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Title

Impacts of a Sugar Sweetened Beverage Tax on Small Retailers and Cross-border Shopping

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Highlights (MAX 85 incldg spaces per bullet)

- We estimate price elasticities using data from consumers facing a proposed SSB excise tax.
- We estimate the impact of an excise tax on small retailers and cross border shopping.
- Estimated price elasticities fall between $-.71$ and -2.0 .
- Small retailers will not see an adverse differential effect from a penny-per-ounce tax on SSBs.
- Consumers will not cross state borders to avoid a penny-per-ounce tax.
- Low-income consumers are not differentially burdened by an SSB excise tax.

Abstract

The authors investigated whether a proposed penny per ounce sugar sweetened beverage (SSB) tax would cause differential economic harm to small retailers due to decreased SSB demand or promote cross border shopping.

We used survey data and difference in difference modeling to examine associations between SSB demand, a SSB excise tax, small retailer purchases, border county residence, and demographic characteristics.

A SSB excise tax would reduce SSB demand. There was no evidence that a penny per ounce SSB excise causes smaller and border county retailers to suffer lower sales compared with other retailers. Results suggested that lower income consumers and overweight/obese consumers do not have a different price sensitivity compared to higher income and healthy weight consumers. For all model specifications, only the tax coefficient was significant. Calculated elasticities were within ranges of other studies, between $-.71$ and -2.0 .

This study suggests that the economic and cross border shopping arguments opposing SSB excise taxes as a policy instrument to help decrease the obesity problem may not have a strong empirical basis.

Keywords

Sugar-sweetened beverage, Tax, SSB, Cross-border shopping, Difference-in-difference, Purchase, Consumer, Elasticity, Pricing

DRAFT

Introduction

Excise tax legislation specific to sugar sweetened beverages (SSBs) has yet to pass in the United States. This is despite support from many in the public health community who believe a tax is one of several policy options that will encourage consumers to decrease their calorie intake, and ultimately reduce the prevalence of obesity (Brownell et al., 2009; Brownell & Frieden, 2009; Faulkner et al., 2011). Proposals to tax SSBs have met with strong opposition from political leaders and special interest groups who raise arguments ranging from lack of evidence of the tax's effectiveness to adverse economic impacts (American Beverage Association, 2012a, 2012b; Capitol Hill Research Center, 2009; Johnson, 2011; Kelly, 2012, July 18; Rogers, 2012, May 14).

This research addresses one frequently raised argument -- small retailers will lose sales critical to their profitability because SSB demand will decrease and/or consumers will cross municipal, state and country borders to purchase untaxed SSBs. Opponents to SSB taxes assert these taxes will "amount to lost jobs and the dislocation of existing businesses" (The Business Council of New York State, 2012). There are no published data showing that a SSB tax would result in these outcomes. Careful examination of material presented by tax opponents reveals hedged language, including "could result in job loss", (National Automatic Merchandising Association, 2012) "could cost jobs", (Stanford, 2012, March 13) and "we have no solid data" (Capitol Hill Research Center, 2009). Arguments asserting these negative economic impacts have placed persuasive pressure on political leaders, reframing the debate from policy interventions to reduce obesity to one of economic harm.

Economic harm to business is difficult to prove, given the U.S. has no experience with a SSB excise tax in an actual market situation (Chaloupka, Powell, & Chriqui, 2011). Sales tax on SSBs is charged in 35 states (Robert Wood Johnson Foundation, 2012). As sales taxes are applied to a variety of goods and are added at the cash register, SSBs are not singled out. Buyers may not associate the higher price due to the general sales tax to one specific item (Chetty, Looney, & Kroft, 2009). Those receiving Supplemental Nutrition Assistance (SNAP) or shopping in military commissaries are exempt from paying sales tax (Barnhill, 2011; Defense Commissary Agency, 2012; Smith, Lin, & Lee, 2010).

