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MARKET POWER & TAX INCIDENCE: EVIDENCE FROM MEXICAN SUPERMARKET STORES

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Market Power & Tax Incidence: Evidence from Mexican Supermarket Stores.*

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Abstract

Because soft drinks intake is considered a major contributor to the epidemic of obesity and overweight in Mexico, there has been a growing interest in evaluating the impact on consumption, and now on prices, of the recently enacted soft drink tax. This work uses information of weekly prices for a large set of soft drink products during the period 2013-2014 to exploit the natural experiment environment caused by this tax reform. The main objective is to evaluate the incidence of the soft drink tax, as well as define the market characteristics that determine this effect. Estimation results indicate over-shifting to final prices when considering the whole soft drink sample, however, they also report a variety of shifting patterns leaning on the individual product-type (soda, juice, sports drinks, powder-mix) market structure. I provide evidence of strong dependence between the shifting effect, the individual demand elasticity and the competitive barriers faced by retailers. Since many attempts in the empirical and theoretical literature have been made to characterize the effect of competition over the tax pass through, this work designs a detailed measure of the degree of competition faced by each establishment using information on store locations. Applying this measure it is shown that competitive barriers create significant differences in the pass-through rate.

Keywords: tax incidence, supermarkets, pass-through, competition, soft drinks.
JEL Classification: D12; D22; D43; H22; L66; O54.

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1 Introduction

The global obesity epidemic and its public health implications have been a worldwide concern in the last decades. Governments around the world have made considerable efforts to promote comprehensive policy packages against this condition, mainly by imposing excise taxes on high calorie foods. Arguably, such taxes should be able to improve social well-being by reducing consumption and rising new sources of revenue (OECD (2013)).

An implicit assumption of the previous argument is that prices will rise as a response to the tax increase. However, economic theory shows that the burden of taxation depends crucially on market structure (Anderson et al. (2001) and Fullerton and Metcalf (2002)). 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 with prices. However, if firms hold some degree of market power and taxed goods are not perfectly homogeneous, price adjustments may vary differentially at a firm or at a brand level. Furthermore, establishment competition predicts that the ability of a single firm to set prices faints as the number of competitors increase within the relevant market, thus it is expected for diferent market configurations to present various tax shifting patterns (Hausman and Parker (2010) and Taylor et al. (2014)). This considerations imply that empirical work on tax incidence requires a more thorough analysis than the standard one.

In Mexico, the epidemic of overweight and obesity is remarkably alarming. Official numbers show that 34.4% of the 5-11 years old children, 73% of women and 69.4% of men suffered of either overweight or obesity in 2012 (Barquera et al. (2010)) and accordingly to the OECD (2013), Mexico occupies the second place in obesity rates only after the United States. However, this epidemic is not more of an issue of public health than it is of public finance. Consistent with the National Agreement for Nutritional Health of 2010, the sum of direct and indirect costs of obesity and overweight is expected to be 83 thousand millions of Mexican pesos in 2017. Hence, as part of a wide strategy to address this concern,[1] in January 2014 the Federal government made effective a new tax on sugar-added beverages also known as soft drinks. The excise tax on soft drinks was set to one Mexican peso per-liter sold.[2] Therefore, in

[1]Estartegia Nacional para la Prevensión y el Control del Sobrepeso, la Obesidad y la Diabetes. Health Department. (2013)

[2]Ley del Impuesto Especial Sobre Producción y Servicios published on the Official Journal of the Federation, 12/11/2013.

this work, a confidential data set of prices is used to empirically assess the impact of an excise tax on prices and its relationship with competitive pressures across establishments.[3]

There is a long tradition in economics to analyze the pass-through of taxes (excise or ad-valorem) into consumer prices. Theoretically, Delipalla and Keen (1992) , Delipalla and O'Donnell (2001) and more recently Weyl and Fabinger (2013) have built on the idea that the pass-through effect of a tax increase is so different under diverse market structures that one may be able to use it in order to characterize market power. They demonstrate that, in presence of imperfect competition, the incidence of ad-valorem and specific taxes may differ and each may be under or over-shifted into prices. The seminal papers by Poterba (1996) and Besley and Rosen (1998) show, empirically, that several shifting patterns are observed in real market configurations. The first one uses city-specific clothing prices and finds evidence of prices rising by approximately the amount of the sales tax for the post-war period in the U.S.. The second documents a variety of shifting patterns over very specific commodities in different U.S. cities using a panel of quarterly data.

Hence, the soft drink tax analysis presented in here is relevant for public policy and for empirical work in tax incidence for two main reasons. First, in Mexico, the latent health hazard posed by the epidemic of obesity and overweight is so strong that public intervention is essential. As stated for the Federal government, the purpose of the soft drink tax is to reduce consumption via price increasing, however, this may not be the observed result due to the Mexican soft drink and retail market structure. If the market is not perfectly competitive and taxed goods are not homogeneous (soda, juice, sports drinks and powder-mix) either, under or over-shifting may occur distorting the real objective of the tax and influencing unexpected results.

Second, the natural experiment environment caused by the exogenous price variation is explioded to evaluate the pricing behavior of retailer stores. This work uses product-specific (brand and presentation) data at the store level to compare prices in a weekly basis. Since the data set is sufficiently rich, it is possible to test a number of relevant hypothesis on tax incidence, such as the differentiated effect on product types, brands and presentations described by Besley and Rosen (1998), Poterba (1996) and Bergman and Hansen (2010). The stickiness of prices predicted by macroeconomic models and discussed in empirical work like the one

[3] Procuraduría Federal del Consumidor (PROFECO), "¿Quién es quién en los precios?" ("Who is who in prices?") PROFECO AL/COLMEX/CEC/177/2013.

in Berardi et al. (2012), and Besley and Rosen (1998), and to consider the effect of competitive barriers on the pass-thorugh effect suggested by the empirical reaserch of Harding et al. (2012), Chiou and Muehlegger (2008), Alm et al. (2009) and Taylor et al. (2014).

This last consideration is of especial relevance as many attempts have been made to approximate the effect of competition on the results of fiscal policy using aggregate measures, such as the density of competitors in rural or urban areas, the availability of lower-tax goods across state borders or the presence of potential entrants. In sharp contrast, this work designs a detailed measure of the degree of competition faced by each establishment using information on store locations. This is notably advantageous to test the hypothesis of pass-through under different market structures.

As implied above, the data set in this work is unique in nature and it is provided by the Federal Agency of Consumer Protection (PROFECO). By law, this agency collects establishment-specific weekly prices for a large set products across the country in order to inform consumers about the date-to-date prices through an internet portal known as "¿Quién es quién en los precios?" ("Who is who in prices?"). Most of the data collected relate to consumption goods, such as food, beverages, medicines and electronic appliances. Since only soft drinks prices and those establishments providing them are targeted in this work, the panel ensembled captures information of 607 stores around 27 cities in Mexico during the 2013-2014 period, this gives a total of over one million of weekly price observations. Therefore, leveraging the estimation on the rich panel structure available, it is possible to obtain clean identification of the tax effect on retail prices controlling for a very substantial fraction of unobserved heterogeneity at store, brand and even product level.

Taking advantage of reduced-form price equations, findings indicate over-shifting to final prices when considering the whole soft drink sample, however, they also report a variety of shifting patterns relient on the individual product-type (soda, juice, sports drinks, powder-mix) market structure. Evidence of the strong dependence of the shifting effect on the individual demand elasticity and on the competitive barriers is provided. Also, accounting for the competitive pressures faced by each establishment it is shown that different market structures create significant differences in the pass-through rate.

This work is organized as follows. Section 2 provides a short review of the related literature and shortly recovers the economic theory behind tax incidence and its use as a tool for inferring market power. Section 3 describes the data set and introduces some descriptive statistics on pricing behavior and the soft drink tax in Mexico. Section 4 describes the empirical strategy and presents the models to be estimated. Section 5 discusses the results and the possible policy implications. Finally, section 6 concludes.

2 Background

This section dicusses some previous reaserch in the empirical evaluation of taxes, and reports the relevant theoretical constructs for this work.

2.1 Literature Review

In the past decades, it has been shown that there exist many other factors determining the incidence of taxation than theory traditionally considered, supply substitution and strategic interactions between retailers and producers are among the most widely analyzed. Recent theoretical work has paid especial attention on the consequences of market structure over the pass-through of a tax (Konrad et al. (2014), Reny et al. (2012), Fullerton and Metcalf (2002) and Delipalla and O'Donnell (2001)). A fundamental implication of this literature is that, in an imperfectly competitive market, where firms interact strategically and have some control over prices, varying degrees of tax shifting are possible in both, the short and the long run. This consideration is just as important to policymakers as it is to academics since the result and consequences for public policy may directly depend on market structure.

As theoretical literature on tax incidence was growing to a better understanding of the matter, knowledge at the empirical level was also expanding rapidly. This line of work have focused on relaxing the often implicit assumptions of (i) homogeneous goods, (ii) full tax shifting and (iii) perfect competition, to evaluate the impact of several tax reforms mainly in the U.S. and Europe.

Cebula et al. (2014) relaxes the homogeneous good assumption to investigate the impact of cigarette excise taxes on the aggregate consumption, its findings highlight the substitution of high for low nicotine cigarettes in the presence of a significant cigarette tax hike in the U.S. market. Christian and Tianji (2011) also discards the assumption of homogeneous goods within the U.S. beer industry and, using brand-specific data of prices and quantity for

58 cities, finds that the effect of a per-unit tax on sales may be different for low-quality brands than for high-quality brands. Besley and Rosen (1998) documents a variety of shifting patterns over very specific commodities as a response to the same tax hike in different U.S. cities over the 1982-1990 period.

As noted before, the inclusion of imperfect competition in the evaluation of tax incidence is of high relevance. Taylor et al. (2014) finds full-shifting for gasoline and diesel taxes in Washington 2003, the competitive conditions are registered as the number of local rival stations as an aggregate measure. Alm et al. (2009) uses monthly gasoline prices over the period 1984-1999 to find that gasoline markets in rural areas exhibit full-shifting but those in urban areas demonstrate under-shifting, level of competition is approximated by assuming higher competition in urban areas. Harding et al. (2012) uses Nielsen Homescan microdata for 2006-2007 to demonstrate that taxes are less than fully passed through to consumer prices (one cent increase in taxes leads to a 0.85 cent increase in prices) approximating the level of competition by the availability of lower-tax goods across state borders. Chiou and Muehlegger (2008) use store-level scanner data from Chicago metropolitan area to estimate a cigarette tax pass-through rate of about 80% of the real increase, this work accounts for competitive barriers by suggesting that cigarette tax incidence varies with tax avoidance opportunities across state borders. Bonnet and Réquillart (2012) evaluates the impact on soft drinks consumption of simulated tax policies in France taking into account the strategic price response of both manufacturers and retailers, its findings suggest that ignoring strategic pricing and competition among firms leads to underestimate the real impact of taxation by 15% to 40% depending on the product and the tax (specific or ad-valorem) implemented.

However, as far as my knowledge comes, none of these, or other related works, have built a thorough and specific measure of the degree of competition to study the role of market structure over fiscal policy. Bearing in mind that the main object of the present investigation are the soft drinks, it is possible to think of them as highly differentiated products which notably differ from each other in terms of taste and quality. Furthermore, the soft drink industry in Mexico is highly concentrated, as is the retail industry. It is thus necessary to explicitly address imperfect competition in the chain to analyze how any changes in input costs are transmitted to the final consumers.

Regrettably there is still lack of empirical evidence regarding the impact of taxes in soft drinks prices. Nonetheless, four recent works by Bonnet and Réquillart (2013), Berardi et al. (2012), Bergman and Hansen (2010) and Grogger (2015) are explicitly devoted to this matter.

Berardi et al. (2012) employs price records of non-alcoholic beverages to evaluate the impact on prices of the so called "soda tax" introduced in January of 2012 in France. Its findings highlight two main results, the impact of the soda tax is different across retailing groups and beverage brands and the heterogeneous shifting pattern among different categories of soft drinks, the tax is fully shifted into soda prices while it is under-shifted in 40% of the official tax increase for juices and in 15% for flavored waters. Bonnet and Réquillart (2013), using a structural model and tax simulations, shows that an excise soft drink tax is likely to be over-shifted 32% of the real increase to final prices in the French economy. Further, Bergman and Hansen (2010) exploits various excise tax shocks on alcoholic and non-alcoholic beverage prices in Denmark, it comes to the conclusion that the two increases in the soft drink tax among 1998 and 2001 were over-shifted on more than 10% of the official tax increase for the 80% of analyzed stores. Finally, Grogger (2015) analyzes precisely the tax reform on soft drinks in Mexico, its findings suggests an average 38% of over-shifting on sodas, however, no other category of soft drinks is considered.

The present work is closest in nature to that of Besley and Rosen (1998), Harding et al. (2012) and the one of Berardi et al. (2012). Although a more complete data set is employed, the estimation process cannot control directly for cost heterogeneity and other factors, as some of these investigations do since only price data is available. However robustness of the estimations is leveraged on the panel structure of the data using establishment-specific, time, product and brand fixed effects. Likewise, an structural approach as in Bonnet and Réquillart (2013) can not be implemented since quantity data is not available. Evidently, this precludes the conclusions for drawing inferences about market conduct. Nevertheless, our data varies greatly in different dimensions thus identification of the tax effect on prices and the effect of the degree of competition on the pass-through effect is ensured.

Conclusively, it is worth to sum up the literature review as follows; Theoretical and empirical literature regarding the impact of excise taxes on prices in markets where imperfect competition prevails is unambiguous; in most cases the effect of the tax depends on factors that policy makers do not even consider when implementing fiscal policy.

2.2 Economic Framework

Before going any further it is important to frame the economic foundations considered in the present analysis. In this context, two sources of prices variation are exploded in order to characterize the Mexican soft drink tax pass-through.

First, since the new tax on sugar added beverages specifies one mexican peso per-liter sold, this sole increase can be thought as many tax raises function of product content, hiking an important amount of exogenous variation. Second, in antitrust literature, it is widely accepted that the smaller the relevant market, the bigger the market power of a single firm. Accordingly, it is expected to witness differences on pricing behavior depending on geographical market configuration (Motta (2004)).

On the null hypothesis that retailer markets are competitive and in the long-run equilibrium with horizontal supply curves, it is expected to observe that all post-tax prices adjust to reflect a one-to-one relation, other things equal. Conforming with this perspective pre-tax prices in different geographical markets, with different degrees of competition, should reflect only differences in operation, locality-specific and season-specific costs. Conversely, if it is observed that post-tax prices differ by amounts that are greater or less than the associated taxes, it implies that the perfect competition hypothesis is inappropriate, and thus, the analysis of tax incidence must be modified accordingly.

Literature has shown that there exist more than one potential model available to conceive the relationship between tax incidence and prices under different market structures. The analysis presented in here is not structural, hence is not intended to appeal to any particular model. However, it is important to highlight that some theoretical structure underlies the econometric specification presented in here.

