Analyzing and Applying Behavioral Science to Philadelphia’s Sugar Sweetened Beverage (SSB) Tax

Anand Apichaidejudom
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Anand Apichaidejudom
Candidate, Master of Behavioral and Decision Sciences
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1. Introduction of the Soda Tax

The sweetening of the global diet, particularly in sugar sweetened beverages (SSBs), has been a particularly worrying trend that has significantly driven the risks of obesity, diabetes, heart disease, and non-communicable diseases (Barry M Popkin, 2016). The World Health Organization (WHO) has linked the consumption of SSBs, beverages that contain added naturally-derived caloric and low caloric sweeteners such as sucrose, as the primary source of added sugars in diets and to 184,000 annual deaths alone (Sarah A. Roache, 2017). The increased prevalence of obesity from 3.2% to 10.8% among men and from 6.4% to 14.9% among women between 1975 and 2014 has been largely associated with SSB consumption. WHO suggested as of 2016 that 1.9 billion or 39% of adults were overweight and 650 million or 13% of adults were obese (John Cawley, 2018). Over 40 million children under the age of 5 were also found to be overweight or obese worldwide (Sarah A. Roache, 2017). North America and Latin America feature the largest number of SSB consumers with strong growth trends among less saturated emerging markets. Despite the heterogeneity in SSB consumption and growth patterns across countries and cultures, there has largely been evidence of the overconsumption of sugar among representative samples of global household purchases. For example, 68% of US barcoded food products consist of some form of added sweeteners (Barry M Popkin, 2016). Highly processed diets in SSBs beyond WHO’s recommendation of less than 10% added sugar intake to total energy intake has led to significant direct and indirect costs on individuals and societies.

Strong scientific evidence across a range of prospective studies, observational studies, clinical studies, and randomized controlled trials proves the adverse physiological and cardiometabolic consequences of regular and high SSB intake. Poor diet has contributed to the escalating burden of diseases related to higher triglycerides and blood pressure, lower HDL cholesterol, strengthened insulin resistance (M Arantxa Colchero, 2016). While several studies claim the weak associations between SSB consumption and weight gain and diabetes, leading researchers in the field claim that such authors erroneously gave larger weights to small negative studies and are funded by the sugar and beverage industries. From a meta-analysis of 88 cross-sectional, longitudinal, and experimental studies, soft drinks and energy drinks provide evidence of unhealthy weight gain including a 55% reported body mass index (BMI) increase among 20 out
of 30 selected studies (Dieticians Association of Australia, 2018). Daily SSB consumers were also found to be 26% more likely to contract diabetes than occasional SSB consumers. The prevalence of diabetes between 1975 and 2014 has increased from 4.3% to 9.0% among men and from 5.0% to 7.9% among women (John Cawley, 2018). Furthermore, prospective eight-year observational studies on 91,249 women have shown the doubling of Type 2 diabetes risk and the 23% increased risk of coronary heart diseases for women consuming one or more SSB servings per day (Kelly D. Brownell, 2010). Mattes et al (2009) have also suggested that caloric beverages supplement 95% or more of calories to daily energy intake (Barry M Popkin, 2016). In addition, short-term clinical trials conducted by Tordoff and Alleva (1990) exhibit the increased energy intake and body weight of subjects given 530 kcal of SSBs per day but an associated decrease for those with non-caloric SSBs for the same 3-week time period (Kelly D. Brownell, 2010). As for children-specific studies, prospective studies and long-term randomized controlled trials depicted the strongest impact of reduced SSB consumption on overweight individuals. Middle school children were found to have an increased 60% obesity risk for every additional daily SSB serving from a two-year prospective study (Kelly D. Brownell, 2010). One-year school-based SSB intervention studies also reduced obesity incidence by 7.7% among British students, produced significant BMI decreases for Boston students in the upper baseline BMI tertile, and led to statistically significant weight changes for Brazilian children (Kelly D. Brownell, 2010). Similarly, overweight Chilean children were found to significantly accrete lean mass from drinking milk as an SSB substitute. Overall, published reviews and meta-analyses suggest that reduced SSB intake decreases body weight by 0.80 kilograms and increased intake leads to a 0.75 kilogram weight gain (Dieticians Association of Australia, 2018).

While SSBs are heavily advertised, inexpensive, and widely available across several retail categories, they do not provide any nutritional value, feature poor satiating properties, and have high glycemic loads. SSBs are usually consumed to satisfy thirst, fulfill social functions, and align with social norms. However, regular SSB consumption may have chronic adverse effects on taste preferences and food acceptance as less sweet options are now unappealing and unpalatable (Luc Louis Hagenaars, 2017). The poor satiating properties of SSBs also contribute empty calories to an overall higher calorie intake diet based on the lack of reduced food intake compensation.
from SSB consumption. For example, short-term feeding studies depict similar food intakes and calorie sources across adults regardless of their consumed beverage type and amount likely due to the resultant releases of ghrelin and insulin hormones (M Arantxa Colchero, 2016). Furthermore, SSB consumption is a negative externality that financially burdens national healthcare systems due to its high glycemic load as well as increased insulin resistance and diabetic risk. Since consumers do not bear the full mounting healthcare costs of their consumption decisions and companies are heavily subsidized by taxpayers, the medical costs to treat those overweight and obese represent 9.1% or $147 billion of US healthcare expenditures alone (Kelly D. Brownell, 2010). Additionally, the most socioeconomically disadvantaged groups are more likely to drink SSBs. The 38% most disadvantaged quintile among the Australian population consumed more SSBs relative to the 31% least disadvantaged (Dieticians Association of Australia, 2018). The issues of SSB overconsumption provides a rationale for government action by shifting individual responsibility of health promotion towards the collective and societal level. Fiscal and financial measures may be used by policymakers to correct for the market failure in the deficient demand of healthy beverages and the excess consumption of SSBs.

Behavioral science contributes to our understanding of the market failures of SSB overproduction and overconsumption. For example, strong social norms of regular SSB consumption in Mexico contribute to the long-term development of habits that get passed on to future generations (M Arantxa Colchero, 2016). Factual beliefs, personal normative beliefs, empirical expectations, and normative expectations within reference networks can decisively play a role towards the preference and choice for regular SSB consumption (Bicchieri, 2016). Consumers also have imperfect information on perceived consumption benefits from the marketing and advertising initiatives of beverage companies. Such companies have emphasized the minimal contributory role of their SSB products towards obesity and health-related diseases, and instead blame such consequences to a lack of physical exercise (Dieticians Association of Australia, 2018). Consumers further have time-inconsistent preferences through the present bias of enjoying short-term gratification at the cost of long-term harm. Children and adolescents prioritize present satisfaction over the future, and so heavily discount future consequences. Individuals and
societies may also be biased towards choosing their current regularly consumed SSB drinks rather than healthier alternatives due to status quo as a cognitive bias impacting their health choices. The confluence of status quo and present biases with social norms and attitudes encourages consumers to fail in fully appreciating the links between SSB consumption and the associated health and financial consequences on households and societies. Policymakers need to carefully consider the use of salient information-based policies during tax enactment and implementation to frame and signal the associated health risks of SSB consumption to consumers. Public awareness campaigns, front-of-packaging nutritional information labels, and product reformulation nudges are successful behaviorally inspired policy tools used in other tax jurisdictions as counterexamples to Philadelphia’s SSB tax from a health and financial perspective.