In 2012, SSB excise taxes were under consideration in eight U.S. states and one city (Yale Rudd Center for Food Policy and Obesity, 2012). Excise taxes are included in the price of an item at the point of selection. The direct association of higher price may increase the likelihood that consumers will decline to make a purchase or choose an untaxed option (Brownell et al., 2009; Todd & Zen, 2010). In Vermont, several state legislators proposed a SSB excise tax during the 2011 - 2012 legislative session, but the proposal never made it out of the House Ways and Means Committee (P. Sterling, personal communication, July 24, 2012). Cross-border purchasing behavior and impacts on small retailers were particularly salient rhetorical issues in the debate. Vermont has a relatively large number of small retail convenience stores (about 700) (Vermont Grocers' Association, 2012) for its size population of ~625,000 (US Census Bureau, 2012) and the state's shared 160 mile border with traditionally lower-tax New Hampshire is frequently raised in tax policy debates ("Shumlin will oppose soda tax," 2012; "Smith's message to lawmakers: Don't raise taxes," 2012; "VT administration to oppose soda tax.," 2011). The Vermont Grocer's Association President, a leading opponent to the proposed tax, summarized

the argument: "It sends commerce across our state borders because the bordering states do not have this tax" ("Study linking sugar, obesity revives interest in soda tax," 2012).

There have been numerous studies of the impact of price increases on purchases of SSBs. Studies using experimental approaches conclude that a SSB tax will decrease the demand for calories (Nederkoorn, Havermans, Giesen, & Jansen, 2011; Temple et al., 2011). The price elasticity of demand for SSBs has been estimated to be between -0.8 and -1.2; a 10 percent increase in price leads to an 8 to 12 percent decrease in demand. Estimates have been reported as inelastic as -0.12 and as elastic as -3.18 (Andreyeva, Long, & Brownell, 2010; Block, Chandra, McManus, & Willett, 2010; Brownell et al., 2009; Duffey et al., 2010; Finkelstein, Zhen, Nonnemaker, & Todd, 2010; Powell & Chaloupka, 2009; Smith et al., 2010; Yang & Chiou, 2010). The wide variation in calculated elasticities results from the type of data available (large panel study, household survey, experimental data), level of disaggregation of beverage data (types of SSB included, inability to remove diet sodas from the analysis, not accounting for the restaurant market), ability to include substitute non-taxed beverages that may be higher in calories than SSBs in the analyses (e.g., whole milk, some juices), the ability to control for factors that may impact demand that are not price related (e.g., retail venue, consumer characteristics), the cause of the price differential (general sales tax, specific SSB tax, discounting, price/quality differences) and assumptions made by modelers. Therefore, comparison across studies is difficult. Challenges to estimating the effect of taxes on SSB demand are well documented in the literature (Block & Willett, 2011; Edwards, 2011; Johnson, 2011; Smith et al., 2010). No study has specifically accounted for the effect of a SSB excise tax

on individual consumer behavior, nor examined the impact of a tax on small and border county retailers.

Price inelasticity is good for business because the revenue generated from consumer expenditures (price x quantity demanded) is greater than before the price increase. However, in the case of a tax, the retailer does not reap the additional revenue. It is transferred to a third party. In the case of a tax specifically on SSBs, decreases in demand for SSBs do not unequivocally lead to lower overall revenues for retailers. If all consumers switch to an alternative purchase, there may be no revenue loss, or possibly a revenue gain. If a majority of consumers choose an untaxed alternative the loss is mitigated. Only if consumers do not make any purchase is the retailer faced with the loss of a full sale. This study examined both cases: no alternative purchases and switching behavior.

Because there is no published research on small business losses related to SSB taxes in the U.S., literature in the area of cross border shopping and tobacco or food taxation are relevant contexts. Like most SSBs, cigarettes are semi-durable and can be stockpiled. They can be purchased bulk and the stock depleted. Unlike SSBs, cigarette storage requires less space and they may be less of an impulse purchase given their addictive nature. Chaloupka et al. (2011) discussed the analogies between SSB taxation and tobacco, including relationships to health and the effect of taxes on decreasing consumer demand. A German study found that 12.3 percent of smokers stated an intention to cross a border to purchase cheaper cigarettes (Hanewinkel & Isensee, 2007). Estimates of decreases in demand due to border crossing were between 14 and 18 percent according to a French study (Lakhdar, 2008). Chiou and Muehlegger (2008) concluded that

distance from a border and heavy cigarette usage were factors that impact cross border cigarette shopping. Tosun and Skidmore (2007) calculated a large price elastic effect (-3.1) of an overall food tax on cross border food shopping of border county residents of West Virginia (a one percent increase in price led to a 3.1 percent decrease in quantity demanded). The state-wide elasticity was -1.38, at the upper end of the SSB tax estimates discussed above. Leal et al. (2010) reported that taxation in general brings a loss of between 2 and 15 percent of revenue, depending on the good or service, border and price difference. It is difficult to empirically determine the effect of a SSB tax on cross border shopping, as it is with any product, due to price fluctuations for reasons other than a tax, including price discounting (Tosun & Skidmore, 2007). The purpose of the current study was to estimate the impact of a proposed penny per ounce excise tax on SSB purchases, focusing on smaller retailers and Vermont residents living in Vermont/New Hampshire border counties. Specifically, we asked:

RQ1. whether an excise tax differentially impacts smaller retailers and sellers in border counties;

RQ2. how a tax impacts consumer switching behaviors; and

RQ3. What beverages would consumers switch to, if any.

