household income is \$50,674 (as of 2022).

divided by sales and number of pills in a package). The different dosages and package sizes will then be accounted for in the empirical model. This helps us avoid distortions. Second, we consider product-specific weekly prices per mg (calculated using weekly product-specific revenues at the store level divided by sales and dosage/strength as measured in mg) to conduct further robustness checks.

¹² The IBM Micromedex data provides information on average wholesale prices. Note that the information is not available for all varieties which explains a slight loss of some observations. However, robustness check show that the loss of observations has hardly any impact on our estimation results.

¹³ Homeopathic medicine is not listed in the Micromedex Database since there is no active ingredient that would require its listing. Manual matching was applied to products that exceed a sales threshold of around 1 percent.

We compare prices across the two cities while first concentrating on the two topselling pain killer products (Tylenol 500mg, 100 caplets and Advil 200mg, 100 tablets). Figure 2 shows that prices of the Tylenol product differ drastically across retailers and cities. Moreover, focusing on one retailer (here, retailer C), prices differ across cities (see Figure 3). It is somewhat surprising that the price in the West Lafayette store is higher than that in the Lafayette store, even though West Lafayette is a smaller city, characterized by lower income and lower age. The demographics would suggest the opposite---that is, prices should be lower in West Lafayette. Turning to the number of stores and retailers as a measure for competition, West Lafayette has fewer stores and retailers than Lafayette, which suggests that competition is lower resulting in less downward pressure on prices. This fact serves as a first indication that competition in local markets plays a relevant role for which we need to account.

We adopt the same search for the other top-selling product (Advil) and realize the same price patterns across cities and stores (see Figures 4 and 5). Moreover, the product prices for Tylenol and Advil are very similar within the stores in West Lafayette and within the store in Lafayette, which signals that in-store competition across products/brands is intense.

2.c) Summary Statistics

To become more familiar with the pain killer market and the data, we provide summary statistics. Table 1 provides information on the 10 largest brands ordered by descending market share. Column 1 shows that private labels hold the largest market share, followed by Advil, Aleve, Tylenol, etc. The top 10 brands generate weekly revenues of around \$700 million (see Column 2). To compare brand prices, we follow earlier studies and consider the average brand price per pill measured at the weekly level ($P_{Brand,Week}$) (see Column 3). There is a large variation in average prices across brands. The average price per pill varies from 5 cents for Bayer products to 76 cents for Goody's products.¹⁴

We now report summary statistics at the product level. Table 2 displays the top 10 pain killers ordered by descending market share. Column 1 shows that Tylenol 500mg caplets, 100 units is the top-selling pain killer product in the U.S. The product generates weekly revenues of \$293 million on average (see Column 2). Column 3 shows that the average weekly product prices per pill ($P_{Product,Week}$) vary drastically across products, from 5 cents to 13 cents per pill. Figure 6 illustrates the evolution of prices of the top 10 products by week in 2018. The figure displays little price variation over time for each product.

We now go beyond the top 10 top-selling pain killer products and consider the price variations of all products in our dataset. Moreover, we focus our analysis on examining price variations of identical products across local markets. We define a local market at the three-digit zip code level and consider product prices offered by stores within local markets in specific weeks.

Table 3 reports an average price per pill of 16 cents with a large standard deviation of 14 cents. The large standard deviation supports the argument that product prices vary drastically. It is important to recognize, however, that these price variations stem from a pooled panel data structure, so price variations are measured across products and within products (across time periods). To gain further insight into the primary source of price variations, we adopt two price dispersion measures commonly used in previous studies (see also Della Vigna and Gentzkow (2019), Goldberg and Verboven (2001), and Hitsch et al. (2021)).

 $^{^{14}}$ We also use pill prices normalized by dosage (in mg) and can confirm that the large price variation across brands prevails.

The first measure focuses on identical products across local markets and evaluates the degree of *price variations across markets* while conditioning on time periods. We construct this measure by focusing on an identical product and dividing the standard deviation of prices across local markets by the mean of prices across markets. We conduct this individual product measure separately for every time period and then use the average across time periods. Finally, we average across all products. The *price variations across markets* measurement returns a value of 1.428. Hence, the standard deviation is much larger than the mean, providing evidence for large price dispersions of the same product.¹⁵ Robustness checks confirm that the large price variation prevails if we condition on tablet dosages and package size.

The second measure captures *price variations within a market (across time)*. In accordance with the first measure, we condition on an individual product and divide the standard deviation of a product price across time by the corresponding mean across time. We repeat this for every product and market and use the average across products and markets. *Price variation within a market* takes a value of 0.139. This value is about 10 times smaller compared with *price variations across products*, which shows that the largest source of price variation is stemming from variation across products and local markets. This result is consistent with Figure 6, which shows large price differences across products but little variation across time periods.

The finding that prices vary drastically across products and local markets indicates that local market characteristics (such as competition, market size, and market demographics) are important features to account for, while seasonal and promotional effects that cause price variation within product lines are not as crucial. At this moment, however, it remains unclear which type of market characteristics influence prices the most.

¹⁵ Other studies using the same measurement report price variations across products that lie in the neighborhood of one and identify these as large price variations (see Grennan (2013)).

