The Economic Impact of PHILADELPHIA'S BEVERAGE TAX

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AMERICAN BEVERAGE ASSOCIATION

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EXECUTIVE SUMMARY

Starting in January 2017, the city of Philadelphia became only the second municipality in the US to impose a tax on sweetened beverages (SBs). Unusually for such taxes, the Philadelphia Beverage Tax (PBT) applies to all SBs, whether sweetened with caloric or non-caloric sweeteners. This reflects the origin of the PBT more as a revenue raiser than as a public health measure.

This study seeks to estimate the economic impact of the PBT on Philadelphia. To do this, we make use of two proprietary datasets. The first relates to wholesale sales of the three largest bottlers in the Philadelphia area—we estimate that together these account for roughly 73 percent of taxed Philadelphia beverage sales. The second relates to retail sales at supermarkets in and near Philadelphia. Both datasets cover the period from January to mid-April in 2017, along with the same period in 2016. These data substantiate several key points in the economics literature surrounding SB taxes, and allowed us to estimate the economic impacts of the PBT from reduced economic activity in bottling, distribution, and retail.

BOTTLER DATA

Bottlers' sales in Philadelphia fell by roughly 29 percent while increasing by roughly 26 percent in the region immediately surrounding the city. This strongly indicates that consumers are traveling outside the city to avoid the PBT. Sales declines were largest at supermarkets and retailers; and lower at restaurants and convenience, gas, and drug store—places where consumers are less likely to plan their shopping (around tax avoidance).

SAME STORE SUPERMARKET SALES DATA

Supermarket sales data corroborate the patterns seen in the bottler data. Same store supermarket beverage sales in Philadelphia fell by 24 percent between early 2016 and 2017, while those outside Philadelphia increased by 14 percent. Furthermore, estimates of consumers' responsiveness to price changes (known as the elasticity of demand) for aggregate categories of beverages were broadly consistent with the existing literature.[1] **The estimated elasticity of demand was 0.90 for carbonated beverages, 0.93 for tea/coffee, and 0.92 for sports drinks.**[2]

1 The elasticity of demand is defined as the percentage change in quantity demanded divided by the percentage change in price.

2 These are somewhat aggregated categories, and shifts in the specific beverages purchased within a category will affect these estimates somewhat.

Retail sales data also showed large increases in the sale of sugary drink powders in Philadelphia, which are not subject to the PBT. Sales of drink mixes increased by 29 percent in Philadelphia between 2016 and 2017, and instant tea mixes by 32 percent, while sales outside the city increased by only 2 and 3 percent respectively. This clearly suggests that, in addition to traveling outside the city, consumers are avoiding the PBT by shifting to untaxed substitute goods.

Finally, and very significantly for the economic impact of the PBT, the data suggest that as consumers began to travel outside of the city to buy their SBs, they also bought other groceries at the same time, and consequently decreased their purchase of other groceries in the city. **This is seen in non-beverage same store grocery sales, which showed a remarkable seven percent decline inside the city, compared to an increase of one percent in the region surrounding Philadelphia.**

ECONOMIC IMPACTS

These results from the above analysis were used to model the economic impact in Philadelphia—in terms of jobs, GDP, labor income, and tax revenue—that resulted from reduced consumer purchases in the city as a result the tax. This was accomplished using input-output (IO) modeling, which traces the impacts of reduced output from industry to industry through the supply chain inside the city of Philadelphia.[3] It is important to note that the impact is measured in gross terms; we do not attempt to model what consumers do with money they might otherwise have spent on SSBs.

Three types of impact were considered: reduced bottling by two bottlers located in the city itself, reduced trade and transport margins on all beverage sales in Philadelphia—both those manufactured inside the city and those that are not, and reduced retail margins due to declines in non-beverage grocery sales. For each of these, three channels of impact were calculated: The direct impact relates to the reduced operations at the bottler, retailer, or wholesaler itself. The indirect impact measures the tax's effect as it ripples through supply chains for these firms. Finally, the induced impact reflects the reduced economic activity that results because less money is spent by those employed directly or indirectly in the industry in the wider consumer economy.

Overall, our models indicate an employment decline of 1,192 workers in Philadelphia as a result of the PBT, or roughly 0.14 percent of Philadelphia employment. These job losses broke out to roughly 5 percent from bottling, 25 percent from beverage trade and transport margins, and 70 percent from reduced non-beverage grocery retail. Operational data provided by bottlers suggests that this modeling actually understates true job losses, by roughly 72 jobs. The modeled job losses correspond to $80 million in lost GDP, and $54 million less labor income. This reduced economic activity results in consequent tax losses, which our modeling can estimate. Overall, we find a $4.5 million reduction in local tax revenue.

3 Implicitly, IO models assume that a reduced output of x percent in a given industry will result in an x percent reduced employment and value-added contribution to GDP

1. INTRODUCTION

In early March 2016, Philadelphia's mayor, Jim Kenney, proposed a citywide sweetened beverage (SB) tax.[4] Ultimately, the Philadelphia City Council approved a 1.5 cent per ounce tax on SBs on June 16, 2016, which took effect January 1, 2017.[5] Proponents of the tax had generally emphasized the positive fiscal impact of its introduction, and in particular, that tax proceeds could be used to fund universal pre-K.[6] Purported health benefits from reducing the consumption of sweetened beverages, and that have been used to justify such taxes in other jurisdictions, appear to have been a secondary consideration.

The Philadelphia Beverage Tax (PBT) is somewhat unusual among actual and proposed SB taxes, in that it applies to all "sweetened" non-alcoholic beverages (including carbonated soft drinks, teas, sports drinks, energy drinks, and juice drinks that are less than 100 percent juice) that use either caloric sweeteners (e.g. sucrose or corn syrup) or low- or no-calorie sweeteners (i.e. "diet" or zero calorie beverages).[7] As is the case with most actual and proposed SB taxes, the tax is levied on distributors, rather than on retailers or directly on consumers as in a traditional sales tax. Fountain drink syrups are taxed based on the volume of the beverage they are intended to produce.[8]

The PBT is only the second SB tax to be implemented by a US municipality. The first was imposed in March 2015 in Berkeley, CA—a city of only 120,000 people, compared to Philadelphia's 1.6 million. Since the PBT tax passed, however, voters in several Bay Area, California cities, including San Francisco and Oakland, as well as in Boulder, Colorado have approved SB taxes (all in November 2016). The County Commission of Cook County, IL (Chicago) enacted an SB tax that became effective in August 2017, but was repealed in October 2017 and abolished on December 1, 2017.[9] Other cities are currently considering imposing such taxes, either legislatively, or through ballot measures. As such, this is an opportune time to explore some of the economic consequences of the PBT.

4 http://6abc.com/politics/kenney-calls-for-soda-tax-in-first-budget-address-to-city-council/1229349/
5 https://www.wsj.com/articles/philadelphia-city-council-approves-sweetened-beverage-tax-1466104155
6 See Purtle, Jonathan, Bent Langellier, and Felice Le-Cherban (2017). "A Case Study of the Philadelphia Sugar-Sweetened Beverage Tax Policymaking Process: Implications for Policy Development and Advocacy." Journal of Public Health Management & Practice. http://journals.lww.com/jphmp/Abstract/publishahead/A_Case_Study_of_the_Philadelphia_Sugar_Sweetened.99608.aspx
7 For this reason, in this paper, we generally refer to sweetened beverage (SB) taxes instead of the more common sugar sweetened beverage (SSB) taxes (that is, we treat SSB taxes a special case of SB taxes). Where the distinction is relevant, we note it.
8 See https://beta.phila.gov/services/payments-assistance-taxes/business-taxes/philadelphia-beverage-tax/.
9 See https://www.forbes.com/sites/brucelee/2016/11/14/5-more-locations-pass-soda-taxes-whats-next-for-big-soda/.

In Philadelphia, following the introduction of the PBT, consumption of locally purchased beverages fell markedly, and more than had been anticipated by city officials. Consumers appear to have been more sensitive to price changes in SBs than expected—or, put another way, the price elasticity was higher than anticipated. What the data appear to show is that many consumers chose either to stop purchasing taxed SBs, or opted to purchase their SBs outside of the Philadelphia taxing jurisdiction. Falling local purchases can, in turn, be expected to have an impact on the economic activity of producers, distributors and retailers.

This study explores what has happened to consumer behavior in Philadelphia following the introduction of the tax, and what the knock-on effects of that change might mean for the wider economic impact of the sector—on bottlers, distributors and retailers.

To do so it makes use of two separate proprietary datasets, as well as public tax receipt data from the City of Philadelphia for context. The first of the proprietary datasets relates to wholesale sales by the three main local bottlers in the Philadelphia area, provided to Oxford Economics through the American Beverage Association, which also sponsored this research. The second proprietary dataset relates to retail supermarket sales in Philadelphia as well as an area immediately outside the city, and was obtained from Information Resources, Inc. (IRI). These datasets, and the public tax data, are discussed further in the box below.

These data allow us to speak to a number of the questions relating to SB taxation that arise in the literature, including how much of the cost of the tax is passed onto consumers (known as the pass-through rate); how responsive consumers are to price increases for these kinds of drinks (the elasticity of demand); the extent to which consumers switch to alternative non-taxed products (substitution effects); and the extent to which consumers simply shift their shopping trips outside the taxing jurisdiction to avoid the PBT (cross-border excise tax avoidance). Section 2 reviews the existing literature on SB taxation and discusses these and a few other topics in greater detail. Section 3 analyzes the three datasets.

Overall, these three datasets paint a consistent picture of significantly decreased beverage sales in Philadelphia, coupled with increased sales outside the city. Importantly, same store supermarket sales for products other than beverages are also down (though to a lesser degree) inside Philadelphia, and up outside the city, suggesting consumers are shifting grocery shopping trips to avoid the tax.

Having explored the impact of the tax on consumer behavior, the remainder of the paper uses these results to explore the impact of these changes on economic activity in Philadelphia—in jobs, GDP, labor income, and taxes—since the tax was introduced and going forward on an annualized basis. The impact derives from three sources: reduced bottling in the city, reduced trade and transport margins on beverage sales, and reduced retail sales margins on other goods. Each of these sources will result in a direct impact that can be estimated—reduced activity at the bottler, wholesaler, or retailer itself. On top of this direct effect, further economic effects will be felt as the consequences ripple out through the economy—in indirect impacts, that is, supply-chain effects; and through induced

impact—reduced economic activity that results from the lost spending of workers out of wages. It is important to note that these are gross rather than net impacts, and that we do not attempt to model how consumers dispose of money they would otherwise have spent on SBs.