Lets consider a *n*-establishment geographical market with asimetric costs of selling the good *i* at time *t*. In this setting, the establishment *j* chooses the variable x_{ijt} [4] to maximize its after-tax profit function. Following Besley and Rosen (1998), it can be expressed as:

$$\pi_{ijt} = R_{ij}(x_{ijt}, \sigma_{it}, Z_{ijt}) - C_{ij}(x_{ijt}, \sigma_{it}) \tag{2.2.1}$$

Where $R_{ij}(x_{ijt}, \sigma_{it}, Z_{ijt})$ is the total revenue function which depends on Z_{ijt}, a vector describ-

[4] Under Bertrand-Nash competition $x_{ijt} = p_{ijt}$, under Cournot-Nash competition $x_{ijt} = q_{ijt}$.

ing the behavior of other firms in the same market, the amount of specific tax (σ_{it}), and the level of x_{ijt}. $C_{ij}(x_{ijt}, \sigma_{it})$ is the total cost function. They both awre assumed to be constant over time.

In the present context, it is widely accepted in empirical work that competition among supermarket chains and retail stores takes place by setting prices (Aguirregabiria and Vicentini (2006), Seaton and Waterson (2013), Griffith and Harmgart (2012), Cleary and Lopez (2011), Chioveanu and Zhou (2013) and Castañeda Sabido (2012)). Hence, a general form to describe the optimal selection of price for the good *i* by the establishment *j* at time *t* , under Bertrand-Nash competition is:

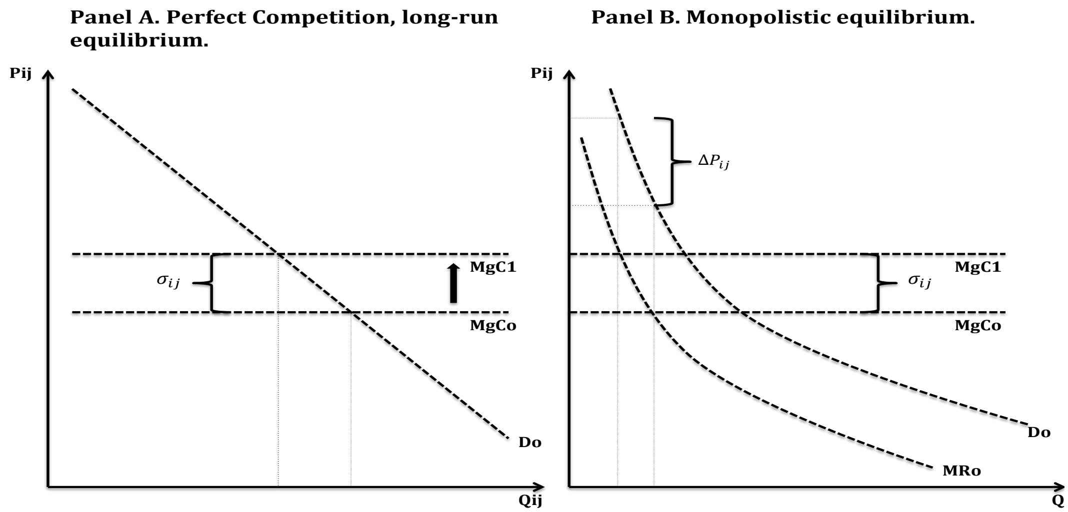
$$p_{ijt} = \mu_{ijt}(m_{ijt}(\sigma_{it})) \tag{2.2.2}$$

Where the function μ_{ijt} captures the mark-up over the marginal cost of establishment *j* for selling the good *i* at time *t*. The marginal cost of selling one good, depends directly on the specific tax ($m_{ijt}(\sigma_{it})$). Since the mark-up is a direct function of the tax σ_{it}, equation 2.2.2 can be reexpressed as:

$$p_{ijt} = f_{ijt}(\sigma_{it}, \gamma_{ijt}) \tag{2.2.3}$$

With γ_{ijt}, a vector containing all unobservable factors that affect the underlying cost of selling the good *i* and which may vary across time and location. It is useful to lay out a basic interpretation of the expected results using two extreme theoretical benchmarks presented in Figure 1.

Figure 1: Pass-through of a specific tax (σ_{it})



Notes: Panel A shows a specific tax increase in a long-run competitive equilibrium with constant marginal cost and thus, an horizontal supply curve. Adjustments to the tax show full-shifting. Panel B depicts the same policy reform in a monopolistic equilibrium with a constant-elasticity demand curve. The graph shows that over-shifting of the tax is more than possible. However, there exists the possibility for the demand curve to be differently shaped. In the case of an unitary elasticity of demand the specific tax hike is more likely to be under-shifted. A nice discussion of this matter can be found in Stiglitz (2003).

Under a perfectly competitive market configuration, in the long-run equilibrium, supply curve is horizontal and firms set prices equal to its marginal cost of selling, $p_{ijt} = m_{ijt}$. Hence an specific tax is a one-to-one relationship with final prices $p_{ijt} = m_{ijt} + \sigma_{it}$. Nontheless, under a monopolistic market configuration the pass-through effect of the same tax is different and highly depends on the shape of the demand curve.

Lets consider the general case of an isoelastic demand function. In this escenario, a monopolist maximize profits by setting marginal costs equal to marginal revenue. Therefore, they often charge a mark-up over marginal costs which can be evaluated using the Lerner index $\frac{p_{ijt} - m_{ijt}}{p_{ijt}} = \frac{1}{\epsilon^{D_{ijt}}}$, so $p_{ijt} = m_{ijt} * \frac{1}{1 + \frac{1}{\epsilon^{D_{ijt}}}}$. After an specific tax increase that affects marginal costs, $p_{ijt} = (m_{ijt} + \sigma_{it}) * \frac{1}{1 + \frac{1}{\epsilon^{D_{ijt}}}}$ and since monopolists set prices on the elastic part of the demand curve, then $\frac{1}{1 + \frac{1}{\epsilon^{D_{ijt}}}} > 1$, there is over-shifting.

Nevertheless, the market configuration of supermarket and retail stores in Mexico do not fit any of this extreme settings, as reported by Castañeda Sabido (2012), Grogger (2015) and

Iacovone et al. (2011), it can be characterized as an oligopolistic industry with few agents holding some degree of market power. In this regard, there is no theoretical consensus on which effect is more likely to occur, Anderson et al. (2001), Delipalla and Keen (1992), Harding et al. (2012), Reny et al. (2012) and Weyl and Fabinger (2013) have demonstrated that, in presence of imperfect competition, the incidence of an specific tax increase may differ from case to case and it can be either full, under or over-shifted into final prices. Yet, it is possible to anticipate from lines above that the elasticity of demand drives a large part of this effect.

To relate the econometric estimation of the pass-through with economic theory, the method in this work is to study the reduced form relationship expressed in equation 2.2.3 assuming that there exist unchanging establishment, product, brand and season-specific characteristics that affect pricing behavior of supermarkets and retail stores. The augmented equation is to be presented in section 4.

2.3 Policy Framework

Over the last few years, extending fiscal policy to certain high-calorie foods have been increasingly seen as a practical response to obesity and obesity-related diseases. The concept of food and beverage taxes came into light within the first decade of the new millennial, precisely when the worldwide obesity epidemic inspired calls for public policy interventions (Andreyeva et al. (2011), Brownell et al. (2009), Brownell and Frieden (2009), and Smith et al. (2010)). Consequently, governments around the world adopted some form of tax on high-calorie foods to lower levels of consumption.

Following the global scene, in late 2013 the Mexican Federal Government announced The National Strategy for the Prevention and Control of Overweight, Obesity and Diabetes,[5] in order to promote the prevention and control of obesity and related afflictions. The initiative consisted of three main pillars: health promotion, public healthcare investments and fiscal policy.

In the latter category, in September 2013, Mexican president Enrique Peña Nieto proposed a tax reform which included a special tax on sugary drinks. Amid criticism, nuance and lobbying from soft drink companies and conservative political parties, Congress approved the tax on soft drinks on October 18^{th} 2013. Only one month later, in December of 2013 new amend-

[5]Estrategia Nacional para la Prevención y el Control del Sobrepeso, Obesidad y la Diabetes. September 2013, Health Department.

ments to the Law on Special Tax on Production and Services (IEPS) were published.[6] The modifications established a uniform tax rise of one-peso per-liter applicable on the sale or exchange of any flavored drinks, concentrates and powders if they contain any kind of added sugars.[7] Finally, the policy reform became effective on January 1^{st} 2014.

Table 1: Example of the Mexican soft drink tax

Product Type	Product Name	Content (ml.)	Corresponding tax-increase (mxn)
Soda	Coca-Cola	1,000	1.00
Soda	Sprite	355	0.35
Sports Drink	Jumex-Sport	600	0.60
Powder-Mix	Tang (1.5 liters)	1,500	1.50
Sparkling Water	Peñafiel	600	non-applicable

Notes: Since the law dictates a mexican peso per-liter thus, products of lower and biger presentations are taxed using a direct conversion to a per-milliliter tax.

Mexico is not alone on taxing soft drinks since similar taxes already existed in some other countries, however, the Mexican tax remains conservative in magnitude its amount is equivalent to 0.12 USD PPP per-liter which is larger than the per-liter tax in France (0.08 USD PPP) but lower than the one in Denmark(0.21 USD PPP), Finland (0.23 USD PPP) and Berkeley CA. (0.33 USD PPP).[8]

3 Data and Descriptive Statistics

As suggested above, the method adopted in this work relies on the estimation of reduced form price functions with the tax increase, competitive barriers and other exogenous determinants of demand and cost conditions included as right-hand-side variables. Therefore, the empirical counterpart of expression 2.2.3 requires data drawn from different sources.

[6] Ley del Impuesto Especial Sobre Producción y Servicios published on the Official Journal of the Federation, 12/11/2013.

[7] In the case of powders, the relevant tax is to be charged on the amount of sweetened beverage that can be prepared following the manufacturer's instructions.

[8] Purchasing power parity conversion factor consulted in http://data.worldbank.org

3.1 PROFECO Data

The Federal Consumer Protection Agency (PROFECO) is the government institution responsible for ensuring fair consumer relations among economic agents. By law, one of its main activities consists in monitoring price setting behavior around the country. Thus, the agency collects prices of various goods through periodic visits to formally registered establishments. The price data employed here comes from this bureau.

The dataset provided for PROFECO is compiled following a precise methodology; each day of the week a trained PROFECO inspector visits a subset of establishments and stores in a particular and strategically defined location . For each establishment, individual prices of various items, as shown on the shelves, are thoroughly registered.[9] If an item is not available, no price is recorded.[10]

Since only soft drinks prices and those establishments providing them are targeted in this work, the assembled panel captures information of 607 stores around 27 cities in Mexico during the 2013-2014 period. Nonetheless, information of many other product prices such as milk, fruits, canned food and sugar itself can be linked to those specific establishments in order to assess the robustness of results. On the other hand, one disadvantage of the dataset is that missing values can arise due to data collection problems (e.g., product and establishments exclusion and inclusion over time, product unavailability on any specific week, etc.), nonetheless, this issue will be specifically addressed in section 4.

As described above, the information used in this work is unique in nature as it captures weekly prices for a large set of narrowly defined soft drink products in four categories, soda, juices, sports drinks and powder-mix, includes information of 52 brands and an average of 3 presentations per brand of soda, 1 for juices, 1 for sports drinks and 2 for powder-mix, giving a total of 75 unique products. The drinks sample is composed as shown in table 2.

[9] When there exist doubts about the price of an specific item, the inspector records the price scanned at the checkout. To avoid errors, every recorded price is verified at both the local and federal level.

[10] All information collected is compiled in a dataset known as “Quién es quién en los precios?”, “Who is who in prices?”.

Available for product-specific consults in: http://www.profeco.gob.mx/precios/canasta/home.aspx?th=1

Table 2: Drinks sample

Product Type	No. of observations	%	Tax Increase (σ_{it})	Mean per-liter price [a]
Sodas[b]	478,525	46.93	Yes	9.22
Sports Dirnks	113,167	11.10	Yes	14.77
Juices[c]	141,230	13.85	Yes	14.61
Powder Mix	91,950	9.02	Yes	2.54
Water [d]	194,840	19.11	No	7.49
Total	1,019,712	100.00	-	-

Notes: [*a*] In mexican pesos (mxn), for all products, presentations and years. [*b*] Not all products in this category contain added sugars, diet products are not taxed. [*c*] All products in this category contain added sugars. [*d*] Includes sparkling water and bottled water.

Approximately 80% of the drinks sample is subject to the tax increase, other products are kept as controls because their prices are highly correlated with those of taxed products.[11] From Table 2 it is clear that the tax increase affects differently each product type. Considering each one of them as a basket of characteristics, the specific tax per-liter affects more directly products like powder-mix since its characteristics became relatively more expensive than those of products such as soda or sports drinks. When prices of two substitute goods, such as powder-mix and soda, are both increased by a fixed per-liter amount, consumption is expected to shift towards the less elastic product. This is true because the added per-liter amount decreases the relative price of the preferred product.

For further description of the dataset, the number of per-chain establishments is described in table 3.

[11]To reach this classification, I examined the contents and nutritional information for every product in the sample. For some products, the so called "Consumers Magazine", an official publication of PROFECO, is used to determine their taxability.

Table 3: PROFECO stores by number of observations

Chain	Establishment Type	No. of observations	%	Cumulative
Wall-Mart	supermarket	164,048	16.09	16.09
Comercial Mexicana	supermarket	171,445	16.50	32.59
Bodega Aurrera	supermarket	152,144	14.92	47.51
Chedraui	supermarket	74,200	7.28	54.79
Soriana	supermarket	214,350	21.02	75.81
Superama	supermarket	71,294	6.99	82.80
Casa Ley	supermarket	28,523	2.80	85.60
Other chains[a]	supermarket	130,113	12.76	98.36
Other stores[b]	convinience store	11,541	1.13	99.49
Other stores[c]	grocery store	2,054	0.45	100
Total	-	1,019,712	100	100

Notes: [*a*] Other supermarkets include 39 different supermarket chains. [*b*] Convenience stores include small retail stores that are open long hours and that typically sells staple groceries, snacks, and beverages like OXXO or 7-Eleven. [*c*] Any other store in the sample that is not classified as supermarket nor as convenience store.

It is necessary to notice that given that most of the price observations in the sample are drawn from stores classified as supermarkets, this work is limited to observe the tax pass-through for this type of establishment. However, this matter does not limit the final conclusions.

Furthermore, the dataset provided by PROFECO varies greatly at the geographical level. This is advantageous to test the hypothesis of pass-through under different market structures. The information includes specific addresses for each establishment, however, in order to locate them in a reliable manner, individual coordinates were built using programming techniques and the benefits of Google Maps.[12] Results are reported in figure 2.

[12]https://www.google.com.mx/maps

Figure 2: PROFECO Stores

Source: Federal Agency of Consumer Protection (PROFECO). **Notes:** Establishment location accounts for 27 cities throughout the country. Each dot on the map represents a unique establishment, clusters are easily identified by accumulation of observations.