2. Soda Tax as a Policy-Making Tool

A government levied tax is a useful public health instrument with considerable total and per person consequences in disincentivizing SSB purchase and consumption behavior. If sufficiently large, well designed, and clearly communicated, SSB taxes have the potential to increase the costs of the entire supply chain of manufacturing, distributing, retailing, and consuming health-damaging products. For example, the WHO recommends governments with no current SSB tax policies to implement a flat excise tax that significantly raises SSB retail prices by at least 20% in order to achieve likely proportional reductions in consumption and desired direction towards healthier diets (Stephan Seiler, 2019). Taxes also generate substantial governmental revenue that can be earmarked for specific public health benefits such as subsidies or increasing the availabilities of healthier food and beverage alternatives. Furthermore, taxes can incentivize manufacturers to reformulate their SSB products and market more healthier beverages that consist of less or no sugar at all (Pym, 2018). Taxes therefore publicly educate consumers with the powerful message conveyed on the unhealthiness of regular SSB consumption, as consumers taper their consumption of unhealthy beverages with elevated prices and substitute towards more economical, healthy alternatives. Targeted taxes and subsidies offer the greatest likelihood of positive consumption changes and reduced chronic disease burdens.
Estimates of passthrough rates and own-price elasticities influence the economic impacts of taxation. Passthrough rates occur as a result of taxes levied on manufacturers, retailers, and distributors as these entities decide on the proportion of taxes absorbed and those passed on to consumers in the form of a sales tax. As a result, the passthrough rate can affect the final price that consumers pay for with higher passthrough rates increasing the likelihood of shifting purchasing behavior. The SSB passthrough rate is usually 100% or more for nationwide taxes as there are fewer opportunities for cross-border purchases and retailers have more power in passing on the taxed amounts to consumers (American Beverage Association; Oxford Economics, 2017). However, the SSB pass-through rate may differ across SSB sub-categories and distance from the border of another untaxed jurisdiction. Stores and retailers closer to the border have less flexibility of charging consumers higher prices and instead pass on lower passthrough rates.

As for own-price elasticity estimates, the sensitivity measure of consumer demand to changes in price can inform likely policy outcomes from the imposition of a taxed rate. Higher elasticity estimates maximize the goal of influencing consumer behavior but elasticities can vary across income groups, cultures, retail format, SSB volume and beverage type. Lower socioeconomic status groups spend a larger relative overall budget share on food, have a higher relative proportion of obese and overweight individuals, and may have lower elasticities attached to taxed SSBs relative to higher socioeconomic groups (Anurag Sharma, 2014). While the regressive nature of taxes is controversial as lower income groups must now spend a greater proportion of their incomes to purchase the taxed SSBs, such groups are disproportionately impacted by non-communicable diseases and have the most to gain in terms of their long-term health (Luc Louis Hagenaars, 2017). Furthermore, cultures with higher empirical and normative expectations of drinking SSBs have lower elasticities due to the presence of strong social norms. For example, the strong cultural component of SSB consumption inherent in Mexican culture can influence the average consumer’s belief on other reference network people’s consumption and belief that others think he or she should also be regularly consuming SSBs, leading to enduring preferences and purchase and consumption choices for SSBs. With the common beliefs of attaching SSB consumption to those with high social status and good hospitality, the average Mexican consumer may still continue regular SSB consumption despite price increases, reducing the
influence of taxation and leading to lower elasticities (M Arantxa Colchero, 2016). The specific SSB beverage type also plays a role in determining elasticity estimates as consumers may be more likely to reduce purchases and demand for energy drinks as compared to more popular drinks such as soda. Beverage volume and retail formats are inherently linked in which convenience stores featuring a greater percentage of low-volume SSBs have lower price elasticities compared to wholesale distributors with large SSB volume bottles. Overall, price elasticity estimates of SSBs from researchers in the field can vary between mildly inelastic and highly elastic ranges.

The implementation of a tax requires significant governmental investment for robust monitoring and evaluation processes but can generate even more substantial tax revenue to be earmarked for specific distributional purposes. A tax impact assessment is required to adjust and replace the inclusion and exclusion of specific SSB sub-categories as well as to monitor the extent of tax abidance and avoidance. The WHO can play a supporting role in supporting tax initiatives by sharing information and the learned experiences of previously successful health taxes imposed on other jurisdictions. Furthermore, WHO can provide technical assistance throughout the adoption and implementation of the policy, and ensure that tax authorities within the jurisdiction have enough resources for tax administration and collection (Sarah A. Roache, 2017).

Stiff and well-coordinated opposition from the beverage industry serves as a major impediment to SSB tax policy proposals but public support has steadily increased. Manufacturers have invested significant resources and various means to promote the associated risks of taxation in regard to its regressive nature, threats to consumer autonomy, and administrative burden. For example, the American Beverage Association spent more than $2 million on Berkeley and $9 million on Philadelphia in their lobbying efforts and advertising campaigns to sway public opinion and prevent the imposition of SSB taxes as a policy precedent (Kathryn Backholer, 2017). In another example, the Australian Beverage Council formed a roundtable of groups potentially impacted by a tax including advertisers, business groups, and sugar cane growers. The Australian Beverage Council also targeted key politicians and political parties and filed multiple lawsuits to repeal the tax policy (Dieticians Association of Australia, 2018). The industry has also stressed political reluctance and opposition, adverse economic circumstances, lack of local evidence, untimely legislative calendar, and legal and administrative constraints as barriers to SSB taxation...
on the political agenda. However, evidence has shown the steady increase in public support for food taxes. The global momentum supporting health-related taxation has increased from 33% in 2001 to 41% in 2003 and 54% in 2004 (Kelly D. Brownell, 2010). Experts, grassroot advocates, philanthropists, and advocacy organizations need to work together to combat the efforts of the industry to limit the use of taxation as a policy tool to combat obesity.

Government authorities have the available policy options of an ad valorem or volumetric excise tax. An ad valorem tax is a percentage increase in price regardless of SSB volume while a volumetric excise tax varies with the sugar content in the product. Ad valorem taxes are therefore more expensive for lower SSB volumes such as a soda can; in contrast, a volumetric excise tax makes large SSB volumes more expensive (Stephan Seiler, 2019). Caro et al (2017) have simulated three different tax policy scenarios to specifically target discouraging unhealthy beverage purchase in the context of Chile. Chile features the highest SSB consumption per capita per day and the second higher adult obesity prevalence of 64% among adults worldwide, and the government implemented an increased ad valorem tax rate from 13% to 18% for SSBs with sugar content higher than 15 grams per 240 milliliters in 2014. The experiments of Caro et al (2017) explored the consequences of an 18% ad valorem tax and restricted marketing on SSBs exceeding certain thresholds of added sugar, a 40% ad valorem tax, and a volumetric excise tax of 1 Chilean peso (0.2 US cents) per gram of added sugar. While all three scenarios led to meaningful reductions in sugar consumption, the first and third policies were found to significantly reduce the number of calories, sodium, carbohydrates, and total fats consumed. The status quo of the 18% ad valorem tax was found to produce the largest reduction and lower 5 grams of sugar consumed per Chilean adult per day. Caro et al (2017) interestingly conclude from their study that increasing the ad valorem tax to 40% did not produce the expected significant reductions in unhealthy nutrients. The result of the study suggests that high taxation rates alone cannot change consumption behavior, and that behavioral elements beyond price elasticities and passthrough rates need to be considered and instilled within a sugar tax policy (Juan Carlos Caro, 2017).

