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Pass-through and competition: the impact of soft drink taxes as seen through Mexican supermarkets

Raymundo M. Campos-Vázquez[*†] and Eduardo M. Medina-Cortina[†]

*Correspondence:
rmcampos@colmex.mx
†Raymundo M. Campos-Vázquez and Eduardo M. Medina-Cortina contributed equally to this work
Department of Economics, El Colegio de México, Camino al Ajusco 20, Col. Pedregal de Santa Teresa, 10740 Mexico City, Mexico

Abstract

In January 2014, Mexico addressed its epidemic of obesity by implementing an excise tax of 1 peso (1 MXN) per liter on soft drinks. This study evaluates the pass-through of the tax, the influence on the tax of competition among different stores, and the after-tax price dispersion. Using an unbalanced panel of weekly prices for 553 stores throughout Mexico, we estimate that the tax increases the per-liter price of soda by 1.12 pesos, of juice by 0.25 pesos, of sports drinks by 1.52 pesos, and of powdered drink mixes by 0.24 pesos. Using information on store locations, we also calculate the degree of competition faced by each store and find that with greater competition in the relevant market, there is less overall pass-through, although the results for individual drink types are statistically significant only for sodas. For those stores facing the greatest competition, the pass-through effect is perfect shifting. We also find that markets with greater competition show a lesser degree of price dispersion.

Keywords: Prices, Competition, Taxes, Relevant market, Mexico

JEL Classification: D22, D40, L10, L81, O54

1 Introduction

In recent decades, the global obesity epidemic and its public health implications have been a worldwide concern. Governments have promoted policies to check its growth, including the imposition of excise taxes on high-calorie foods (OECD 2013). Medical research has provided ample empirical evidence linking obesity to the consumption of soft drinks (Andreyeva et al. 2011; Brownell et al. 2009; Cutler et al. 2003). The governments of Norway (1981), Australia (2000), Finland (2011), France (2012), and several cities in the U.S. (Berkeley in 2014 and Chicago, Oakland, and Philadelphia in 2017) have implemented taxes on soft drinks. In this paper, we analyze the impact of Mexico's 2014 national soft drink tax on final prices and the effect that establishment competition has over the tax pass-through.

The epidemic of overweight and obesity in Mexico is alarming.[1] According to the OECD (2013), Mexico has a rate of obesity second only to the United States. In 2012,

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[1] Overweight is defined as a Body Mass Index (BMI, weight in kilograms divided by height in meters squared) from 25 to 30, and obesity as BMI of 30 or more.

the proportion of individuals either obese or overweight was 69.4% for men and 73% for women, figures which have tripled since 1980 (Barquera et al. 2010). In January 2014, the federal government addressed this problem by promulgating a new tax of 1 peso (1 MXN) per liter on beverages with added sugar.[2] The tax is equivalent to 0.12 USD PPP, more per liter than the same tax in France, but lower than taxes in Denmark, Finland, and the city of Berkeley, California.

In order to reduce consumption, such a tax needs to increase the final price. However, economic theory holds that the burden of taxation depends crucially on the market structure (Fullerton and Metcalf 2002; Anderson et al. 2001). In the long run, under perfect competition, homogeneous goods, and constant marginal costs, the pass-through effect of a tax increase is a one-to-one relation. On the other hand, if firms hold some degree of market power and the goods taxed are not perfectly homogeneous, price adjustments may vary at the establishment or brand level, and they may be either undershifted or overshifted into final prices (Delipalla and Keen 1992; Weyl and Fabinger 2013).

Given such considerations, the present study evaluates the pass-through of the tax, the influence on the tax of competition among stores, and after-tax price dispersion, using a confidential dataset of product-specific prices (classified by brand and presentation).[3] The dataset is provided by the Federal Consumer Protection Agency (PROFECO). By law, this agency collects store-specific weekly prices for a large set of products throughout the country and makes the current data available to consumers through an internet portal, "¿Quién es quién en los precios?" ("Who's Who in Prices?"). Historical data, however, are not provided to the public; this type of data is confidential and was provided to us under a collaboration agreement. Most of the data collected relate to consumer goods, such as food, beverages, medicines, and electronic appliances. The panel used in this study captures information from 553 stores that sold soft drinks in 27 cities in Mexico during 2012–2014, with a total of almost one million weekly price observations.

In order to capture the effect of competition on the tax pass-through, we adopt a standard measure from the empirical literature on supermarket competition. Using fixed-radius circles of 2 and 5 km, we find the exact number of relevant competitors surrounding each establishment for which we possess price information, and we weight it by the number of employees to value its proportional competitive influence (Ellickson and Grieco 2013; Castañeda 2012; Hausman and Parker 2010; Ridley et al. 2010; Downing 1973).

Using reduced-form price equations, we find that the pass-through effect of the one-peso tax per liter is 1.12 pesos for sodas, 1.52 pesos for sports drinks, 0.25 pesos for juices, and 0.24 pesos for powdered drink mixes. A one standard deviation increase in the number of competitors decreases the overall tax overshifting by 38%, although for individual drink types, the effect is statistically significant only for sodas. We also find that price dispersion is related to the extent of local competition, moving from a market with 20 competing stores to one with 29 lowers the overall price dispersion by 10%. This

effect is exacerbated after the exogenous price shock caused by the tax: the net effect is 16%.

The rest of this article is organized as follows. Section 2 provides a short review of the relevant literature. Section 3 describes the Mexican excise tax on soft drinks. The dataset and descriptive statistics for pricing behavior are introduced in Sect. 4. Section 5 presents the empirical strategy and the models to be estimated. Section 6 discusses the results and their possible policy implications. Finally, Sect. 7 provides some concluding remarks.

2 Literature review

There is an extensive economic literature analyzing the pass-through of excise and ad valorem taxes into consumer prices. Delipalla and Keen (1992), Delipalla and O'Donnell (2001), and more recently Ten and Niels (2005) and Weyl and Fabinger (2013) have built on the idea that the pass-through effect of a tax increase differs dramatically under different market structures. They show that in the presence of imperfect competition, the incidence of ad valorem and excise taxes may differ and may be either over- or under-shifted into prices. The seminal papers by Poterba (1996) and Besley and Rosen (1999) demonstrate empirically that various shifting patterns are observed in real market configurations. The former finds evidence for the rise in city-specific clothing prices in the postwar U.S. by approximately the amount of the sales tax. The latter uses a panel of quarterly data to document a variety of shifting patterns over specific commodities in different U.S. cities.

The soft drink tax analysis of the present study is relevant to public policy and empirical work in tax incidence. The Mexican government's objective with the tax is to reduce consumption by increasing the price, but the Mexican soft drink and retail market structure may not produce this result. If markets are not perfectly competitive and taxed goods (soda, juice, sports drinks, and powdered drink mixes) are not homogeneous, under- or overshifting may distort the outcome.[4]

Although prior studies have analyzed the impact of taxes on soft drinks, our analysis goes beyond the previous literature by including the effects of store competition on the pass-through effect and the after-tax price dispersion of this type of tax. Berardi et al. (2016) employ establishment price records to evaluate the impact on prices of the soda tax introduced in France in January 2012. They highlight the different impact of the tax across retail groups, brands, and categories of soft drinks, and find that it is fully shifted into soda prices but undershifted for juices and flavored waters.[5] Bergman and Hansen (2010) use price data at the establishment level to exploit various excise tax shocks on beverage prices in Denmark. They conclude that more than 10% of the tax increases analyzed (1998 and 2001) overshifted for the 80% of stores analyzed. Cawley and Frisvold (2015) analyze soda prices after the 2014 imposition of a tax on sugar-sweetened

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[4] Previous analyses of soft drink taxes have been carried out mainly for developed countries like Denmark, France, and the United States. The degree of competition and market structures across countries may be different. A World Bank report (2015) comparing the ease of doing business in different countries ranks Mexico in thirty-ninth place, while Denmark ranks seventh, France thirty-first, and the United States fourth. Higher barriers to competition may exacerbate the pass-through effect of a tax and distort its purpose.