Finally, although the sample is not constructed at random, its supermarket-chain configuration is very close to that reported by the National Association of Supermarkets and Department Stores (ANTAD) to be the actual configuration of the Mexican retailing industry, with six big chains competing among other smaller establishments.[13] Moreover, the sample covers the major markets for the most representative cities over all geographic areas of the country, hence, representativeness is assured.

3.2 Mexican Store Universe

Since one of the main objectives of this work is to determine the influence of the level of competition on the pass-through effect of a tax, building a robust representation of the competitive universe that each one of the PROFECO stores face is essential. Therefore, I employed the National Statistics Directory of Economic Units (DENUE) for 2013 and 2014 provided by the National Institute of Statistics and Geography (INEGI), which includes identification, location, economic activity, number of employees and asset size information for all economic

[13] ANTAD: www.antad.net/index.php and Girón and Ramírez (2014)

units formally registered in the country. Then the Industrial Classification System of North America (SCIAN) is employed to define the relevant store universe as follows:

Table 4: Relevant establishments by activity

SCIAN code	Economic activity
431	Wholesale groceries and food
461	Retail groceries and food sales
4621	Retailing (supermarkets)
462111	Retailing (mini-market)
462112	Retailing (convenience stores)

Source: Industrial Classification System of North America, (SCIAN).

After selecting only the relevant establishments from the universe of registered stores, the sample consists in 685,999 establishments located around the country as shown in the figure 3.

Figure 3: DENUE 2013-2014 Stores

Source: National Statistics Directory of Economic Units (DENUE) for 2013 and 2014, INEGI.

An straightforward way to test the location map constructed for the PROFECO stores is to directly compare figures 3 and 2. In fact, PROFECO stores are located at the exact same location as the establishment clusters depicted by the coordinates from the store universe. A detailed map can be found in Appendix A.

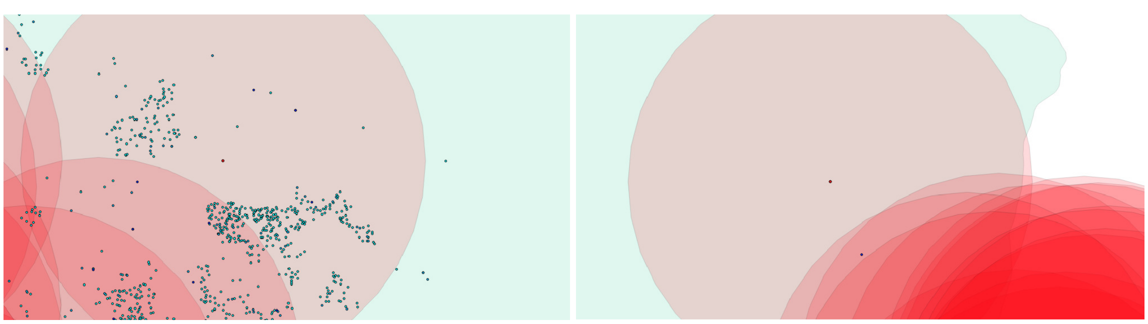
3.3 Descriptive Facts

3.3.1 Degree of Competition

This work uses three definitions of relevant market to study the level of competition faced by each establishment. Relevant market is defined using fixed-radius circles of two, five and eight kilometers around the establishments for which I possess price information, the PROFECO stores. This interpretation is widely used in competition analysis among supermarket and other stores mainly because it considers both, geographical distance and transport mode costs (See, for example, Hausman and Parker (2010), Castañeda Sabido (2012), Beare and Szakiel (2009) and Ellickson and Grieco (2013)).

The economic intuition behind this definition is as follows; For most people the closest supermarket is the first and most frequent option. If that one has unsatisfactory supply or too high prices the next establishment becomes the preferred option. The question then converts to how many extra kilometers or minutes one is willing to spend on passing by the closest supermarket and go to the next one? Thus, the competitive barriers of the first-choice supermarkets are other establishments with traveling time not bigger than, I believe, 10 to 15 minutes for most of the consumers. Distances of two, five and eight kilometers are defined using this criterion.

Figure 4: Relevant market heterogeneity



Source: INEGI and PROFECO. **Notes:** Both panels show supermarket stores belonging to the same supermarket chain in the same State, city , time and less than 6 km. (crow-fly) away. Thus, the only difference between them both is the number of surrounding stores, high and low competition.

Figure 4 shows the existent heterogeneity between geographical location and the number of competing establishments that each supermarket faces within its relevant market. This differences represent the ideal variation needed to identify the pressure that competitive barriers pose on the price setting behavior. Specifically, the price adjustments after the exogenous variation caused by the tax increase.

However, there is absolutely no reason to believe that convenience stores or smaller grocery stores compete on the same intensity as supermarkets or warehouse clubs. Hence, in order to capture the degree of competition exerted over supermarkets by each kind of store I used the number of employees, provided by the DENUE database, to weight each individual influence. The methodology and descriptive tables are reported in Appendix A. Finally, I built the degree of Competition [14] faced by each establishment for two, five and eight kilometers as the average number of establishments surrounding each of the PROFECO stores weighted by a factor that describes the level of competition it represents.

[14] The variable ($Comp_i$) is the standardized value of the degree of Competition.

Table 5: Summary statistics for degree of competition

	No. of weighted compeitng establishments		
	Competition 2km	Competition 5km	Competition 8km
Mean	20.59[a]	91.2	183.03
Standard deviation	8.98	49.52	129.49
Max.	63.52	249.89	536.54
Min.	0.021	0.021	0.021
	No. of other supermarket and mini-market stores[b]		
	Competition 2km	Competition 5km	Competition 8km
Mean	12.40	55.14	108.76
Standard deviation	5.59	28.99	65.95
Max.	63.52	159.28	273.05
Min.	0.10	0.10	0.10

Notes: [*a*] number of establishments weighted to compete in a one-to-one scale with supermarket stores (i.e., recall figure 4, on the left panel, with high competition, the number of weighted establishments is 40.59 in a 2km-radius circle, on the right panel, with low competition, the number of establishments is 1 since only one other store -classified as a supermarket- is located within the relevant market). [*b*] grocery stores, convenience stores and warehouse clubs are excluded from the relevant market.

It is also relevant to notice that a time-dependent measurement of competition is more desirable than the static measurement proposed in here, nonetheless, the set of relevant establishments that opened between 2013-2014 and that fulfill the condition of being relevant for the PROFECO stores using the two, five and eight kilometers market definition are so uncommon that it is possible to avoid this issue without bias in the estimates.

3.3.2 The Federal Excise Tax

In January 2014 the one Mexican peso per-liter soft drink tax became effective. In order to begin exploring the pass-through effect table 6 and 13 presents the mean pre-tax and after-tax per-liter prices for the most popular products in the sample.

Table 6: Mean per-liter price by product and brand (pre-tax and after-tax)[a].

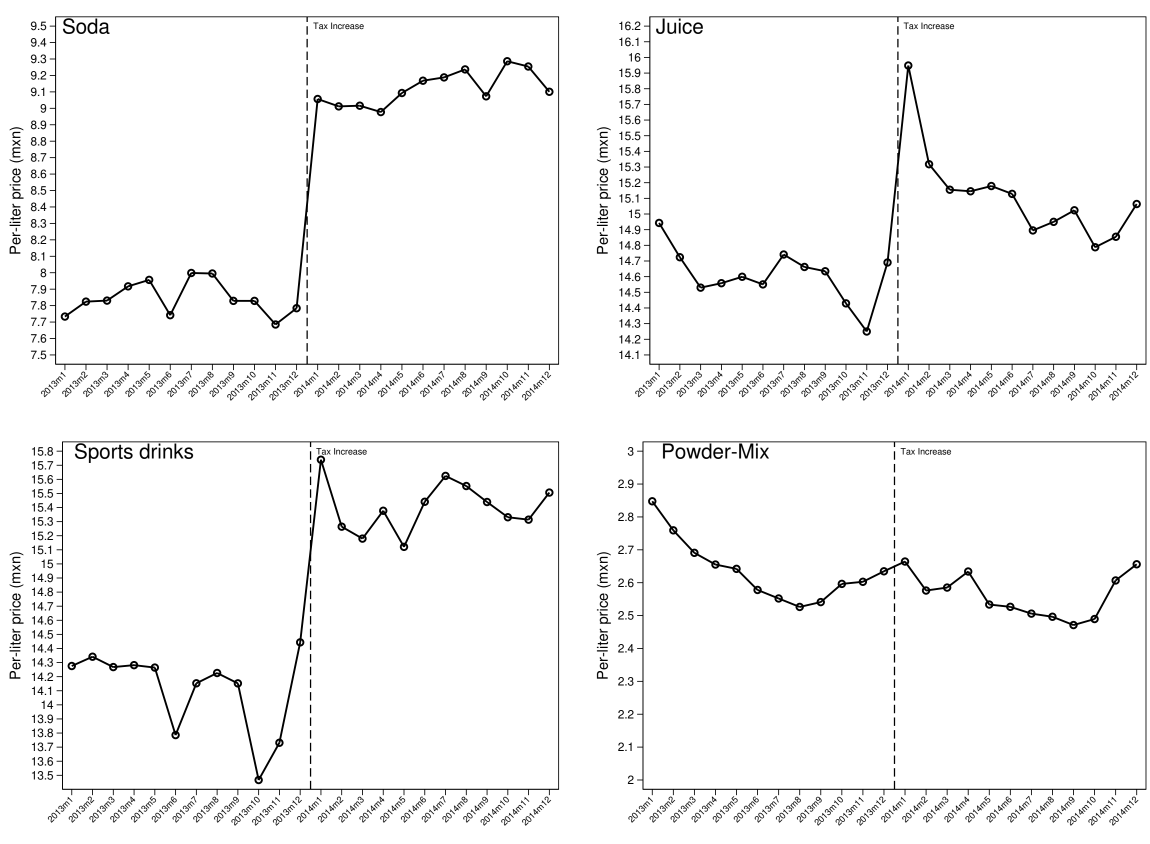
Product	Tax	Nov2013	Dec2013	Jan2014	Feb2014	Average Pass-through[b]
Water						
Bonafont (1500ml.)	No	5.01	5.10	5.61	5.52	0.50
Ciel (1500ml.)	No	5.37	5.49	5.47	5.47	0.02
E. Pura (1500ml.)	No	5.49	5.39	5.38	5.23	-0.19
Soda						
Coca cola (Coke) (2500ml.)	Yes	8.45	8.53	9.80	9.66	1.20
Coca cola (355ml.)	Yes	21.16	21.11	22.71	22.78	1.57
Coca cola light (2000ml.)	No	9.85	9.95	10.32	10.37	0.41
Pepsi (2500ml.)	Yes	6.94	6.86	8.83	8.75	1.89
Pepsi light (2000ml.)	No	7.96	7.73	7.45	8.15	-0.04
Big cola (3300ml.)	Yes	4.43	4.54	5.89	6.28	1.59
7up (2000ml.)	Yes	7.10	7.19	8.24	8.38	1.17
Fanta (2000ml.)	Yes	6.67	6.97	7.97	7.90	1.11
Juice						
Ades (1000ml.)	Yes	17.05	17.78	18.03	17.35	0.55
Del Valle (1000ml.)	Yes	13.63	14.33	16.08	15.20	1.66
Florida 7 (1000ml.)	Yes	11.53	11.16	13.52	12.25	1.53
Jumex (1000ml.)	Yes	14.59	15.36	16.02	15.82	0.95
Sports drinks						
Enerplex (600ml.)	Yes	14.14	14.00	14.54	14.91	0.29
Gatorade (600ml.)	Yes	20.60	23.11	25.46	24.93	3.34
Jumex Sport(600ml.)	Yes	15.19	15.83	16.04	15.99	0.5
Powder-Mix						
Frisco (1000ml.)	Yes	2.14	2.18	2.19	2.15	0.01
Frutimax (1000ml.)	Yes	2.49	2.52	2.67	2.36	0.01
Tang (1000ml.)	Yes	3.06	3.10	3.12	3.10	0.003

Note: Products considered in this table have over 1,500 observations per month. [a] Prices in mexican pesos. [b] Average pass-through is computed as $(Jan2014 + Feb2014) * 0.5 - (Nov2013 + Dec2013) * 0.5$.

Inspection of table 6 reveals that for virtually all cases of soda, the mean rates of tax passthrough are substantially over 1 peso, suggesting that soda taxes are more than fully passed through into prices. Surprisingly, presentations with less content in this category have an individual price, once converted to per-liter prices, much higher than larger presentations. This finding helps to build some intuition about the tax shinfting effect, quite possibly, the smaller presentations are somehow different whitin the soda category.

Furthermore, mean per-liter prices for other soft drinks categories show different shifting patterns. On the one hand, juice and sport drinks prices entirely transferred the tax in early 2014, but decreased in the following month. And on the other powder-mix prices, which should be specially affected by the tax, did not increase at all, suggesting that the burden of the tax is fully bore by producers or retailers.

Figure 5: Mean per-liter prices by category of soft drinks



Note: Mean per-liter prices are computed from products with more than 1,700 observations per month. Prices in Mexican pesos.

Following the full mean per-liter price trend throughout 2013 and 2014, it is clear that prices of the various categories of soft drinks behave differently. Soda prices show an after-tax stability, contrastingly, the process followed by products like juice and sports drinks, tell a different story. Astonishingly, the mean trend of prices show that most establishments decided to left unchanged the prices of powder-mix, even after the tax became effective.

The information obtained from table 6 and figure 5 suggests that in order to characterize the effect of the tax increase over prices it is necessary to consider the unobserved heterogeneity between brands, presentations and product types.

4 Empirical Approach and Estimation

Have supermarkets passed the increase on the specific tax over the soft drinks in Mexico and to which extent? Are there any differences across taxed goods and/or retailing groups? To what extent the level of competition faced by each establishment determines the pass-through effect? This section aims to provide an econometric approach to solve these questions.

4.1 Pass-through Effect

Whenever we think on prices and its determinants it is important to bear in mind both, demand and supply side factors that affect pricing behavior. Prices may vary greatly due to differences in operating costs by store or location, by endemic differences between geographical markets, differences in purchasing power, population size and other socio-demographic variables. They may also vary as a function of supply-substitution, barriers to entry for new competitors, close product substitutes, in between others.

Although it is an almost impossible task to control for the complete set of this price determinants, it is assumed along this work that unobserved heterogeneity among establishments exists and that it is constant given the exogenous tax increase. Therefore, to take care of this constant characteristics at the establishment, brand and product levels, as well as changes in the macroeconomic environment that affect establishments the same way a fixed effects model is fully justified.

Accordingly, retaking equation 2.2.3 and leveraging the estimation on the panel structure of the data, the implementation of the fixed effects approach relies on the following model:

Model 1

$$P_{ijt} = \Psi_{FE} + \alpha_1 * \sigma_{it} + u_{ijt} \tag{4.1.1}$$

With, $\Psi_{FE} = \theta_E + \gamma_B + \phi_T + \omega_{MO} + \varrho_{TxYM} + \varphi_{PxT}$

Where the dependent variables P_{ijt} are the individual prices of product i in the establishment j at the time t and σ_{jt} renders the product specific tax increase as described in section 2.3.