Sharma et al (2014) similarly analyzed the effects of taxing SSBs across different income groups using an Almost Ideal Demand System and Household level censored demand model and 2011 panel data of 1,390 Australian households over 52 weeks. The authors compared the policy
scenario effects of a 20% ad valorem tax and 20 cent per liter volumetric tax. Sharma et al (2014) found that both tax scenarios produce substantial weight changes for heavy SSB consumers in low income households with a total weight reduction of 2.3 kilograms from the ad valorem tax and 4.4 kilograms from the volumetric tax. The ad valorem tax produced decreased consumptions of regular soft drinks by 17.67%, cordials by 46.5%, and fruit drinks by 20.03% for the average consumer per quarter (Anurag Sharma, 2014). Within the breakdown of reduced soda consumption by socioeconomic status, low-income households reduced demand by 16.68%, middle-income households by 17.97%, and high-income households by 18.58%. The resulting significant substitution of 23% in increased bottled water purchases further reduced 16,087 kilojoules of energy intake and 81,300 kilojoules per year for the average consumer at the 95th percentile. However, the volumetric tax produced significantly greater yearly per capita weight loss with an 87% increased bodyweight reduction than the ad valorem tax for low-income households. Additionally, the average per-capita tax burden was 0.21% of income for low-income households and 0.025% for high-income households under the ad valorem tax, while the tax burden was 16% lower for low-income and 30% lower for high-income households from the volumetric tax. Sharma et al (2014) conclude their findings with evidence of positive behavioral responses for households across income groups to SSB taxes with negligible monetary tax burdens ranging from $10.10 to $17.90 despite evidence of their mildly regressive nature (Anurag Sharma, 2014). Therefore, the volumetric tax encourages a lower tax burden and significantly higher weight reduction but may involve greater implementation and administration costs. From a behavioral perspective, it is clear from the findings of Sharma et al (2014) that a volumetric tax produces significantly greater economic incentives that alter the preferences, choices and behaviors of heavy SSB consumers (Anurag Sharma, 2014).

Counterfactual simulations from structural models predict far-reaching public health outcomes of SSB taxes. Wang (2015) modeled a 7.6% reduction of high-income household consumption and 9.7% decrease of low-income household consumption from a 1 cent per ounce soda tax. Kifer (2015) also suggested a 140% pass-through rate with a 75% demand reduction from a 2 cents per ounce soda tax. Dubois et al (2017) further found a 140% pass-through rate and 11-15% reduced consumption from a 1.2 cents per ounce tax (Stephan Seiler, 2019). National studies outside the
US have found significant passthrough rates and associated demand reductions as well as moderate price increases in untaxed substitute beverage categories. Within the US, Bollinger and Sexton (2018) analyzed the limited impact of highly localized taxes as reduced demand was found to be offset by increased purchases outside the taxing jurisdiction (Stephan Seiler, 2019).

Through modeling, observational studies, and price elasticity studies, the early adopters of Berkeley, Mexico, and UK among others prove the effectiveness of soda taxes as an evidence-based empirical strategy that can be applied by other levels of government in other taxable jurisdictions. While 8 US jurisdictions including Philadelphia have adopted SSB taxes covering more than 8 million Americans in 2016, 33 current states have minor sales taxes that are too small to affect consumption (Sarah A. Roache, 2017). Specifically in the case of Berkeley’s citywide tax levy in 2014, consumers changed their behavior with decreased consumption of targeted products. The Berkeley tax was found to effectively encourage healthier drink habits with an increased frequency of bottled water consumption by 37% and overall water consumption by 63% relative to a 19% increase in overall water consumption among the comparison cities of Oakland and San Francisco as non-taxed jurisdictions at the time of the study (Luc Louis Hagenaars, 2017). Through a repeated cross-sectional study from intercept interviews on high foot traffic intersections in racially, demographically diverse neighborhoods in Berkeley, Oakland, and San Francisco, the frequency of SSB consumption was found to be reduced by 21% in Berkeley compared to a 4% increase for the comparison cities. Furthermore, Berkeley residents reported a 52% decrease in SSB consumption and 29% increase in water consumption three years after 2014 compared to pre-tax levels (John Cawley, 2018). Given that the tax also generated $2 million in 2014 for the Berkeley city government to allocate towards nutrition-related program, the results offer strong evidence that soda taxes can be used as an effective tool to influence long-term soda consumption habits (Manke, 2019).

3. In-depth Investigation of Philadelphia’s SSB Tax

Philadelphia, as the second US municipality to impose an SSB tax, applied a volumetric tax of 1.5 cents per ounce of added sugars and sweeteners on regular and diet beverages on January 1, 2017. While Mayor Jim Kenney’s proposed 3 cents per ounce was significantly scaled down, the Philadelphia City Council approved the imposition of the new policy that unusually applied to all
sweetened and artificially sweetened beverages regardless of caloric or non-caloric sweeteners with a 13-4 vote (Purtle J., 2018). The tax applied to beverages such as diet soft drinks, pre-sweetened coffee and tea, and non-100% fruit juices. The primary motivation of the city government from the Philadelphia Beverage Tax was to generate revenue and fund universal pre-kindergarten educational programs. The associated health benefits of reduced consumption of unhealthy beverages, decreased obesity rates, and lowered healthcare costs were minimized and not considered by policymakers. Mayor Kenney explicitly framed the tax with a pre-implementation projection of $92 million towards financing education as a community investment goal for which broad public support existed. Rather than deliberately framing the tax as a public health intervention during policy development, advocacy, and implementation, Mayor Kenney highlighted the benefits of tax revenue proceeds to fund his policy priority of education (Yann Le Bodo, 2018).

The passthrough rate of the tax and associated SSB prices and quantities stabilized over time across store formats. Grocery stores, mass merchants, drugstores, and convenience stores were found to have a brief adjustment period of prices and quantities over the first four months with lower passthrough rates and less quantity decreases. The relatively high tax of 1.5 cents per ounce eventually led to stores increasing the availability of untaxed beverages in their shelves. It also encouraged an average 97% passthrough rate and 34% price increase of 1.45 cents per ounce relative to the average pre-tax SSB price of 4.26 cents per ounce across various types of stores, chains, and products. The range of price per ounce increases of 1.16 to 1.78 depended on the store format (Stephan Seiler, 2019). Convenience stores, dollar stores, and drugstores accounted for 30% of SSB sales, and featured lower volumetric tax price increases due to their greater proportion of smaller pack, lower volume SSB options. Such stores featured moderate or no decreases in SSB volumes sold as a result of the impulse purchases associated with small pack sizes. In contrast, grocery stores, mass merchants, and wholesale clubs featured two-thirds of SSB purchase volumes and had larger price increases from their available selection of larger pack sizes and volumes. Chains that sold large quantities had a 41-69% decrease in volume sales relative to the pre-tax weekly average sales of 122,000 ounces per store. Supermarket SSB sales in Philadelphia decreased by 24% in comparison to the 14% increase in supermarkets of
comparison cities with a moderately lower net effect on overall bottler sales (John Cawley, 2018). Generally, the passthrough rates were greater in stores closest to the Philadelphia city center and furthest from stores selling untaxed beverages. There was also geographical evidence of higher passthrough rates in low income, high obesity neighborhoods such as North and West Philadelphia. Lower socioeconomic households were found to be less likely to engage in cross-border shopping due to the costs of traveling across the border, indicating the mild regressive nature of the SSB tax (American Beverage Association; Oxford Economics, 2017).