These economic impacts of the PBT are discussed and modeled in section 4. Section 5 concludes.

DATA SOURCES

For this study, Oxford Economics obtained data from a number of sources, including those described below.

1.1.1 City of Philadelphia tax receipts

One key data source is actual tax receipts for 2017 taxed beverage sales in the city of Philadelphia through June.* Combined with other sources on sales changes from 2016 to 2017, and annual sales relative to half-year sales, as well as on the share of beverage sales subject to the tax, these data help to establish the total volume of beverages sold in Philadelphia, and to corroborate the magnitudes of sales data reported by the bottlers.

1.1.2 Bottler sales data

Data were provided by ABA members Coke, Pepsi, and Canada Dry on their local bottling, sales, and distributions operations. (This does not include products sold by one of these companies but bottled outside the region, for example most Gatorade products.)

All three bottlers provided sales data over the period roughly from January 1–April 17 of 2017 and 2016, as well as annual data for 2016 and 2015. In two cases, these sales data were provided in units of ounces, while in the third case they were provided in units of dollars. Additional breakouts of the sales data, for example by channel (grocery, convenience, etc.), and product type were also provided. One company provided an explicit estimate of what share of its 2017 Philadelphia sales was subject to the PBT, while product data from the other companies was roughly consistent with this value.

The bottlers also provided operational data on the number of employees at their Philadelphia area operations, and their employment changes between April 2016 and 2017. These employment changes are compared with modeled economic impacts presented in section 4.

1.1.3 IRI data

Retail-level sales data for Philadelphia area supermarkets was provided for this study by Information Resources, Inc. (IRI). These data cover retail sales both for beverages as well as for other grocery products. Each of the eight beverage categories in this report is somewhat aggregated (e.g. carbonated beverages, refrigerated juices/drinks, etc.), and none is entirely taxed, limiting the analysis somewhat. Because sales are reported on both a dollar value and a volumetric basis, however, we are able to calculate prices per ounce and observe retail price changes in response to the PBT. An interesting feature of these data is that some stores reported their sales prices inclusive of the new tax, while others excluded it.

Overall, this data set includes sales data for 32 stores in the city of Philadelphia, and 39 stores near the city with sales in both 2016 and 2017. (Similarly to the corporate data, the comparison is made for the period for January through mid-April.) A smaller set of 27 stores in Philadelphia and 27 stores outside of Philadelphia have sales extending back to 2014, and this subset was used to examine trends in same-store sales over a longer period.

* See https://beta.phila.gov/documents/fy-2017-city-monthly-revenue-collections.

2. BACKGROUND

A significant economics and public health literature has grown up around SB taxes.[10] Much of this literature focuses on potential health benefits of SB taxes, a topic which is fundamentally outside the scope of this study. Another thread of the literature focuses on the demographics of those most affected by SB taxes. Because our data are from manufacturers and retailers of SBs, rather than consumers, we have nothing to add to this topic.

This study focuses on the economic implications of the PBT, given that it was implemented primarily on fiscal grounds. The following topics from the economics literature surrounding SBs are most relevant to this work, and are reviewed in subsections 2.1 through 2.5 below.

- The pass-through of the tax to consumer prices—or the extent to which distributors or retailers absorb the price rise instead.
- The responsiveness of demand to price rises (elasticity)—how sensitive consumers are to changes in price for the goods in question.
- Substitution effects—the extent to which consumers simply swap one product for another to avoid the tax.
- Cross-border excise tax avoidance—the extent to which consumers make purchases in other places to avoid the tax.
- The impact of SB taxes on the economy in terms of lost jobs and GDP in bottling and related industries.

2.1 PASS-THROUGH OF THE TAX TO CONSUMER PRICES

The concept of "pass-though" suggests that when a new tax is introduced or the cost of producing or distributing a good increases, sellers may opt to pass the increased cost (in this case an excise tax) onto purchases, or alternatively absorb a portion of the cost. Where the intent of a tax is to affect consumer behavior—i.e. by reducing the amount of SBs consumed—to the extent that producers/distributors absorb the increase, the intended impact of the tax will be reduced. If sellers absorb some or all of the costs, then consumers will not experience as dramatic a price increase and will be less likely to change their current consumption. On the other hand, in the case where the intent is to raise revenue, if producers/distributors absorb the excise tax, this will increase the local fiscal effectiveness of

10 As we note above, most of this literature refers to sugar sweetened beverage (SSB) taxes; however because the PBT applied to both naturally and artificially sweetened beverages, we refer more generally to sweetened beverage (SB) taxes.

the tax by keeping sales and subsequent tax collections high (consumers won't experience a price change and so won't reduce consumption). Ultimately, the more of the tax that passes through to consumers, the higher the likelihood that a consumer will shift his or her behavior.

In the case of the 1¢/ounce tax to consumer prices tax introduced in Berkeley, Falbe et. al. found the pass-through rate to be roughly 57 percent overall for SBs, with the highest pass-throughs at liquor stores and supermarkets, and the lowest at drugstores.[11] Silver et. al. found pass-throughs of 65-67 percent overall, with 107 percent pass-through at large chain supermarkets, 131 percent at small chain supermarkets and gas stations, 45 percent at pharmacies, and –64 percent (i.e. prices fell) at independent corner stores and gas stations.[12]

As seen in some contexts above, pass-throughs of over 100 percent in response to new increases in taxes (i.e., prices to consumers increasing by more than the value of the tax), especially in the short run, are not uncommon. Bergman and Hansen, exploring six incidents of tax changes—increases and decreases—in Denmark find an "overshifting of tax hikes and undershifting of tax cuts."[13]

2.2 RESPONSIVENESS OF DEMAND TO PRICE INCREASE (ELASTICITY)

In general, as the price of a good increases, whether because of a new tax or for another reason, the quantity of that good demanded will decrease. Economists typically measure this sensitivity of consumer demand to price by the good's own-price elasticity of demand (ε), which is defined as:[14]

$$\varepsilon = \frac{\%\text{ change in the good's quantity demanded}}{\%\text{ change in the good's price}}$$

The lower the elasticity, the less demand for SBs will fall in response to the same price change—i.e. consumers are not sensitive to changes in price. To the extent that the goal of a tax is to influence consumer behavior, such as to reduce consumption of SBs, a higher elasticity will maximize this goal. To the extent that the goal is to raise government revenue, a lower elasticity will maximize this goal.

The elasticity of demand for SBs depends on a number of factors, including, for example, the availability of substitute goods, which are discussed below. As another example, those with higher incomes may be less sensitive to small changes in the price of a soda relative to

11 Falbe, Jennifer, Anna Grummon, and Kristine Madsen (2015). "Higher Retail Prices of Sugar-Sweetened Beverage 3 Months After Implementation of an Excise Tax in Berkeley, California." American Journal of Public Health 105(11): 2194-2201.

12 Silver, Lynn, Shu Ng, Suzanne Ryan-Ibarra, Lindsey Taillie, Marta Induni, Donna Miles, Jennifer Poti, and Barry Popkin (2017). "Changes in prices, sales consumer spending, and beverage consumption one year after a tax on sugar-sweetened beverages in Berkeley, California, US: A before-and-after study." PLOS Medicine. https://doi.org/10.1371/journal.pmed.1002283

13 Bergman, U. and Niels Hansen (2012). "Are Excise Taxes on Beverages Fully Passed Through to Prices? The Danish Evidence." Working paper. Quote in abstract.

14 Throughout, we present elasticities in absolute values.

their income. Conversely, areas with lower incomes may be more sensitive—i.e. have higher elasticities of consumer demand.

Andreyeva et. al. reviewed 160 studies on the elasticity of demand for food and nonalcoholic beverage products in the US and found values between 0.27 and 0.81, with a value of 0.79 for soft drinks.[15] This means, for example, that a 10 percent increase in the cost of a soft drink would lead to a 7.9 percent decrease in consumption of soft drinks. In another review of the literature on US food elasticities, Powell et. al. estimated a much more elastic demand, 1.21, for SSBs in particular, meaning a 10 percent increase in SSBs would decrease consumption by 12 percent.[16] Note that in this latter case, SSBs specifically exclude diet beverages, perhaps accounting for the differences between the two studies.

2.3 SUBSTITUTION EFFECTS

One factor potentially affecting the responsiveness (elasticity) of consumer demand to the price changes caused by the tax is the availability of substitute goods. Where taxes only affect sugary beverages, this may include diet sodas. However, the PBT also includes diet sodas. Juice, milk, or (bottled) water may also serve as substitutes for SBs. Another common substitute is beer and other alcoholic beverages, often excluded from the tax. Wansink et. al. documented an increase in beer consumption in alcohol-consuming households in response to a simulated SBs tax in a field experiment.[17] An SB substitute that has received limited attention, which we document increased sales for in this paper, is sugary drink mixes (powders), which are exempted under most SB taxes, including the PBT.

2.4 CROSS-BORDER EXCISE TAX AVOIDANCE

The phenomenon of cross-border shopping to avoid excise taxes, often in the context of cigarette and alcohol sales, is well known in the economics literature, although relatively few studies have attempted to measure it directly.[18] In general, one would expect greater cross-border tax avoidance where the tax is higher, residents are more mobile (e.g., where many people own cars and/or commute cross-border), and where the taxing jurisdiction is geographically smaller.

An important potential ramification of cross-border excise tax avoidance for the taxing jurisdiction is that consumers may shift additional purchases, besides just the good on which the tax is being avoided, out of the jurisdiction. For example, if Philadelphia residents travel

15 Andreyeva, Tatiana, Michael Long, and Kelly Brownell (2010). "The Impact of Food Prices on Consumption: A Systematic Review of Research on the Price Elasticity of Demand for Food." American Journal of Public Health 100(2): 216-222.

16 Powell LM, Chriqui JF, Khan T, Wada R, Chaloupka FJ. "Assessing the potential effectiveness of food and beverage taxes and subsidies for improving public health: a systematic review of prices, demand and body weight outcomes." Obes Rev. 2013;14(2):110–128.

17 Wansink, Brian, Andrew Hanks, and David Just (2013). "From Coke to Coors: A Field Study of a Fat Tax and its Unintended Consequences." Working paper.