[5] Bonnet and Requillart (2013) analyze the same tax increase in France with a structural econometric model and find that a soft drink excise tax is likely to be overshifted by 32%.

beverages in Berkeley, California, making an interesting comparison with the neighboring city of San Francisco (which had no such tax). Their results show a 50% undershifting of the tax into final prices; the nearby availability of cheaper products is a possible explanation. Falbe et al. (2015) compare soft drink prices in Berkeley, San Francisco, and neighboring Oakland and find distinct patterns related to product presentation and type: with the Berkeley tax, smaller presentations of sodas were undershifted by 31% and juices (fruit-flavored beverages) by 53% relative to San Francisco and Oakland, and larger presentations by 54% and 51%, respectively. Finally, Grogger (2015) and Aguilar et al. (2016) analyze the precise effects of the Mexican tax on soda prices. The former, using average prices at the city level, as in Besley and Rosen (1999), find an average overshifting of 38%. The latter, using a scanner panel dataset of more than 10,000 households, find a pattern in line with that result: 25% to 50% overshifting into consumer prices. They also discuss the policy results of the tax, highlighting a 6.7% reduction in household consumption.

The previous literature, however, has not analyzed the relationship between the degree of competition and the ability of stores to shift taxes into consumer prices. Such analysis has been carried out for cement, gasoline, and tobacco products, but not for soft drinks. Alm et al. (2009) use monthly gasoline prices (1984–1999) to examine the incidence of state gasoline excise taxes. Approximating the level of competition by assuming higher levels in urban areas, they find full shifting in urban gasoline markets but undershifting in rural ones. Taylor and Silvia (2014), analyzing a 2003 gasoline and diesel tax reform in Washington state, report full shifting for those taxes but no significant retail pass-through under competitive conditions, as measured by the aggregate number of rival local gas stations. Harding et al. (2012) use Nielsen Homescan microdata for 2006–2007 to demonstrate that tobacco taxes are less than fully passed through to consumer prices and that the closer an establishment is to a lower-tax state, the lesser the pass-through.[6] Miller et al. (2015) use 30 years of data for the Portland cement industry to examine the effects of industry-wide cost changes on prices; they find that cost changes are more than fully transmitted into prices (about 50% more) and that the rate is unaffected by the degree of competition, measured as the number of competing plants and the total competitor capacity within a distance threshold.

Another important question is whether establishment competition has any effect on after-tax price dispersion. Since soft drink prices are similar in different establishments within the same region, patterns in price variation that differ as a function of competitive pressures may reveal the effects of competition in the Mexican retail market. In monopolistic competition, for example, greater competition is invariably accompanied by lesser price dispersion. However, other models incorporating imperfect consumer information or heterogeneous search costs imply an increase in price dispersion with the increasing number of sellers resulting from their tendency to discriminate in pricing.

Empirical studies are no more definitive in their conclusions. In the gasoline market, for example, Barron et al. (2003), using data from Phoenix, Tucson, San Diego, and San Francisco, find evidence that in markets with a larger number of gas stations within a

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[6] Additional studies of the pass-through of tobacco taxes, but which do not analyze the impact on competition, are Hanson and Sullivan (2009), Kenkel (2005), and Keeler (1996).

1.5-mile radius, there is a decrease in both the mean price and price dispersion (measured by the variation in prices that remains unexplained after controlling for station and brand attributes) for regular gasoline (an increase of 1.41% in the number of sellers increases price dispersion by 1%). Lewis (2008), using 2000 and 2001 prices for 327 gas stations in San Diego, California, measures competition within 1.5-mile radii and finds that a 50% increase in competition corresponds to a 7.5% decrease in price dispersion. Borenstein and Rose (1994) analyze the price dispersion in airline tickets to different passengers on the same route, and find it to be about 36% of the average ticket price on routes with greater competition or lesser flight density. This result is consistent with discrimination based on consumers' cost of switching to alternative airlines or flights. Walsh and Whelan (1999) use Nielsen data to model multiproduct retail pricing between related brands in the Irish grocery market and find that price dispersion increases with competition. Thus, as in the theoretical literature, there is divergence in descriptions of the relationship between price dispersion and competition.

3 The Mexican soft drink tax

In the past several years, excise taxes on certain high-calorie foods have increasingly been used as a policy response to obesity and obesity-related diseases. This use of food and beverage taxes was introduced in the first decade of the new millennium, precisely when the worldwide obesity epidemic inspired calls for public policy interventions (Andreyeva et al. 2011; Smith et al. 2010; Brownell et al. 2009). Accordingly, a number of governments around the world adopted some form of tax on high-calorie foods in order to discourage their consumption. The countries of Norway (1981), Australia (2000), Finland (2011), France (2012), and cities in the United States (Berkeley in 2014, Chicago, Oakland, and Philadelphia in 2017) instituted special taxes on soft drinks.

   Mexico joined this trend in late 2013, when the federal government announced the National Strategy for the Prevention and Control of Overweight, Obesity, and Diabetes. The initiative included three pillars: health promotion, public health investment, and fiscal policy. In the latter category, Mexican president Enrique Peña Nieto proposed a tax reform which included a special tax on sugary drinks, and it was approved by Congress on October 18, 2013. Two months later, the government published amendments to the special tax on production and services (IEPS),[7] which established a uniform tax of 1 peso per liter, applicable to the sale or exchange of any flavored drinks, concentrates, or powders containing any kind of added sugar.[8] The tax became effective on January 1, 2014. Compared with similar taxes in most other parts of the world, the Mexican tax, equivalent to 0.12 USD PPP per liter, is conservative: higher than the tax in France (0.08 USD PPP), but lower than those in Denmark (0.21 USD PPP), Finland (0.23 USD PPP), and Berkeley, California (0.33 USD PPP).[9]

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[7] Ley del Impuesto Especial Sobre Producción y Servicios (IEPS), published in the *Diario Oficial de la Federación*, December 11, 2013.

[8] For example, a 1-l bottle of Coke is subject to a 1 peso price increase, and a 355-ml can of soda (diet soda not included) is subject to an increase of 0.35 pesos. For powdered drink mixes, the tax is based on the amount of beverage to be prepared following the manufacturer's instructions. Bottled and sparkling water are not taxed.

[9] Reported tax for France from Berardi et al. (2016); for Berkeley, California from Cawley and Frisvold (2015); for Denmark from Bergman and Hansen (2010); and for Finland from Grogger (2015). The amounts were adjusted using the purchasing power parity (PPP) conversion factor at http://data.worldbank.org.

4 Data and descriptive statistics

4.1 PROFECO data

PROFECO (the Mexican Federal Consumer Protection Agency) is the government agency responsible for ensuring fair consumer relations among economic agents. One of its main activities consists of monitoring price-setting behavior around the country. To this end, the agency collects the prices of various goods and products through periodic visits to formally registered establishments. The price data employed here come from this bureau.

Every day, trained inspectors from PROFECO visit a subset of stores in strategically defined locations and record the individual prices of various items, as shown on the shelves.[10] If an item is not available, no price is recorded. The dataset includes weekly prices of individual goods in specific locations, based on these observations. For example, we can observe that the price of a 355-ml can of Coca-Cola was 8.10 pesos in week 2 of year 2014 in a specific Walmart in Mexico City.[11]

The dataset includes the prices of various products, including processed and unprocessed foods, beverages, hygiene products, medicines, and household appliances. The panel collected includes information from 553 stores that sold soft drinks in 90 municipalities within 28 cities in the period 2012–2014, focusing on soda, juices, sports drinks, and powdered drink mixes, as well as information on other common purchases such as water, corn tortillas, and chicken breasts from the same stores in order to contrast those prices with those of the soft drinks.

This dataset is thus unique in nature; it provides more information than the dataset used by the National Institute of Statistics and Geography (INEGI), based on the average monthly prices of unique products (brand and presentation) in 46 cities in Mexico, to calculate the Consumer Price Index (CPI). The beverage data in the CPI incorporates approximately eighty brands with, in general, four product presentations for each (355-ml, 1 l, 2 l, etc.). A total of 355 unique products are classified into three categories—juices and nectars, bottled water, and sodas—ignoring other categories of taxable soft drinks, such as sports drinks and powdered mixes. Brands and presentations are not included for every city or every month: in 2013–2014, each city includes an average of 42 unique product observations by month. Of these, 22 monthly observations are for sodas, 10 for bottled water, and 10 for juices. As the INEGI dataset does not report establishment-specific information, it is not possible to know whether a price increase is due to a large change in price by a small number of establishments or a small change in price by many establishments.

Our sample, however, includes unique product observations at the establishment level on a weekly basis. It incorporates information on 54 brands and an average of three presentations per brand of soda, one for juices, one for sports drinks, and two for powdered mixes, giving a total of 82 unique products identified within establishments; we are thus

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[10] When there is doubt about the price of an item, the inspector records the price scanned at the checkout. Every price is compared with others at both the local and federal levels to avoid major discrepancies.