The consequences of the tax on beverage purchases and consumption were moderately successful. Several studies found evidence of product substitution towards untaxed beverage purchases and cross-border substitution towards increased SSB purchases in nearby untaxed jurisdictions outside Philadelphia that affected the financial and public health goals of the tax policy. Within the first two months of implementation, repeated cross-sectional studies by Cawley et al (2018) found that Philadelphian residents were 40% less likely to consume regular soda, 64% less likely to consume energy drinks, and 58% more likely to consume bottled water on a daily basis relative to residents in three geographically close comparison cities. Over time, exit interviews from longitudinal surveys between 2016 and 2017 among a representative sample of retail stores in Philadelphia found that the tax led to a decrease from 25.3% to 21.3% of consumers purchasing taxed beverages and an increase from 10.1% to 14.1% of consumers purchasing untaxed beverages (John Cawley, 2018). In contrast, the comparison areas in nearby untaxed jurisdictions for the years 2016 and 2017 featured an increase from 21.3% to 29.7% of consumers purchasing taxed beverages and an increase from 10% to 11.5% of consumers purchasing untaxed beverages. In another study, the average Philadelphia household purchased 13.2 ounces of taxed beverages and 7.4 ounces of untaxed beverages per shopping trip before the tax imposition. The tax reduced the baseline monthly frequency of 54 SSB consumption by 4-5 times for adults and baseline of 38 SSB consumption by 2-4 times for children. Adults were found to reduce their regular soda intake from one beverage a day pre-tax to one beverage every three days with an overall 30% reduced consumption probability (John Cawley, 2018). However, the net effect was found to be disappointing as over half of the reduction was offset by increased comparison store purchases in untaxed jurisdictions outside the city, limiting the health and
financial benefits of taxation. The remaining Philadelphia residents and consumers who continued purchasing SSBs in Philadelphia were less price sensitive and had more inelastic demand than average pre-tax consumers.

The negative frequency of consumption of taxed beverages was not found to produce statistically significant long-term effects on nutritional intake for non-African-American adults and children residing in Philadelphia. Due to tax avoidance and leakages from substitution, the tax decreased caloric intake by only 16%. The associated 9.6 daily calorie decrease for children and 23.6 daily calorie decrease or long-term 2-pound weight reduction for adults was not found to be statistically significant (Stephan Seiler, 2019). Interestingly, the tax encouraged a substantially positive reduction in overall sugar consumption among African-American households as well as those with high pre-tax consumption levels. The encouraging results show that African-American children significantly lowered their daily added sugar consumption by 8 grams or 32 calories, while adults reduced their frequency of monthly consumption by 14.6 times (John Cawley, 2018).

Furthermore, the tax reduced added sugar consumption by 22% for children with high baseline consumptions at the 93rd percentile of the daily consumption of 67 grams of added sugars. Additionally, low-income households decreased their SSB purchases by 12.7 ounces per shopping trip in Philadelphia stores relative to comparison area stores as compared to the average 6.1 ounce decrease per shopping trip (John Cawley, 2018). However, the decreased SSB purchase quantity among low-income households is lower by 10% than the one observed among high-income households. The high correlation between income and location makes it more difficult for low-income households to cross the border for cheaper SSB substitute purchases, and so they are forced to bear a relatively larger tax burden. From a behavioral perspective, it is imperative for the government to distribute the tax proceeds towards social programs that help support the livelihoods of the low-income households.

The influence of cross-border shopping complicated the accuracy of measures of SSB purchases and associated consumption for Philadelphian residents and households. There was a large degree of cross-border tax avoidance due to the significantly high tax, mobility of Philadelphian residents, and the highly localized taxes across a geographically small jurisdiction. Seilar et al (2019) found that the quantity of SSBs sold increased significantly for stores within a 6-mile radius
outside Philadelphia. For example, the average store within 1 mile of the city increased an average 182,000 ounces of SSB sales compared to an average Philadelphia store with a decreased 64,000 ounces of SSB sales. In comparison cities, the increased average 6.8 ounces of beverage purchases per shopping trip did not decrease over two years while SSB prices remained unchanged (Stephan Seiler, 2019). However, authors found that pre-tax shopping was already fairly common at an average of 17.4% due to the proximity of the closest untaxed store at 3.2 miles from the city border (John Cawley, 2018). Consumers were found to be more likely to purchase SSBs when they already were traveling outside the city. Interestingly, Thomassen et al (2017) analyzed the importance of statistically significant yet small in magnitude basket-level substitution effects. Philadelphian residents who substituted their SSB purchases to outside the city were found to start purchasing other non-taxed products in their average shopping trips. Same store grocery sales for non-beverage category sales declined by 7% in Philadelphia and increased by 1% in stores surrounding the region (Stephan Seiler, 2019).

Based on the actual 2017 governmental revenue of $79 million relative to the expected generation of $92 million, city officials did not anticipate the decrease of local SSB purchases from product and cross-border substitutions (Yichen Zhong, 2018). City officials forecasted the expected tax revenue based on a continuation of pre-tax purchasing trends without considering the extent to which consumers would shift their beverage and location purchases. Given that tax receipts were 15% below pre-implementation policy estimates, substitution analyses exhibited the 29% increase of untaxed sugary drink powder mix sales and 32% increase of instant tea mix sales within Philadelphia stores. Philadelphia store sales data featured an average 24% decline of overall beverage sales with the largest decreases of 57% in grocery stores and 35% in retail store formats. For example, the unit sales of a 2-liter popular soda brand had a substantial drop. Furthermore, the 2-3% increase of untaxed sales in stores outside Philadelphia contributed to the 14% sales volume increase in drink categories where Philadelphia’s store sales declined the most (American Beverage Association; Oxford Economics, 2017). The highly localized nature of the Philadelphia tax became less effective due to ease and leakage of cross-shopping. Because the revenue generated by the SSB tax only represented a 1.17% share of the city government’s total tax revenue, there is evidence of the significantly decreased taxable revenue opportunities.
due to the combination of consumer substitution towards untaxed beverages and purchases from untaxed jurisdictions.

Corporate sales data from the three largest national bottlers and retail sales data from supermarkets suggest reduced economic activity in the form of labor, wages, and GDP throughout the supply chain of bottling, distribution, and retail as a result of Philadelphia’s SSB tax. In a paper by Oxford Economics and the American Beverage Association (2017), researchers used input-output modeling to analyze the total impact on GDP, employment, labor income, and taxes. The researchers used the 29% decrease in bottler sales or $22 million lower output to estimate the reduced manufacturing and bottling activities and associated concomitant declines in trade, transport, and retail margins as well as additional indirect supply chain impacts such as the lost wages and spending of unemployed workers. The researchers found the modeled results of an overall 0.14% unemployment impact of 1,192 workers and 0.08% lost GDP impact of $80 million. In addition to $54 million in lost wages, the researchers modeled a total $4.5 million decrease in local taxable revenue as a result of reduced economic activity, leading to a $74.5 million net effect on 2017 tax revenue. Therefore, the tax was found to have far reaching consequences that may not have been properly considered and addressed by the city government (American Beverage Association; Oxford Economics, 2017).