This is an empirical question, and it becomes the main focus in our empirical model section.

Table 3 shows summary statistics of the main variables used in our empirical analysis.¹⁶ The average price per pill across weeks, products, and local markets is 16 cents with a corresponding standard deviation of 14 cents. For robustness purposes, we also use the pill prices per mg dosage. The average is around 0.8 cents with a standard deviation of 0.6 cents. The large standard deviation relative to the mean further strengthens the existence of large price dispersions.

The average wholesale price per pill is 13 cents with a standard deviation of 7 cents. It is noteworthy that the standard deviation of the wholesale price per pill is smaller than the standard deviation of product prices. Moreover, the standard deviation divided by the mean is much smaller for wholesale prices compared to the product prices. Hence, the price variation is larger for product prices in comparison with wholesale prices. This observation further supports the fact that differential market characteristics across local markets are important in explaining price differentials.

Turning to the average (normalized) price-cost margin----defined as *[[Price per Pill-Wholesale Price per Pill]/Price per Pill*]---Table 3 displays an average (normalized) pricecost margin of 27 percent. The magnitude of the margin is reasonable, and it conforms with published industry insights from the business press.¹⁷ It should be noted that the variation measure, as defined by standard deviation divided by the mean, amounts to 0.7 which indicates a large amount of variation in price-cost margins. This variation is also large compared to the variation in wholesale prices (0.54). This is explained by the fact that prices are part of the price-cost margins and this pronounces the price-cost margin

 $^{^{16}}$ The variable definitions and the corresponding data sources are provided in the Appendix, Tables A.1 and A.2.

 $^{^{17} \}underline{https://pharmatimes.com/news/margins_squeezed_at_otc_drugmakers_995672/.$

variations. This finding further supports the conjecture that market characteristics are important determinants of price variations.

We now turn our focus to various market characteristics that could impact product prices. We begin with the competition measures. We will incorporate several competition environments that reflect different viewpoints in terms of who has the authority to set product prices. We then empirically test the extent to which each competitive environment explains downward pressure on prices.

We consider four competition environments. The first two competition environments capture competition within a store, while the others account for competition across stores.

Product Competition Within a Store: This environment relates to the fact that products compete within a store. Several studies refer to store managers as being in charge of setting product prices. This implies that product prices are susceptible to product offerings within a store. This is a reasonable view since shoppers choose between alternative products offered within the store. Opportunities for customers to switch between products impose downward pressure on prices. Prices will decline as more products are introduced into the store. We establish the measure *Product Competition Within a Store* by using the number of pain killer products offered within a store.

It should be noted that a larger number of products in a store can also cause a countereffect and elevate product prices. The reason is that customer appreciate having larger product variety, as it becomes more likely that they will find their desired products in one store without having to switch stores. Consequently, consumers' willingness to pay for products may increase, which can result in price increases.

Table 3 shows that there is large variation in terms of the number of products offered within stores, which may imply different degrees of *Product Competition Within Stores*. On average, stores offer 50 pain killer products (with a standard deviation of 24).

Figure 7 shows that the distribution of the number of products offered in stores is slightly left skewed. Figure 8 shows that the average price per pill declines as the number of products offered in a store increases. At first sight, the number of products offered in a store appears to impose downward pressure on prices.

Brand Competition Within a Store: This competition environment builds on studies demonstrating that brand recognition is an important characteristic that influences consumer purchasing behavior. Furthermore, it is shown that manufacturers and retailers determine retail prices depending on store presence. It is reasonable to assume that brands compete less with products within their own product line (due to internalization of demand externalities) but compete more intensely with products from other brands. We establish the competition measure Brand Competition Within a Store using the number of brands offered within stores. This measure allows us to test whether competition among brands within stores is more intense than competition among products within stores. Table 3 shows that on average 12 brands compete within a local store (with a standard deviation of 3). Figure 9 shows that the number of brands in stores is close to normally distributed. Figure 10 shows a negative correlation between number of brands and product prices.

Store Competition Within a Market: This competition measure builds on spatial models that show that a larger number of stores introduced into the market reduces consumers' transportation costs and provides more opportunities for consumers. Therefore, more competing stores introduced into the market causes higher competition and more downward pressure on product prices. Table 3 shows that the number of stores differs drastically across markets, taking an average of 113 stores with a large standard deviation of 85 stores. Figure 11 shows that the distribution of the number of stores is right skewed. Figure 12 displays a slightly negative correlation between the number of stores in a local market and product prices.¹⁸

Store Competition Within Retailers: This competition measure accounts for the fact that a retailer can internalize competitive externalities among its own stores within a local market. Coordination of prices among a retailer's own stores diminishes price competition. Table 3 shows that a retailer introduces on average nine stores into the same local market (with a standard deviation of 6). Figure 13 indicates that the distribution of stores is right-skewed. Figure 14 shows that a higher number of stores owned by the same retailer increases price. It seems unusual that more stores by a retailer would in fact increase price (rather than attenuate price reductions). However, when evaluation the total effect of store competition within retailers, we need to account for the fact that another store per se is introduced into the market another effect (as measured by the variable Store Competition Within a Market).

We are especially interested in empirically evaluating the isolated effects of each competition environment on prices. Since product prices are affected by more than just the competition environments, we also include product characteristics (wholesale costs, dosage, packaging size) and other market characteristics (market size and consumer demographics).