θ_E represents establishment-specific fixed effects that capture differences between spatial and temporal costs affecting establishments in the same way. I assume the existence of constant and fixed characteristics that affect the costs of selling and thus, prices. (i.e. transport costs, rent tariffs, legislation, marginal cost, local wages and differences in the up-stream production chains are among the most used in the literature). γ_B and ϕ_T depict brand (Coca-cola, Pepsi cola, Mundet, etc.) and product-type (soda, juices, powder-mix and sports drinks) unchanging characteristics respectively, they capture constant and particular heterogenity by brand and product-type that affect price setting (i.e. elasticity of demand and supply, quality, popularity, equity of the brand, seasonality, market niche and costs of raw material). ω_{MO} represents month-specific fixed effects and controls for those changes in the macroeconomic enviroment at affect all establishments in the same way (i.e. seasonal demand, income per-capita, raw material prices, wages, etc.). ϱ_{TxYM} (ProductXTime) fixed effects, control for the possibility of differentiated effect of product-type characteristics over time (year-month). Finally u_{ijt} is a withe noise error term.

From the perspective of tax incidence the key parameter is α_1, its value relates on whether the specific tax increase is under-, full- or over-shifted into prices. Usually, policy makers assume that $\alpha_1 = 1$ so that tax-inclusive prices perfectly reflect any tax levied on every single good; the perfectly competitive prediction. However, a value of $\alpha_1 \neq 1$ helps disprove the null hypothesis of perfectly competitive retailer market, as well as it helps to evaluate the result of the tax as a public policy. Thus, a tax increase designed to promote healthier food consumption and therefore improve public health might only be considered as effective if the policy is fully shifted into prices and if the market does not suffer significant distortions.

The econometric specification of model 1 is similar to that in Harding et al. (2012), Berardi et al. (2012) and Besley and Rosen (1998), as it assumes constant heterogeneity affecting pricing behavior and adopts the fixed effects model as the most reliable approach. Yet, due to the richness of the available data, it is possible to improve this aproximation introducing more specific treatments such as fixed effects by establishment, by brand, and by product type. In like manner, Brownell et al. (2009), Allais et al. (2010), Bergman and Hansen (2010), Rojas (2008) are devoted to analyze, empirically, the impact of taxes over prices, however, most of these analyses have two main downfalls: First, they assume the lack of strategic pricing behavior, that is, producers, distributors and retailers are supposed not to adjust, strategically, product prices in response to the tax. Nonetheless, in the present context, Mexican soft drink industry is characterised by large retailer chains with different supply and distribution chains and few producers with some amount of market power, thus, it is essential to consider that each agent in the distribution chain charge an additional mark-up over the price of the product that will be finally reflected into consumer prices.

Second, much of this literature is based on the estimation of structural models which requires the adoption of very restrictive assumptions, such as the functional form of costs or revenue. Additionally, the data demanded for this estimates is very costly since demand and supply side information is required. Therefore, many studies have used proxy variables to address the effect of factors determining pricing behavior. Still, the very nature of these variables is to provide an approximation, consequently the pass-through estimates may be biased.

Model 1 controls for strategic behavior at the processing, distribution and retailing levels by including establishment-specific, type of product and brand fixed effects that allow to capture strategic interactions at all levels of the distribution chain. Likewise, the establishment fixed effects enable to recover all the differences in the cost of sales and distribution that remain constant during the study period, solving completely the above limitations. The originality of this approach is to integrate the consideration of strategic pricing to obtain a causal effect of the tax increase on prices.

It is also worth notice that the implicit assumption of α_1 as independent of time, geographical location and product heterogeneity, is clearly very restrictive, as there is no justification for the tax pass-through to be similar among this considerations or even constant over time. Nonetheless, I relax this assumption to assess the robustness of the results, furthermore, it is relaxed as a way for acquiring additional information on the pricing behavior in the Mexican retail market, such as brand-specific or product-presentation pass-through effect.

4.2 Competitive Barriers Effect

Empirical literature on tax incidence concludes that there may be imperfect pass-through in prescence of less than perfectly competitive markets. (See, for example, Delipalla and O'Donnell (2001), Rojas (2008), Katz and Rosen (1983), Hamilton (1999) and Nakamura and Zerom (2010)). The main explanation is the markup adjustment of manufacturers and retailers along the distribution chain, as well as the ability to fix prices by companies with market power in affected industries. Overall, this literature suggests that final prices are likely to be adjusted in response to a tax increase policy but not as the perfectly competitive scheme.

Although the relevance of market power is now widely accepted in the study of tax incidence, the issue has not been directly addressed, works like the one in Harding et al. (2012), Chiou and Muehlegger (2008), Alm et al. (2009) and Taylor et al. (2014) approximate the competitive conditions faced by firms using aggregate measures such as the density of competitors in rural or urban areas, the availability of lower-tax goods across state borders or the presence of potential entrants. Hence, in order to assess the specific relevance of competitive barriers on the pass-through effect, the following model is estimated:

Model 2

$$P_{ijt} = \Psi_{FE} + \alpha_1 * \sigma_{it} + \delta_1 * Comp_i + \delta_2 * (\sigma_{it} * Comp_i) + \beta_{ijt} Z_{ijt} + u_{ijt} \tag{4.2.1}$$

With, $\Psi_{FE} = \gamma_B + \phi_T + \rho_{BxT} + \omega_{MO} + \varrho_{TxYM} + \upsilon_{State} + \lambda_{(StateXYear)} + \eta_{Ch} + \pi_{(ChainXState)}$

Where the variable $Comp_i$ measures the degree of competition faced by each establishment, its construction is explained thoroughly in section 3.3.1. Since the inclusion of establishment specific fixed effects takes down the variation needed to identify the effect of competition, they lost usefulness in this specification. Hence, they are replaced by state-specific fixed effects υ_{State}, an interaction of State and Year fixed effects $\lambda_{(StateXYear)}$, chain-specific fixed effects η_{Ch}, an interaction of State and chain fixed effects, $\pi_{(ChainXState)}$, and a vector Z_{ijt} of covariates such as municipality population, per-capita income and economically active population, to control for heterogeneity at state, municipality and chain levels.

Following a Bertrand-Nash competition scheme, δ_1 and δ_2 are expected to be negative. In a Bertrand model of oligopoly, firms independently choose prices in order to maximize profits. The resulting equilibrium is a Nash equilibrium in prices which is often referred as Bertrand-Paradox to describe that, even in concentrated markets, the effect of competition on strategic pricing behavior conduces firms to charge a price equal to their marginal cost. In real-world market configurations, retailers charge prices above marginal costs due to the existence of fixed costs, however, it is implied that, in presence of more competition within the relevant market, prices will converge to the marginal cost faster.

Of particular relevance is the coefficient δ_2 from the interaction term tax-competition, adding this interaction expands greatly the understanding of the relationship between the pass-through effect and competition in the model and allows for more hypotheses to be tested. Specifically, the hypothesis that the relationship between the degree of competition in the relevant market on the pass-through effect is different depending, precisely, on the competitive barriers faced by each establishment.

In Model 2 with the interaction term $(\sigma_{it} * Comp_i)$, the coefficient α_1 represents the expected change on the price of good i in the establishment j at time t associated with one unit change in the level of the tax conditional on the degree of competition to be at zero $(Comp_i = 0)$. As stated in section 3.3.1 the variable $Comp_i$ is a standardized variable, therefore α_1 represents the mean effect of the tax when the degree of competition stands at its average level.

δ_2 from the interaction term, thus, express how much effect the degree of competition faced by each establishment has on the effect of the tax on prices. If the interaction coefficient is negative, the effect of σ_{it} on prices decreases as the degree of competition increases, if positive the opposite. If the interaction coefficient is zero, then the effect of the tax on prices is independent of the degree of competition.

4.3 Alternative Specifications

So far two main issues have been addressed, first the pass-through effect of the tax increases and second the effect competition over the price adjustment. Nonetheless, there exist other important issues yet to be taken care of. For instance, are there any differences across taxed goods and/or retailing groups? how does the pass-through effect behaves over time?

To address the first question I relax the assumption of $\alpha 1$ as independent of time and product heterogeneity in Model 1. Slackening this assumption allows to examine for brand-specific, chain-specific and presentation-specific pass-through effect. Furthermore, since another important issue is the conduct of the over-shifting effect over time the following model is estimated.

Model 3

$$P_{ijt} = \Psi_{FE} + \alpha_1 * \sigma_{it} + \sum_{t=Jan}^{Nov} \beta_t(t2013) + \sum_{t=Jan}^{Dec} \phi_t(\sigma_{it} * t2014) + u_{ijt} \tag{4.3.1}$$

Where

$$\Psi_{FE} = \theta_E + \gamma_B + \phi_T + \rho_{BxT} + \varphi_{PxT}$$

and $Jan2013$, ..., $Nov2013$, $Jan2014$, ..., $Dec2014$ are dummy variables representing month and year, thus each interaction term gives information about the evolution of price adjustment to the tax over 2014. Since $December2013$ is excluded from the specification, all coefficients should be interpreted as relative to it. I do so for it is possible to clarify if supermarkets respond before the tax was effective, an anticipation effect before January 2014.

5 Results and Discussion

Given that the method in this work involves the estimation of several reduced-form price equations, the choice of specification has been empirical. This means that I have searchced for the specification which best fits and takes advantage of the unique data set available, subject to the properties assumed by the estimator being satisfied. The results are commented below.

5.1 Baseline pass-through results

I begin by discussing the estimates of model 1 in equation 4.1.1 and then analyze some alternative specifications to gather more evidence on the pass-through effect. To set up the analysis, I estimate the model using the full soft drink sample adopting different sets of fixed effects to asses the robustness of the results. The same model is estimated by relaxing the product, geographical and chain-independence of α_1 to report differences in shifting patterns.[15]

Table 7: Pass-through effect

	(1)	(2)	(3)	(4)
Excise Tax	1.86***	1.41***	1.33***	1.31***
	(0.018)	(0.010)	(0.019)	(0.019)
Fixed effects				
Establishment	Yes	Yes	Yes	Yes
Monthly	Yes	Yes	Yes	Yes
Product-Type	Yes	Yes	Yes	Yes
Brand	-	Yes	Yes	Yes
PresentationXType	-	-	Yes	Yes
TypeXTime	-	-	-	Yes
No. Obs.	1,019,712	1,019,712	1,019,712	1,019,712
Effect	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*
Mxn	0.86	0.41	0.33	0.31

Notes: Reported α_1, the shifting parameter. Mxn refers to the over-shifting magnitude in mexican pesos. In parentheses (-) standard errors clustered by establishment. *,** and *** statistically significant at the 0.10, 0.05 and 0.01 level respectively.

Although it would be difficult to specify all the economic, institutional, and demographic characteristics that determine price-setting behavior between establishments, it is possible to capture permanent heterogeneity affecting the costs of selling (i.e. transport costs, rent, legislation, local wages, differences in the up-stream production chains, etc.) using establishment specific fixed effects. In a similar way, if there exists any change in the macroeconomic environment that influence establishments all along, monthly fixed effects are able to capture those components. Moreover, given that in section 3.3 it was possible to gain some insight on the differentiated effects of the tax hike within the soft drinks set, it is important

[15]It is important to clarify that the dataset does not constitute a balanced panel of products. This may be a concern if, for example, the response to the tax increase from establishments is to substitute some expensive products for cheaper products or vice versa. This possibility should be captured by brand, product presentation and product-type fixed effects. However, I constructed a more balanced panel of products and obtain similar results so it was resolved to keep the largest dataset, results are reported in Appendix B.

to control for product-type unchanging characteristics , hence, product-type is considered in the primary set of fixed effects. All the above considerations deliver the estimate of column (1) in Table 7, reporting an over-shifting of 86% of the tax.

However, since the soft drinks set includes broadly defined groups of brands it is fundamental to control for those unchanging characteristics at the brand level (quality, popularity, equity of the brand, seasonality, market niche, etc.) that may be influencing the tax pass-through in the same product but with different brand name (Coca-cola 355ml. and Pepsi 335ml.) thus, brand fixed effects are included in the estimate of column (2) which reports an over-shifting of 41% of the real tax hike.

Yet, there still exists the possibility for differences in the price setting behavior due to presentation-type constant characteristics. If these differences are ignored, then it is implicitly accepted that the determinants for the price of, for example, one liter of juice and one liter of soda are similar. I control for this possibility using an interaction Presentation-Type fixed effects, the estimation is reported on column (3).

Even further, the reaction of prices to the tax increase may include another component of the costs of selling so far neglected, the possibility for a differentiated effect of product-type characteristics over time. This kind of costs may vary greatly from time to time due to seasonal demand or seasonal raw material costs. Therefore, taking into consideration that different product types require different raw materials but also that they may be demanded differently by consumers, an interaction Product-Time fixed effects are implemented. Pooling together all the previous considerations, column (4) shows, I believe, the most reliable estimation of the pass-through effect, signaling an over-shifting of 30.1% above the real tax increase.

Result 1: *There exists an over-shifting of 30.1% above the real tax increase considering the complete set of soft drinks prices in Mexico. This result is not consistent with the competitive paradigm, evidencing a concentrated Mexican supermarket industry.*

As it is stressed in section 2, empirical and theorical work on tax incidence have demonstated that over-shifting is possible in a number of distinct market structures. Specifically, Delipalla and Keen (1992), Delipalla and O'Donnell (2001) and Reny et al. (2012) show that, in a conjectural variations model with constant marginal costs for producers and a constant price elasticity of demand different patterns of shifting, other than full-shifting, are very likely to take place. Then, in order to understand the resulting over-shifting, it is unavoidable to wonder if these assumptions hold for the Mexican supermarket industry. We know from section 3 that this industry is, in fact, highly concentrated with few dominant supermarket chains that could well be interacting strategically.

Additionally, since the time scope considered in this work covers a period of two years (2013-2014), it is reasonable to uphold that supermarket chains have not drastically changed their distribution channels and their business processes, keeping marginal costs constant. Furthermore, Castro and Carrillo (2014) and Barquera et al. (2008) show a relatively constant price elasticity of demand for soft drinks in Mexico from 2004 to 2012 so we can assume a similar turn for the years considered in here. Hence, the 31-cent over-shifting on soft drink prices is, by no means, a pathological or unexpected result.

Inasmuch as the hypothesis of a perfectly competitive supermarket industry has been disproved, it is possible for the after-tax prices of distinct soft drink products to react differently to the same tax increase as a function of the market structure. An straight forward way to gain some insights into the possible shifting patterns, is to recall the theoretical benchmark monopoly model highlighted in section 2. In this context, even if marginal costs are constant, the response to a specific tax increase highly depends on the elasticity of the demand.