4. **Comparison Between the Counterfactual Case Studies and Philadelphia**

The main similarity between the counterfactual case studies of Mexico, Chile, and the UK as compared to Philadelphia is the relatively early adoption of an SSB tax policy for their respective jurisdictions. The counterfactuals and Philadelphia all had strong, decisive political leaders who championed the potential benefits of a tax policy for SSBs. These political leaders saw the dangers of SSB overconsumption as a market failure and negative externality issue, and used the tax to change individual economic incentives and associated behavior and decision-making. Based on conventional economics, the facilitation of the tax enactment provided the government authorities with the ability to regulate and realign market forces and SSB prices to incorporate the societal costs of overconsumption. The taxes were designed to reduce SSB purchase and consumption, while simultaneously generating governmental revenue to be earmarked towards specific purposes (Barry M Popkin, 2016).
Several differences between the counterfactuals and Philadelphia include the policy rationale and behavioral elements involved. The Philadelphia city government explicitly highlighted the budgetary rationale of the tax to be earmarked for educational purposes in financing universal pre-kindergarten across the city. It did not use any behavioral elements in its policy introduction and implementation, and strategically chose to minimize any public health motives of the policy. The Philadelphia city government also did not consider and include the contributions of public health experts and advocates due to its prioritized financial motive over any health-related impacts. In contrast to Philadelphia, the counterfactual case studies all similarly emphasized the health benefits of SSB taxation by applying behavioral science to policy decisions under a health perspective and context. The public policymakers of Mexico, Chile, and UK consisted of a combination of financial and health experts that focused their comprehensive tax policy designs around behaviorally inspired incentives derived from consumer biases associated with SSB overconsumption. Complementary policymaking measures through behavioral interventions were considered in addition to the traditional economic taxation tool of SSB price changes.

The policymakers of the counterfactuals all used carefully crafted and salient information-based policies to address the behavioral components of status quo and present bias, framing and signaling, and social norms and attitudes. Consumers are prone to place a greater value for present benefits and hyperbolically discount the future costs of SSB consumption based on time inconsistent preferences. Consumers in several cultures also have strong social norms supported by empirical and normative expectations of regular SSB consumption. Given the known behavioral biases of consumers, policymakers of the counterfactual jurisdictions have designed behaviorally inspired incentives and tools including public awareness campaigns, front-of-packaging nutritional information labels, and product reformulation nudges aimed at the soda industry. The comprehensive tax policy designed in conjunction with the approaches of asymmetric paternalism and libertarian paternalism provides consumers with more and better information on their behavioral biases and sends a concerned signal on the associated risks and dangers of SSB overconsumption. The involvement of health advocates, public policy officials, and community groups in health-orientated media campaigns and pro-tax advocacy efforts have also increased the exposure, attentiveness, and awareness of consumers to health messaging (M
Furthermore, public health experts and scientific organizations have analyzed and disseminated health-related evidence to help stimulate debates on risks of unhealthy diets and to increase the potential emotional tax and costs to consumers. Salient informational nudges and highly visual cues can additionally evoke negative emotions among consumers and trigger behavioral changes at an automatic and unconscious level. Therefore, recurring context cues, disruption to existing cues, and environmental reengineering through informational provision have been used by counterfactual policymakers to sufficiently help consumer deal with internalities and better align their purchasing and consumption decisions with preferences (Wendy Wood, 2016).

Policymakers of the counterfactual cases used the information-based policies to introduce group incentives and pressure from social norms. The reduced salience of cues to unhealthy choices and increased salience of cues to healthy choices are targeted at changing attitudes and beliefs and encouraging the collective decision to change to eventually establish new normative and empirical expectations. Awareness of the negative externality, SSB consumption risks, and internalities creates shared reasons for reference networks to collectively change their expectations for SSB purchase and consumption. Furthermore, the empirical expectations of everyone else’s changed behavioral patterns within reference networks can facilitate the development of new personal beliefs and attitudes. For example, the lower proportion of reference networks consuming SSBs during social events or situations can induce new factual and normative beliefs towards SSBs. The taxation of SSBs further encourage collective action planning and group discussions on developing a common understanding of the problem and solutions that need to be achieved. Because SSB consumption is a socially conditional preference and interdependent choice depending on empirical and normative expectations, policymakers of the counterfactual jurisdictions focused the salient informational policies to break existing unhealthy habits and simultaneously promote and establish healthy ones (Bicchieri, 2016).

The economic, social, and health benefits of governmental policies tackling SSB consumption are strong. Alvarez-Sanchez et al (2016) state that “The implementation of tax policy needs to be accompanied with highly visible campaigns to increase knowledge of SSBs and enhance motivation” (Cristina Alvarez-Sanchez, 2016). Nudging, signaling, and framing information under
a multi-disciplinary, comprehensive tax policy raises the advocacy, publicity, and public awareness of health risks and de-normalizes consumption for the public. Mexico’s public awareness campaigns, Chile’s nutritional package labels, and UK’s product reformulation emphasis exhibit how behavioral interventions can be appropriately and effectively combined with traditional taxes as largescale, cost-effective and top-down policies to solve the health and financial-related issues associated with SSB consumption.

5. Counterfactual Case Studies of Mexico, Chile and UK

Mexico, Chile, and the UK as counterfactual case studies strongly suggest that behavioral elements beyond price elasticities and pass-through rates are crucial in understanding the effectiveness of soda taxes.

5.1. Counterfactual Case Study of Mexico

The financial and health-related successes of Mexico’s 2013 10% SSB excise tax serve as a particularly interesting counterfactual case study for altering preferences and reducing consumption behavior in the context of Mexico having deeply entrenched social norms of heavy SSB consumption. SSBs concerningly contribute to 70% of added sugars to the Mexican diet as its consumption is inherent as a strong cultural component that signals conviviality, hospitality, and social status. As the leading per capita consumers worldwide, Mexicans also possess the highest SSB exposures since infancy to have learned preferences over time in addition to the innate, genetic human predisposition to prefer sweet tastes. Despite the doubling of SSB intake between 1999 and 2006 across all age groups and the behavioral change challenges of tackling local sociocultural aspects, Mexican policymakers were able to successfully generate $1.2 billion in tax revenue to increase the access to clean water in schools (M Arantxa Colchero, 2016). Mexican policymakers were also able to attribute part of their successes to a shift in social norms and attitudes as evidenced from behavioral, personal normative belief, empirical expectation, and normative expectation measurements. The shift in social norms was supported by the accompaniment of the tax with highly visible educational and informational campaigns (Gastropod, 2018).
Empirical evidence on the signaling effect of the Mexican SSB tax by Alverez-Sanchez et al (2016) highlights the importance of signaling and framing information. The policy debate on the potential benefits and consequences of the SSB tax promoted considerable media attention and raised the profile of issues to the public and key decision-makers. While the entire soda industry had a united front with significant media activism including TV, radio, press, and advertisement campaigns, health advocates similarly used a public awareness campaign of over 1,000 articles during the 5-month lead up to the tax vote (Cristina Alvarez-Sanchez, 2016). The result of the visible and controversial campaigns between tax proponents and opponents provided consumers with both the behavioral rationale and traditional economic justification on the necessary changes to their dietary habits. Public health professionals framed the dangers of the sugar content within SSBs and the potential of using taxable revenue to build purified water fountains in schools. Furthermore, public awareness campaigns involved creative slogans such as “Share Diabetes with Maria” and lines such as “1 out of 2 Latino children will get Type 2 Diabetes” that linked SSBs to diabetes and took advantage of Coca-Cola’s “Share a Coke” summer campaign (Cristina Alvarez-Sanchez, 2016). These initiatives triggered Mexican consumers to consider their short and long-term health goals and addressed status quo and present biases by attaching higher costs to unhealthy SSB choices at the time of purchase. The accompanying public health and nutrition education campaigns to the tax increased the knowledge, exposure, and attentiveness of consumers to health messaging and encouraged significantly higher self-reported decreases in SSB consumption. For example, Alverez-Sanchez et al (2016) found that urban adults were more likely to be aware of the tax, approve its effectiveness and drink 16.6% less SSBs due to Mexico City as the center of the most advocacy and opposition campaigns. Respondents aware of the tax were also 30% more likely to reduce SSB consumption the two years prior and 23% more likely to self-report decreased SSB consumption than those unaware. Furthermore, Alverez-Sanchez et al (2016) highlighted the complementary nature of self-efficacy and self-regulation programs to Mexico’s behavioral tools to have high sense of self-control and confidence in overcoming potential impediments and barriers to the long-term adoption and maintenance of healthy behaviors. While beliefs on health outcomes serve as preconditions for change, high self-efficacy and low liking of SSBs were additionally highlighted to reduce SSB
purchases, consumption, and caloric intake (Cristina Alvarez-Sanchez, 2016). Therefore, framing strategies can influence popular support for lifestyle-related, behavioral change policies especially in conjunction with the economic elastic nature of SSBs.