3) The Empirical Model

The aim of our empirical analysis is to examine the sources of price variation observed in the data. We have shown that *price variations of identical products across markets* largely exceed *price variations within a market (across time)*. Therefore, we put

¹⁸ Note that we use the predicted prices after controlling for demographics and dosage, which limits the sample due to outliers.

special attention to how differential market characteristics---including the different types of competition---affect prices.

We follow standard theoretical models in specifying a pricing equation, which includes various product and market characteristics:

$$\ln(Price \ per \ Pill_{i,t}) = \alpha + \beta * X_i^P + \gamma * X_{i,t}^C + \delta * X_{i,t}^M + FE_t + \epsilon_{i,t} ,$$

where the dependent variable is the natural log of *Price per Pill*. The sub-indices *i*, and *t* represent a particular product *i* in a particular store located in a specific local market (specified by the three digit zip-code), at the corresponding week *t*, respectively. On the right-hand side of the equation, we include a constant, α , and a vector, X_i^P , which includes a set of product characteristics. We include *Package Size* since a larger package size saves on packaging costs and, therefore, generates scale economies, having a potential effect on price. We also include *Dosage* of a pill since higher concentrations require larger amounts of ingredients, which increases material cost and prices. Finally, we include the log of *Wholesale Price*, which captures procurement and remaining production costs. The β vector includes the associated coefficients.¹⁹

The vector $X_{i,t}^{\mathcal{C}}$ includes the competition environment introduced earlier. We account for two within store competition measures (*Product Competition Within a Store* and *Brand Competition Within a Store*) as well as two across store competition indices (*Store Competition Within a Market* and *Store Competition Within Retailers*).²⁰ The

¹⁹ Note, the magnitude of the coefficient estimate for the *Wholesale Price* will indicate the extent to which wholesale prices will be passed on to sale prices, also referred to as the pass-through. The pass-through is expected to be between zero and one, indicating no and full pass-through, respectively. For further discussion on the pass-through of costs in the context of cartel overcharges, see Verboven and Van Dijk (2009).

²⁰ Our empirical analysis relates to the store level and, thus, controls for competition among stores, see also Della Vigna and Gentzkow (2019). We also added retailer-fixed effects, but this led to decreasing explanatory power of the overall model while the magnitudes of the estimation coefficients change only minimally. Results are available upon request.

vector of coefficients (γ) summarizes the effects that each competition environment has on product prices.

The vector $X_{i,t}^{M}$ includes further market characteristics such as *Market Size*, *Age*, *Income*, and the U*nemployment Rate*. The associated price effects are summarized in the coefficient vector δ .

4) The Estimation Results

Table 4 displays the estimation results of the price equation (1). The first five columns show various specifications that differ by subsequent additions of competition indices. We estimate these specifications by OLS.

The coefficient estimates on the product characteristics appear reasonable in terms of signs and magnitudes. Larger *Package Sizes* reduce prices while higher Dosages and higher *Wholesale Prices* increase product prices.

Most coefficients on the competition environments carry negative signs, as expected. It should be mentioned, however, that the coefficients on *Product Competition Within a Store* and *Store Competition Within Retailers* carry positive signs in the full specification, as shown in Column (5). The positive coefficient on *Store Competition Within Retailers* could be explained by the fact that retailers internalize competitive externalities, as mentioned earlier. It should be noted that the total effect of a retailer introducing another store is composed of the sum of two isolated effects---*Store Competition Within Retailers* and *Store Competition Within a Market*---since an additional store introduced by a retailer also creates additional competition.

The positive coefficient estimate on *Product Competition Within a Store* seems to indicate that the love of product variety and the associated higher consumer willingness to pay outweighs the product competition effect.

Finally, the coefficients on the market determinants *Market Size, Income,* and *Unemployment Rate* carry the expected signs, while the estimate for *Age* is switching signs across the five specifications.

It is important to recognize that the estimation results need to be interpreted carefully due to potential endogeneity concerns regarding the competition measures. More specifically, missing variables and unobserved shocks having an impact on prices could also determine entry incentives. For example, large employers entering a local market may increase demand and prices and cause additional incentive to introduce products, brands, and stores.

We address the potential endogeneity issue of these competition measures using "Hausman"-type instruments, as frequently used in industrial organization and marketing studies (see Hausman (1996) and Nevo (2000)). The instrumental variable technique suggests the use of instrumental variables of nearby local markets. In our application, this relates to using the competitive measures (number of products and brands within stores, number of stores within a market, and number of other retailer stores within a market) from adjacent markets.

The rationale of adopting this instrumental variable strategy relies on correlation between retail prices across local markets due to common costs across markets. This rationale applies in our context since product, manufacturing, and ingredient costs are specific to the products but independent of local market. Marginal costs are drug specific since a drug is manufactured based on a specific molecular structure and its associated chemical ingredients. Furthermore, transportation and procurement costs support the fact that markets in close proximity are characterized by similar marginal costs.

A further underlying assumption of this instrumental variable approach is that demand shocks are uncorrelated across local markets. This is a plausible assumption in our case since shopping behavior is rather local and no demand spillovers exist across local markets. Furthermore, we observed drastic price variations across markets, which supports the notion that prices are determined by local market characteristics.