In the soft drinks market there is no reason to believe that price elasticity of demand is constant among product types and consequently there is no grounds to presume that the price response is the same.[16] To substantiate this argument I relax the product-type independence of the shifting parameter, the results are reported in table 8.

[16]Indeed, the literature suggests that the elasticities of demand of these commodities are rather different from each other. Castro and Carrillo (2014), Barquera et al. (2008) and Gil (2006).

Table 8: Shifting patterns

		Panel A[b]				Panel B[c]			
	(1)[a]	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Soft Drinks	Soda	Powder-Mix	Juice	Sports Drinks	Soda	Powder-Mix	Juice	Sports Drinks
Excise Tax	1.31***	1.48***	-0.02**	0.52***	0.75***	1.39***	0.084	0.46***	0.71***
	(.0193)	(.0021)	(0.002)	(0.010)	(0.007)	(0.004)	(0.053)	(0,009)	(0,008)
Shifting (Mxn)	1.31	0.49	0.00	0.52	0.75	1.39	0.00	0.46	0.72
No. Obs.	1,019,712	478,525	91,950	141,230	113,167	673,365	286,790	336,070	308,007
		Panel C[d]				Panel D[e]			
		(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
		Soda	Powder-Mix	Juice	Sports Drinks	Soda	Powder-Mix	Juice	Sports Drinks
Excise Tax		1.39***	-0.030**	0.51***	0.75***	1.39***	-0.03**	0.52***	0.75***
		(0.004)	(0.002)	(0.009)	(0.007)	(0.004)	(0.002)	(0.009)	(0.009)
Shifting (Mxn)		1.39	0.00	0.51	0.75	1.39	0.00	0.52	0.75
No. Obs.		478,525	91,950	141,230	113,167	1,437,551	1,050,976	1,100,256	1,072,193

Note: *,** and *** statistical significance at the 0.10, 0.05 and 0.01 respectively. [*a*] Cell (1) includes establishment, brand, product-type, monthly and typeXtime fixed effects. [*b*] In cells (2)-(5), estimation is computed by product type, hence, product-type fixed effects are omitted and product presentation fixed effects are incorporated. [*c*] Cells in panel B include establishment, brand, product-type, monthly and product presentation fixed effects. Parameters are estimated using a combined sample of the individual product-type and water prices as a control (*"diff-in-diff"* parameter). [*d*] Panel C includes establishment, brand, product-type, monthly and product presentation fixed effects, It also includes the mean weekly water price as a covariate. [*e*] Panel D includes establishment, brand, product-type, monthly and product presentation fixed effects. Parmameters are estimated using a combined sample of the individual product-type, milk, sugar, citrics, eggs, coffe, corn tortilla and other goods as controls.

As startling as it might be, the different shifting patterns observed within the soft drinks set reveal an extreme heterogeneity of demand and supply for each product, and suggests that they should not even be considered as elements of the same market. In table 8, I set up the analysis running the standard model 1 by product type, however, being that estimation is computed by product category this specification has an strong disadvantage as the shifting parameter is identified by comparing price variation within the same category between 2013 and 2014, a *"difference"* estimator.

An straight forward solution to this downfall is to include a relevant set of prices as a control, this set must fulfill the condition of having a similar trend to soft drink prices before the tax become effective and, as shortly described in the section 3, water prices meet this requirement. Thus, parameters in panel B are estimated using a combined sample of the individual product-type and water prices as a control in order to compute *"diff-in-diff"* estimators.

To assess the robustness of results, yet two other specifications are tested. In panel C the mean weekly water price is included as a covariate. This specification controls for time-varying shocks that affect establishments and soft drinks prices at the same time, the results are fairly similar. Furthermore, panel D also tries to recover "diff-in-diff" estimators, allowing for more products as controls, prices of, milk, sugar, citrics, eggs, coffee, corn tortilla and other regularly consumed products in Mexico are included in the sample, results are somehow identical from those in panel B suggesting that, indeed, the tax only affected soft drinks products.[17]

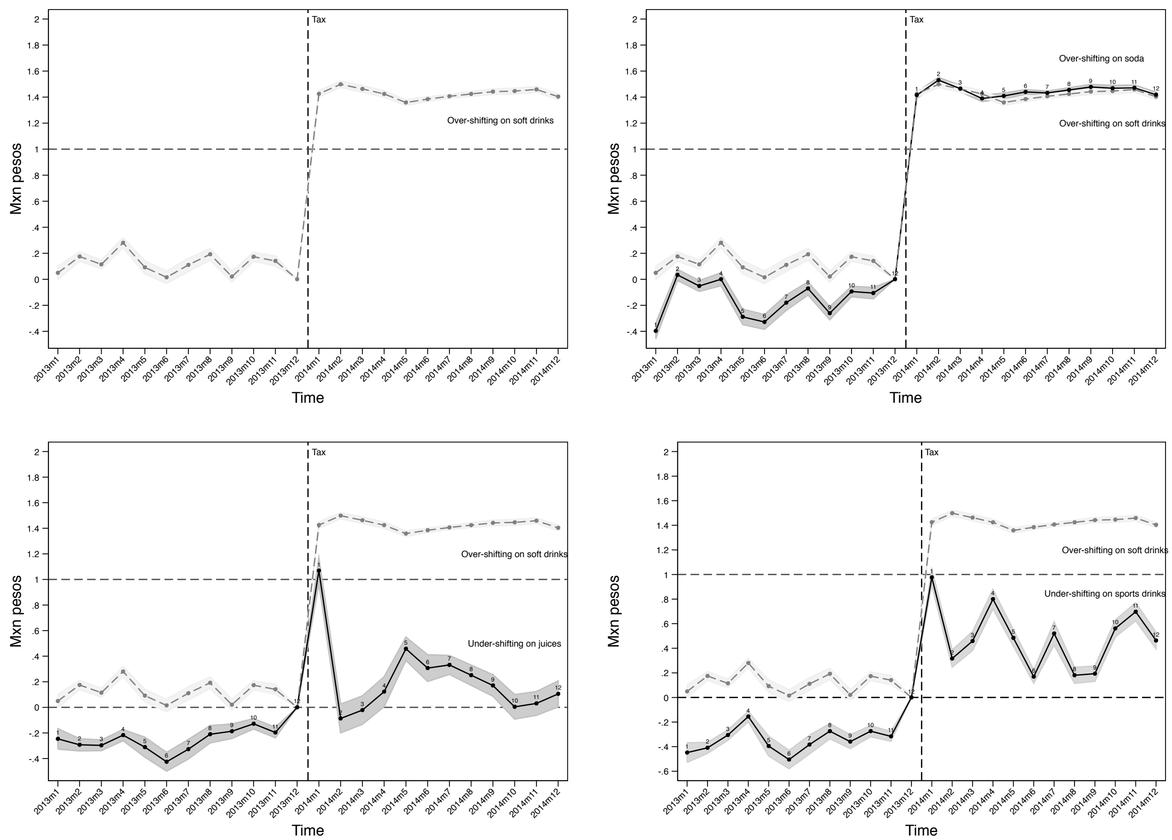
Result 2: *The tax shifting patterns are uncommonly heterogeneous among types of products. Shifting goes from 0.39 mxn pesos of over-shifting on soda prices, to a 0.54, 0.28 and 1.00 mxn of under-shifting into juice, sports drinks and powder-mix prices respectivelly.*

At the light of these results, a comprehensive way to understand the differences on shifting patterns may be to analyze each product individually and attempt to rationalize the findings on the basis of various market structures. In order to present evidence of differentiated structures, the shifting behavior over time is analized using model 3 in equation 4.3.1, which gives information about the evolution of price adjustment before and after the tax was effective, thus it is possible to track the timing of supermarkets' response, the results are shown in

[17] If increases in soft drink prices around 2014 were caused by economy-wide price shocks, rather than the soda tax, then those price shocks should be observable in the prices of untaxed as well as taxable goods.

figure 6.

Figure 6: Shifting patterns



Note: In model 3, as December 2013 is omitted from the specification, all coefficients should be interpreted as relative to it. In this manner is possible to clarify any anticipation effect before January 2014.

The first point to notice is that the results drawn from the available data set provide empirical evidence to the theoretical debate about the rigidity of prices facing exogenous cost shocks. In sharply contrast to the results presented in Bonnet and Réquillart (2013), which found a six-month period of price adjustments to a "soda tax" in France 2008, it is clear that the tax shifting takes place within the first month of 2014 for all product categories. This result may be in the interest of the macroeconomists who often wonder about the existence of rigidities on prices. Ultimately, the empirical response at the Mexican soft drink market, is that prices react immediately and with no anticipation effect to cost shocks.

In the interest of this work is also worth to notice that from January 2014 on, each product type follows an independent path directly related with the market structure in which it belongs. For example, the stability of the over-shifting estimates for soda prices suggest that the desired prices adjustments associated with the tax increase were completed by the end of the first month and the over-shifting prevailed as the new equilibrium, this result is consistent with the oligopoly model described lines above.

Contrastingly, the processes followed by products like juice and sports drinks, tell a whole different story. It is true that the tax shiffting took place at the begining of 2014, however, the dynamics of the market lead to a fading effect. It is possible that figure 6 depicts a lon-run convergence to the kind of equilibrium reached in the perfectly competitive model with an horizontal supply curve, sustaining a one-to-one relation between the tax increase and the prices. Astonishingly, results also show that most establishments decided to left unchanged the prices of powder-mix, even after the tax became effective. This practice has also been reported by Bergman and Hansen (2010) in the soft drinks market regarding a similar tax cut in Denmark 2003, its results show a mean under-shifting of 67% in a singel tax cut.

An important consideration is that, in Mexico, the price of fruit is relatively low compared with developed countries, they are so inexpensive that represent a real competitive barrier for some processed beverages. In this sense, products such as bottled juices and powder-mix have much more competition within their relevant market than sodas or sports drinks which compete against products in the same category and bottled water. The difference in the number of close substitutes is also fundamental to understand the competitive pressures faced by retailers and the pass-through effect of the tax.

Result 3: *Prices do not anticipate the tax rise. Moreover, different pricing behavior is observed among product types, soda prices respond immediately to the tax rise and stay high as a new equilibrium. Juices and sports drinks react differently, they increase as the tax became effective but cannot sustain the price rise, their prices decline in the following months but with a different intensity. Meanwhile, the powder-mix tax increase is fully borne by retailers.*

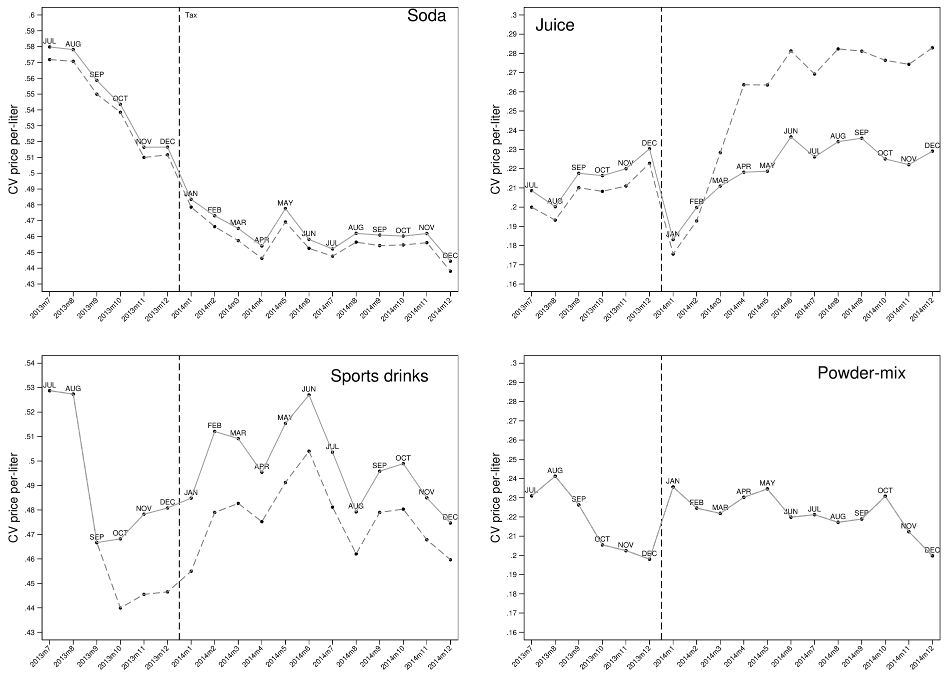
Being even more thorough in the analysis if sodas, juices, powder-mix and sports drinks belong to the same market then it is expected for their prices to be strongly interrelated. In particular, it is expected a decline in the price of a product to be accompanied by declines in the price of substitute products, so that the relative price levels are maintained stable (Hofer et al. (2009)).

Clearly, a trend with strong and positive correlation between the price of soda and juice is not observed in figure 6, nor between soda and sports drinks. In the months following the tax increase, prices of juice and sports drinks behave contradictorily to soda prices, while the first two go up the other one goes down and vice versa. Thus, by transitivity, prices for juice and sports drinks seem to follow a dynamic consistent with a higher degree of substitutability.

The price data available not only suggest that per-liter prices follow different dynamics but also that market structures are different among soft drinks categories. Then, the main argument to explain the different shifting patterns becomes the differences in precisely this structures, particularly, the competitive barriers and the elasticity of demand. Being that changes in competitive structures are associated with changes in the dispersion of market prices even for homogeneous goods,[18] a natural indicator of the presence of a more or less concentrated market is the so called variation coefficient which indicates the variation of prices across sellers of the same good keeping its characteristics fixed.

[18] Stigler (1961) noted that significant price dispersion is typical of natural markets even for perfectly homogeneous goods in local geographic markets, so a lack of dispersion indicates some degree of market concentration. Abrantes et al. (2006) examines price movements after the collapse of a big collusion in the retail gasoline industry, it finds that a low price variation is an strong indicator of collusion. Bolotova et al. (2008) compares the differences in the price setting during collusive and competitive phases of two public conspiracies in the Unites States. According to its results, the variance of prices during the conspiracy is dramatiacally lower than during more competitive periods.