The quantitative and statistical analyses of Colchero et al (2016) further exhibit the behavioral change hurdles overcome and associated policy successes. Using a difference-in-difference fixed effects model, Colchero et al (2016) estimated the counterfactual volumes that would have been purchased assuming the continuation of pre-tax trends. The researchers found a 6.1% average decline of taxed SSB purchases in 2014 relative to pre-tax trends with an even greater decline of 9-17% among low socioeconomic households. For example, the average urban Mexican purchased and consumed 4,241 fewer milliliters of taxed SSBs than expected. A 4% or 12,827 milliliter increase in average Mexican consumer purchases of untaxed beverages such as bottled plain water than compared to the expected counterfactual estimate was also discovered (M Arantxa Colchero, 2016). Colchero et al (2016) further advocated the much larger long-term impacts of price changes and acceleration of purchase reduction over time as a result of the widening of absolute and relative differences between actual post-tax purchased volumes and estimated counterfactuals in the 12 post-tax months. Based on an own-price elasticity estimate of -1.0 to -1.3 for SSB quantity demanded, the reduced consumption was predicted to decrease the average adult weight by 3 pounds and BMI by 1.8% (M Arantxa Colchero, 2016). The authors therefore found SSB demand to be price elastic for relatively small taxes to make larger demand differences. Relative to the Philadelphia Tax, the Mexican tax policy was behaviorally effective in providing salient information that changed consumer beliefs and expectations and increased their price elasticities from an initial expected price inelastic estimate. Consequently, the expected regressive burden of the tax was found to be counteracted with the progressive nature of broader fiscal effects of the tax revenues, especially with the earmarking of increased water fountain availability for children.

From a behavioral perspective, the insights learned from the Mexican counterfactual study suggest the importance of the salience of informational nudges and visual cues in altering consumer purchasing and consumption behavior. The signaling and framing of information especially through highly visible campaigns and slogans targeted the status quo and present
behavioral biases. Mexican consumers now subconsciously associate SSBs with diabetes, obesity, and other health-related risks from the frequent repetition and recurrence of contextual cues. The environmental reengineering of general beliefs and attitudes towards SSBs through the information campaigns further conveyed warning messages on the associated danger of SSB consumption. Increased emotional taxes from the negative emotions such as pain and guilt evoked also increase the attachment of net costs to the present, and lead consumers to comprehend the full-scale consequences of their actions in regard to the internalities of long-term health and externalities on societal healthcare costs. Rather than continually sticking to the status quo SSB choice, consumers with their changed beliefs now contemplate other previously disregarded healthier beverage alternatives. The behavioral effects of the nudge interventions culminate in the strengthening of group pressure supported by new social norms and attitudes. As empirical and normative expectations change over time based on observational changes on the frequency of SSB consumption among their reference networks, Mexican consumers are increasingly found to have a newfound enduring lifestyle habit of decreased SSB consumption that positively benefits the health of their future generations.

5.2. Counterfactual Case Study of Chile

Chile, as another country with one of the highest SSB per capita consumptions in the world, utilized and expanded its tax policy from beverages with added colorants, flavorings, and sweeteners to encompass all other junk foods. The ad valorem tax policy was increased from 13% to 18% for beverages exceeding added sugar concentrations of 6.25 grams per 100 milliliters and decreased from 13% to 10% for all other SSBs below the threshold. The comparatively small financial incentive for consumers was found to be effective in reducing SSB consumption through large sales declines of high sugar content beverages. Academics from the University of York (2018) used a time-series data to find an overall 21.6% decrease in monthly purchases for beverages exceeding the threshold one year after the tax implementation relative to three-year averages of pre-tax purchasing patterns. More specifically, high-income households reduced their purchases by 31%, middle-income households by 16%, and low-income households by 12% (University of York, 2018). While the sugar intake reductions at the population level have encouraged significant health gains from a public health perspective, it does not reduce the
socioeconomic inequalities associated with diet-related health. From a policymaker’s perspective, a higher tax rate does not need to be excessive to have largescale public health impacts, but tax authorities should also consider initiatives that mitigate the mild regressive nature of their imposed tax policies.

Chile’s behavioral intervention of instilling dark, negative front-of-package warning labels in addition to its tax is particularly notable for being the first of its kind. Chilean policymakers wanted to carefully mandate an information-based policy on manufacturers and bottlers to publicize nutritional information on beverage products to consumers. However, recent results from authors such as Jue et al (2012) suggest the lack of impact on calorie messaging and nutritional information on product labels. Consumers may get confused from the calorie numbers, misunderstand what they mean, and misinterpret recommended daily calorie counts and overall calories consumed (J. Jane S. Jue, 2012). Chilean policymakers as a result have been inspired by the positive voluntary label systems of other countries indicating a “healthy choice” or “low in fat” to implement its own dark, negative front labels from June 2016 onwards in its new Chilean Law 20.606 regulation (Gastropod, 2018). Bold, black stop-signs and warning symbols are prominently displayed and visibly printed on the front of food and drink products. For example, one stop sign indicates the product is high in fat, two signs depict high sugar contents, and three signs convey high salt levels. Consumers were also educated through government released advertisements to help them comprehend the meaning of the stop signs and understand why the particular labelled products are not good healthy choices (Gastropod, 2018).

Using a behavioral perspective, the behavioral approach of the warnings system increases the emotional tax of calorie labels, leverages Type 1 subconscious thinking, and nudges consumers to the right healthy choices that are better aligned with their long-term preferences. The behavioral approach of the labeling introduces a salient informational nudge on the average Chilean consumer that evokes negative emotions such as pain, anxiety, fear, and guilt at the time of purchase. Higher emotional taxes coupled with the economic incentives of taxes address the present bias as consumers now reevaluate their purchasing decisions in the context of their internalities of long-term health and externalities on additional societal costs. The labels also correct for status quo bias by changing the packaging of SSB products typically purchased. The
color black and readable stop sign encourage regular and heavy SSB consumers to subconsciously associate the need to pause on their Type 1 thinking, and carefully and consciously consider the consequences of their consumption with Type 2 thinking. Furthermore, color psychology explains the association of the color black to a mysterious, hidden and unknown allure. Rather than employing a red stop sign, Chilean policymakers creatively use an incongruous combination of the color black with a typical stop sign for consumers to think and learn more about the hidden meaning and message behind the label. The simultaneous government-run advertisements help consumers understand the concerned risks and dangers associated with their SSB consumption. Consumers still have the freedom to continue their SSB purchases but are nudged towards healthier alternative choices that do not feature the label warning. The disruption to existing visual cues through front-of-package labeling therefore evoke negative emotions supported by salient informational nudges and highly visual cues that eventually influence purchase and consumption behaviors.