The instrumental variable estimation results are shown in Table 4, Column (6). A joint F-test of these instruments returns an F-statistic of at least 4.4e+05, which exceeds the value of 10 and provides strong support for using these instruments. The coefficient estimate on *Product Competition Within a Store* shows that having a larger number of products within stores intensifies competition and reduces prices. An additional pain killer product reduces the product price in the store. Column (7) shows the corresponding elasticity indicating that a 10 percent increase in the pain killer variety reduces the product price by 0.16 percent, which appears to be relatively small. However, if we doubled the number of products within a store, the price would be reduced by 1.6 percent. This appears reasonable given that the average normalized price-cost margin is 27 percent. In general, the downward pressure on price is probably smaller than expected. As noted earlier, however, the price competition effect seems to be attenuated by the product variety effect, which works in the opposite direction; it therefore diminishes the impact of Product Competition Within a Store. The small effect suggests that store managers have less incentive to reduce prices as the number of products in a store increases. It could possibly be interpreted that store managers would not readjust prices that much. Moreover, a brand manufacturer is hesitant to engage in severe price competition among its own products as well since this would cannibalize its own demand and take away from the brand's profits. Finally, we need to factor in that the price effect is limited to a change in only one out of four competition measures.

Turning to the second within store competition measure (*Brand Competition Within a Store*), the results show a coefficient estimate of -1.03. The corresponding elasticity shows that a 10 percent increase in brands within a store would reduce prices by 10.3 percent. Therefore, *Brand Competition Within a Store* imposes a higher downward

pressure on prices compared with *Product Competition Within a Store*, highlighting the importance of intensive inter-brand competition. The intensive *Brand Competition Within a Store* effect on prices (especially in comparison with *Product Competition Within a Store*) is remarkable and explained by the fact that brand manufacturers compete intensively against other brands. However, they avoid competing against their own products, as the *Product Competition Within a Store* measure shows. Finally, the strong brand competition indicates that prices are determined by brand manufacturers or at a higher retailer level determining prices across stores.

Turning to the competition across stores measures, the coefficient on *Store Competition Within a Market* takes on a negative value. The associated elasticity shows that a 10 percent increase in local stores would reduce product prices by 0.8 percent. While the price effect is quite pronounced, it is slightly smaller compared with the brand competition effect.

The coefficient estimate on *Store Competition within Retailers* shows that a 10 percent increase in additional stores by a retailer increases prices by 2 percent. This net effect has to be adjusted by the fact that another store is being introduced, which imposes downward pressure on prices. The net effect results in a 1.2 increase in price if a retailer increases its store representation by 10 percent. At first glance, this result appears counterintuitive, as more stores are expected to increase competition and reduce prices. However, our result provides evidence that a retailer internalizes negative competition externalities that it imposes on each of its outlets. Therefore, it accounts for the fact that an additional store would cannibalize its demand and impose competitive downward pressure on price. To alleviate this downward pressure on price, it considers a joint profitmaximization objective, which accounts for competition and internalizes cross-price effects among its own retailers and results in elevated prices. In other words, retailers coordinate prices among their outlets.

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Turning to the estimation results of the remaining market determinants (Table 4, Column (6)), we find retailers serving markets with larger and older populations and higher unemployment rates charge lower product prices. In contrast, stores located in wealthier neighborhoods charge higher prices. Among these remaining market determinants, *Income* exerts the highest price effect. A 10 percent increase in average income in the neighborhood would increase price by 1 percent. This effect is smaller than any of the four competition measures.

Overall, we find that the remaining market determinants impact prices, which supports price discriminatory strategies. Competition matters, as it has the strongest effect on prices compared to other market characteristics.

It is debatable whether the measurement on prices per se is an appropriate procedure to evaluate differential competitive forces. While proponents suggest that price is all that matters from a consumer's perspective, opponents remark that products are characterized by different markups that characterize providers' market power and this is a more appropriate measure for competition (see also Boone (2008) and Griffith et al. (2010) for a discussion on price-cost margins).

We adopt this alternative measure and replace the endogenous variable in our regression equation (1) with the normalized price-cost margins [[price per pill-wholesale price per pill]/price per pill] while using the same regressors and the same set of instruments as before.

Table 5 shows the instrumental variable estimation results. The coefficients on the competition measures and the remaining market characteristics return the same signs as in our earlier estimations. Moreover, most coefficients using the markups are smaller in magnitude. This is reasonable since the normalized price-cost margin is smaller than price.

We evaluate the elasticities of these variables to illustrate the relative impact of the different variables. As shown, *Brand Competition within a Store* exerts the largest impact of all competition variables. An increase by 1% reduces the price-cost margin by 2%. The second-largest impact is caused by *Store Competition within a Market*; an increase in *Store Competition within a Market* by 1% reduces the price-cost margin by 0.14%. An increase of *Product Competition within the Store* by 1% reduces the price-cost margin by only 0.08%. The coefficient of *Store Competition Within Retailers* has still a positive sign, showing that an increase of 1% of this measure increases the margin by 0.37%. Overall, the elasticities show that *Brand Competition within a Store* has a strong competitive impact on the prices of pain killer products.