Figure 7: Coefficient of variation (Price per-liter)



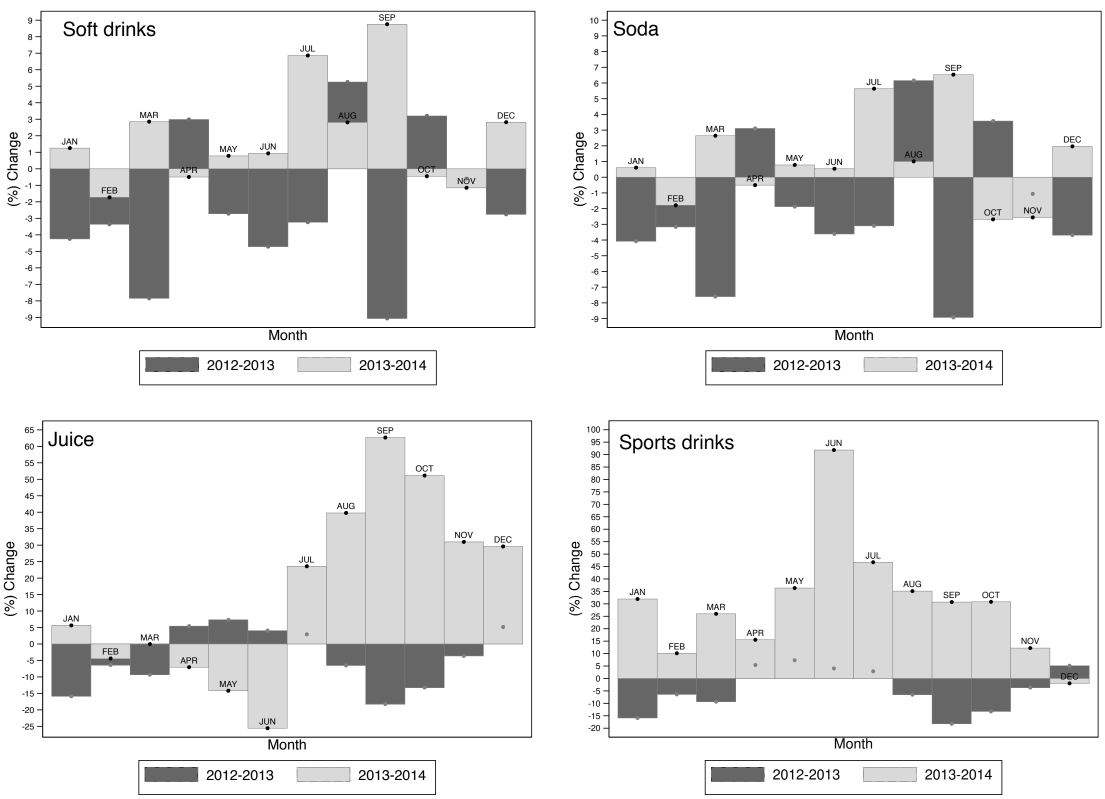
Note: Dashed line (Full sample). Continuous line (A balanced panel of the same products and presentations). Only taxable products are included, since retailers may differentiate prices to increase consumption of diet products.

Interpretation of figure 13 is straight forward, the higher the coefficient of variation the greater the heterogeneity of prices, which is related to a more competitive market structure. The results are overwhelming, perhaps, the most striking is the trend followed by the distribution of soda prices, it maintains a descendant trajectory in the pre-tax period, meaning a constant reduction in the price-setting heterogeneity among establishments, this drop stops only in the after-tax period and maintains its level for 2014. This findings are consistent with a highly concentrated market where some firms agree to set prices at some level to accommodate the tax increase. Meanwhile, prices of juices and sports drinks follow a different path. After the tax is imposed, the former increases the variation in price setting, presumably due to a stronger competitive reaction from retailers, the latter follows a similar trend but the over-all reaction is more conservative.

Another difference in market structure that may be driving the heterogeneity in shifting patterns is the elasticity of demand. If the elasticity plays an important role determining the tax shifting, then it is expected to witness differences in the consumption level after the tax increase and that these settings play the counterpart of the coefficient of variation.

Unfortunately, detailed information about soft drink consumption by category is scarce and does not allow to test this hypothesis formally. However, it is reasonable to assume that the monthly production of soft drinks is, for the most part, intended for regular consumption (i.e production is not stored), then an approximation for consumption may be the total monthly production by category.

Figure 8: Production volume variation by product type (2012-2013 & 2013-2014)



Source: Monthly Survey of Manufacturing Industry (EMIM), INEGI. **Note:** Monthly variation is calculated as Month2012-Month2013 and Month2013-Month2014.

In figure 8, the total of thousands of liters (tons in the case of powders) produced in 2014 is compared with the total production on the same month for 2013 (the same for years 2012-2013). The results reinforce the argument of different market structures as the reaction of production is different among categories. It is important to notice, in the first place, that the overall impact of the tax is not as expected for the authorities, at least as far as production is concerned, the total amount of soft drinks produced did not decline after the tax was imposed and rather seems to have increased.[19]

Similarly, production of soda for 2014 does not decrease compared with its 2013 levels, even though the average price for one liter increase in more than 1 mexican peso (over-shifting), this image allows to suggest that the demand for soda is highly inelastic. On the other hand, the drastic decline in juice production in early 2014 depicts a very price-sensitive demand. However, the coefficient of variation also illustrates an increased price competition for the after-tax period, the effect of competition vanished the tax price-increasing effect and forced retailers to maintain less than a one-to-one relationship between the tax and prices. I believe that this constitutes fairly compelling evidence that the shifting results presented in here are being served by different market structures for each product.

Result 4: *Shifting patterns depend on the market structure in which each product is located, particularly, on the elasticity of demand and the competitive barriers faced by retailers. Evidence shows that the level of shifting is lower the higher the elasticity of demand in each market.*

Being even more specific, Castro and Carrillo (2014) suggests that the elasticity of demand within product type follows a positive relation with the product content in the Mexican market, implying that the more the product content the less the elasticity of its demand. To test this hypothesis I estimate model 1 for an only-soda sample allowing for the coefficient α_1 to vary according to the product presentation.

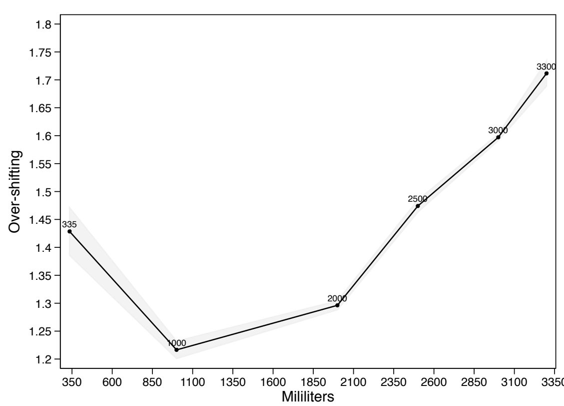
[19]In fact, Calvillo et al. (2015) reports that in the after-tax period, many soft drink companies intensified their propaganda and advertising campaigns which may be driving the increased production.

Table 9: Pass-through effect on soda by product content

	(1)	(2)	(3)	(4)
Milliliters	No. Obs.	Shifting Parameter	Effect	Mxn
355	49,401	1.42***	*over-shifting*	0.42
1,000	20,402	1.21***	*over-shifting*	0.21
2,000	227,724	1.29***	*over-shifting*	0.29
2,500	58,036	1.47***	*over-shifting*	0.47
3,000	115,885	1.59***	*over-shifting*	0.59

Note: Reported α_1, the shifting parameter. Mxn refers to the over-shifting magnitude in mexican pesos. Figures in parentheses (-) are standard errors clustered by establishment. All regressions include establishment-specific, brand and monthly fixed effects.Parameters are estimated using a combined sample of the individual product-type and water prices as a control. *,** and *** statistically significant at the 0.10, 0.05 and 0.01 level respectively.

Figure 9: Shifting parameter on soda prices by product presentation



Results reported in table and figure 9 are somehow consistent with the elasticity approach so far considered. They signal that the less elastic presentations are those of family-size and the commonly consumed canned soda, indicating a pattern of significant consumption in Mexican households. This outcome should not be very surprising since in table 6 it is reported that the per-liter soda price, under any brand, is much higher for smaller presentations than their larger counterparts, this phenomenon and the differentiated shifting patterns add evidence on the different market structures among presentations and product content within the same product type.

To gather more information on the pass-through effect of the soft drink tax, I also consider model 1 and relax various assumptions on the shifting parameter such as brand, chain and geographical independence. Results are highly consistent with different market structures on any of this considerations. Two issues should be highlighted: First, bigger and more rooted brands in Mexico, with a presumably less elastic demand and greater market power such as Coca-cola (coke) or Pepsi over shift a bigger amount of the tax (0.61 and 0.80 Mexican pesos respectively), while the over-shifting is much lower for brands with less market power as Jarritos or Mundet (0.20 and 0.19 respectively). Second, shifting patterns also vary greatly from chain to chain and in concordance with the market power approach, results suggest that chains with higher market power over shift a large amount of the tax, for example Wal-Mart and Bodega Aurrera with 0.51 and 0.53 Mexican pesos respectively, meanwhile chains like ISSSTE, a government store, over shifts a lower amount, 0.15 mexican pesos. All this evidence embodies the hypothesis that the tax incidence of a specific tax depends largely on market structure of the taxed good.[20]

5.2 Competitive Barriers

In order to assemble a thorough analysis on tax incidence, it is fundamental to analyze, the influence of market structure on price setting behavior and the extent on which this institutional structure influence the expected results. As mentioned in section 2, this concern has been handled in the literature under different treatments.

Taylor et al. (2014) finds full-shifting for gasoline taxes aproximating competitive conditions as the number of local rival stations. Alm et al. (2009) uses gasoline prices to find that gasoline markets in rural areas exhibit full-shifting, but those in urban areas demonstrate under-shifting. Harding et al. (2012) finds under-shifting of various tax hikes approximating the level of competition by assuming that the availability of lower-tax goods across state borders creates significant differences in the passthrough rate. Chiou and Muehlegger (2008) approximates competitive barriers showing that cigarette tax incidence varies with tax avoidance opportunities across state borders.

However, none of these or other related works have built an specific measure of the degree of competition to examine the role of market structure over fiscal policy. Thereby, as detailed in sections 3 and 4 three definitions of relevant market are adopted in here to study the level

[20]Detailed estimates can be consulted in Appendix B.

of competition faced by each establishment in this work. Using fixed-radius circles of two, five and eight kilometers, the degree of competition is defined as the number of surrounding stores for each of the 607 establishments for which I possess price information. Then, the relevance of competition on the pass-through effect is estimated using model 2 in equation 4.2.1 and results are reported in Table 10.

Table 10: Competitive barriers effect

	With establishment-specific fixed effects[a]			Without establishment-specific fixed effects[b]		
	(1)	(2)	(3)	(4)	(5)	(6)
Coeficient	2 km.	5 km.	8 km.	2 km.	5 km.	8 km.
Shifting Parameter	1.31***	1.32***	1.32***	1.31**	1.31**	1.31**
(α_1)	(0.007)	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)
Competition Parameter	n.a	n.a	n.a	-0.000	0.026**	0.040**
(δ_1)	-	-	-	(0.007)	(0.007)	(0.011)
(Tax X Competition)	-0.12***	-0.13**	-0.12***	-0.05**	-0.11**	-0.12***
(δ_2)	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)
$(\frac{\delta_2}{\alpha_1})\%$	-9.16	-9.84	-9.09	-3.81	-8.40	-9.16
Effect	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*
Shifting (Mxn)	0.31	0.32	0.32	0.31	0.31	0.31

Note: Figures in parentheses (-) are standard errors clustered by establishment. *,** and *** statistically significant at the 0.10, 0.05 and 0.01 level respectively. [a] Regressions in Columns (1)-(3) include establishment-specific, brand, product-type, monthly and typeXtime fixed effects. [b] Regressions in Columns (4)-(6) include geographical zone, product-type, typeXtime, product presentation, municipallity, brand, chain, monthly fixed effects and other co-variables such as total population by municipality, municipal socio-economic stratum, economically active population and municipal per capita income as right hand side variables.

To identify the influence of competition over the pass-through effect of a tax hike is not an easy task, to obtain a clean identification it is fundamental to control for all the factors that potentially affect price setting behavior among chains, municipalities and even establishments. I take advantage of the rich panel data available and estimate a fixed effects model that allows to isolate the effect of competition taking into consideration constant heterogeneity between establishments. The results are reported in columns (1)-(3) for the three measures of relevant market considered in here.

Recall from section 4 that the coefficient α_1 represents the average expected change on the price of good i in the establishment j at time t associated with one unit change in the level of the tax conditional on the degree of competition to be at zero ($Comp_i = 0$). Since the variable $Comp_i$ is standardized, then α_1 represents the mean effect of the tax increase when the degree of competition stands at its average level. δ_2, thus, express how much effect the degree of competition faced by each establishment has on the effect of the tax rise on prices. Given that the interaction coefficient is negative in all cases, the effect of σ_{it} on prices decreases as the degree of competition increases, giving empirical support to the hypothesis that the higher the level of competition the less the over-shifting of tax into prices.

The interpretation of the magnitude of the effect should be constructed relative to the measures of central tendency for the variable $Comp_i$, recall from section 3 table 5, in a 2 kilometer radius, the average number of supermarkets (as the number of different stores have been weighted) surrounding the stores for which price information is available is 21 and a positive alteration of one standar deviation constitutes an increase of 9 establishments within the circular area of 12.56 square kilometers.[21] Thus, the interpretation of the parameter δ_2 is as follows: the average pass-through of the tax hike, considering a 2km relevant market, is 0.31mxn where the degree of competition is at zero (i.e in geographical markets with 21 supermarkets within the 12.5km relevant area), if we move towards a geographical market with 30 supermarkets in the relevant market, it is expected a reduction on the over-shifting of 9.1%.[22] The same is true for other distances.

Since, the inclusion of establishment-specific fixed effects takes down the variation needed to identify the individual effect of the degree of competition over prices, model 2 is also estimated using a different set of fixed effects and several demand- and supply-side factors to control for heterogeneity at state, municipality and even at store level. However, as columns (4)-(6) in table 10 suggest, it is difficult to capture all the relevant price determinants. Indeed, estimates of the pass-through effect in columns (4)-(6) do not differ substantially from those

[21] The average number of establishments within each one of the relevant markets is potentially high, this is because of PROFECO uses a methodology that gives priority to specific and strategic locations in some major cities, presumably with a large number of stores. However, the data also accounts for large amounts of variation which can be perceived in the minimum-maximum range. A detailed semiparametric representation of the distribution of the variable $Comp_i$ is presented in Appendix C.

[22] For example, recall figure 4 in section 3, this is a graphical representation of two supermarket stores belonging to the same supermarket chain in the same municipality at the same period of time (less than 6 crow-fly km. away), the only difference between these two is, precisely, the number of surrounding competitive stores. Then it is expected, for the over-shifting to be relatively lower for the most inhibited establishment.

presented in (1)-(3). Nonetheless, the signs obtained for the competition variable are inconsistent with the theoretical expectation. In any case, this effect is very close to zero for all distances.

Even more, I believe that this should not be considered as a dramatic outcome because, as stressed before, there are many other unobserved factors affecting pricing behavior that may be driving up the results. Moreover, the signs and magnitudes estimated for the interaction term, report a direct and negative effect of competition over the pass-through effect closely related of those reported in (1)-(3).[23]

A further interesting matter is whether it is adequate to assume that the average and negative effect of competition is constant over all degrees of competition. To test this hypothesis, model 1 is estimated by sort of degree of competition for the relevant market of 2km and 5km, the shifting parameters estimated are plotted in figure 10.