Preliminary results from Chile’s comprehensive tax policy suggest the effectiveness of its interventions in altering consumer and industry behaviors. Popkin (2018) has made an ambitious prediction that Chile will become the first country to reduce obesity prevalence within the next five or eight years due to its innovative policy design (Gastropod, 2018). According to Popkin (2018), “The effects of the Chilean stop sign system is much bigger than the tax in terms of cutting sugar and improving public health.” Popkin (2018), however, suggests the complementary nature of the tax and stop sign system and the need for both interventions as a strong pro-tax and pro-warning label advocate (Gastropod, 2018). Through eight focus group interviews on low- and middle-income households, Popkin (2018) has found evidence of young children clearly rejecting beverage products with black labels. His qualitative examples include a child asking his mother to stop purchasing black labeled products and buying only healthy foods and another child requesting her mother for salads instead of packaged foods. The results of Popkin’s focus group interviews indicate that the warning label behavioral intervention has successfully exposed children to the conveyed information and nudged them towards the right direction, counteracting any social norms associated with long-term habitual SSB consumption (Gastropod, 2018). Furthermore, the warning system has encouraged the soda industry to change and
reformulate their product recipes to avoid significant sales decreases from the black stop signs printed onto their packaging. For example, Fanta introduced its Fanta Zero product and cut down sugar by 30% with artificial sweetener acesulfame in its regular Fanta product to be below the mandated threshold of the warning system. Additionally, the warning system eases the identification process of taxable items and simplifies the administration of the tax for tax authorities. The labeling scheme provides important insights on the current food supply and properly delineates and clarifies unhealthy products (Gastropod, 2018).

Chile’s comprehensive tax has been so effective in nudging consumers towards the right healthier behavioral consumer choices that it has inspired policymakers across other jurisdictions. Israel, Peru, Uruguay, and Brazil are analyzing its policy design and copying most of its features rather than inflating their soda taxes to higher levels. However, a main caveat to Chile’s promising initiative is the exacerbation of health disparities as found by the research of Hartmann-Boyce et al (2018). Nutrition-based interventions such as front of package profiling and labeling interventions comparable to that of Chilean regulations were found to be more effective for socioeconomically advantaged household groups with smaller benefits derived for low-income households (Jamie Hartmann-Boyce, 2018). The interesting findings of Hartmann-Boyce et al (2018) exhibit the differential effects of behavioral interventions similar to that of taxes towards various socioeconomic group and advocate the need for socially progressive initiatives that benefit low-income households.

5.3. Counterfactual Case Study of the UK

The recent UK soda tax in 2018 serves as an innovative policy model to target the taxing of sugar rather than soda itself. With the UK having the highest obesity level in Western Europe, UK policymakers have introduced a tiered SSB tax policy based on sugar content in SSB products following a two-year lead-in period. More specifically, the policy consisted of tax exemptions for SSBs with less than the 5 grams of sugar per 100 milliliters thresholds, 18 pence ($0.25) per liter tax on SSBs with more than 5 grams of sugar per 100 milliliters, and 24 pence ($0.35) tax on SSBs with more than 8 grams per 100 milliliters. The tax proceeds are earmarked for tackling childhood obesity through physical education activities and breakfast clubs in primary schools (Arthur, 2018). UK public health and finance policymakers cooperated using a step-by-step governmental
approach to facilitate the policy process in order to levy a flexible tax scheme that explicitly conveyed the policy intention of targeted product reformulation incentives to manufacturers. The collaborated efforts between The Center for Health and Social Change and The Center for Global Non-Communicable Diseases to combat obesity drove the motivation to encourage competition between manufacturers and importers for reducing sugar content, offering healthier SSB products, and lowering portion sizes (Arthur, 2018). The decisiveness of the UK chancellor along with the role of public health experts and scientific organizations to disseminate evidence and stimulate debates strongly encouraged industry acceptance of SSB product reformulation to reduce potential tax liabilities.

Evidence from a combination of modeling studies and empirical observations exhibit the success of the UK’s graduated tax scheme from a public health perspective. Briggs et al (2017) forecasted and modeled the three potential scenarios of manufacturers opting to sell smaller SSB portion sizes, reformulating their product recipes, and not taking any action and accepting the higher tax rate. Based on a modeling study, Briggs et al (2017) estimated that product reformulation would be the most likely response of manufacturers and would also likely produce the largest positive health impact (Adam D M Briggs, 2017). In terms of empirical evidence, preliminary data demonstrates that businesses, manufacturers, and the soda drink industry have used the two-year period to change their recipes to lower sugar amounts while simultaneously ramping up product launches of low and no-sugar SSBs. For example, Irn-Bru reduced its sugar content from 10.3 grams to 4.7 grams per 100 milliliters and its parent company A.G. Barr developed an unprecedented number of new recipes for 99% of its beverage portfolio to escape the levy. Other examples include reductions of Ribena from 10 grams to less than 4.5 grams and Lucozade from 13 grams to less than 4.5 grams. Retailers including Tesco, Asda, and Morrisons have also reformulated their own-label fizzy drinks to be below the 5 grams per 100 milliliters levy threshold and gain full tax exemptions. Additionally, Coca-Cola has responded by reducing its bottle sizes from 1.75 liters to 1.5 liters in order to pay less tax liabilities (Gastropod, 2018). As a result of the soda industry response, the British Treasury estimated the reduction in sugar content in beverages by 50% of all beverages or 45 million kilograms per year and modeled the associated decreases of obese adults by half a million and new type 2 diabetes cases by 300,000.
Overall, the British Treasury revised its pre-tax estimates from 520 million pounds ($667 million) to 240 million pounds ($308 million) in the first year and raised the tax proceeds of 153.8 million pounds ($197 million) during the first seven months of implementation (Triggle, 2018).

Several behavioral lessons can be derived from the UK’s graduated tax scheme. The tax policy nudged soda manufacturers and bottlers with economic incentives to decrease their sugar contents and bottle sizes as a productive long-term approach (The Conversation, 2016). Policymakers clearly framed and signaled the introduction of the policy with their intentions. They also provided the necessary flexibilities of ample time between the tax announcement and collection for manufacturers to conduct and execute their planning strategies. As a result, soda manufacturers and bottlers are pressured to become more operationally efficient in an increasingly competitive market where tax liabilities can be accounted for sizable cost savings.

The policy changed the norms of the soda industry as the increased regulation has led to manufacturers competing against each other for the lowest sugar contents in their drinks while still maintaining similar tastes to the original formulations. Furthermore, the empirical observations of other soda companies introducing new product lines with lowered sugar contents can induce the production of healthier recipes on new SSBs. Additionally, the policy does not interfere in the personal choices of consumers. Consumers can continue purchasing and consuming their favorite SSBs with new product formulations that are healthier, similar in taste, and have lower sugar contents. Therefore, the economic incentives as a nudge and the signaling and framing of information contributed to the successes of the UK policy in altering the behaviors of the soda industry.