[11] All information collected is compiled into the dataset "Quién es quién en los precios?" ("Who's Who in Prices?"), which is available for product-specific searches at http://www.profeco.gob.mx/precios/canasta. However, the website does not provide historical price data. The collaboration agreement between El Colegio de México and PROFECO allows us access to the historical data.

able to follow the weekly price of a specific product in the same establishment from 2012 to 2014. It is, however, an unbalanced panel, as not all establishments sell the same products across locations, and some of them include more products on their shelves than others. There is also the possibility that the weekly price of a specific product is not recorded due to unavailability. Finally, PROFECO added establishments to the dataset throughout the study period.[12] Importantly, this dataset allows geographic localization of each establishment and its competition. We can thus go beyond previous studies of the effect of taxes on soft drinks in Mexico and elsewhere by analyzing the pass-through by product presentation with an estimation of the effect of local competition (Berardi et al. 2016; Bonnet and Requillart 2013; Bergman and Hansen 2010; Grogger 2015).

The total number of price observations in the sample is 965,843, evenly distributed from 2012 to 2014 (26%, 31%, and 42% in each respective year), almost half of which are for soda, followed by juices, powdered mixes, and sports drinks (55%, 25%, 11%, and 9%, respectively). The average price of a liter of soda is 9.02 pesos, of juices is 12.75 pesos, of sports drinks is 19.71 pesos, and of powdered drink mixes is 2.46 pesos. Most (97%) of the observations come from supermarkets, and the rest from smaller grocery or convenience stores. The supermarket Soriana accounts for 18% of all beverage observations, followed by Comercial Mexicana and Walmart, both of which account for slightly more than 16%. The Walmart group also owns Bodega Aurrera (targeted generally to low-income households) and Superama (targeted generally to high-income households). The Walmart group thus accounts for 39% of the establishments in the sample.[13]

4.2 Competition among establishments

The degree of competition faced by each establishment in the sample is calculated as follows. First, using information on specific locations (full street address), which we corroborate using Google Maps, a pair of coordinates is obtained for every establishment in the PROFECO sample. Second, we use INEGI's National Statistical Directory of Economic Units (DENUE) for 2013 and 2014 to define the relevant store universe for each establishment. The DENUE for 2013 and 2014 includes information on location, economic activity, number of employees, and asset size for all economic units registered in the country. In order to include only the relevant competition, we use codes of up to six digits from the North American Industry Classification System (SCIAN) to select economic units defined as supermarkets, convenience stores, or grocery stores.[14] Third, we calculate the competition faced by each PROFECO establishment within a fixed radius of two and 5 km. This criterion is widely accepted in the analysis of supermarket competition

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[12] Another major difference between these two datasets is in their product sampling. In the soda category, 62% of the observations in the CPI dataset are for products of less than one liter and only 12% are for those from two to three liters. In contrast, 17% of these observations in the PROFECO dataset are for products smaller than one liter and 42% are for those from two to three liters. In the juice category, the opposite is true: the CPI dataset includes several presentations, from 200 ml to 3.9 l, while the PROFECO dataset includes only two presentations: 946 ml and one liter. If there are substantial differences in pass-through patterns across presentations, the results will differ, depending on the dataset used. We do not reweight our data to compare them with product presentations included in the CPI.

[13] Although PROFECO does not randomly sample the establishments in the dataset, the supermarket composition is close to the actual distribution of Mexican retailers. Cruz and Rindermann (2006), Castillo et al. (2014), and Reardon and Berdegue (2002) report a highly concentrated market with four to six big chains competing among other smaller establishments. In 2011, Walmart held 47.8% of the Mexican retail market, Soriana 18.8%, Chedraui 8.5%, and Comercial Mexicana 7.8% (as compared with sample shares of 39%, 18%, 7%, and 16%, respectively).

[14] The six-digit SCIAN tags used are 431110, 431211, 461110, 461213, 462111, and 462112.

because it considers both geographic distance and transport mode costs (Ellickson and Grieco 2013; Castañeda 2012; Hausman and Parker 2010; Ridley et al. 2010).[15] Finally, we use the number of employees for each store type to proportionally weight the competitive influence of each establishment. According to the DENUE, grocery stores have 1–5 employees, convenience stores have 6–10, mini-markets have 11–30, supermarkets have 31–250, and warehouse clubs have 251–300.[16] Using the middle number of each range as a weighting factor, a grocery store is equivalent to 0.02 supermarkets, a convenience store to 0.06, a mini-market to 0.15, and a warehouse club to 1.9. The measure of competition faced by each PROFECO establishment is then described by the standardized addition of stores within a fixed-radius circle in terms of supermarket equivalents.[17]

Within the 2 km radius, the average number of rival establishments a store faces is 20, with a standard deviation of 9; another 29% face 20–29 rival stores within their relevant market, and 45% face 10–20. Within the 5 km radius, all of the stores face at least one rival establishment in their market, 28% face 106–155, and 42% face 50–150. The number of establishments in the relevant markets within the 2 km or 5 km radius is potentially high, because PROFECO's methodology gives priority in major cities to specific strategic locations, presumably with a large number of stores. However, the data also include large variation, as seen in the breadth of the ranges. Overall, our data include 553 establishments throughout the country, of which 506 are classified as supermarkets, allowing us to observe weekly soft drink prices for 10.58% of the registered supermarkets in the country and 17% of the other types of establishments located in the same municipalities.[18]

4.3 Descriptive information

Mexico's 1 peso per liter soft drink tax took effect in January 2014. Table 1 shows the mean pre-tax and after-tax per-liter prices of the most popular soft drink products in the sample, along with comparison products. For virtually all types of soda, the mean rates of tax pass-through are substantially over 1 peso, suggesting that the taxes are more than fully passed through to prices. The individual per-liter prices of smaller presentations in this category are much higher than those of larger presentations. This finding provides an insight into the effect of tax shifting on prices: smaller presentations quite possibly show a different effect within the soda category. There is also large variation across brands. The per-liter price of the 2.5-l bottle of Coca-Cola rose by 1.24 pesos, while that

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[15] The economic intuition behind this definition is as follows. For most people the closest supermarket is the first and most used option. If that option has unsatisfactory supply or prices the next closest establishment is the second option. The question then becomes how many extra kilometers or minutes one is willing to spend in passing the closest supermarket to go to the next closest one. The literature considers a radius of 5 km to be sufficient for an analysis (Ellickson and Grieco 2013; Castañeda 2012; Competition Commission 2000).

[16] Grocery stores are small retail stores that sell primarily food. In Mexico, they are mostly family-run businesses employing from one to five people. Convenience stores stock a range of everyday items, such as groceries, snack foods, soft drinks, tobacco products, and alcoholic beverages, and have long hours: some are open 24 h. Mini-markets often sell the same range of products as convenience stores; however, they may include a pharmacy or a specialized section with products like basic household appliances. A supermarket is a self-service store offering a wide variety of food and household products, organized into aisles. A warehouse club usually sells a wide variety of merchandise offered only in large, wholesale quantities, and requires customers to purchase a membership.

[17] A time-dependent measurement of competition would be preferable to the static measurement used in this study, but the set of relevant establishments that opened from 2013 to 2014 within the 2- and 5-km boundary do not substantially change the measure of competition. DENUE reports a total of 5223 supermarkets in the country in 2013 and 2014.

[18] There is no establishment in the sample with fewer than four other stores (large supermarkets or small grocery stores) within a 5 km radius, because of PROFECO's strategic inclusion of stores that are, for the most part, in urban areas.

of 2.5-l Pepsi rose by 1.92 pesos and the Fanta (orange soda) by 1.13 pesos. Diet sodas, which are not subject to the tax, show a large variation across brands. The price of the 2-l Pepsi Light did not increase, but the price of the same size Coca-Cola Light rose by 0.44 pesos. Table 1 also shows different shifting patterns in the per-liter prices for other soft drink categories. On the one hand, juice and sport drink prices fully transferred the tax in early 2014, but the transfer decreased in the following month. On the other hand, the prices of powdered drink mix, which should be especially affected by the tax, did not increase at all, meaning that the burden of the tax was fully carried by producers or retailers. The prices of products not targeted by the soft drink tax, such as water, chicken breast, and corn tortillas appear to be unaffected by the tax.