[23] It is also worth noticing that the coefficients for the three relevant markets provide empirical evidence for the validity of the definition of relevant market used in this work, as in both specifications the negative effect of competition over the pass-through grows importantly from the 2km to the 5km relevant market, but stays still for the bigger distance, 8km. Thus, validating the intuition that consumers are only willing to spend a (10-15)-minutes drive to substitute a supermarket.

Figure 10: Pass-through and competitive barriers (2km.)

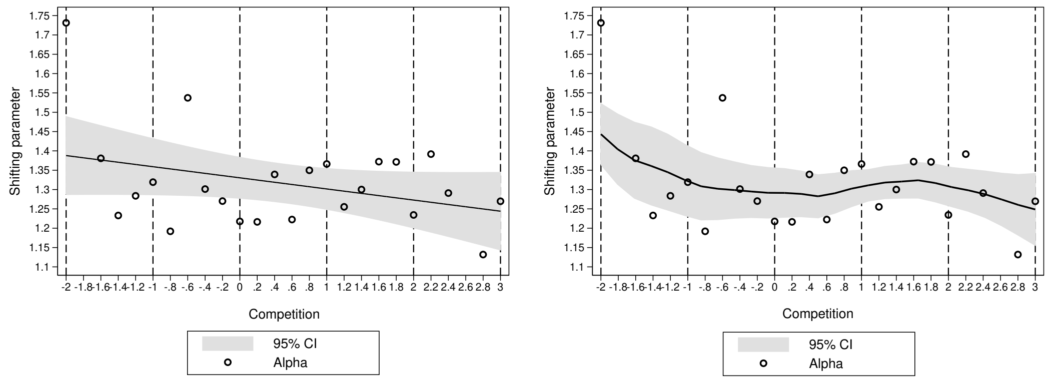


Figure 11: Pass-through and competitive barriers (5km.)

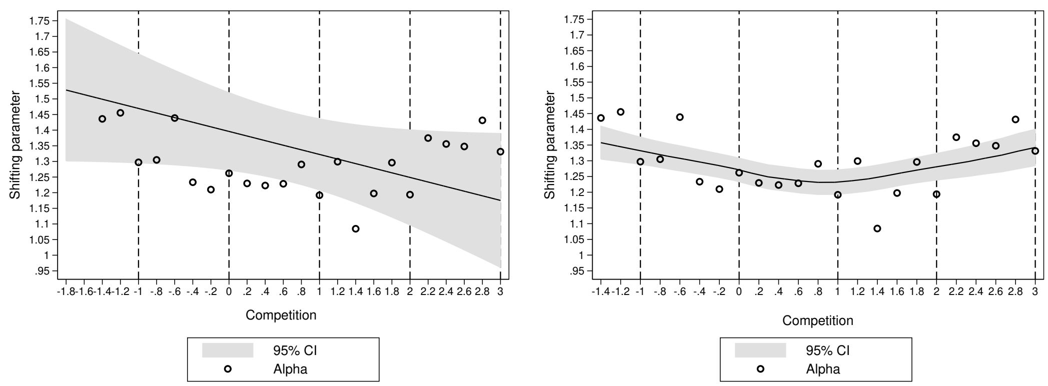


Figure 10 and 11 work in two directions. First, using a semiparametric approach, it illustrates that the effect of competition is not constant over the scale of competition, since the mean of the variable competition is zero, it is very clear that its effect is higher for those establishments located in a geographical market below the average (for 2km less than 21 supermarkets and for 5km less than 91 supermarkets) than for those operating in markets with a greater number of competitors. Additionally, it seems that ther e exists a limit for the negative pressure imposed by the competition on the pass-through, the restrictive effect faints for those establishments that are located in highly competitive markets. Second, the slope of the fitted line validates the estimates of δ_2 presented in table 10, the -0.12 for 2km and the -0.13 for 5km are easily spoted.

In order to understand the resulting estimates in the clearest possible way, it is needed to frame them within some economic intuition, then, the economic construct behind this results, I believe, is that in the standard Bertrand competition model. Given that it is accepted that supermarkets compete by setting prices, a given firms best response to a price increase of a competitor is to also increase prices. A tax increase can be thought of as a price increase by one firm that causes subsequent price increases of other firms. Thus, the first order effect of a tax rise is that firms increase their own prices because of the higher cost imposed by the tax, furthermore, this effect is magnified because establishments are reacting to the higher observed price from competitors (resulting in over-shifting of the tax to prices). However, this trend faints rapidly as the number of competitors and other competitive barriers increase within the relevant market. A single deviation from the higher price, and since supermarkets often sell the same product range (homogeneous goods), causes a rapidly drop in prices that only stops when the new marginal cost of selling the good is met, causing the desired full-shifting.

Result 5: *The number of stores in the relevant market has significant effects on the pricing behavior of retailers. Specifically, the degree of competition faced by establishments determines the shifting effect of a tax hike. Results show that, the effect of increasing the number of supermarkets from 21 to 30 within a circle of radius 2km reduces the mean over-shifting (0.31mxn) in 9.1% and increasing the number of supermarkets from 91 to 140 within a circle of radius 5km reduces the mean over-shifting in 9.8%.*

A major criticism about the extent of the level of competition considered so far is that, perhaps, supermarkets do not consider smaller stores as direct competition and therfore do not take part in supermarkets' price setting process. To test this hypothesis, a variation of the variable $Comp_i$ is drawn considering only supermarkets and similar stores within the circles of 2km, 5km and 8km radius. Results are reported in in table 11.

Table 11: Competitive barriers effect No. stores v.s. No. peers

	No. stores (weighted)			No. supermarkets and mini-markets		
	(1)	(2)	(3)	(4)	(5)	(6)
Coeficient	2 km.	5 km.	8 km.	2 km.	5 km.	8 km.
Shifting Parameter	1.31***	1.32***	1.32***	1.31***	1.32***	1.32***
(α_1)	(0.007)	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)
(Tax X Competition)	-0.12***	-0.13**	-0.12***	-0.004*	-0.03***	-0.05***
(δ_2)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)
$(\frac{\delta_2}{\alpha_1})$%	-9.16	-9.84	-9.09	-.30	-2.28	-3.80

Note: Figures in parentheses (-) are standard errors clustered by establishment. *,** and *** statistically significant at the 0.10, 0.05 and 0.01 level respectively. Regressions in Column (1)-(6) include establishment-specific, brand, product-type, monthly and typeXtime fixed effects.

Recall from table 5 that the number of supermarkets and mini-markets within the relevant market is relatively smaller than the full measure of competition, therefore, results in table 11 reveal an interesting result.

Result 6: *Supermarkets are not only concerned about peer stores within their relevant markets. Other establishments such as grocery stores, convenience stores and warehouse clubs take part on their price setting decision.*

Furthermore, following the competitive barriers notion used to analyze the pass-through effect, a valid intuition is whether supermarkets react differently depending on the product type and the competitive barriers faced. Given that it has been established that the elasticity of demand drives a huge effect on price setting behavior, a differentiated effect of competition over pass-through among different product types would indicate that the elasticity of supply is also a highly related factor.

Table 12: Competitive barriers effect by product

	Soda			Juice		
	With establishment-specific fixed effects[a]			With establishment-specific fixed effects		
	(1)	(2)	(3)	(1)	(2)	(3)
Coeficient	2 km.	5 km.	8 km.	2 km.	5 km.	8 km.
Shifting Parameter	1.49***	1.50***	1.50***	0.52***	0.53***	0.54***
(α_1)	(0.002)	(0.002)	(0.002)	(0.007)	(0.007)	(0.007)
(Tax X Competition)	-0.09***	-0.11**	-0.10***	-0.004**	-0.018	-0.039*
(δ_2)	(0.004)	(0.004)	(0.004)	(0.0253)	(0.028)	(0.027)
$(\frac{\delta_2}{\alpha_1})\%$	-6.04	-7.33	-6.67	-0.77	-3.80	-7.41
	Sports drinks			**Powder-mix**		
	With establishment-specific fixed effects			With establishment-specific fixed effects		
	(1)	(2)	(3)	(1)	(2)	(3)
Coeficient	2 km.	5 km.	8 km.	2 km.	5 km.	8 km.
Shifting Parameter	0.75***	0.72***	0.71***	-0.03***	-0.03***	-0.03***
(α_1)	(0.022)	(0.027)	(0.027)	(0.006)	(0.007)	(0.007)
(Tax X Competition)	0.03	0.08**	0.09**	0.00	0.00	0.00
(δ_2)	(0.021)	(0.024)	(0.027)	(0.005)	(0.006)	(0.006)
$(\frac{\delta_2}{\alpha_1})\%$	4.00	11.11	12.67	0.00	0.00	0.00

Note: Figures in parentheses (-) are standard errors clustered by establishment. *,** and *** statistically significant at the 0.10, 0.05 and 0.01 level respectively. [a] Regressions in Column (1)-(3) for each category include establishment-specific, brand, monthly, and product presentation fixed effects.

Results in Table 12 reinforce the findings of previous section, in fact, heterogenity on demand elasticities among different product types lead much of the tax pass-through. However, the joint consideration of the level of competition and the effect of competitive barriers is key to fully understand the effect of a tax increase as a public policy.

6 Conclusion

The effectiveness of employing soft drink taxation, as a tool for controlling consumption and combating obesity problems is not yet well documented, even less the effect of competitive institutions over the expected effect of taxation. However, from a public health perspective, the success of such intervention relies primarily on the pass-through from retailers to consumers in the form of increased prices. The findings in this work demonstrate that, across soft drinks categories and market settings, a tax increase have different shifting patterns and thus, is not clear who bears the burden of the tax.

Mexico imposed a nationwide one-peso per-liter tax on sugary drinks, effective January 2014, in order to combat the growing obesity problem and other public health concerns by increasing the final consumer prices. Thus, using a rich dataset of weekly prices for 75 unique soft drink products across 607 stores around the country, I evaluate the incidence of the Mexican soft drink tax, controlling for a large amount of constant heterogeneity across establishments, product types, product presentation and brands.

Findings show strong and consistent evidence of a 31% over-shifting of the tax into prices. However, they also prompt that the over-shifting is entirely driven by sodas with a shifting of 1.39 Mexican pesos into per-liter prices, since any other product category such as juices, sports drinks and powder-mix disclosed under-shifting into their final prices (0.46, 0.71 and 0.00 respectively). Such shifting patterns are consistent with different market structures going from oligopolized markets, such as Mexicos soda market with no close substitutes, to more competitive arrangements such as the juices market, sports drinks and powder-mix.

Along this work it is also found evidence supporting that that the effects of the tax in 2014 were reflected almost immediately into final prices and that there was any anticipation effect from establishments. This provides empirical proof on the theoretical debate about the rigidity of prices facing exogenous cost shocks. Furthermore, market structure (supply and demand conditions and competitive barriers), in which every category of soft drinks is considered, drove the long run effect of the tax. From January 2014 on, each product type follows an independent path. The stability of the over-shifting estimates for soda prices suggest that the desired prices adjustments associated with the tax increase was completed by the end of the first month and the over-shifting prevailed as the new equilibrium. Contrastingly, the processes followed by products like juice and sports drinks imply the tax shifting took place at the beginning of 2014, but the dynamics of each individual market lead to a fading effect. Surprisingly, results show that most establishments decided to leave unchanged the prices of powder-mix, even after the tax became effective.

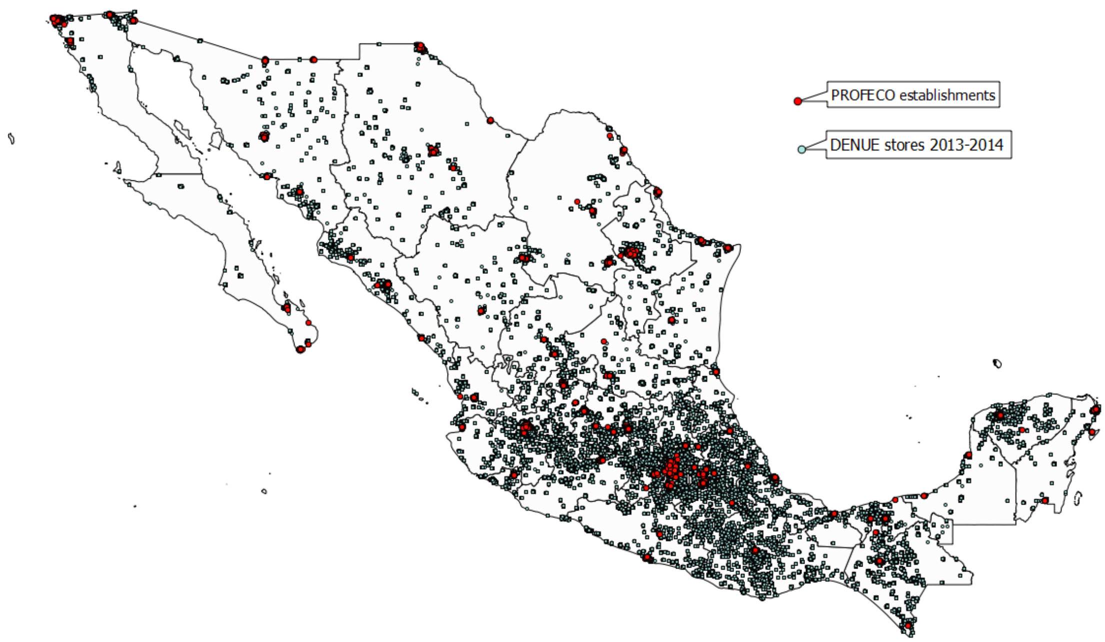
In this work, I also intended to bring forward a relevant discussion in the empirical competition literature, the effect of local competition and spatial information on pricing behavior and, explicitly, the effect of relevant competition over fiscal policy such as excise taxes. In order to capture the existent heterogeneity between geographical location and the number of competing establishments that each supermarket faces within its relevant market I designed a through measure of the degree of competition. Results highlight that the number of stores within the relevant market of a single store has significant effects on its pricing behavior. Even more, the degree of competition faced by establishments determines the shifting effect of a tax hike.

Evaluation and design of fiscal policy are typically generated under the assumption that commodity taxes are fully shifted and with no further consideration of any other market structure. The estimates in this work show that these simplifications do not always have empirical validity. Policy implications of the results presented in here are striking, as distributional and effectiveness considerations for proposed policy interventions are thus, typically biased. If, in fact, prices on some commodities go up more or less than on a one-to-one relationship, then taxes on these items are more or less burdensome than the usual analyses would suggest.

Apendix A

I.

Figure 12: PROFECO and DENUE establishments



Source: Federal Agency of Consumer Protection (PROFECO) and DENUE 2013-2014.

II. Degree of competition ($Comp_i$)

In order to design a comprehensive measure of the degree of competition faced by each establishment for which I possess information, an standard technique of the empirical supermarket competition literature is adopted. Using programming techniques and the computational power of geographic information system programs (GIS), I was able to recover the exact number of relevant establishments surrounding the PROFECO stores within fixed-radius circles of two, five and eight kilometers. After calculations were made, each one of the sorrounding establishments was classified according to the number of employees reported in the DENUE 2013-2014.