Table 6 shows the impacts of the competition measures on the normalized margin (as shown in Column 1) and the overall impact of the competition measures evaluated at the mean of the observed sample (Column 2). *Brand Competition Within a Store* again exerts the largest competitive impact. Evaluating the impact at the sample mean of the sample shows that brand competition reduces price-cost margins by 57 percent. The second largest competitive impact is caused by *Store Competition Within a Market*, which reduces the normalized price-cost margin by 12 percent. Consistent with our earlier findings, *Product Competition Within a Store* has the smallest competitive effect; if products were doubled, the price-cost margin would change from 27 to 25 percent.

Finally, the effect of *Store Competition within Retailers* confirms our earlier results that retailers are able to coordinate prices among their stores. If retailers doubled their multi-store presence, the price-cost margin would increase from 27 percent to approximately 37 percent. The net effect, however, has to consider the introduction of a further store per se and it would result in a 1 percentage point decline in the price-cost margin.

We applied further robustness checks. First, we used alternative definitions of our competition variables. More specifically, instead of using the number of products, brands, stores, and retailers per se, we weight these numbers by the revenues within a store and retailer. The estimation results are shown in Table A.1. The estimation results confirm our previous results in terms of signs, magnitudes, and significances.

We also tested whether our results are robust regarding the definition of local markets. In following other studies, we defined the local market at the more aggregate level and use the county level instead of the zip code level. The estimation results are quantitatively and qualitatively similar to our previously reported results.

5) Conclusion

This article examines why and to what extent prices differ across stores and local markets. Building on big data, we empirically evaluate the extent to which different market determinants affect prices. We highlight the relevance of different competition environments in the marketplace having strong price-reducing effects.

We find that the highest price-reducing effects are caused by *Brand Competition Within Stores*, followed by *Product Competition Within Stores*. In contrast, *Store Competition Within Local Markets* has a rather small effect on prices. Hence, a strong take-away is that competition among products and brands within stores exerts more downward pressure on prices compared with competition across stores. We also find that retailers operating multiple stores in a local market adopt pricing strategies to internalize competitive externalities.

Our results provide important insights for competition policies targeting the evaluation of competition and investigating determinants of price, such as market entry and mergers. Our results are also insightful for business managers when determining optimal prices.

Figures

Figure 1: West Lafayette and Lafayette in Indiana



Figure 1 shows that the cities, West Lafayette and Lafayette (Indiana), are located next to each other.

CURBSIDE CURBSIDE *LENOI* **EVIENO** Extra Strength **TYLENOL** TYLENOL 100 Pick up today Pick up today Pick up today Tylenol - Extra Tylenol Extra Tylenol - Caplet **TYLENOL** Strength... Strength Pai... - Extra... Acetaminoph... \$10.97 \$10.99 \$12.99 \$13.99

Figure 2: Price Comparison for one Tylenol Product

Figure 2 shows a price comparison for Tylenol 500mg, 100 caplets.

Figure 3: Price Comparison for one Tylenol Product across Markets



Figure 3 shows a price comparison (Tylenol 500mg, 100 caplets) across Retailer C's stores in both local markets. The left (right) display shows West Lafayette (Lafayette).



Figure 4: Price Comparison for one Advil Product

Figure 4 shows a price comparison for Advil 200mg, 100 tablets.

Figure 5: Price Comparison for one Advil Product across Markets



Figure 3 shows a price comparison (Advil 200mg, 100 tablets) across Retailer C's stores in both local markets. The left (right) display shows West Lafayette (Lafayette).



Figure 6: Top Ten Products

Figure 6 shows product-specific prices per pill for the top ten pain killer products across weeks in 2018.



Figure 7: Number of Products in Stores across Markets

Figure 7 shows the number of pain killer products offered in retail stores across U.S. local markets.

Figure 8: Prices depending on Number of Products per Store



Figure 8 shows the prices of pain killer products depending on the number of products offered in a store.

Figure 9: Number of Brands in Stores across Markets



Figure 9 shows the number of pain killer brands offered in retail stores across U.S. local markets.



Figure 10: Prices depending on Number of Brands per Store

Figure 10 shows the prices of pain killer products depending on the number of brands offered in a store.



Figure 11: Number of Stores across Markets

Figure 11 shows the number of stores across U.S. local markets.





Figure 12 shows the prices of pain killer products depending on the number of stores in local markets. Fitted values use predict price conditioned on demographics and dosage.



Figure 13: Number of Stores per Retailer across Markets

Figure 13 shows the number of retail stores per retailer across U.S. local markets.

Figure 14: Prices depending on Number of Stores per Retailer



Figure 14 shows the correlation between the number of stores per retailer and product prices.

Figure 15: Price Impact of Competition Variables (Semi-Elasticity)



Figure 15 shows the impact of the competition indices on prices based on the estimation results shown in Table 4, Column 6. Mean values of specific competition variables are encircled.