18 See, for example, Chiou, L., & Muehlegger, E. (2008). Crossing the line: direct estimation of cross-border cigarette sales and the effect on tax revenue. The BE Journal of Economic Analysis & Policy, 8(1). Also, DeCicca, P., Kenkel, D., & Liu, F. (2013). Excise tax avoidance: the case of state cigarette taxes. Journal of health economics, 32(6), 1130-1141. Also, Stehr, M. (2007). The Effect of Sunday Sales Bans and Excise Taxes on Drinking and Cross—Border Shopping for Alcoholic Beverages. National Tax Journal, 85-105.

to a supermarket outside the city to buy SSBs as a result of the tax, they may choose to do additional grocery shopping outside the city at the same time.

Note that empirical measurements of elasticities of demand as described above will be biased upwards by cross-border tax avoidance. This occurs because consumers are not necessarily changing their purchasing behaviors. Instead, they are changing the location of their purchases to avoid the tax.

2.5 ECONOMIC ACTIVITY IMPACTS

A smaller set of work has focused on the economic impact of SB taxes on industries that might be affected: bottlers, distributors, and retailers.[19] As SB taxes reduce consumption of beverages, those employed in the bottling, trade, and transport industries, as well as their supply chains, will feel the impact.

To the extent that consumers redirect the resources they would otherwise have spent on SBs towards other products—either close substitutes for the foregone beverages or unrelated consumption—these other purchases, however, will have other economic impacts. Put another way, the impacts calculated here are gross, not net. Because of their bulky nature, however, SBs are unusual in the extent to which they are locally produced, and smaller localities may therefore feel the economic impact of an SB tax more than larger regions.

This may be especially the case where, as discussed above, SB taxes shift additional retail purchases, beyond just the products taxed themselves, outside of taxing jurisdiction. In this case, additional retail economic activity not directly connected to the SBs themselves is lost, and this activity is unlikely to be compensated for by any additional consumer spending within the tax jurisdiction.

19 See Oxford Economics (2013). "The Impacts of Selective Food and Non-Alcoholic Beverages Taxes." Prepared for the International Tax & Investment Center. http://www.oxfordeconomics.com/my-oxford/projects/341055

3. CONSUMER IMPACT OF THE PBT

This section reviews the three key data sources available on the impact of the tax: city tax data, corporate sales data, and IRI retail data. Given the fundamental differences between the data sources, where possible, we attempt to compare the results from different sources to arrive at mutually reinforcing conclusions.

3.1 CITY OF PHILADELPHIA TAX DATA

Since the start of 2017, the city of Philadelphia has been reporting monthly tax receipt data for the Beverage Tax. Because the tax is applied on an ad valorem basis of 1.5¢ per ounce, these tax receipts provide an authoritative estimate of the volume of sweetened beverages sold in the city of Philadelphia in 2017, absent tax evasion. Fig. 1 presents these results.

FIG. 1. City of Philadelphia tax data

	Tax receipts	Implied ounces	Budget estimate	%
January	$5,931,239	395,415,933	$7,697,167	77%
February	$6,180,869	412,057,933	$7,697,167	80%
March	$7,042,953	469,530,200	$7,697,167	92%
April	$6,521,859	434,790,600	$7,697,167	85%
May	$6,872,198	458,146,533	$7,697,167	89%
June	$6,920,394	450,000,000	$7,697,167	90%
	$39,469,512	2,629,941,200	$46,183,000	85%

Source: City of Philadelphia monthly revenue collections

According to city tax data, roughly 2.2 billion ounces of sweetened beverages were sold in Philadelphia in the first five months of 2017, or roughly 434 million ounces per month on average. There is some evidence for a stockpiling effect in lower-than-average sales in January and February (i.e., that retailers and/or consumers may have "stocked-up" on taxed products in anticipation of the implementation of the tax), but this is small in magnitude.

Note that, as has been reported in the press, tax receipts have been far below pre-implementation estimates, by roughly 15 percent.[20] This suggests that city forecasters did

20 See, e.g., http://www.philly.com/philly/news/city-soda-tax-revenue-to-fall-short-20170613.html.

not anticipate the extent to which consumers would shift away from purchases of taxed beverages within the city.

The corporate data described below was collected approximately for the period from January 1st to April 17th in 2017. For comparison purposes, according to city data, approximately 1,523 million ounces of taxable beverages were sold during this period.[21]

3.2 BOTTLER SALES DATA

As described above, for this project, Oxford Economics obtained proprietary sales data from the three major beverage distributors for their sales in the Philadelphia area. While these data provide important quantitative evidence for this work, various limitations make necessary certain approximations and assumptions that require explanation.

First, and most significantly, while two of the three companies provided sales data in ounces, the third provided sales data in dollar terms. For the total ounces figures below, dollar sales were converted to ounce figures using a (pre-tax) wholesale price of 2.4 ¢/ounce in general, falling to 2.2 ¢/ounce in Philadelphia in 2017.[22] This price fall following imposition of the PBT reflects the declining average price of beverages observed in the retail sales data, which is mainly attributable to the greater share of bottled water as soda sales were displaced (see section 3.3.2 for more discussion of this point).[23]

FIG. 2. Combined sales for Coke, Pepsi, and Canada Dry

	Total ounces (millions)			
	Philadelphia	Immediately surrounding Philadelphia	Remainder of region	Full sales region
2015	6,563	2,606	19,636	28,805
2016	6,920	2,658	19,769	29,347
2016 thru ~Apr 17	1,890	743	5,426	8,059
2017 thru ~Apr 17	1,338	935	5,529	7,802
2016–2017 change	-29%	26%	2%	-3%

Source: Bottling company data and Oxford Economics calculations

21 This is the sum of January-March sales, plus 17/30 of April sales.

22 These per ounce prices were arrived at using a combination of retail price data, sales mark-up data, and expert opinion. Overall, this is a higher wholesale price than the industry average implied by the price and markup assumptions in section 4. In general, these three bottlers, being major name-brand sellers, have higher prices than the industry-average.

23 Relative to assuming a constant price, the assumed decrease in wholesale price in Philadelphia in 2017 serves to decrease the estimated magnitude of the sales declines in Philadelphia measured in ounces following the imposition of the PBT, and is thus a conservative assumption. Changing product shares in the bottler sales data are generally consistent with the observed shift in product shares described in section 3.3.2 (including, again, the greater share of bottled water).

Note that the sales figures presented in Fig. 2 are for all beverages, not just those covered under the PBT. Only one company was able to provide a precise estimate of the share of 2017 beverage sales in Philadelphia covered by the tax, namely 83 percent. Product-category level data (e.g. bottled water versus carbonated beverages vs. teas) for the other two companies, however, suggest a similar share of taxed beverages, and so we apply this figure to the 1,338 million ounces of beverages sold through April 17, 2017 in order to estimate that these three companies sold 1,111 million ounces of taxed beverages during this period, or roughly 73 percent of the total estimate of 1,523 million ounces based on city data derived above (see section 3.1 above).[24] This roughly conforms with the prior expectations of those we spoke with at the companies themselves, and helps corroborate the data.[25]

FIG. 3. Comparison of tax data and corporate sales data

Description:	Total taxed sales through mid-April	Total sales of 3 companies through mid-April	Approximate share taxed	Implied taxed sales by 3 companies	3 companies' share of total taxed sales
Source:	City of Philadelphia	Bottling company sales data	Bottling company sales data	Calculation	Calculation
Units:	Ounces (millions)	Ounces (millions)	%	Ounces (millions)	%
Value:	1,523	1,338	83%	1,111	73%

The key result from this analysis, which will be used as a basis for the economic impacts in section 4 below, is a decline of 29 percent in wholesale beverage sales in the city of Philadelphia and of three percent for the sales region as a whole. In addition to serving as indicators of the tax's influence in their own right, these will serve as inputs for the economic impact models in section 4 below.

3.2.1 Relative sales declines by channel

Two of the three bottlers that provided data for this study were able to provide sales data by channel, which is presented in Fig. 4 below.[26] The data reveal a very large decline in sales to grocery stores and other retailers, and smaller but still very significant declines in sales to restaurants, convenience, gas and drugstores and other outlets. While it is worth noting that

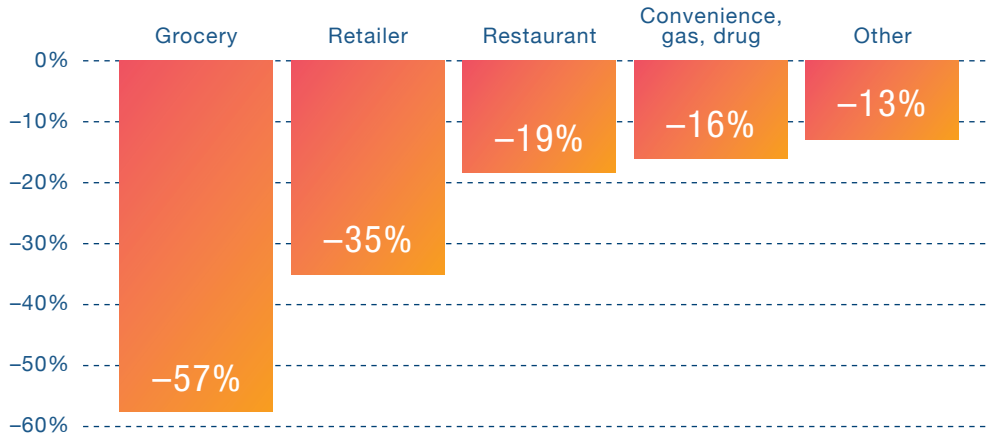
24 Recall that this excludes drinks supplied by these companies but not bottled locally.

25 Experts we spoke to considered this 73 percent figure slightly, but not extremely, high, and reasonable given the uncertainties that went into this estimate. Note that none of the economic impact or other results presented below are directly dependent on this result; rather it is presented here as a sense check to corroborate the data we use. Note that a significant share of the bottlers' Philadelphia sales is distributed in Philadelphia through intermediaries who themselves pay the PBT, so that direct tax payments by the bottlers would not match the estimates presented here.