Given that soft drink prices from PROFECO are also available for the previous year, 2011, for descriptive purposes, we include prices from this year in the sample and analyze price trends by computing the average monthly change for every specific product (establishment, brand, and presentation) from year to year. For example, we take the difference between the monthly average price of a 600-ml can of Coca-Cola in a specific Walmart store in January 2013 and in January 2014. We then collapse these price changes by product category. The results are shown in Fig. 1. These changes in price within establishments allow for the visualization of mechanical price increases before the introduction of the tax.

Figure 1 includes six panels, each devoted to a specific product category. Panel A shows the results for soda, panel B for juices, panel C for sports drinks, and panel D for powdered drink mixes. Panels E and F include drinks that are not affected by the soft drink tax in order to analyze similar trends for a more broadly defined category of products: panel E for bottled and sparkling water, and panel F for diet sodas with no sugar added. In each panel, we show the average monthly price change from year to year (e.g., 2012m1 refers to the change between the average prices in January months of 2012 and 2011). The black line is the observed change, and the blue line is the difference between the change in price from 2013 to 2014 and that from 2012 to 2013.
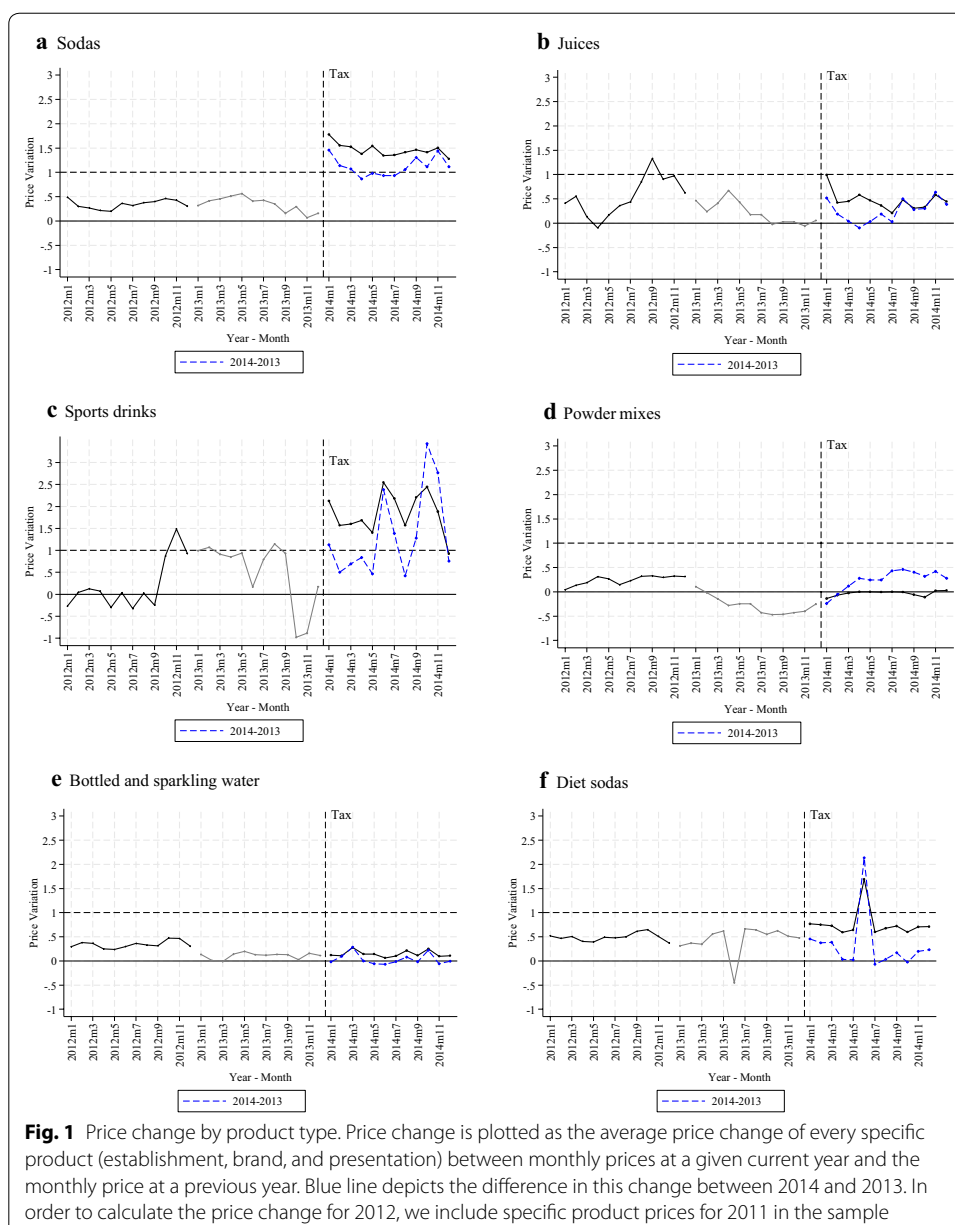
Analysis of Fig. 1 suggests a systematic price change for every category considered in the soft drink sample. For example, prices for sodas (panel A) change every year. Prices for January 2012 are 0.5 pesos higher than prices for January 2011 (black line). Similarly, prices for January 2013 are 0.4 pesos higher than those for January of 2012. Neglecting this systematic price increase may result in overestimating the pass-through effect of the soft drink tax. The blue line in each panel illustrates the level of prices in 2014, discounting the systematic price change in the soda category. This is a plausible counterfactual scenario: the potential price increase that discounts the previous year's increase. In sum, from 2011 to 2013, there is an average yearly price increase for sodas (A) of approximately 0.36 pesos, for juices (B) of 0.21 pesos, for sports drinks (C) of 0.50 pesos; for powdered drink mixes (D), there is a systematic price decrease of 0.23 pesos. This systematic price change is also observed for the untaxed categories of bottled and sparkling water (E), with an increase of 0.25 pesos, and for diet sodas with no added sugars (F), with an increase of 0.50 pesos.

Figure 1 also reveals that, unlike in previous studies, none of the product categories showed anticipation effects or price rigidity related to the tax (Berardi et al. 2016; Besley and Rosen 1999). That is, drink prices were unaffected before the tax took effect and

Table 1 Mean per-liter price by product and brand (pre-tax and after-tax)

Product	Tax	November 2013	December 2013	January 2014	Feburary 2014	Average pass-through
Water						
Bonafont (1500 ml)	No	5.13	5.23	5.69	5.58	0.45 [0.028]
Ciel (1500 ml)	No	5.37	5.47	5.45	5.45	0.03 [0.029]
E. Pura (1500 ml)	No	5.36	5.47	5.35	5.22	− 0.13 [0.020]
Evian (1500 ml)	No	18.65	17.46	17.41	17.29	− 0.74 [0.020]
Soda						
Big cola (3300 ml)	Yes	4.43	4.52	5.91	6.28	1.64 [0.045]
Coca-cola (Coke) (2500 ml)	Yes	8.45	8.51	9.79	9.65	1.24 [0.020]
Pepsi-cola (2500 ml)	Yes	6.94	6.82	8.85	8.77	1.92 [0.069]
Coca-cola light (2000 ml)	No	9.87	9.95	10.32	10.38	0.44 [0.021]
Pepsi-cola light (2000 ml)	No	7.96	7.76	7.39	8.15	− 0.09 [0.099]
7-Up (2000 ml)	Yes	7.13	7.20	8.26	8.41	1.16 [0.036]
Fanta (2000 ml)	Yes	6.67	6.96	7.95	7.92	1.13 [0.029]
Coca-cola (355 ml)	Yes	21.20	21.16	22.74	22.80	1.59 [0.349]
Juice						
Ades (1000 ml)	Yes	17.02	17.80	18.06	17.34	0.32 [0.062]
Del Valle (1000 ml)	Yes	13.63	14.31	16.02	15.17	1.70 [0.069]
Florida 7 (1000 ml)	Yes	11.54	11.17	13.53	12.26	1.55 [0.054]
Jumex (1000 ml)	Yes	14.51	15.31	16.00	15.78	1.00 [0.047]
Sports drinks						
Enerplex (600 ml)	Yes	14.21	14.13	14.72	15.01	0.70 [0.058]
Gatorade (600 ml)	Yes	20.50	23.03	25.44	24.90	3.42 [0.110]
Jumex sport (600 ml)	Yes	15.18	15.85	16.10	16.06	0.56 [0.077]
Powder mix						
Frisco (1000 ml)	Yes	2.15	2.19	2.19	2.15	0.00 [0.007]
Frutimax (1000 ml)	Yes	2.49	2.52	2.69	2.36	0.04 [0.026]
Tang (1000 ml)	Yes	3.04	3.11	3.11	3.11	0.03 [0.011]
Other products						
Chicken breast (1 kg)	No	67.66	68.47	68.23	68.10	− 0.10 [0.003]
Corn tortilla (1 kg)	No	9.87	9.85	9.81	9.89	− 0.02 [0.045]