Tables

Brand Names	Market	Revenues	Price per
PRIVATE	0.30	2,501.09	0.06
ADVIL	0.22	$1,\!841.55$	0.29
ALEVE	0.14	$1,\!119.15$	0.07
TYLENOL	0.12	984.79	0.12
BAYER	0.08	640.18	0.05
EXCEDRIN	0.06	510.95	0.26
MOTRIN	0.04	302.03	0.13
BC	0.01	72.46	0.15
GOODY'S	0.01	63.17	0.76
MIDOL	0.01	62.61	0.31
Mean	0.08	689.25	0.17

Table 1: Top Ten Brands (Ordered by Descending Market Shares)

Table 1 shows brand-specific summary statistics ordered by market shares in descending order. Market Shares are computed using the total number of observations of 71,202,013. Brand-specific variables encompass all brand-specific products. The unit of observation is defined at the brand-weekly level. Revenues are measured in million dollars and prices are measured in dollars.

Table 2: Top Ten Products (Ordered by Descending Market Shares)

	Market Shares	Revenues	Price per Pill
Product Names	(1)	(2)	(3)
TYLENOL Acetaminophen Extra Strength Caplets, 100 pills	0.035	293.434	0.102
TYLENOL Acetaminophen Extra Strength Caplets,	0.033	275 569	0.075
225 pills	0.000	210.000	0.010
ADVIL Ibuprofen Tablets, 200 pills	0.027	221.943	0.078
ADVIL Ibuprofen Tablets, 100 pills	0.022	184.819	0.094
BAYER Aspirin Low Dose Enteric Coated Tablets, 300 pills	0.022	184.279	0.051
ADVIL Ibuprofen Tablets, 300 pills	0.021	170.661	0.069
ADVIL Ibuprofen Liquid Gel Capsules, 160 pills	0.019	157.003	0.104
PRIVATE LABEL Ibuprofen Tablets, 500 pills	0.019	156.802	0.029
ADVIL Ibuprofen Liquid Gel Capsules, 80 pills	0.018	146.399	0.131
ADVIL Ibuprofen Liquid Gel Capsules, 200 pills	0.014	116.006	0.104
Mean	0.02	206.194	0.087

Table 2 shows product-specific summary statistics ordered by market shares in descending order. Market Shares are computed using the total number of observations of 71,202,013. The unit of observation is defined at the product -weekly level. Revenues are measured in million dollars and prices are measured in dollars.

Variables	Mean	\mathbf{StdDev}	Min	Max
Product Characteristics				
Price per Pill	0.16	0.14	0.01	0.99
Price per mg	8.29E-04	5.90E-04	8.61 E- 05	6.51E-03
Wholesale Price	0.13	0.07	0.05	0.44
Normalized Price-Cost Margin	0.27	0.19	9.63e-09	0.88
Package Size	87.34	105.25	1.00	1,000.00
Competition Indices				
Competition Within Stores				
Product Competition Within a Store	49.83	23.54	1	143.00
Brand Competition Within a Store	12.34	3.17	1	29.00
Competition Across Stores				
Store Competition Within a Market	112.65	85.47	1	524.00
Store Competition Within Retailers	9.06	5.61	1	34.93
Market Determinants				
Market Size	1,099,876	1,752,498	731	$1.01\mathrm{e}{+07}$
Age	38.29	3.92	24.9	67.5
Income	$64,\!632.55$	14,408.18	$33,\!533.79$	163,395
Unemployment Rate	3.92	1.04	1.4	18.9

Table 3: Summary Statistics across Local Markets

Table 3 shows summary statistics of the main variables used in our empirical analysis. Total number of observations: 71,202,013. Prices and income are in US-Dollars. Market size is measured using the population. Package size is measured by the number of pills.