26 This is an unweighted average of sales declines for between the two retailers for each category. In one case, sales declines were measured in volume, in the other dollars. Since the main purpose of this chart is to show relative declines between the different channels, we are not overly concerned with these inconsistencies.

these three bottlers are all name-brand soft drink manufacturers, and thus not representative of all sales in any given channel, these results are indicative of the relative magnitude of declines across channels. Additionally, they are consistent with the view that grocery and other retailer sales are the most responsive to the tax, in significant part because consumers can shift these purchases outside the taxing jurisdiction. This issue is explored more in the section on retail grocery data immediately below.

FIG. 4. Sales declines by channel



Source: Bottler data and Oxford Economics calculations

3.3 IRI RETAIL GROCERY SALES DATA

Data from IRI covering retail sales of beverages and other products were also obtained for this project. This includes data for 32 stores in the city of Philadelphia, and 39 stores near the city for which sales data are available in both 2016 and 2017. A smaller set of these stores had sales extending back to 2014, and this subset was used to examine trends in same-store sales over a longer period. All data are for the period roughly from January through mid-April of each year.

In Appendix B, we explore the IRI data itself in greater detail, and consider possible sources of bias. In general, we conclude that the IRI data are reliable.

3.3.1 Beverage sales declines

Fig. 5 below shows changes in volume sales (i.e. in ounces) in the first three and a half months of the year at same store[27] for different beverage categories.[28]

27 I.e., stores with sales in each year from 2014-2017, of which 27 in Philadelphia and 39 in the border region.
28 The "other" category includes shelf-stable canned juices, cocktail mixes, energy drinks, and shelf-stable non-fruit drinks, each of which accounts for less than 1% of sales.

FIG. 5. Changes in volume sales, same-store sales

	Philadelphia			Border		
	2016–2017	2015–2016	2014–2015	2016–2017	2015–2016	2014–2015
All beverage	-24%	10%	10%	14%	6%	10%
Bottled water	4%	20%	16%	11%	16%	20%
Carbonated beverages	-60%	3%	3%	30%	-4%	2%
Juices/drinks - rfg	-30%	3%	-1%	0%	-1%	-3%
Tea/coffee	-56%	3%	18%	14%	2%	11%
Bottled juices - ss	-26%	1%	11%	7%	-3%	7%
Sports drinks	-55%	8%	4%	12%	3%	4%
Aseptic juices	-40%	0%	8%	4%	-2%	1%
Other	-29%	4%	-1%	12%	0%	2%

Source: IRI data and Oxford Economics calculations

The results from analyzing IRI same-store sales data suggest three key themes:

- they corroborate the decline reported by bottlers and distributors;
- they align with expectations of changes in consumer price elasticity of demand; and
- they support the hypothesis of cross-border tax avoidance.

As the figure above shows, overall beverage sales declined by 24 percent within Philadelphia. This is in the same order of magnitude as shown by the corporate sales data decline of 29 percent above. In the border region, the data show that volume sales increased by 14 percent. This is somewhat smaller than the 26 percent volume sales increase in the corporate data above. Note, of course, that the corporate data include all channels of distribution, while the IRI data only include grocery; and that the IRI data includes drinks from all manufacturers, while the corporate data includes only the three top three manufacturers.

Second, differences between categories in magnitudes of decline appear to generally reflect common sense, with untaxed bottled water sales increasing slightly, and sales of juices (some of which are untaxed because they contain 100 percent juice), generally declining but less than sports drinks, carbonated beverages, and tea/coffee drinks, the majority of which are taxed.

Finally, border store sales increased most in the drink categories where Philadelphia sales declined the most, supporting the hypothesis that Philadelphia residents began traveling outside the city to purchase these drinks.

3.3.2 Price effects

A unique feature of the IRI data is that they allow for an analysis of the price impact of the tax. About half of the Philadelphia area stores report their 2017 taxes inclusive of the PBT, while the other half reports their prices without the tax. Along with a comparison to stores in the border region, this allows us to estimate the tax pass-through.

FIG. 6. Price effects of beverage tax[29]

		Volume (million ounces)		Price per ounce (¢)		Change 2016–2017	
		2017	2016	2017	2016	¢	%
Philly--tax included (15 stores)	All beverage	199	261	2.79	2.64	0.15	6%
	Bottled water	63%	44%	1.18	1.23	-0.05	-4%
	Carbonated beverages	11%	25%	4.76	2.85	1.91	67%
	Tea/coffee	6%	10%	5.01	3.12	1.89	61%
	Juices/drinks - rfg	9%	9%	6.03	5.24	0.79	15%
	Bottled juices - ss	6%	6%	5.48	4.98	0.50	10%
	Sports drinks	2%	3%	5.37	3.37	2.01	60%
	Aseptic juices	1%	2%	6.93	4.88	2.05	42%
	Other	1%	1%	11.46	9.69	1.77	18%
Philly--tax excluded (16 stores)	All beverage	619	809	2.10	2.28	-0.18	-8%
	Bottled water	63%	46%	1.02	1.02	0.00	0%
	Carbonated beverages	11%	20%	2.95	2.69	0.27	10%
	Tea/coffee	5%	10%	3.30	2.84	0.46	16%
	Juices/drinks - rfg	9%	10%	4.74	4.16	0.58	14%
	Bottled juices - ss	8%	8%	4.00	3.78	0.22	6%
	Sports drinks	1%	2%	3.34	3.23	0.11	3%
	Aseptic juices	2%	2%	4.63	4.23	0.40	9%
	Other	1%	1%	8.24	7.37	0.87	12%
Border (39 stores)	All beverage	1,143	1,004	2.50	2.53	-0.03	-1%
	Bottled water	45%	46%	1.18	1.16	0.01	1%
	Carbonated beverages	25%	22%	2.73	2.85	-0.12	-4%
	Tea/coffee	11%	11%	3.15	3.09	0.06	2%
	Juices/drinks - rfg	7%	9%	4.98	4.89	0.09	2%
	Bottled juices - ss	6%	7%	4.54	4.58	-0.03	-1%
	Sports drinks	3%	3%	3.31	3.30	0.00	0%
	Aseptic juices	2%	2%	4.88	4.93	-0.05	-1%
	Other	1%	1%	8.95	9.54	-0.60	-6%

Source: IRI data and Oxford Economics calculations

29 Only 31 of the Philadelphia stores with data for 2016 and 2017 are included in this table because one store could not be clearly classified as to whether it included PBT in the sales price.

It is important to note that each drink category represents a collection of multiple products and brands, and that the prices presented here are all averages per unit volume. An increase (decrease) in pre-tax price, therefore, might reflect a shift in the composition of purchases towards relatively more (less) expensive products within any given category, or it might reflect a change in the pricing behavior of the store. Such a shift in purchasing behavior might make sense for a number of reasons—for example, relatively more price sensitive consumers may be the most likely to shift their behavior because of the tax, while relatively price insensitive consumers would be less likely to do so.

There is no clear way to differentiate between a change in consumer behavior or a change in store pricing given these data. Moreover, we do not have precise estimates for any category of what share of the products in it are subject to the PBT.[30]

With those caveats nonetheless taken at face value, we see a greater than 100 percent "pass-through" of the tax (i.e. an increase in pre-tax price and/or an increase of more than 1.5¢ in post-tax price) in several categories, namely: carbonated beverages, tea/coffee, sports drinks, aseptic juices, and other beverages.

3.3.3 Elasticity estimates

Using the price and sales volume changes from the Fig. 6 and Fig. 5 respectively, implied elasticity values are calculated and displayed in Fig. 7 below.[31] Recall that elasticity is defined as the percentage change in quantity demanded divided by the percentage change in price. High elasticities (greater than one) represent elastic demand, meaning that consumers are relatively sensitive to a product's price. Low elasticities mean that consumers are relatively insensitive to price, and will continue to buy in similar quantities despite price increases.

FIG. 7. Elasticity estimates

	% change in price per unit volume (tax included)	% Volume sales change	Elasticity (absolute value)
All beverage	6%	-24%	4.12
Bottled water	-4%	4%	1.15
Carbonated beverages	67%	-60%	0.90
Tea/coffee	61%	-56%	0.93
Juices/drinks - refrigerated	15%	-30%	1.99
Bottled juices - shelf stable	10%	-26%	2.57
Sports drinks	60%	-55%	0.92
Aseptic juices	42%	-40%	0.95
Other	18%	-29%	1.58

Source: IRI data and Oxford Economics calculations

30 A rather imprecise estimate can be obtained by taking the difference in price changes per ounce between those stores for which tax is included and those for which it isn't, and then dividing this by the tax rate of 1.5¢. In practice, this results in estimates exceeding 100 percent in many cases.

31 In this table, we use price changes at stores that included tax in the sales price, and volume changes at all stores with same store sales data. In essence, we are assuming that sales changes are similar between these two sets of stores. Elasticity estimates change little if we narrow the sample only to those stores that included taxes in sales prices.

It is important to note that each category in this table, as in previous tables, is a composite of many product and brand types—some untaxed—and this ultimately skews the measured elasticity. This is most visible in the most aggregated category of all, the "all beverages" category, where prices increase little (owing, again, to a shift in composition towards cheaper beverages, especially bottled water), while sales declined significantly, resulting in an overall elasticity of 4.12—extremely elastic demand. This is the most likely explanation for the also very high elasticities in some bottled juice categories, which are also aggregates of both taxed and untaxed beverages, and which display a fair degree of heterogeneity in price per unit volume.

These same concerns will affect every category to a greater or lesser extent. However, it seems likely that measured elasticities for carbonated beverages, tea/coffee, and sports drinks, which are generally consistent with the existing literature (see section 2.2) are reasonably accurate. (Estimates for bottled water, which was generally not subject to an exogenous tax, are based on a small change in price and are likely unreliable.)

3.3.4 Effects on non-beverage grocery sales

In addition to declines in beverage sales, there is reason to think that, as a result of the beverage tax, sales of other grocery products might also decline. In particular, if consumers shift their grocery shopping trips outside the city in order to avoid the PBT, they will likely purchase a large number of other goods at the same time.

Fig. 8 and Fig. 9 present the change in dollar sales between 2016 and 2017 for a variety of products, as well as for the aggregate categories: total store sales, all beverages, and all non-beverages.[32] Note that the difference between the beverage category here and that in Fig. 5 above is that those figures are measured in volume whereas these are measured in dollars.