Table 13: Weighting factors, establishment classification

Establishment type	Range of employees	Avg. no. of employees	Weighting factor[a]
Grocery store	1-5	3	0.0213
Convenience store	6-10	8	0.0569
Mini-market	11-30	20.5	0.1459
Supermarket	31-250	140.5	1.00
Werehouse club	251-300	275.5	1.960

Note:[a]Weighting factor is calculated as the ratio avg(store-type)/avg(supermarket).

Then, the variable $Comp_i$ is defined as the weighted average of the number of establishments that surround each of the PROFECO stores. Finally, to simplify the interpretation of results the variable is standardized.

Apendix B

I.

Table 14: Pass-through effect (Two balanced paneles of products)

	Balanced panel 1[a]			
	(1)	(2)	(3)	(4)
Excise Tax	1.73***	1.40***	1.35***	1.13***
	(0.012)	(0.010)	(0.008)	(0.014)
No. Obs.	797,131	797,131	797,131	797,131
	Balanced panel 2[b]			
	(1)	(2)	(3)	(4)
Excise Tax	1.89***	1.41***	1.19***	1.31***
	(0.012)	(0.012)	(0.008)	(0.014)
No. Obs.	602,115	602,115	602,115	602,115
Fixed effects				
Establishment	Yes	Yes	Yes	Yes
Monthly	Yes	Yes	Yes	Yes
Product-Type	Yes	Yes	Yes	Yes
Brand	-	Yes	Yes	Yes
PresentationXType	-	-	Yes	Yes
TypeXTime	-	-	-	Yes
Effect	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*

Notes: Reported α_1, the shifting parameter. Mxn refers to the over-shifting magnitude in mexican pesos. In parentheses (-) standard errors clustered by establishment. *,** and *** statistically significant at the 0.10, 0.05 and 0.01 level respectively. [a] Balanced panel 1: each unique product observation (establishment, product type, brand and product presentation) have, at least, 35 weeks of information. [b] Balanced panel 2: I kept the most repeated products at every establishment.

II.

Table 15: Pass-through effect on Soda by Brand

Brand	(1) No. Obs.	(2) Shifting Parameter	(3) Effect	(4) Mxn
Coca-Cola (Coke)	73,150	1.37**	*over-shifting*	0.37
		(0.004)		
Fanta	43,759	1.61**	*over-shifting*	0.61
		(0.004)		
Fresca	36,246	1.46**	*over-shifting*	0.46
		(0.004)		
Jarritos	17,118	1.20**	*over-shifting*	0.20
		(0.008)		
Pepsi	43,573	1.80**	*over-shifting*	0.80
		(0.006)		
SidraL Mundet	18,039	1.19**	*over-shifting*	0.19
		(0.006)		
Sprite	42,183	1.47**	*over-shifting*	0.47
		(0.004)		
Squirt	17,847	1.35**	*over-shifting*	0.35
		(0.012)		

Note: Reported α_1, the shifting parameter. Mxn refers to the shifting magnitude in mexican pesos. Figures in parentheses are standard errors clustered by establishment. All regressions include establishment-specific, monthly and product presentation fixed effects.

III.

Table 16: Average pass-through effect by Georaphical Zone

Geographical Zone	(1) No. Obs.	(2) Shifting Parameter	(3) Effect	(4) Mxn
Centro Norte	90,354	1.12**	*over-shifting*	0.12
		(.0248)		
Centro Sur	433,601	1.28**	*over-shifting*	0.28
		(.0236)		
Noroeste	94,994	1.08**	*over-shifting*	0.08
		(.0294)		
Occidente	117,515	1.17**	*over-shifting*	0.17
		(.0218)		
Oriente	83,059	1.29**	*over-shifting*	0.29
		(.0299)		
Sureste	88,882	1.13**	*over-shifting*	0.13
		(.0279)		
Suroeste	30,596	1.43**	*over-shifting*	0.43
		(.0406)		

Note: Reported α_1, the shifting parameter. Mxn refers to the shifting magnitude in mexican pesos. Figures in parentheses(-) are standard errors clustered by establishment. All regressions include establishment-specific, brand, product-type, monthly and typeXtime fixed effects.

IV.

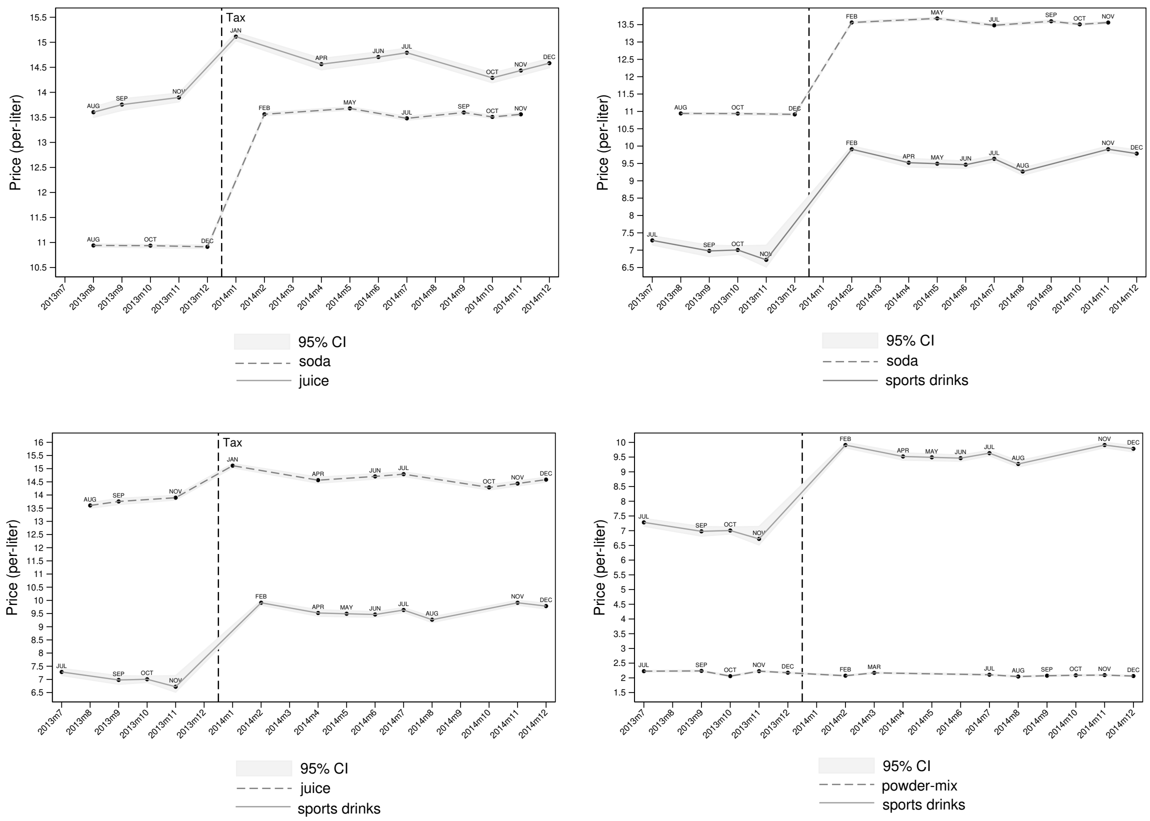
Table 17: Pass-through effect on soda by supermarket chain

	(1) Bodega Aurrera	(2) Comercial Mexicana	(3) Soriana	(4) Wall-Mart	(5) ISSSTE
Shifting Parameter	1.51**	1.49**	1.47**	1.53**	1.15**
	(0.005)	(0.005)	(0.005)	(0.006)	(0.017)
Effect	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*
Mxn	0.51	0.49	0.47	0.53	0.15
R^2	0.91	0.90	0.89	0.91	0.98
No. Obs.	67,483	68,702	87,351	60,468	3,681

Note: Reported α_1, the shifting parameter. Mxn refers to the shifting magnitude in mexican pesos. Figures in parentheses (-) are standard errors clustered by establishment. All regressions include establishment-specific, brand, monthly, and product content fixed effects.

V.

Figure 13: Price evolution (per-liter)



Note: An alternative specification of Model 3 is employed to estimate the expected price for one liter of product using establishment-specific, brand, product-type, monthly and typeXTime fixed effects. A balanced panel of the same products and presentations is built to avoid price variation for different products.

Apendix C

I.

Table 18: Competitive Supermarket Barriers Effect

	With establishment-specific fixed effects[a]			Without establishment-specific fixed effects[b]		
	(1)	(2)	(3)	(4)	(5)	(6)
Coeficient	2 km.	5 km.	8 km.	2 km.	5 km.	8 km.
Shifting Parameter	1.31**	1.32**	1.32**	1.30**	1.31**	1.32**
(α_1)	(0.007)	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)
Competition Parameter	n.a	n.a	n.a	0.02**	0.069**	0.067**
(δ_1)	-	-	-	(0.004)	(0.006)	(0.008)
(Tax X Competition)	-0.004*	-0.03**	-0.05**	-0.04**	-0.05**	-0.06**
(δ_2)	(0.005)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
R^2	0.834	0.835	0.835	0.40	0.39	0.49
Effect	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*	*over-shifting*
Shifting (Mxn)	0.31	0.32	0.32	0.30	0.31	0.32

Note: Figures in parentheses (-) are standard errors clustered by establishment. Instead of accounting for all the stores sorrounding an establishment, only other supermarket stores were considered.

[*a*] Regressions in Column (1)-(3) include establishment-specific, brand, product-type, monthly and typeXtime fixed effects.

[*b*] Regressions in Column (4)-(6) include geographical zone, product-type, typeXtime, product presentation, municipallity, brand, chain, monthly fixed effects and other co-variables such as municipality total population, municipal socio-economic stratum, economically active population and municipal per capita income as right hand side variables.

II.

Table 19: Competitive barriers effect by product including covariates

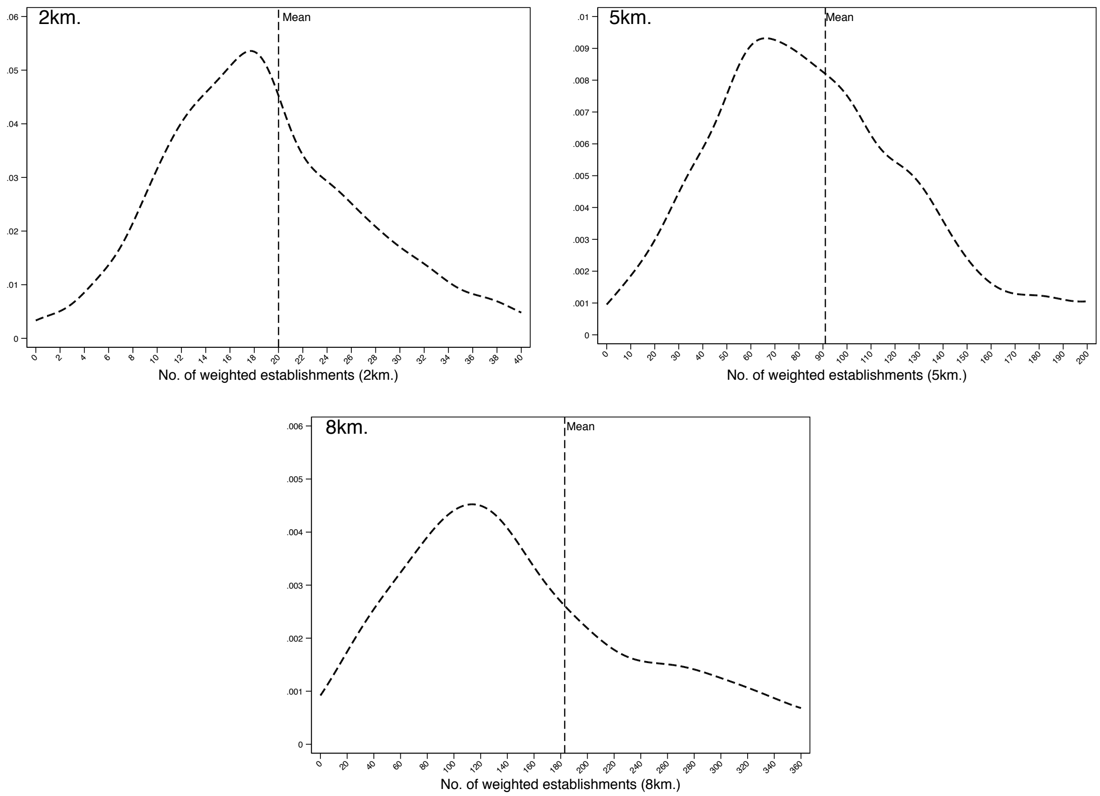
	Soda			Juice		
	Without establishment-specific fixed effects[a]			Without establishment-specific fe		
	(1)	(2)	(3)	(1)	(2)	(3)
Coeficient	2 km.	5 km.	8 km.	2 km.	5 km.	8 km.
Shifting Parameter	1.49***	1.50***	1.50***	0.51**	0.52**	0.53**
(α_1)	(0.046)	(0.045)	(0.045)	(0.032)	(0.032)	(0.005)
Competition Parameter	0.03**	0.03*	0.02	0.03**	0.10**	0.011**
(δ_1)	(0.014)	(0.020)	(0.028)	(0.014)	(0.031)	(0.048)
(Tax X Competition)	-0.08***	-0.10**	-0.09***	-0.006	-0.02*	-0.04*
(δ_2)	(0.032)	(0.033)	(0.035)	(0.0253)	(0.027)	(0.036)
$(\frac{\delta_2}{\alpha_1})\%$	-5.36	-6.66	-6.00	-0.8	-3.40	-5.55
	Sports drinks			**Powder-mix**		
	Without establishment-specific fixed effects			Without establishment-specific fe		
	(1)	(2)	(3)	(1)	(2)	(3)
Coeficient	2 km.	5 km.	8 km.	2 km.	5 km.	8 km.
Shifting Parameter	0.75**	0.73**	0.71**	-0.03***	-0.03***	-0.03***
(α_1)	(0.032)	(0.297)	(0.290)	(0.028)	(0.029)	(0.029)
Competition Parameter	0.00	0.01	0.00	0.00	0.02**	0.03**
(δ_1)	(0.010)	(0.0263)	(0.036)	(0.004)	(0.008)	(0.008)
(Tax X Competition)	0.03	0.08	0.08*	0.00	0.00	0.00
(δ_2)	(0.026)	(0.027)	(0.033)	(0.003)	(0.006)	(0.006)
$(\frac{\delta_2}{\alpha_1})\%$	4.00	10.95	11.26	0.00	0.00	0.00

Note: Figures in parentheses (-) are standard errors clustered by establishment. *,** and *** statistically significant at the 0.10, 0.05 and 0.01 level respectively.

[a] Regressions in Column (1)-(3) for each category include geographical zone, product presentation, municipallity, brand, chain, monthly fixed effects and other co-variables such as total population by municipality, municipal socio-economic stratum, economically active population and municipal per capita income as right hand side variables.

III.

Figure 14: Semiparametric distribution of degree of competition.



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