Compiled by the authors using data from PROFECO. We report only products with more than 1000 observations per month. Prices in Mexican pesos (MXN). The average pass-through is computed as the average prices in January and February of 2014 minus the average prices in November and December of 2013, considering the number of price observations as a weighting factor. Numbers in brackets are standard errors; calculations were made over the unbalanced sample of 607 establishments

Fig. 1 Price change by product type. Price change is plotted as the average price change of every specific product (establishment, brand, and presentation) between monthly prices at a given current year and the monthly price at a previous year. Blue line depicts the difference in this change between 2014 and 2013. In order to calculate the price change for 2012, we include specific product prices for 2011 in the sample

reacted immediately after it was imposed (January 2014). Figure 1 thus helps eliminate the possibility of over- or underestimation of the pass-through effect due to another price component.

5 Empirical strategy

5.1 Pass-through effect

Prices vary in different supermarkets because of differences in operating costs, geographical markets, purchasing power, supply substitution, population, and other sociodemographic variables in the relevant market. We aim to control for such differences using fixed effects in the estimation, a common approach in studies of tax incidence to

the problem of unobservable and constant heterogeneity that may be correlated with the tax pass-through (Berardi et al. 2016; Harding et al. 2012; Besley and Rosen 1999).

A further concern is how to differentiate the effect of a tax increase on prices from the actual price trend. The challenge is to build a credible counterfactual that separates the mechanical price increase without the tax from the impact of the tax. Previous studies have implemented various approaches, controlling for seasonality using real prices, using control prices of products unaffected by the tax, or assuming constant seasonal effects. For example, in their analysis of the soft drink tax in Berkeley, California, Cawley and Frisvold (2015) use prices from a similar nearby city and prices of close substitute products that were not taxed (diet soft drinks), which allows them to control for any price shocks around the tax. In his analysis of Mexico, Grogger (2015) employs monthly real prices deflated according to the Consumer Price Index. He points out that while the real price of soda rose by 1.32 pesos from 2013 to 2014, other products, such as milk, chicken, rice, and bread, did not experience price increases. Besley and Rosen (1999) and Poterba (1996) examine different tax increases and include sets of quarterly fixed effects in their estimations to allow for the possibility of seasonal pricing behavior. Harding et al. (2012) include a thorough set of date-of-purchase fixed effects with the same purpose. Delipalla and O'Donnell (2001) deflate all monetary denominated variables (prices and taxes) using consumer price indexes.

Our approach controls for mechanical price increases by using variation within establishments. We use the monthly change in price of a specific product (product, presentation, brand, and establishment) instead of prices in levels as the dependent variable, and assume constant characteristics at the brand, product, and establishment levels. Specifically, we estimate the following regression:

$$\Delta P_{ijt} = \varphi_{\text{FE}} + \alpha_1 * \text{IEPS}_{2014} + u_{ijt} \tag{1}$$

with

$$\varphi_{\text{FE}} = \theta_{\text{E}} + \gamma_{\text{int}} + \rho_{2012},$$

where ΔP_{ijt} is the change in the price of good i in establishment j from time $t-1$ to time t. Time t is defined at the month–year level (e.g., within establishment j, we compare the change in price for good i from January 2013 to January 2014). The variable IEPS_{2014} is a dummy indicating the tax effect (e.g., a 1-l Coca-Cola has $\text{IEPS}_{2012-2013} = 0$ for 2012–2013 and $\text{IEPS}_{2014} = 1$ in 2014, since the tax was implemented in January 2014). The variable θ_{E} represents establishment-specific fixed effects that capture differences between spatial and temporal costs affecting establishments in the same way during the period of analysis. We also include specific product fixed effects for presentation by brand by establishment (e.g., a 355-ml can of Coca-Cola sold in a specific Walmart store in Mexico City), denoted by γ_{int}, which captures constant heterogeneity by brand and product-type that affects price-setting in a specific establishment (e.g., elasticity of supply and demand, quality, popularity, seasonality, market niche, and costs). Given that we are using data since 2012, we also include a dummy variable for that year (ρ_{2012}), so that the estimate is a comparison between the years 2013 and 2014.

From the perspective of tax incidence, the parameter α_1 relates to the pass-through of the tax into prices. If $\alpha_1 = 1$, the tax-inclusive prices perfectly reflect the application of the tax, a perfectly competitive prediction. However, a value of $\alpha_1 \neq 1$ helps to disprove

the null hypothesis of a perfectly competitive retailer market, as well as to evaluate the success of the tax as public policy ($\alpha_1 < 1$ means undershifting and $\alpha_1 > 1$ overshifting). We estimate the model by product type: sodas, juices, sports drinks, and powdered drink mixes.

5.2 Competitive barriers effect

Establishments adjust their mark-up according to consumer substitution patterns and their degree of power in their relevant market (Hausman and Parker 2010; Konrad et al. 2014; Fullerton and Metcalf 2002). The literature on supermarkets shows that greater competition promotes lower prices in homogeneous products, so we should expect that the soft drink tax will have a larger pass-through in establishments that face lower competition (Castañeda 2012; Basker and Noel 2009).

Although the relevance of market power is now widely accepted in the study of tax incidence, the issue has not been directly addressed. Cleary and Lopez (2014), analyzing the milk market in Dallas, Texas, and Castañeda (2012), in a study of Mexico, have shown that supermarkets have different pricing policies that vary according to the number and identity of rivals within the relevant market. Harding et al. (2012), Chiou and Muehlegger (2008), Alm et al. (2009), and Taylor and Silvia (2014) approximate the competitive conditions faced by stores using aggregate measures. For example, they calculate the impact on prices of lower-tax goods available across state lines or the potential arrival of new competition. One contribution of the present study is to connect the literature on relevant markets with that on the impact of excise taxes on final prices.

In order to assess the specific relevance of competitive barriers on the pass-through effect, we estimate the following model:

$$\Delta P_{ijt} = \varphi_{\text{FE}} + \alpha_1 * \text{IEPS}_{2014} + \delta_1 * \text{Comp}_i + \delta_2 * \left(\text{IEPS}_{2014} * \text{Comp}_i\right) + u_{ijt}, \qquad (2)$$

where ΔP_{ijt} and φ_{FE} are described in Eq. (1). The variable Comp_i measures the degree of competition faced by establishment i; its construction is explained in Sect. 4.2. Of particular importance is the coefficient δ_2 from the interaction term tax-competition. This term allows us to test the hypothesis that the relationship between competition in the relevant market and the pass-through effect depends on the competitive barriers faced by each establishment. In the interaction term $\left(\text{IEPS}_{2014} * \text{Comp}_i\right)$, in regression 2, the coefficient α_1 represents the expected change in the price of good i in establishment j at the time t associated with one unit change in tax with the degree of competition at its mean $\left(\text{Comp}_i = 0\right)$. Similarly, δ_2 expresses the effect of competition faced by each establishment (expressed as the number of standard deviations) on the price effect of the tax. If the interaction coefficient is negative, the effect of IEPS_{2014} on prices decreases as competition increases; if it is positive, the opposite is true. If the interaction coefficient is zero, the effect of the tax on prices is independent of the degree of competition.

5.3 Competition effect on the after-tax price dispersion

The relationship between competition and price dispersion is not direct. On the one hand, in a setting with monopolistic competition, greater competition is invariably accompanied by lesser price dispersion. On the other hand, search-theoretical models of consumption that incorporate consumers' imperfect information imply greater price

dispersion, with an increase in the number of sellers resulting from their tendency to discriminate in pricing.