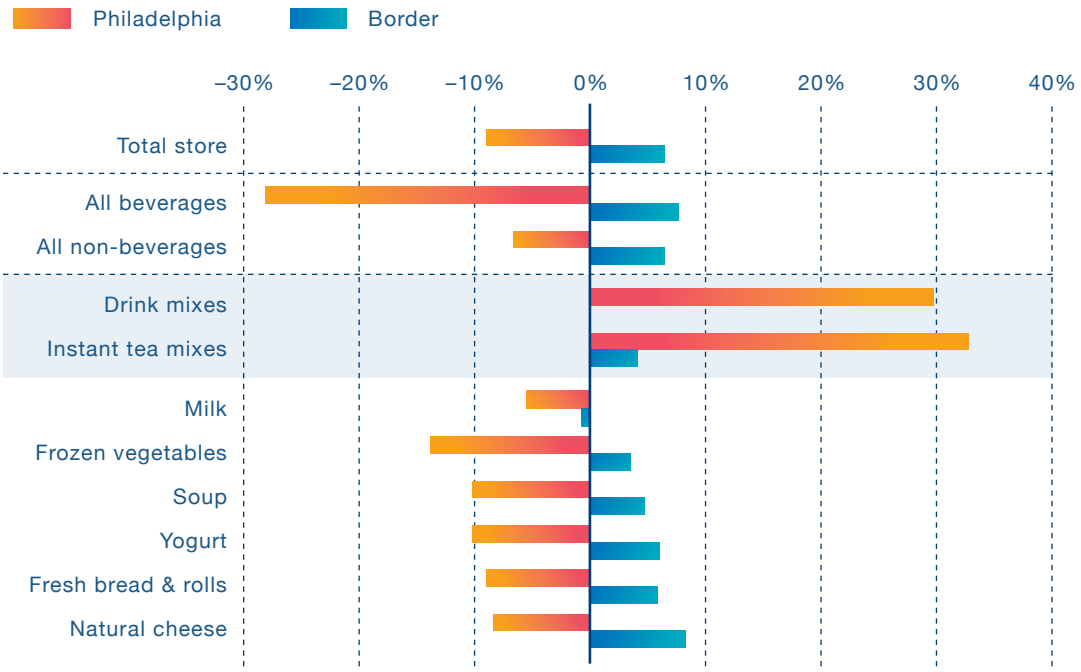
Fig. 8, as well as Fig. 9 which presents the same 2016-2017 same store sales change data in table form, along with 2015-2016 and 2014-2015 changes, provides strong evidence that the PBT resulted in increased sales of close substitutes to SSBs, namely untaxed drink mixes and instant tea mixes. These show increased sales of 29 and 32 percent respectively in Philadelphia following imposition of the tax, but only 2-3 percent increases in the border region. Anecdotal evidence from those familiar with Philadelphia retail strongly supports the result presented here that close substitutes like these have experienced robust growth since the implementation of the tax.[33] Unfortunately, there is no straightforward way to estimate the total caloric effect associated with this change.

Looking beyond close substitutes for SSBs, however, a wide variety of categories of goods experienced declining sales in Philadelphia grocery stores in 2017. Excluding the beverage

32 The all beverage category used here is identical to the one above, and the non-beverage category is everything else. Note that this means a few drinkables, such as milk, are part of the non-beverage category.

33 Another likely substitute to SBs, increased sales of which are reported anecdotally, is beer. Unfortunately, IRI grocery data provide a very limited window on Philadelphia beer sales.

FIG. 8. Dollar sales changes 2016-2017, same store sales



Source: IRI data and Oxford Economics calculations

FIG. 9. Dollar sales changes, same store sales

	Philadelphia			Border		
	2016–2017	2015–2016	2014–2015	2016–2017	2015–2016	2014–2015
Total store	-9%	6%	8%	2%	2%	7%
All beverages	-28%	7%	9%	12%	3%	6%
All non-beverages	-7%	6%	7%	1%	2%	7%
Drink mixes	29%	1%	-2%	2%	-4%	-2%
Instant tea mixes	32%	4%	7%	3%	-5%	0%
Milk	-5%	0%	3%	3%	-3%	3%
Frozen vegetables	-14%	3%	8%	-2%	-4%	3%
Soup	-10%	4%	4%	0%	-3%	4%
Yogurt	-10%	6%	8%	0%	1%	8%
Fresh bread & rolls	-9%	6%	8%	1%	2%	5%
Natural cheese	-8%	8%	16%	1%	1%	13%

Source: IRI data and Oxford Economics calculations

categories addressed above, remaining same store grocery sales (measured in dollars) declined by seven percent overall from 2016 to 2017, a stark decline and counter to the consecutive year-over-year growth that occurred previously.[34]

Unlike other estimates presented in this section, we have no additional cross-checks on this estimated sales decline. In appendix A, we discuss some of the tests we conducted on IRI data assist in validating this result. (This includes a discussion of the relatively higher increase in same store sales in Philadelphia than in the border region between 2015 and 2016, as seen in Fig. 9.)

34 More precisely, the non-beverage sales decline in Philadelphia was 6.7 percent, which is the value used in section 4.1.3 below.

4. ECONOMIC IMPACT OF THE PBT

In this section, we consider the economic impact on the Philadelphia economy of reduced purchases of beverages and other products (within the city of Philadelphia) as a result of the PBT. For this work, we consider three sets of impacts:

- Reduced manufacturing activities at bottling establishments in the city of Philadelphia,
- Reduced retail, and wholesale and transport margins from lower beverage sales in the city, and
- Reduced retail trade margins from lower non-beverage sales in the city.

The economic impacts are calculated using IMPLAN, an industry standard economic impact modeling software. Economic impacts are described in more detail in the box on the following page.

Section 4.1 below reviews the assumptions that go into each of these three sets of impacts; section 4.2 presents the impact results.

In order to calculate the first three impacts, we have relied on IMPLAN data on trade and transport margins in the soft drink industry to split the value of soft drink sales between factory and trade and transport sectors. These margins are presented in Fig. 10 below.

FIG. 10. Trade and transport margins in the soft drink industry

	As a share of retail price	As a share of wholesale price	As a share of factory gate price
Factory gate prices	59%	83%	100%
Wholesale & transport margins	12%	17%	21%
Retail margins	28%	40%	48%

Source: IMPLAN based on Bureau of Economic Analysis data

It's important to note that applying input-output modeling techniques, which are described in the box on the next page, to this problem makes a fundamental assumption that a one percentage point decline in output in a given industry will result in a one percentage point decline in that industry's employment and value-added contribution to GDP. This assumption may not be perfectly accurate, especially in the short term. For example, a grocery store

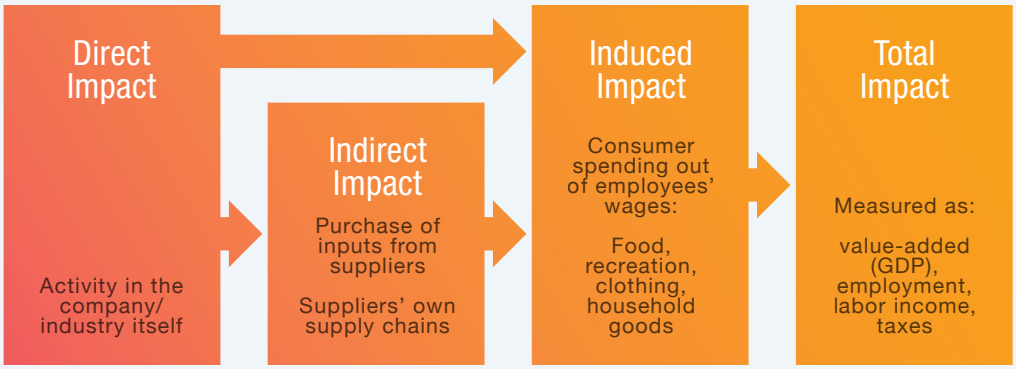
INTRODUCTION TO ECONOMIC IMPACT MODELING

Input-output (I/O) modelling follows the flow of economic activity through the economy using data on inter-industry supply chain linkages. In this study, the impacts trace the full economic activity supported by final production (of beverages themselves, as well as of retail, wholesale, and transport services) that is modelled to be lost as a result of the PBT.

Impacts are calculated across three channels, which are defined as:

- **Direct impact**: The direct impact is the jobs and activity taking place in the industry or activity itself.
- **Indirect impact:** The indirect impact is the jobs and activity supported down the supply chain of the industry or activity itself, including suppliers of suppliers.
- **Induced impact:** The induced impact is the jobs and activity supported by the spending out of wages of those employed directly or indirectly.

FIG. 11. Economic impact channels



We measure impacts in four ways:

- **Employment:** Headcount employment, including self-employment, as used by the Bureau of Economic Analysis.
- **GDP:** the total value added in the industry/impact channel.
- **Labor income:** Employee compensation, including benefits, and self-employment income
- **Taxes:** Federal, state, and local taxes generated by the full impact of the economic activity. Includes a variety of tax types, such as income, social insurance, sales, and property taxes, among others.

For this work, we used IMPLAN economic impact software, an industry standard economic impact modeling software.

that experiences a ten percent decline in its sales might trim less than ten percent of its workforce because the need for certain job functions is fixed and does not vary with total sales. Conversely, short-run employment losses may exceed output or GDP losses in a given industry for a variety of reasons, and this could help explain the discrepancy discussed in section 4.2.3 below. Over a longer period, entry and exit within the industry is likely to result in employment adjustments that more closely resemble our assumptions.

4.1 ASSUMPTIONS

This section describes the assumptions underlying each of the three sets of impacts. The results coming out of these assumptions are presented in section 4.2 below.

4.1.1 Bottling impacts

According to the Census Bureau's County Business Patterns, there were two soft drink bottling establishments of appreciable size in Philadelphia County in 2015.[35] These bottling facilities, operated by two of the three companies that provided data for this study, supply beverages both inside and outside of the city of Philadelphia. They employ workers, who live both inside and outside the city, and purchase input goods and services both inside and outside the city.

The third company that provided data for this study bottles outside, but near, Philadelphia. It also employs workers who live inside and outside the city, and has a supply chain that partially draws from the city. For the purposes of this work, however, we quantify only the economic impacts of changes in bottling activity actually inside the city of Philadelphia.

Fig. 12 below presents the assumptions that go in to calculating the bottling impacts. The primary input is a reduction of $22.0 million in bottling output—measured in (constant 2017)[36] wholesale prices—between 2016 and 2017.