6. Analysis and Discussion

SSB taxes have been identified as a powerful economic tool as a means to improve population diets, weight, and health outcomes and to generate governmental revenues for earmarking of social programs (Luc Louis Hagenaars, 2017). However, tax policies are not always effective in promoting behavioral change. Regular and heavy SSB drinkers may still continue their consumption habits based on innate preferences for taste and for social interdependent reasons among their reference networks regardless of the tax rate. Social norms of empirical and normative expectations supported by observations, beliefs, and attitudes can lead to the
persistence of SSB purchases and consumption. Furthermore, consumers may view and perceive the taxation as a violation of their personal freedoms without truly understanding the meaning, motivation, and messages behind the tax. Consumers may find that government policymakers are overstepping their roles and power to regulate public health and are crossing the line between paternalism and freedom of choice through taxation. Taxation as an economic tool used in isolation to offer economic incentives is therefore often found to be ineffective and inefficient to effect significant behavioral changes necessary to solve population health issues and mitigate healthcare burdens.

Real world evidence from Mexico, Chile, and the UK portray the largescale, cost-effective, and impactful interventions of behaviorally informed tax policies. The counterfactual studies all share a central theme in common; policymakers used carefully crafted and salient information-based nudge policies as triggering tools to facilitate the development of new beliefs and attitudes. Mexico’s public awareness campaigns, recurrent visual cues of “Sharing diabetes with Maria”, and environmental reengineering provided consumers with better information and introduced reasons for change. Chile’s dark and negative black label warning stop sign system was high in visibility and citizens were willing to understand the SSB consumption risks, negative externalities to society, and internalities that aligned their long-term health preferences with choices. The UK also used a targeted informational nudge campaign on soda manufacturers through economic incentives that contributed to industry acceptance for an increasingly competitive marketplace for healthier beverage offerings. These behavioral interventions elicited emotions and evoked emotional taxes on both consumers and manufacturers to consider the true social costs of SSB consumption and focus on ways in which societal welfare can be maximized.

The joint contributions of health and finance policymakers in the introduction and implementation of effective behavioral tax policies exemplify the significance of a social norm approach to behavioral change. These policymakers illustrated how the signaling and framing of information through the disruption to existing cues and introduction of new visual and salient cues can encourage norm abandonment among first movers (Wendy Wood, 2016). With the cues, trendsetters realize the social dilemma problem and understand the social costs of their personal behavior. As negative emotions are now evoked and associated with SSBs, the trendsetters are
incentivized to start a change movement and demonstrate to others that such a change is possible even in deeply entrenched cultural environments of habitual SSB consumption. The updating of people’s empirical expectations towards a certain threshold as they observe each other’s changed behavior leads to a tipping point and cascade for behavioral change. With the empirical expectations that everyone in the relevant network is drinking healthier beverages, the normative expectations that everyone believes all should and ought to drink healthier beverages will then follow. Overall changes to empirical and normative expectations create reasons for the coordinated and collective abandonment of the original community practice of regularly and habitually consuming SSBs. Collective discussions on changed factual beliefs, attitudes, and expectations further promote the norm creation of healthier food and beverage consumption, and emphasis on both positive personal and public health (Bicchieri, 2016).

Behavioral insights from Mexico, Chile, and the UK can be derived and applied towards other jurisdictions that lack a soda tax policy. The policymakers targeted social expectations, engaged the community, and used bottoms-up strategies to emphasize shared accountability and responsibility for the prevalence of obesity and health-related diseases. The various informational nudges and context cues of the counterfactuals are examples that successfully dealt with known behavioral present and status quo biases. The status quo choice of SSB no longer becomes as desirable as the future consumption costs to the individual and society are not as heavily discounted. As a result, the examples challenged the subconscious thinking and sociocultural norms at the time and facilitated collective discussions for change using the approaches of asymmetric paternalism and libertarian paternalism. Long-term compliance to the new practice of healthier SSB consumption becomes more sustainable as the social norm becomes conditional on social expectations (Bicchieri, 2016).

7. Conclusion

The Philadelphia Beverage Tax is a step in the right direction to solve unhealthy diets but more needs to be done to combine the fiscal policy of taxation with behavioral elements. Establishing enduring healthy lifestyle habits require behaviorally informed policies that deal with behavioral biases, advance habit-forming mechanisms, and create new social norms. The lack of consideration for behavioral components during the introduction and implementation of the
Philadelphia tax significantly affected its ability to achieve pre-tax revenue goals and population health benefits, and led to product and cross-border substitutions. While changing the whole norms of eating and culture of beverage consumption is challenging and will take time, the counterfactual examples provide hope of aligning consumer preferences to their choices and altering long-term consumption behavior. The counterfactual interventions in Mexico's highly visible public education campaigns, Chile's labeling scheme, and the UK's flexible and graduated tax scheme are all examples of what the Philadelphia city government could have and can be implementing today. Based on policy priorities and intentions, Philadelphian policymakers can be inspired and expand upon Mexico's intervention at the consumer level of nutritional education, Chile's efforts at the grocery store and retailer level, and UK's endeavors at the soda manufacturer and bottler level. They can even go above and beyond the counterfactual examples by instilling progressive policies that combat the mild regressive natures of the tax and behavioral interventions and provide the much needed support for the livelihoods of low-income households. Philadelphian policymakers need to therefore increasingly consider ways throughout the SSB supply chain in which context cues can be disrupted and leveraged, and how new cues can be recurrent and salient under an environmental reengineering effort to change social attitudes and expectations (Wendy Wood, 2016). Consequently, a comprehensive multi-faceted tax policy design instilled with incorporated behavioral interventions can inspire a social norm approach to behavior change by ensuring the simultaneous norm abandonment of regular SSB consumption and the norm creation of healthier diets.
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Appendix: Motivation and Acknowledgements

This research-based capstone aims to combine my interests in health and taxation, and allows me the opportunity to delve deeper into how tax policies can be behaviorally informed. My deep dive into the literature reviews and case studies of soda beverage taxes implemented across multiple jurisdictions such as Philadelphia, Australia, and Chile has exhibited the wide range of available tools for public policy makers and analysts to introduce successful, long-lasting, and cost-effective public health policies. Through counterfactual studies in Mexico where social norms are deeply rooted into the consumption of soda, traditional economic instruments have been found to sustainably work in tandem with behavioral tools as part of a broad and multifaceted approach. My analysis on the economic and behavioral responses of for-profit companies, nonprofit organizations, governmental agencies, and local communities to behavioral tax policy interventions will further inform a greater understanding on the implications of largescale, top-down interventions for all stakeholders involved. Overall, my research paper will advise the Philadelphia City government on how the institution could have utilized a more behaviorally inspired policy to achieve its goals and outcomes.

Insights from the MBDS coursework, previous academic and professional experiences, and my current full-time career as a tax consultant have inspired the writing of this research paper. I am especially grateful to my MBDS professors Dr. Enrique Fatas, Dr. Nazli Bhatia, Dr. Barbara Mellers, and Dr. Cristina Bicchieri for their courses, class presentations and assignments, and informal office hour conversations that have shaped the ideas in my paper. I would also like to thank Dr. Chris Nave for guiding me throughout my professional studies as a behavioral economist at Penn. My MBDS training and support from my aforementioned mentors has equipped me with the theoretical knowledge of how behavioral economics can be applied to public policy. Through this capstone paper, I hope to fill in the noticeable gap of behavioral literature on Philadelphia’s soda tax policy, and inspire the potential for effective behavioral interventions to tackle obesity and health-related outcomes while simultaneously generating sources of government revenue.