These two models and their predictions about the relationship between competition and price dispersion can be summarized as follows. The standard monopolistic competition model assumes all sellers have the same marginal and visiting cost. Two types of asymmetry are assumed to generate price dispersion in the equilibrium. The first is heterogeneity in the distribution of visiting costs across sellers, which, if prices are the same, can result in differences in the sellers' price elasticities of demand. With heterogeneous demand, some sellers will make more profit than others. Perloff and Salop (1985) show that in such a case, an increase in the number of sellers tends to increase the price elasticity of demand, decrease the markup, and thus lower the equilibrium price. Given a common marginal cost, this reduction in markups for sellers suggests that the variance in markups would decrease with an increase in the number of sellers, and that there would thus be reduced price dispersion. A second type of asymmetry assumes heterogeneity of sellers' marginal costs but homogeneous visiting costs. Given this assumption, if all sellers charged the same price, then price elasticities and markups would be identical across establishments. However, the cost asymmetry implies that the optimal price-setting condition would not hold for all sellers. In equilibrium, there will be differences in prices across sellers. A reduction in price dispersion occurs as the number of sellers increases, since the increase in price elasticity forces the prices of all sellers toward their respective marginal costs (Rosenthal 1980; Samuelson and Zhang 1992).

Search-theoretical models of consumption are based on the assumption of imperfect price information among consumers. Again, there are two main sources of asymmetry for generating price dispersion in these models: heterogeneous search costs and imperfect consumer information. With respect to the former, Carlson and McAfee (1983) demonstrate that the range of search costs determines the price elasticity of demand faced by individual sellers and thus leads to lower markups and a reduction in the average price. Regarding the latter, Varian (1980) presents a seemingly odd result after dividing consumers into two groups: the "informed," with sufficiently low search costs that they search all establishments, learn their prices, and purchase from those with the lowest prices; and the "uninformed," who find it too costly to visit more than one seller. An increase in the number of sellers reduces the likelihood that a given price captures the informed consumers. Given sellers' tendency to discriminate in pricing, the relative reduction in the success of this strategy leads to an overall increase in price dispersion.

In order to provide empirical evidence to describe the relationship between price dispersion and competition, we model price dispersion using a fixed effects approach similar to that used in Barron et al. (2003) and Lewis (2008). A two-step procedure is employed to extract variation in prices caused by constant differences in operating costs by store or location, by endemic differences between geographic markets, by differences in purchasing power, supply substitution, population size, and other sociodemographic variables in the relevant market. We then further model this dispersion as a function of the standardized measure of competition described in Sect. 3. Unlike previous models, ours exploits the exogenous price shock caused by the tax on price dispersion. It does so by restricting the estimation sample to include only observations for the 4 months prior

to and the 4 months after the tax took effect, to compare price dispersion before and after the tax.

We first estimate a price equation controlling for any constant price differences between establishments that result from variation in operational costs or consumer taste, and for the price dispersion resulting from the extensive range of products sold by different establishments.[19] Each residual u_{ijt} indicates whether the price of product j in establishment i was above or below its expected level during time t. The estimated variance of u_{ijt} may thus be interpreted as a measure of price dispersion. After recovering the error term from step one (u_{ijt}), its variance is calculated by taking the square of the term and assuming that the condition $E\left(u_{ijt}\right) = 0$ holds. We take logs to simplify interpretation of the results. The second stage consists of estimating the following regression:

$$\log\left(\hat{u}_{ijt}^2\right) = \alpha + \varphi_{\text{FE}} + \delta * \text{year2014} + \beta * \text{Comp}_j + \mu * \left(\text{year2014} * \text{Comp}_j\right) + \zeta_{ijt},$$

(3)

where φ_{FE} stands for brand-presentation fixed effects intended to eliminate any constant variation caused by individual products in the sample. The variable year2014 is a dummy indicating year of observation, and Comp_i represents the standardized measure of competition faced by establishment i. The effect of the exogenous price shock on price dispersion is captured by μ from the interaction term and is different for different values of the variable Comp_i. The net effect of the exogenous price shock is thus $\delta + \mu * \text{Comp}_i$. Complementarily, the effect of competition on price dispersion is β during 2013, but $\beta + \mu$ for 2014.

6 Results and discussion

6.1 Pass-through results

Table 2 shows the pass-through effect of the tax using regression model 1. Regressions are computed using a set of unique product (establishment, brand, and presentation) and monthly fixed effects. We exploit the variation within establishment-product over time. Our results show a more conservative picture than previous estimations. For soda and sports drinks, mean overshifting variations are 12% and 52% of the tax, respectively. Juice and powdered drink mixes show undershifting variations of 75% and 76%, respectively.[20]

Result 1   The tax shifting patterns are heterogeneous among product types. The shifting parameter ranges from an overshifting of 0.12 and 0.52 pesos for sodas

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[19] Specifically, we estimate the following model: $P_{ijt} = \varphi_{\text{FE}} + \alpha_1 * \text{IEPS}_{2014} + u_{ijt}$, where the dependent variables P_{ijt} are the individual per-liter prices of product i in establishment j at time t, IEPS_{2014} is a dummy variable indicating the tax effect, and φ_{FE} is the set of fixed effects described in Eq. 1.

[20] In results not shown, we explore different specifications of regression model 1 as robustness checks. We first estimate the model using product and monthly fixed effects and including average monthly per-unit prices of popular consumer products as controls: water, corn tortillas, and chicken breasts homologated to per-unit prices, 1 kg in the case of tortillas and chicken breasts and 1 liter for water. These prices are individually matched to the same establishments that are the sources of drink price observations. If in a given month there is no information from a specific establishment or if it does not sell that product, a missing value is assigned. Second, instead of including current control prices, we include control prices but lagged by one period, so as to include a general price trend in the estimation. Finally, we estimate the same regression as model 1 without control prices, but excluding prices from December 2013 and January 2014 from the sample. Results in all specifications are surprisingly similar. As Fig. 1 shows, the tax was not anticipated into prices for any product type; the increase of prices is completely related to the external cost shock caused by the tax and does not include any other economy-wide disturbance. Moreover, these results are indicators that our dependent variable specification correctly eliminates unrelated price variations that may bias the tax pass-through estimation.

Table 2 Pass-through effect by product type

	(1) Soda	(2) Juices	(3) Sports drinks	(4) Powder mix
Shifting parameter	1.12*** [0.018]	0.25*** [0.031]	1.52*** [0.106]	0.24*** [0.014]
No. of observations	66,986	35,395	11,209	10,368
R-squared	0.249	0.011	0.113	0.147

$\Delta P_{ijt} = \text{FE} + \alpha_1 * \text{IEPS}_{2014} + u_{ijt}$

Shifting parameter refers to the shifting magnitude in Mexican pesos. Standard errors are clustered by establishment and presented in brackets. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Estimation is computed regressing each product type per-liter price change (month–year) against the tax increase (1 MXN). Regressions include a set of interaction (Establishment-specific X Brand X Product Content) and monthly fixed effects (FE)

and sports drinks to an undershifting of 0.75 and 0.76 pesos for juices and powdered mixes, respectively

The price data available not only suggest that the prices of different soft drinks follow different dynamics, but also that their market structures are different. The main argument to explain the different shifting patterns then becomes precisely the differences in these structures, particularly the competitive barriers and the elasticity of demand. If the elasticity of demand plays an important role in determining the tax shifting, then we should expect to see differences in consumption levels after the tax increase; these differences would be the counterpart to the coefficient of variation. Unfortunately, the scarcity of detailed information about soft drink consumption by category does not allow for a formal test of this hypothesis.
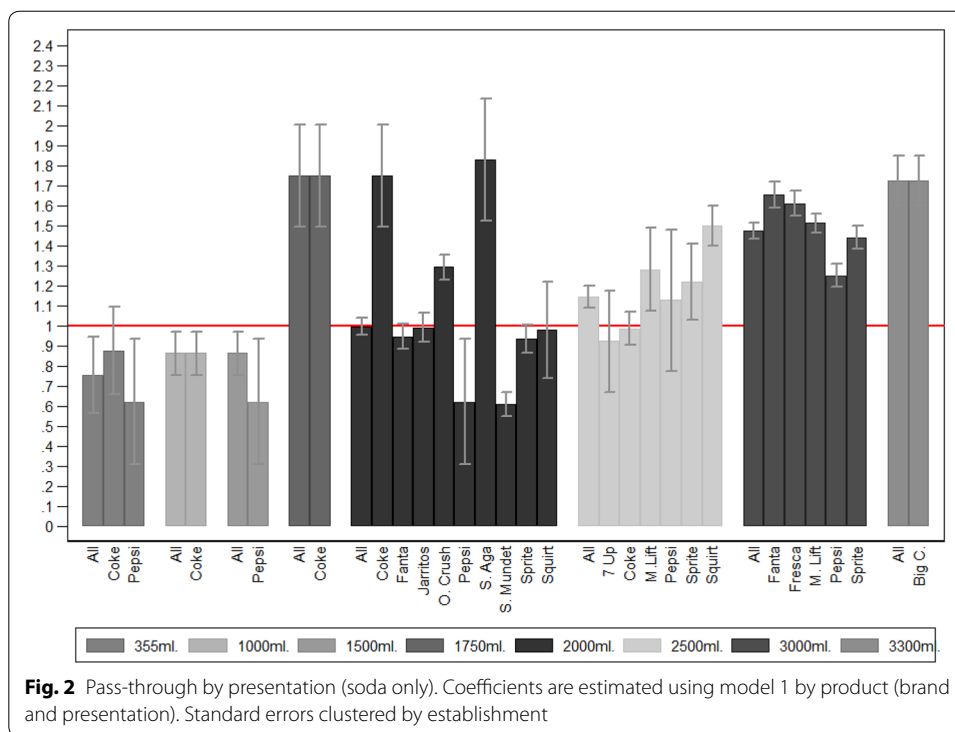
However, given the richness of the data, we are able to test whether the price shifting varies with product content. We test this hypothesis by allowing the coefficient α_1 to vary according to product presentation. The results are shown in Fig. 2.