Table 4: Regression Results

							Elasticity (Price per
Dependent Variable:			OLS			IV	(I fice per Pill)
Ln(Price per Pill)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	-0.507***	-0.461***	-0.447***	-0.233***	-0.277***	0.478***	
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	
Product Characteristics	(0.000)	(0.00-)	(*****)	(****=)	(*****)	(0.000)	
Package Size	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.003***	-0.257***
<u> </u>	(1.37E-06)	(1.35E-06)	(1.37E-06)	(1.36E-06)	(1.37E-06)	(1.83E-06)	(1.40E-04)
Dosage	3.79E-04***	3.74E-04***	3.78E-04***	3.71E-04***	3.74E-04***	3.34E-04***	0.096***
0	(4.31E-07)	(4.26E-07)	(4.24E-07)	(4.18E-07)	(4.18E-07)	(5.21E-07)	(1.50E-04)
Ln(Wholesale Price)	0.591***	0.590***	0.588***	0.593***	0.591***	0.589***	0.589***
	(1.50E-04)	(1.53E-04)	(1.53E-04)	(1.51E-04)	(1.50E-04)	(2.12E-04)	(0.00)
Competition Environments							
Competition Within Stores							
Product Competition Within a							
Store		-0.001***	-0.001***	0.001^{***}	0.001***	-3.26E-04***	-0.016***
		(3.41E-06)	(3.41E-06)	(4.37E-06)	(4.36E-06)	(1.56E-05)	(7.90E-04)
Brand Competition Within a							
Store				-0.020***	-0.021***	-0.083***	-1.033***
				(3.26E-05)	(3.26E-05)	(1.30E-04)	(1.63E-03)
Competition Across Stores				4.075			
Store Competition Within a Market			0 001***	-4.97E-	0 001***	0 003***	0 088***
market			(2.32E.06)	(2.27E.06)	-0.001 (2.86F.06)	(5.54 ± 0.6)	(1.75E.04)
Store Competition Within			(2.52E-00)	(2.27 E-00)	(2.8012-00)	(0.04 ± -00)	(1.7512-04)
Retailers					0.005***	0.021***	0.200***
					(1.46E-05)	(4.90E-05)	(4.66E-04)
Market Determinants					· · · /	, , ,	· · · · ·
Market Size	2.94E-09***	3.36E-09***	5.40E-09***	5.08E-09***	3.06E-09***	-2.83E-09***	-3.59E-03***
	(3.00E-11)	(3.00E-11)	(3.00E-11)	(3.00E-11)	(3.00E-11)	(6.00E-11)	(7.84E-05)
			-7.44E-			. ,	. ,
Age	2.47E-04***	$3.30E-04^{***}$	05***	-0.001***	0.000***	-0.001***	-0.030***
	(1.77E-05)	(1.76E-05)	(1.77E-05)	(1.77E-05)	(1.77E-05)	(2.24E-05)	(8.59E-04)
Income	3.93E-07***	$5.89E-07^{***}$	$7.79E-07^{***}$	$4.07E-07^{***}$	$6.52 \text{E-} 07^{***}$	$1.51E-06^{***}$	0.100***
	(4.44E-09)	(4.42E-09)	(4.53E-09)	(4.52E-09)	(4.58E-09)	(6.59E-09)	(4.35E-04)
Unemployment Rate	-0.003***	-0.005***	-0.004***	-0.005***	-0.005***	-0.018***	-0.070***
	(6.96E-05)	(7.00E-05)	(7.01E-05)	(6.94E-05)	(6.93E-05)	(8.77E-05)	(3.42E-04)
NOBS	20,181,369	$20,\!181,\!369$	$20,\!181,\!369$	$20,\!181,\!369$	$20,\!181,\!369$	20,172,072	20,172,072
R-squared	0.77	0.77	0.77	0.77	0.77	0.64	

Table 4 shows the regression results of equation (1). The unit of observation is a store within a market in a week. We instrumented for all competition indices. Our preferred specification is shown in column (6). All specifications include time fixed effects. The wholesale price elasticity is evaluated at the average wholesale price of the sample. Robust standard errors are shown in parenthesis (Specification 1-6). Elasticities in column (7) based on the estimates in column (6). Standard errors of column (7) are computed via the Delta-Method. ***, **, and * indicate 99%, 95%, and 90% significance levels, respectively.

Dependent Variable:		
Normalized Margin	Coeff.	Elasticity
Constant	0.366^{***}	
	(0.001)	
Product Characteristics		
Package Size	-0.002***	-0.443***
	(1.15E-06)	(0.000)
Dosage	$2.36E-04^{***}$	0.251^{***}
	(3.48E-07)	(0.000)
Ln(Wholesale Price)	-0.229***	-0.853***
	(1.47E-04)	(0.001)
Competition Indices		
Competition Within Stores		
Product Competition Within a		
Store	-4.23E-04***	-0.079***
	(9.39E-06)	(0.002)
Brand Competition Within a	(0.00-00)	(0000-)
Store	0.046***	-2.137***
50010	(7.56E.05)	(0, 004)
Competition Across Stores	(1.001-00)	(0.004)
Stone Competition Within a		
Store Competition within a	0 001***	-0.143***
Market	-0.001***	(0,000)
	(3.53 E-06)	(0.000)
Store Competition Within		0.372***
Retailers	0.010***	
	(3.00E-05)	(0.001)
<u>Market Determinants</u>		
Market Size	-8.50E-10***	-0.004***
	(4.00E-11)	(0.000)
Age	-2.18E-04***	-0.031***
	(1.39E-05)	(0.002)
Income	7.21E-07***	0.178^{***}
	(4.12E-09)	(0.001)
Unemployment Rate	-0.010***	-0.151^{***}
	(5.41E-05)	(0.001)
NOBS	$15,\!629,\!512$	

Table 5: Margin Estimates

Table 5 shows the estimation results for the normalized margin. The unit of observation level is a store within a market in a week. We instrumented for all competition indices. All specifications include time fixed effects. The wholesale price elasticity is evaluated at the average wholesale price of the sample. Robust standard errors are in parenthesis. *** indicate 99% ** 95% and * 90% significance levels.

Dependent Variable:		
Normalized Margin	Coeff.	Elasticities
	(1)	(2)
Competition Within Stores		
Product Competition Within a		
Store	-4.23E-04***	-0.021
	(9.39E-06)	
Brand Competition Within a		
Store	-0.046***	-0.571
	(7.56E-05)	
Competition Across Stores		
Store Competition Within a		
Market	-0.001***	-0.122
	(3.53E-06)	
Store Competition Within		
Retailers	0.010***	0.095
	(3.00E-05)	

Table 6: Impact on Normalized Price-Cost Margin

Table 6 shows the marginal impacts of the competition measures on the normalized margin (as shown in column 1) and the overall impact of the competition measures when evaluated at the mean of the observed sample (column 2). Computations are based on the estimation results as shown in Table 5. Robust standard errors are in parenthesis. *** indicate 99% ** 95% and * 90% significance levels.