FIG. 12. Bottling impact assumptions

Item	2016–2017 difference	Sources
Reduced regional sales, wholesale prices ($ millions)	-$22.0	Oxford Economics calculations based on company data
Factory share	-$18.3	IMPLAN margins
Wholesale & transport share	-$3.8	IMPLAN margins

35 See https://factfinder.census.gov, Table CB1500A13, NAICS code 312111. One employed between 100 and 249 employees in 2015, the other between 250 and 500. One other bottler employed fewer than 5 people.

36 I.e., the intention is to correct for inflation. One of the bottlers provided data in dollars, for which 2016 data was adjusted to 2017$. The other bottler provided data in ounces. In this case, as in section 3.2 above, we applied a constant wholesale price of 2.4 ¢/ounce, except in Philadelphia in 2017 where 2.2 ¢/ounce was used to reflect the changing makeup of sales following the tax.

The precise details of the calculations that go into this assumption cannot be disclosed here because they reflect sales data for only two of our three companies, from which sales data for the third could be backed out; however, the magnitude of this assumption can be put into the context of other results. Fig. 13 below estimates (for reference) the value of reduced sales of all beverages in Philadelphia as $38.5 million in wholesale prices.[37] However, increased sales (likely from displaced purchases) in the area surrounding Philadelphia, combined with the fact that the two bottling plants in Philadelphia supply only a fraction of the total beverage sales in Philadelphia, leads us to estimate a figure of $22.0 million.[38]

4.1.2 Beverage wholesale and retail impacts

This section considers trade and transport margins on beverage sales in Philadelphia. As fewer beverages are being sold, there is a concomitant reduction in the amount of goods being transported and sold and therefore reduced activity in the transport and trade sectors. Specifically, we calculate impacts in three industries: truck transport, wholesale trade, and retail trade. For simplicity, we combine transport and wholesale margins in the assumptions below, and report the results for all three sectors together.

Unlike in the previous section, the trade and transport impacts considered in this section are for the whole beverage industry, not just for the two bottlers with facilities in Philadelphia, or the three bottlers we collected data from. Additionally, these margins reflect only final sales in Philadelphia.[39]

Fig. 13 on the next page outlines the assumptions that go into the wholesale and retail impact calculations. Note in particular the constant price assumption—this conflicts with the results in section 3.3.2 above that average prices of beverages fell following imposition of the PBT, again largely as a result of the increased share of bottled water sales. However, for the purposes of calculations here, we assume that wholesale and retail margins per unit volume did not fall as a result of the changing makeup of beverage sales (i.e., that trade and transport margins are similar for different types of beverages). Note that this is a conservative assumption—if trade margins did fall, this would increase the impacts of the tax. We also assume a constant price/trade markup in order to look at real (i.e., inflation adjusted) impacts of the tax.

37 I.e., $31.9 million in factory gate prices plus $6.6 million in wholesale and transport margins. Note that the purpose for the assumptions in Fig. 11 is as a basis for estimates of changes in Philadelphia trade and transport margins, not as an independent estimate of the value of beverage sales declines, which nowhere enter directly into our estimates.

38 Additionally, as was the case in section 3.2 above, we assume a higher per-ounce price for the output of these two (name-brand) bottlers, than for the average across all beverages in Fig. 12.

39 While this is clearly appropriate for retail trade margins, which occur at the point of final sale, the geography of wholesale and transport impacts is somewhat more complex. To be conservative, we only consider margins for product sold in Philadelphia, even though some wholesale and transport activity for product distributed outside the city likely occurs in Philadelphia, and we use IMPLAN data on the share of wholesale and truck transport services used in Philadelphia that is locally purchased.

FIG. 13. Assumptions underlying beverage wholesale and retail impacts in Philadelphia

	2016	2017	Difference	Sources
Philadelphia sales				
Total sales volume in Philadelphia (million ounces)	7,408	5,260	-2,148	City of Philadelphia for 2017 scaled to full year; 29% sales decline from bottler data
Average pre-tax retail price (¢ / ounce)	2.5	2.5	0	Approximation based on IRI retail data
Pre-tax retail value of sales ($ millions)	$185.2	$131.5	-$53.7	Multiplication
Factory gate prices	$110.1	$78.2	-$31.9	IMPLAN margins
Wholesale & transport share	$22.6	$16.0	-$6.6	IMPLAN margins
Retail share	$52.5	$37.3	-$15.2	IMPLAN margins
Philadelphia local purchase				
Wholesale & transport	77%			IMPLAN data
Retail share	100%			Assumption

4.1.3 Non-beverage retail impacts

Fig. 14 presents assumptions for the non-beverage retail impact. The primary basis for this scenario is the 6.7% decline in non-beverage same-store sales observed in the IRI data. This decline is then applied to the non-beverage share of grocery store sales, also from IRI, and then to the total grocery store employment in Philadelphia, from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages data from the most recently available year, 2015.[40]

FIG. 14. Assumptions underlying non-beverage retail impacts

Item	Value	Sources
2016–2017 non-beverage sales declines	6.7%	IRI—same store sales
Philadelphia 2015 grocery (non-convenience) employment (NAICS 44511)	10,657	BLS QCEW
Non-beverage share of grocery	91.2%	IRI
Non-beverage direct employment decline	651	Calculation

Note that this impact, more so than the two described above, is somewhat speculative, and based only on the measure of same-store sales declines in IRI data. It is also by far the largest of the three impacts.[41]

40 IMPLAN software can take employment as input for economic impact scenarios in lieu of output dollar values. In this case, the real measure of employment is applied to a 2017 scenario, so results are in 2017$.

41 Appendix B explores the estimate/assumption of 6.7 percent non-beverage sales declines in more detail.

4.2 RESULTS

4.2.1 Economic impact

Fig. 15 below presents results for the three sets of impact reviewed above. Overall, they result in a decline in Philadelphia employment of 1,192 jobs, with $80 million reduction in GDP, and a $54 million decline in labor income. For context, 2015 total employment in Philadelphia was 849,000, and GDP was $99.8 billion.[42] Thus, overall impacts represent roughly 0.14 percent of Philadelphia's employment and 0.08 percent of its GDP. Notwithstanding the cautions expressed elsewhere, this negative impact on GDP could therefore serve as a headwind slowing Philadelphia's economic growth. Real GDP growth in the Philadelphia MSA was 1.6 percent in 2016, roughly in line with national real GDP growth of 1.5 percent in that year.[43]

FIG. 15. Results summary

Impact group	Channel	Employment	GDP ($ millions)	Labor income ($ millions)
1. Philadelphia bottling	Direct	-22	-$3.8	-$2.2
	Indirect	-23	-$3.4	-$2.3
	Induced	-14	-$1.3	-$0.8
	Total	-60	-$8.6	-$5.2
2. Beverage trade and transport margins	Direct	-243	-$13.6	-$9.9
	Indirect	-33	-$4.5	-$2.6
	Induced	-42	-$4.0	-$2.4
	Total	-317	-$22.0	-$14.9
3. Other retail margins	Direct	-651	-$30.4	-$23.8
	Indirect	-67	-$9.5	-$5.1
	Induced	-97	-$9.2	-$5.5
	Total	-815	-$49.1	-$34.4
Total	Direct	-916	-$47.8	-$35.9
	Indirect	-123	-$17.4	-$9.9
	Induced	-152	-$14.6	-$8.7
	Total	-1,192	-$79.7	-$54.5

Source: Oxford Economics

Fig. 16, on the next page, shows the relative magnitude of the three impact types in terms of job losses. Roughly 60-70 percent of this overall modelled impact is the result of reduced retail margins on non-beverage retail. This is the impact group about which there is the greatest uncertainty, in that these estimates rest on (and are linear in) the assumption that

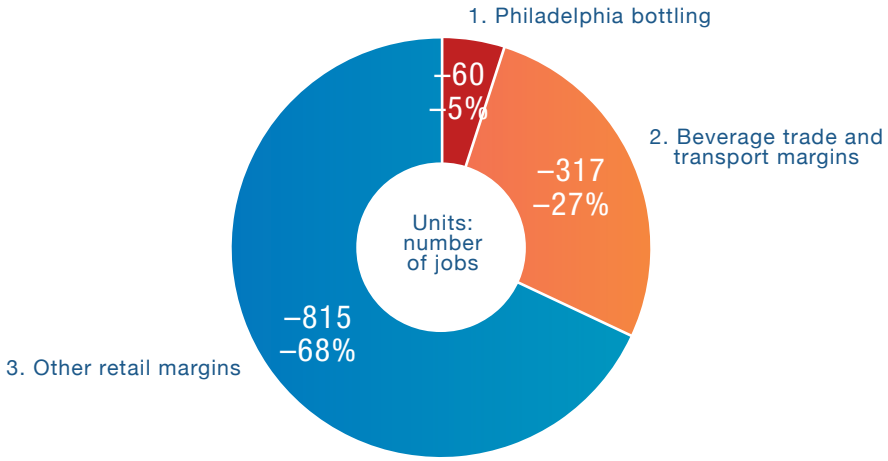
42 Philadelphia employment is from BEA table CA25N (https://bea.gov/iTable/index_regional.cfm); GDP, which is not estimated at this level of geographic detail by the BEA, is from IMPLAN. Note that the employment series includes self-employment and so is larger than some other commonly used employment estimates. Although these 2015 data points are slightly dated, they are the most comparable to our impact estimates.

43 See http://www.bea.gov/regional/

non-beverage grocery sales declined 6.7 percent as a result of the tax (see section 4.1.3 for the assumptions that go into this impact group). Appendix B explores the IRI sales data upon which this result is based, and considers some alternate assumptions.

Focusing in on bottling and beverage trade and transport margins, the total job impact is 377, with a GDP decline of $31 million. The larger share of these job declines (84 percent, or 317 jobs) were related to trade and transport margins.

FIG. 16. Job impacts by impact group



Source: Oxford Economics

4.2.2 Tax impact

The economic impact above, in turn, drives a tax impact, estimates of which are reported in Fig. 17, on the next page. These impacts include a variety of tax types: personal income and social insurance taxes, sales taxes, property taxes, corporate taxes, and others; however, these different types of taxes cannot be reliably broken out using IMPLAN.[44]

Overall, we estimate a local tax loss of $0.4 million from bottling, $1.4 million from beverage trade and transport margins, and $2.7 million from other retail margins. This totals $4.5 million of local tax impact overall. In relative magnitude, these patterns are similar to the impacts presented above, as would be expected.