Figure 2 illustrates the tax pass-through estimation for the soda category by brand and presentation; it is consistent with the elasticity approach considered so far. The less elastic presentations are the family size and the commonly consumed 355-ml can of soda. This outcome is not surprising; as Table 1 shows, the per-liter soda price for all brands is much higher for smaller presentations than their larger counterparts. In addition, brands like Coca-Cola, presumably with less elastic demand and greater power in the Mexican market, overshifted a much larger portion of the tax than less powerful brands like Jarritos or Mundet.

Result 2   Shifting patterns depend heavily on the market structure in which each product is located, particularly on the elasticity of demand faced by retailers. Evidence suggests that the lower the elasticity of demand in each market, the higher the level of shifting.

6.2 Competitive barriers

In order to assemble a thorough analysis of tax incidence, it is essential to examine the influence of market structure on price-setting behavior and the extent to which this institutional structure influences the results. As already noted, a number of studies have approached this problem in different ways (Alm et al. 2009; Harding et al. 2012; Taylor and Silvia 2014). However, as far we can determine, none of these

Fig. 2 Pass-through by presentation (soda only). Coefficients are estimated using model 1 by product (brand and presentation). Standard errors clustered by establishment

studies have constructed a specific measure of the degree of competition to estimate its impact on the pass-through effect of a tax. A recent working paper by Miller et al. (2015) does incorporate such a measure of competition by counting the number of competing plants and total competitor capacity within a distance threshold. Their findings suggest that the pass-through rate is unaffected by the degree of competition. We take a further step by integrating the literature on tax incidence with that on supermarket competition in a different market in order to generate additional evidence. As detailed in Sect. 3, we adopt two definitions of the relevant market to study the level of competition faced by each establishment. Using fixed radii of 2 and 5 km, the degree of competition is defined as the number of surrounding stores for each of the 553 establishments for which we possess price information. Then, the influence of competition on the pass-through effect is estimated using model 3, which includes the standardized measure of competition, in interaction with the implementation of the tax in 2014.

The results are shown in Table 3 for the full sample and by product type. Recall from Sect. 3 that the coefficient α_1 represents the average expected change in the price of good i in establishment j at the time t associated with one unit change in tax, with zero competition $(\mathrm{Comp}_i = 0)$. Since the variable Comp_i is standardized, α_1 represents the mean effect of the tax increase with the degree of competition at its average level. The variable δ_2 thus expresses the effect of competition on the price increase associated with the tax. We do not obtain a significant coefficient for the full sample. However, results by product type demonstrate that this effect is important and negative only for sodas (-0.05 pesos). A one standard deviation increase in the measure of competition faced by each establishment decreases tax overshifting by 38%.

The magnitude of the effect is interpreted relative to the measures of central tendency for the variable $Comp_i$. Within the 2 km radius, there is an average of 20 rival establishments surrounding a store (given our weighting). An increase in competition of one standard deviation is equivalent to nine additional establishments within the circular area of 12.56 km^2. The average pass-through of the tax in that relevant market, with an average degree of competition, is 1.13 pesos. With 29 establishments in the relevant market, there is a reduction of 0.05 pesos in the overshifting of the tax. Although the linear effect of competition for the 5 km radius is not statistically significant, its magnitude is similar, suggesting that in the stores facing the greatest competition, the pass-through effect is perfect shifting.[21]

We also investigate whether the average and negative effect of competition is constant over all degrees of competition. We gather together all the establishments facing a specific level of competition, at intervals of 0.5 on the scale of competition for the relevant market within a 2 km radius. We then estimate the regression model 1 for those establishments at every rung of the scale. Estimates of the shifting parameter are plotted in Fig. 3, which shows that the effect of competition is not constant over the scale for soda and sports drinks. The mean of the variable Competition is zero, meaning that the effect of competition is greater for those establishments with less than average competition than for those facing more competition.

Result 3　　In the case of soda and sports drinks, the effect of competition is negative. That is, the greater the competition, the lower is the shifting effect of the tax. A one standard deviation increase in the number of supermarkets (from 20 to 29) within a radius of 2 km reduces overshifting by 38% (0.05 pesos). The stores facing the greatest competition are not able to overshift the tax

6.3 After-tax price dispersion

In order to analyze the relationship between price dispersion and competition, we model price dispersion using a two-step procedure. We first estimate the model in Eq. 2 to explain soft drink prices, controlling for any constant price differences between establishments and for differences resulting from the extensive range of products in the sample. Each residual u_{ijt} indicates whether the price of product j in establishment i was above or below its expected level during time t. After obtaining the error term from step one (u_{ijt}), the second step is to estimate the model in Eq. 3. The results are reported in Table 4.

Estimates of the parameters for the second step are presented in column 1. Recall that the dependent variable represents unexplained variation in specific prices at the establishment level. Thus, the negative coefficient for the number of competitors within in a 2 km radius describes a negative relationship between competition and price dispersion

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[21] To present a nonlinear representation of the effect of competition on the shifting parameter, we also estimate an alternative specification. We exchange the variable $Comp_j$ for a quintile categorization of the competition faced by each establishment (dummy variables indicating the quintile level of competition: Q2, Q3, Q4, and Q5). In like manner, the interaction term $\left(year2014 * Comp_j\right)$ is replaced by interaction terms $\left(year2014 * Q_j\right)$ for $i = 2, 3, 4 \text{ and } 5$. The results of this regression are similar to those shown in the main analysis. For those establishments facing the highest level of competition (Q4 and Q5), the perfect shifting hypothesis cannot be rejected ($\alpha = 1$), whereas for those establishments facing lower levels of competition (Q2 and Q3), there is overshifting.
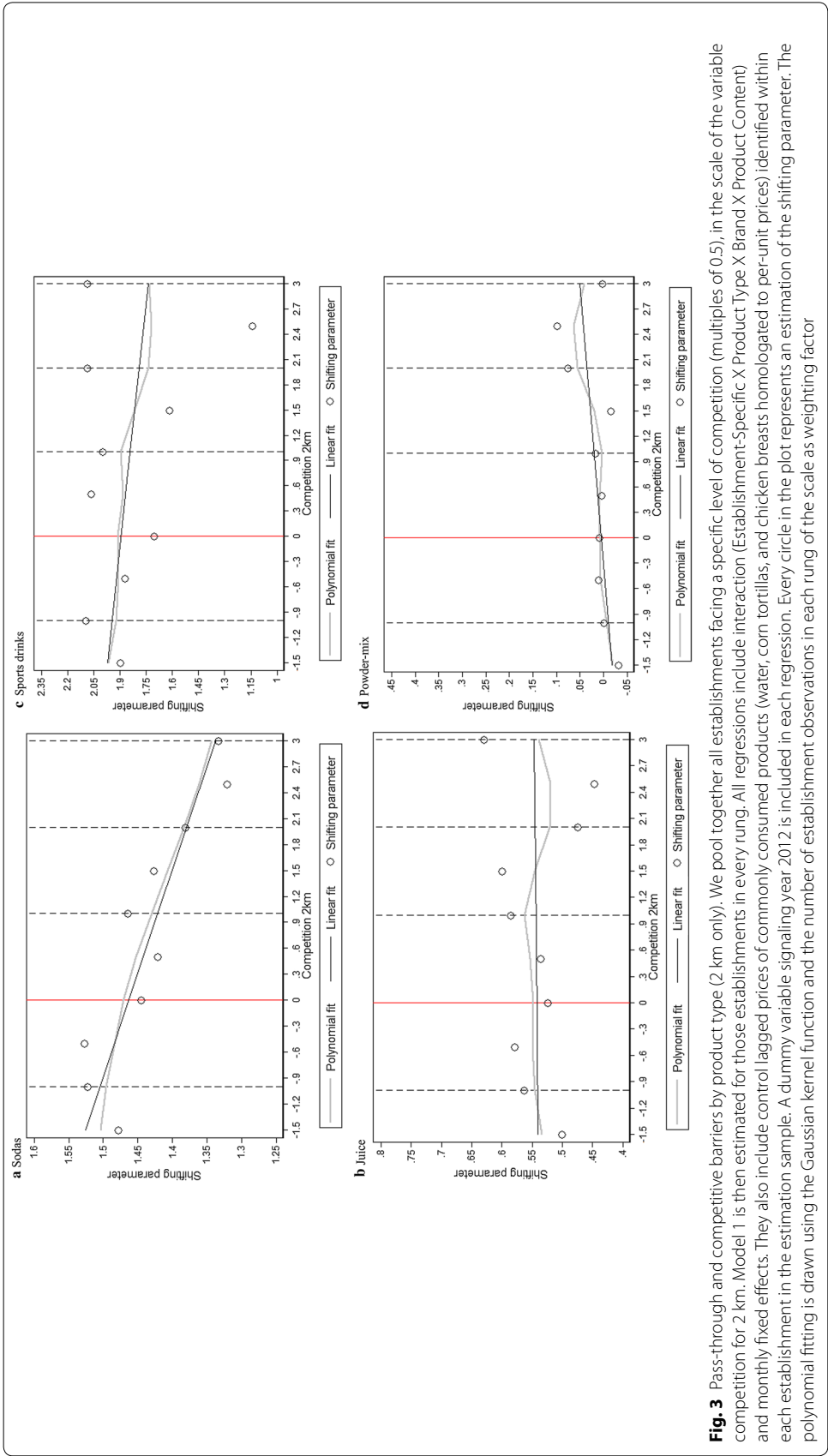
Table 3 Competitive barrier effects