Table A1: Robustness Check using Alternative Competition Measures

	I	1	Elasticity
Dependent Variable:	OLS	IV	(Price per Pill)
Ln(Price per Pill)	(1)	(2)	(3)
Constant	-0.609***	-0.620***	
	(0.001)	(0.001)	
Product Characteristics			
Package Size	-0.004***	-0.004***	-0.287***
	(1.32E-06)	(1.36E-06)	(1.04E-04)
Dosage	$3.10E-04^{***}$	$2.92\text{E-}04^{***}$	0.084***
	(4.09E-07)	(4.16E-07)	(1.20E-04)
Ln(Wholesale Price)	0.580***	0.577***	0.577***
	(1.52E-04)	(1.55E-04)	(1.55E-04)
Competition Environments			
Competition Within Stores			
Product Competition Within a			
Store	1.449***	1.958^{***}	0.068***
(Share of Product in Store)	(0.003)	(0.004)	(1.25E-04)
Brand Competition Within a			
Store	0.188***	0.159^{***}	0.019***
(Share of Brand in Store)	(0.002)	(0.002)	(2.39E-04)
Competition Across Stores			
Store Competition Within a			
Market	0.188***	0.694^{***}	0.018***

(Share of Store in Market) Store Competition Within	(0.002)	(0.006)	(1.45E-04)
Retailers	-0.085***	-0.227***	-0.033***
(Share of Store in Retailer)	(3.66E-04)	(0.001)	(1.10E-04)
Market Determinants			
Market Size	$3.02E-09^{***}$	$2.89E-09^{***}$	0.004***
	(3.00E-11)	(4.00E-11)	(4.49E-05)
Age	$5.16E-04^{***}$	$4.47E-04^{***}$	0.017***
	(1.71E-05)	(1.76E-05)	(0.001)
Income	8.69E-07***	$1.03E-06^{***}$	0.068***
	(4.46E-09)	(4.90E-09)	(3.24E-04)
Unemployment Rate	-0.006***	-0.007***	-0.025***
	(6.79E-05)	(7.02E-05)	(2.74E-04)
NOBS	20181369	19658524	
R-squared	0.78	0.78	

Table A1 shows the regression results of equation (1) using alternative measures of competition as described in the text. The unit of observation is a store within a market in a week. Our preferred specification is shown in column (2), where we instrumented for all competition indices. All specifications include time fixed effects. Robust standard errors are shown in parenthesis. Elasticities are shown in column (3) and calculated based on the estimates displayed in column (2). The wholesale price elasticity is evaluated at the average wholesale price of the sample. Standard errors of column (3) are computed using the Delta-Method. ***, **, and * indicate 99%, 95%, and 90% significance levels, respectively.

Independent Variables	Definitions	Sources
Unit Price	Average price paid at a store at the local three- digit zip code market level in 2018 divided by the number of pills per package, weekly basis.	NielsenIQ Data
Wholesale Price	Average wholesale price paid by retailer, annual basis.	IBM Micromedex Data
Dose	Milligram of Active Ingredient per Pill, annual basis.	IBM Micromedex Data
Population	Average population at the local market level in 2018, annual basis.	Census
Age	Average age at the local market level in 2018, annual basis.	Census
Unemployment Rate	Average unemployment rate at the local market level in 2018, annual basis.	Census
Income	Average income at the local market level in 2018, annual basis.	Tax Survey
Product Competition Within a Store	Number of Products (UPCs) offered at a particular store, weekly basis	NielsenIQ Data
Brand Competition Within a Store	Number of brands offered at a particular store, weekly basis	NielsenIQ Data
Store Competition Within a Market	Number of retail stores in local markets, weekly basis	NielsenIQ Data
Store Competition Within Retailers	Number of distinct stores of a particular retailer in a local market, on weekly basis	NielsenIQ Data
Package Size	Number of pills per package, annual basis	NielsenIQ Data

 Table A.2: Dependent and Independent Variables

Table A.2 provides definitions of independent variables.

Table A.3:	Instrumental	Variables
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Hausman-type of instruments	Definitions	Sources
Average no of products at a retailer in	Average no of products (UPCs) at a specific week, at a store of the retailer	NielsenIQ Data
surrounding local markets	in the surrounding two-digit zip-market areas without considering the	
	values within the corresponding three-digit zip code market area the	
	observed observation is located in.	
Average no of brands at a retailer in	Average no of brands at a specific week, at a store of the retailer in the	NielsenIQ Data
surrounding local markets	surrounding two-digit zip-market areas without considering the values	
	within the corresponding three-digit zip code market area the observed	
	observation is located in.	
Average no of stores in surrounding	Average no of retailer at a specific week, in the surrounding two-digit zip-	NielsenIQ Data
local markets	market areas without considering the values within the corresponding three-	
	digit zip code market area the observed observation is located in	
Average no of stores per retailer in	Average no of stores of a corresponding retailer at a specific week, in the	NielsenIQ Data
surrounding local markets	surrounding two-digit zip-market areas without considering the values	
	within the corresponding three-digit zip code market area the observed	
	observation is located in	

Table A.3 provides definitions of instrumental variables.

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