State and federal tax impacts are also estimated and reported, but these represent only gross impacts in Philadelphia, and do not consider additional state and federal tax revenues (in the case of trade and retail margins) from increased sales outside the city.

44 In particular, sales taxes from reduced retail sales are included in the estimate, which are estimated on the basis of average directly paid taxes by retailers as a share of retail output; however sales taxes are not broken out separately from other directly paid taxes on products and imports in the IMPLAN results. See http://support.implan.com/index.php?option=com_content&view=article&id=419:419&catid=237:237.

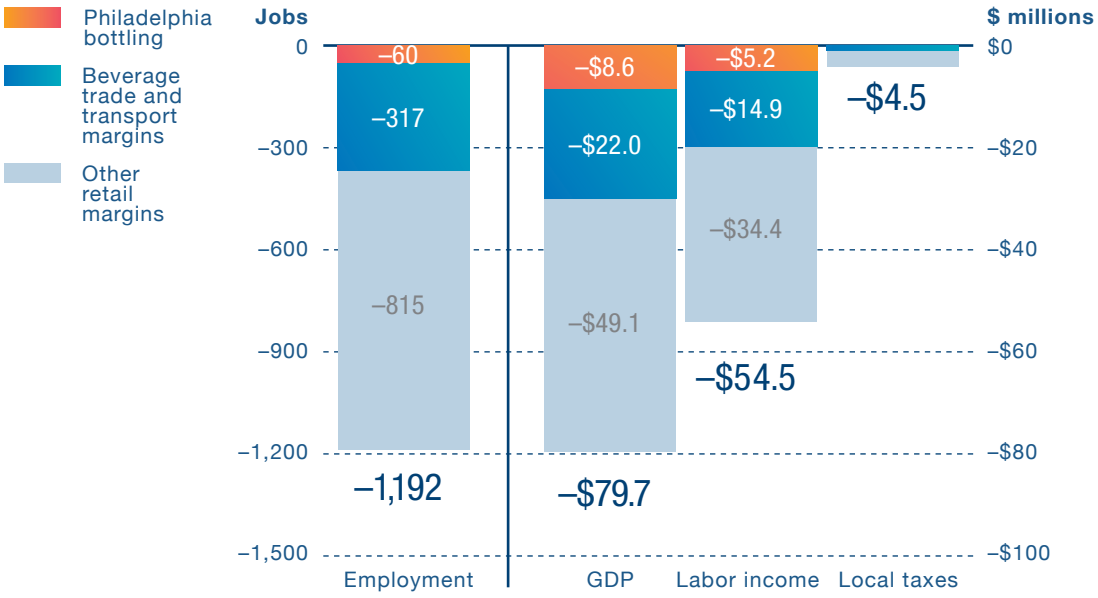
FIG. 17. Tax impacts

Impact group	Channel	Taxes ($ thousands) Local	State	Federal	Total
1. Philadelphia bottling	Direct	-$113	-$87	-$496	-$697
	Indirect	-$184	-$136	-$468	-$787
	Induced	-$69	-$51	-$179	-$299
	Total	-$367	-$274	-$1,142	-$1,784
2. Beverage trade and transport margins	Direct	-$965	-$699	-$1,947	-$3,611
	Indirect	-$187	-$140	-$563	-$890
	Induced	-$205	-$151	-$526	-$882
	Total	-$1,357	-$990	-$3,037	-$5,384
3. Other retail margins	Direct	-$1,874	-$1,364	-$4,439	-$7,677
	Indirect	-$397	-$298	-$1,163	-$1,858
	Induced	-$477	-$352	-$1,225	-$2,054
	Total	-$2,749	-$2,014	-$6,826	-$11,589
Total	Direct	-$2,953	-$2,150	-$6,882	-$11,985
	Indirect	-$769	-$573	-$2,194	-$3,535
	Induced	-$751	-$555	-$1,930	-$3,236
	Total	-$4,473	-$3,278	-$11,005	-$18,756

Source: Oxford Economics

Impacts from Fig. 15 and Fig. 17 are presented together in Fig. 18 below.

FIG. 18. Summary of impacts



Source: Oxford Economics

4.2.3 Comparison with bottler operational data

In addition to the wholesale sales data discussed in section 3 above, the bottlers provided direct employment data for their bottling operations to Oxford Economics. Together, the two bottlers with facilities in Philadelphia report having reduced payroll by 115 workers between April 2016 and April 2017. This includes both bottling workers, as well as those working in distribution and sales.

In Fig. 19 below, we compare the bottler employment declines with IMPLAN estimates based on the results presented above for the direct employment impacts given our assumptions on reduced sales. The bottling estimate of 22 workers matches exactly with the direct bottling impact estimate in Fig. 15 above. The wholesale and transport estimate is a part of the beverage trade and transport margin impacts, and is based on these bottlers' shares of reduced distribution in Philadelphia.

FIG. 19. Comparison of bottler operational data with IMPLAN estimates

	IMPLAN estimates	Bottler data
Bottling	-22	
Wholesale & transport	-21	
Total	-43	-115

Source: Bottler operational data and Oxford Economic calculations

It is clear from Fig. 19 that the IMPLAN estimates understate the actual observed job declines that bottlers have experienced following imposition of the PBT, specifically by 72 job losses. There are three potential explanations for this:

- In general, the bottlers' self-reported data show lower labor productivity (i.e., higher employment per unit of output) than the IMPLAN data, which are based on of national data from the Bureau of Economic Analysis. This may be because these bottlers locate more of their sales and account management functions locally than the BEA data would suggest. With lower labor productivity, the same decline in beverage sales leads to a larger job impact. To the extent that this is the cause of the discrepancy, the direct impacts of the tax presented in Fig. 15 above would additively underestimate (in magnitude) the true direct impacts by approximately 72 (i.e., 115 minus 43) workers. The indirect impacts would be roughly correct, while the induced impacts would be slightly understated because of the spending by additional direct workers.
- Many assumptions went into the above calculations and it is possible that we have systematically underestimated the magnitude of the sales declines these companies experienced. To the extent that this is the case, the bottling impacts described above (i.e., impact group 1) would multiplicatively underestimate the true impacts by 115 / 43 =

2.7 times, in which case the direct, indirect, and induced impacts should be scaled up by this amount.

- Finally, it is possible that idiosyncratic factors unrelated to the PBT may account for some portion of the job losses the bottlers experienced. To the extent that this is case, the impact estimates calculated above would be correct, and the additional 72 direct job losses would be unexplained. We are not aware of any unrelated factors that might have caused such job losses, and such an explanation would imply a strange coincidence of timing.

While all three factors may come into play to some extent, we believe the balance of the evidence—in particular, the observed lower labor productivity of local bottling than in the national data—leans towards the first of these possibilities as the predominant cause of the discrepancy.

Again, this would imply that the above impact results should be increased by an additional 72 direct job losses, as well as a small number of additional induced job losses, which we do not quantify.

5. CONCLUSION

In this paper, we have explored the economic effects of the PBT since it was implemented on January 1, 2017. For this work, we used two unique data sets, one of bottler sales data from the three main Philadelphia area bottlers together representing roughly 73 percent of SBs sales in Philadelphia, and the other a set of retail data from IRI.

Using these data, we have presented results substantiating several key points in the economics literature surrounding SB taxes: sales by local bottlers in Philadelphia fell by roughly 29 percent, while increasing by roughly 26 percent in the region immediately adjacent to Philadelphia, strongly indicating that consumers are traveling outside the city to purchase SBs. Sales declines were largest at supermarkets and retailers, and lower at restaurants and convenience, gas, and drug stores.

Retail supermarket same-store sales data corroborate these patterns, with beverage sales in Philadelphia falling 24 percent, and outside Philadelphia increasing 14 percent. These data allowed estimates of consumer demand elasticities for certain aggregate categories of beverages that are broadly consistent with the existing literature: 0.90 for carbonated beverages, 0.93 for tea/coffee, and 0.92 for sports drinks. Retail data also show strong increases in sales of drink mixes inside Philadelphia, but not outside, a clear indication of consumers shifting to untaxed substitute goods. Finally, same-store sales data for non-beverage products show a remarkable decline of 7 percent, compared to an increase of 1 percent in the region surrounding the city. This is consistent with consumers shifting grocery buying trips outside the city in response to the tax.

These results from the above analysis were used to model economic impacts—in terms of jobs, GDP, labor income, and tax revenue—in Philadelphia stemming from reduced bottling activity, and trade and transport margins from consumer purchases in the city as a result the tax. It is important to note that these are gross impacts; we do not attempt to model what consumers do with money they might otherwise have spent on SBs. Three groups of impacts were considered: reduced bottling by two bottlers located in the city itself, reduced trade and transport margins on all beverage sales in Philadelphia, and reduced retail margins from lower non-beverage grocery sales.

Overall, our models indicate an employment decline of 1,190 workers in Philadelphia as a result of the PBT, roughly five percent from bottling, 25 percent from beverage trade and transport margins, and 70 percent from reduced non-beverage grocery retail. This corresponds to $80 million in lost GDP, and $54 million less labor income. This reduced economic activity results in consequent tax losses; overall, we estimate a $4.5 million reduction in local tax revenue. Operational data provided directly by the bottlers suggest that this modeling actually understates total job losses by roughly 70 jobs.

APPENDIX A—
DETAILED IMPACT TABLES

This appendix provides additional sectoral details on the impacts reported in Fig. 15.