	2 km radius			
	(1)	(2)	(3)	(4)
	Soda	Juice	Sports drinks	Powder mix
Shifting parameter	1.13*** [0.019]	0.25*** [0.032]	1.55*** [0.109]	0.24*** [0.014]
Interaction (tax X competition)	− 0.05*** [0.016]	0.01 [0.027]	− 0.09 [0.119]	0.02 [0.012]
No. of observations	68,193	35,964	11,384	10,592
R-squared	0.305	0.011	0.114	0.148
	5 km radius			
	(5)	(6)	(7)	(8)
	Soda	Juice	Sports drinks	Powder mix
Shifting parameter	1.13*** [0.024]	0.25*** [0.033]	1.55*** [0.122]	0.24*** [0.015]
Interaction (tax X competition)	− 0.03 [0.017]	− 0.02 [0.031]	− 0.06 [0.105]	0.01 [0.013]
No. of observations	68,193	35,964	11,384	10,592
R-squared	0.305	0.011	0.114	0.148

$\Delta P_{ijt} = FE + a_1 * IEPS_{2014} + \delta_1 * Comp_j + \delta_2 * (IEPS_{2014} * Comp_j) + u_{ijt}$

Shifting parameter refers to the shifting magnitude in Mexican pesos. Standard errors are clustered by establishment and presented in brackets. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. All regressions include interaction (Establishment-Specific X Product Type X Brand X Product Content) and monthly fixed effects (FE). In addition, all estimations include a dummy variable signaling 2012 prices

of significant magnitude. This coefficient indicates that for 2013, moving from the mean of 20 competing stores to a market with 29 lowers the price dispersion by 10%. This effect is exacerbated after the exogenous price shock caused by the tax: the net effect is 16%. The effect of just the external price shock on price dispersion is considerable and negative: the tax reduces price dispersion about 13% for markets with an average number of competitors. This effect increases with the number of rival establishments. These results are consistent with the predictions of monopolistic competition models and with the search-theoretical approach assuming heterogeneous consumer search costs. They thus imply that consumers have imperfect price information and that consumer search is an important aspect of establishment competition in the soft drink market. They also provide empirical evidence about the relationship between price formation, market structure, external price shocks, and price dispersion.

As a robustness check, we include several considerations. First, given that competition between establishments is focused within geographical areas, we include establishment-specific fixed effects in the estimation of the second step. Even though the inclusion of these fixed effects eliminates the variation needed to identify the effect of competition on price dispersion, this procedure ensures that the effect of the external price shock is preserved and that it is correlated with the level of competition within the relevant market. Further, we estimate the same specifications in columns (1)–(2) but with a balanced set of products; these results are reported in columns (3)–(4). Although different in magnitudes, presumably because of the restricted selection of products, the relative relations hold and the interpretation is maintained.

Fig. 3 Pass-through and competitive barriers by product type (2 km only). We pool together all establishments facing a specific level of competition (multiples of 0.5), in the scale of the variable competition for 2 km. Model 1 is then estimated for those establishments in every rung. All regressions include interaction (Establishment-Specific X Product Type X Brand X Product Content) and monthly fixed effects. They also include control lagged prices of commonly consumed products (water, corn tortillas, and chicken breasts homologated to per-unit prices) identified within each establishment in the estimation sample. A dummy variable signaling year 2012 is included in each regression. Every circle in the plot represents an estimation of the shifting parameter. The polynomial fitting is drawn using the Gaussian kernel function and the number of establishment observations in each rung of the scale as weighting factor

Table 4 Competition, external price shock, and price dispersion

Variables	(1) log (price dispersion)	(2) log (price dispersion)	(3) log (price dispersion)	(4) log (price dispersion)
Year2014	− 0.13*** [0.009]	− 0.17*** [0.011]	− 0.23*** [0.012]	− 0.23*** [0.014]
Competition	− 0.10*** [0.006]	–	− 0.08*** [0.008]	–
(Comp*y2014)	− 0.06*** [0.009]	− 0.06*** [0.010]	− 0.06*** [0.011]	− 0.05*** [0.013]
No. of observations	212,117	212,117	133,431	133,431
Establishment FE	No	Yes	No	Yes
(Brand X Pres) FE	Yes	Yes	Yes	Yes

Standard errors are clustered by establishment and presented in brackets ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Result 4   Price dispersion is related to the extent of local competition, and varies significantly depending on the number of surrounding establishments. Our results indicate that moving from a market with an average number of competitors toward a market with higher competition lessens price dispersion. Furthermore, this effect is reinforced after the exogenous price shock caused by the tax

7 Conclusion

The effectiveness of employing soft drink taxation as a tool for controlling consumption and combating obesity is not yet well documented, and the effect of different competitive structures on the expected consequences of these taxes is even less well understood. The findings of this study demonstrate that, across soft drink categories and market settings, a tax increase has different shifting patterns.

Using a rich dataset of weekly prices for 82 unique soft drink products across 553 stores around the country, we evaluate the incidence of the Mexican soft drink tax, controlling for a large degree of constant heterogeneity across establishments, product types, product presentations, and brands. We highlight four key results: (1) there is no evidence of anticipation effects or rigidity of prices in the sample. (2) The tax shifting patterns are uncommonly heterogeneous among taxed product types. There is an overshifting effect in soda and sports drinks, with a shifting of 1.12 and 1.37 pesos, respectively, in per-liter prices. The other taxed product categories of juices and powdered drink mixes showed undershifting of 0.72 and 0.68 pesos, respectively, in their final prices. (3) The number of stores within the relevant market has a significant effect on establishments' pricing behavior only for soda. For example, increasing the number of stores from 20 to 29 within a radius of 2 km reduces the mean overshifting for soda from 1.12 to 1.07 pesos, suggesting that the stores with the greatest competition are not able to overshift the tax. (4) Price dispersion varies significantly depending on the number of surrounding establishments. Our results indicate that moving from a market with an average number of competitors to one with greater competition lowers price dispersion. This effect is exacerbated after the exogenous price shock caused by the tax. These results add to our understanding of the pass-through effect of a specific tax and provide useful evidence for the formulation of public policy and for empirical work on tax incidence.

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