FIG. 20. Employment detailed impacts

		Employment			
Impact type	**Sector**	**Direct**	**Indirect**	**Induced**	**Total**
1. Philadelphia bottling	Natural Resources	0	0	0	0
	Construction	0	0	0	0
	Manufacturing	22	0	0	23
	Trade, Transport, Utilities	0	9	3	12
	Information	0	0	0	1
	Financial Activities	0	2	1	4
	Business Services	0	9	1	10
	Education and Health	0	0	4	5
	Leisure and Hospitality	0	2	2	4
	Other Services	0	1	2	2
	Government	0	0	0	0
	Total	22	23	14	60
2. Beverage trade and transport margins	Natural Resources	0	0	0	0
	Construction	0	0	0	1
	Manufacturing	0	0	0	0
	Trade, Transport, Utilities	243	12	8	263
	Information	0	1	0	1
	Financial Activities	0	5	4	9
	Business Services	0	10	3	13
	Education and Health	0	0	13	14
	Leisure and Hospitality	0	2	6	8
	Other Services	0	2	5	7
	Government	0	0	0	1
	Total	243	33	42	317
3. Other retail margins	Natural Resources	0	0	0	0
	Construction	0	1	1	2
	Manufacturing	0	0	0	1
	Trade, Transport, Utilities	651	25	20	695
	Information	0	1	1	3
	Financial Activities	0	12	9	21
	Business Services	0	18	7	26
	Education and Health	0	1	31	32
	Leisure and Hospitality	0	3	15	18
	Other Services	0	4	12	16
	Government	0	1	1	2
	Total	651	67	97	815

Source: Oxford Economics calculations

FIG. 21. GDP detailed impacts

		GDP ($ thousands)			
		Direct	Indirect	Induced	Total
1. Philadelphia bottling	Natural Resources	$0	$0	$0	$0
	Construction	$0	$24	$6	$31
	Manufacturing	$3,777	$114	$11	$3,902
	Trade, Transport, Utilities	$0	$1,101	$206	$1,307
	Information	$0	$226	$71	$296
	Financial Activities	$0	$603	$480	$1,083
	Business Services	$0	$1,226	$108	$1,334
	Education and Health	$0	$1	$288	$289
	Leisure and Hospitality	$0	$70	$98	$169
	Other Services	$0	$48	$62	$110
	Government	$0	$26	$15	$41
	Total	$3,777	$3,439	$1,347	$8,563
2. Beverage trade and transport margins	Natural Resources	$0	$0	$0	$0
	Construction	$0	$36	$19	$56
	Manufacturing	$0	$44	$32	$76
	Trade, Transport, Utilities	$13,576	$1,015	$608	$15,199
	Information	$0	$524	$208	$732
	Financial Activities	$0	$1,650	$1,416	$3,066
	Business Services	$0	$961	$319	$1,280
	Education and Health	$0	$24	$850	$874
	Leisure and Hospitality	$0	$78	$290	$367
	Other Services	$0	$104	$183	$288
	Government	$0	$44	$44	$88
	Total	$13,576	$4,480	$3,969	$22,025
3. Other retail margins	Natural Resources	$0	$0	$0	$1
	Construction	$0	$90	$45	$135
	Manufacturing	$0	$67	$74	$141
	Trade, Transport, Utilities	$30,443	$2,138	$1,415	$33,996
	Information	$0	$1,041	$484	$1,525
	Financial Activities	$0	$3,838	$3,296	$7,134
	Business Services	$0	$1,729	$742	$2,471
	Education and Health	$0	$66	$1,979	$2,045
	Leisure and Hospitality	$0	$160	$675	$835
	Other Services	$0	$228	$427	$654
	Government	$0	$103	$102	$205
	Total	$30,443	$9,460	$9,238	$49,142

Source: Oxford Economics calculations

FIG. 22. Labor income detailed impacts

		Labor income ($ thousands)			
		Direct	Indirect	Induced	Total
1. Philadelphia bottling	Natural Resources	$0	$0	$0	$0
	Construction	$0	$19	$5	$24
	Manufacturing	$2,157	$33	$4	$2,193
	Trade, Transport, Utilities	$0	$650	$132	$782
	Information	$0	$171	$38	$209
	Financial Activities	$0	$209	$127	$335
	Business Services	$0	$1,058	$89	$1,147
	Education and Health	$0	$1	$270	$271
	Leisure and Hospitality	$0	$48	$66	$114
	Other Services	$0	$33	$58	$91
	Government	$0	$31	$16	$47
	Total	$2,157	$2,252	$805	$5,213
2. Beverage trade and transport margins	Natural Resources	$0	$0	$0	$0
	Construction	$0	$28	$15	$43
	Manufacturing	$0	$15	$11	$26
	Trade, Transport, Utilities	$9,936	$675	$388	$10,999
	Information	$0	$447	$111	$557
	Financial Activities	$0	$382	$372	$755
	Business Services	$0	$823	$263	$1,086
	Education and Health	$0	$23	$798	$820
	Leisure and Hospitality	$0	$57	$195	$252
	Other Services	$0	$80	$171	$250
	Government	$0	$34	$47	$81
	Total	$9,936	$2,564	$2,370	$14,870
3. Other retail margins	Natural Resources	$0	$0	$0	$1
	Construction	$0	$70	$35	$105
	Manufacturing	$0	$26	$26	$52
	Trade, Transport, Utilities	$23,802	$1,390	$903	$26,095
	Information	$0	$896	$257	$1,154
	Financial Activities	$0	$807	$865	$1,673
	Business Services	$0	$1,481	$613	$2,094
	Education and Health	$0	$63	$1,856	$1,919
	Leisure and Hospitality	$0	$115	$455	$570
	Other Services	$0	$167	$397	$564
	Government	$0	$76	$109	$185
	Total	$23,802	$5,092	$5,517	$34,411

Source: Oxford Economics calculations

APPENDIX B— IRI DATA DISCUSSION

In section 3.3, we generally focus attention on same store sales (i.e., sales at the same set of stores, which remain in the sample from 2014-2017) to avoid complications from stores entering and leaving the sample. This is a common technique in analyzing retail data, but it is not without its own concerns. In particular, it is our understanding that the IRI sample includes most of the grocery stores in Philadelphia, and stores moving in and out of sample mostly reflect actual store openings and closings, respectively. Thus, increases in same store sales might reflect stores picking up market share as nearby stores close, and vice versa. It's also important to note that our data are for the grocery channel only, and so a shift in consumer purchasing behavior, for example towards greater online shopping, or more (or less) grocery shopping at big box or convenience stores, might affect our results. In part, the sales data from the region nearby Philadelphia serve as a control against this; however, this control is imperfect in that those data are also used to measure displaced sales. Additionally, shifts in shopping channel might in part be driven by store openings and closings, which differ between Philadelphia and the surrounding region.

FIG. 23. Comparison of same store and all store IRI sales data

Region	Measure type	Year	# stores	Beverage sales	% change	Non-beverage sales	% change
Philadelphia	Same stores	2014	27	$20,750,800		$169,194,716	
		2015	27	$22,573,952	8.8%	$181,862,250	7.5%
		2016	27	$24,263,410	7.5%	$193,343,466	6.3%
		2017	27	$17,545,422	-27.7%	$180,370,304	-6.7%
	All stores	2014	55	$30,229,476		$252,770,339	
		2015	56	$29,498,267	-2.4%	$243,480,135	-3.7%
		2016	33	$27,453,081	-6.9%	$223,047,811	-8.4%
		2017	35	$20,882,938	-23.9%	$215,645,433	-3.3%
Outside Philadelphia	Same stores	2014	36	$22,325,901		$221,306,537	
		2015	36	$23,734,444	6.3%	$236,610,610	6.9%
		2016	36	$24,512,826	3.3%	$240,262,644	1.5%
		2017	36	$27,601,052	12.6%	$243,263,340	1.2%
	All stores	2014	49	$25,520,069		$249,584,378	
		2015	48	$25,511,828	0.0%	$252,251,263	1.1%
		2016	39	$25,413,863	-0.4%	$249,352,651	-1.1%
		2017	41	$30,354,720	19.4%	$262,612,842	5.3%

Source: IRI data and Oxford Economics calculations

In order to identify whether such concerns are affecting our conclusions based on same store sales data, Fig. 23 presents total beverage and non-beverage sales data inside and outside Philadelphia over the sample period.[45] The most obvious difference between same store and all store sales measures occurs in 2016 in Philadelphia, when 23 stores simultaneously exit the all stores data, and sales decline by 7 percent for beverages and 8 percent for non-beverages; while in the same store data, sales increase by 7 percent for beverages and 6 percent for non-beverages. Something similar happens outside Philadelphia, where 9 stores close that year, though the magnitude is smaller. This change appears to be related to the closing of the Bottom Dollar chain of supermarkets around this time.[46]

Since this market shake-up took place well in advance of the implementation of the PBT, we do not expect that it should bias our estimates of the impact of the tax on beverage and non-beverage sales in Philadelphia. One source of concern, however, is that same store grocery sales were up strongly in Philadelphia in 2016, while all store sales were down (related to all the closings), and same store sales outside the city were up much less. If sales were artificially elevated in 2016 in our Philadelphia same store sample, either because of a genuine transient effect of the closing of other stores, or because of some sort of measurement error, this might us to overestimate sales declines in 2017, and attribute the decline to the PBT.

In order to test for this possibility, we consider store-level correlations in the 2015-2016 and the 2016-2017 growth rates for total sales for the 27 stores in our same store Philadelphia dataset. If some sort of transient effect were elevating 2016 sales for some stores, we would expect to see a negative correlation between these growth rates, whereas in fact the correlation between them is 0.0559, which is not statistically different from zero (p-value of 0.78).[47] Finally, our largest economic impact results in section 4 are a result of declining non-beverage retail sales, which we base on the 6.7 percent sales decline at same store Philadelphia groceries, which is repeated in Fig. 23 above. As shown there, this decline is only 3.3 percent in the all stores data, raising the possibility that we are overestimating the magnitude of the decline.

However, even though the number of stores in the all store sample increases by two between 2016 and 2017, this hides one large store leaving the sample and three small stores entering. As a (third) measure, we consider instead the *expanded same store sample* for the 32 stores with sales in both 2016 and 2017 (5 of which do not have sales in either 2015 or 2014, and so are excluded from our larger same store sample). In this case, the decline in non-beverage sales between 2016 and 2017 is 6.0 percent, only slightly smaller than the 6.7 percent we use in section 4.

45 Note that, as discussed in section 3.3, for some stores in Philadelphia, the value of the tax is included in the beverage sales, while for other stores it is not. As this is not the focus of this exercise, we do not attempt to correct for this here.

46 See http://www.wfmz.com/news/berks/bottom-dollar-closing-all-of-its-stores_20160530041445420/20561604.

47 Privacy considerations prevent us from showing a scatterplot of this relationship at the store level, but it shows no obvious relationship between the two years' growth rates.

Note that all the non-beverage retail impacts presented in section 4 are linear in this assumption of declining non-beverage grocery sales. If one prefers our 6.0 percent estimate of declining non-beverage grocery sales (based on the expanded same store sales sample) over our 6.7 percent baseline, these results could be scaled down by 10 percent from 815 job losses (see Fig. 15) to 730 job losses. If one prefers our 3.3 percent estimate (based on the all stores sample), they would be scaled down by 51 percent to 401 job losses.

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