Methods

Data

To answer these questions we utilized a Robert Wood Johnson Foundation funded consumer survey focused on consumer attitudes and behaviors related to a proposed SSB excise tax in Vermont. The survey was conducted using computer aided telephone interviewing in February, 2011.

Using a random sample chosen from all land line telephone numbers in Vermont, (Infogroup, 2011) 508 completed responses were generated, resulting in 95 percent confidence (± 2.5 percent) that this group was representative of Vermont adults aged 18 and older with respect to gender, age, percentage with more than a high school education and percent overweight/obese (based on national statistics). SSBs were defined for the respondent as non-diet soda, sweetened tea and sports or energy drinks. This study focused on 36.7 percent (181) of the original 508 respondents who reported purchasing a SSB in the past month, a subsample that provided 95 percent confidence (± 6.18 percent) that the sample was representative of Vermonters with respect to the demographic characteristics described above. These respondents were provided a scenario in which they were asked about their SSB purchase behavior if the price of a 16 ounce SSB beverage increased from \$1.50 (the reference price) to \$1.66 (one cent per ounce excise tax), purchased in a convenience store or gas station.

Measures

The dependent variable was number of 16 ounce equivalents purchased per week, calculated for baseline time period 1 from a series of questions which collected information about frequency and size of purchase over the past month. Respondents were then asked about their purchasing behavior given the proposed excise tax. In the no switching scenario, if respondents indicated they would not buy the SSB, Demand₁₆ in time period 2 was coded as 0, otherwise it remained as the amount at baseline. In the switching scenario, if a respondent indicated they would make an alternative purchase, there was no change in the number of 16 ounce equivalents purchased. We assumed that consumers who switch would, on average, substitute a 16 ounce equivalent at the same \$1.50 price of a SSB pre- tax. Smith, Lin and Lee (2010) found that low fat milk and 100 percent juice alternatives are generally priced higher than carbonated non-alcoholic

beverages, while water is generally priced lower. Consumers may actually switch to an alternative that costs more or less than the original SSB. Covariates included the tax, measured through the use of a dummy variable coded as a 1 in time period 2 and 0 otherwise. Age, measured continuously, was calculated based on the survey question, “in what year were you born?” Low income was created as a dummy variable coded 1, if respondents were in the lowest quartile of income for the state. Income information was obtained through a series of two questions which began by asking respondents if their household income was “more or less than \$50,000” (median income for Vermont is \$51,618 (US Census Bureau, 2012)), and branching to “more or less than \$35,000” if a respondent answered less to the first income question and 0 otherwise (University of Vermont Center for Rural Studies, 2012). Gender was self-reported and coded 1 if a respondent was female; 0 otherwise. Overweight/obese was determined using guidelines produced by the National Heart, Lung, and Blood Institute (NHLBI) (National Institutes of Health, 1998). Calculations were made from a two part question which first asked a respondent’s height. The interviewing program was programmed to access a BMI calculator. The next question asked was, “do you weigh less than x,” given a BMI of 25 for self-reported height. Respondents were then asked, “do you weigh less than x,” given a BMI of 30 for reported height (Kolodinsky & Desisto, 2012). Overweight/obese was coded as 1 for those who responded no to either weight question or 0 otherwise.

The small retailer variable was created from a question that asked respondents where they purchase most of their SSBs. This variable was coded 1 if a respondent answered “gas station, mom and pop store, or convenience store,” and 0 otherwise. Based on self-reports of county of

residence, the border county residence variable was coded 1 if a border county resident and 0 otherwise. Descriptive statistics are presented as Table 1.

Table 1 here

Statistical Analysis

Difference in Difference (DiD) analysis (Ashenfelter & Card, 1985) was used to identify the effects of both residing in a border county and making a majority of SSB purchases from small retail retailers. DiD is a study design used by economists and other social scientists to estimate the effects of policy interventions (Athey & Imbens, 2006). The estimated equation is:

$$y = \beta_0 + \beta_i X_i + \beta_j Z_j + \delta_0 T + \delta_i X_i T + \delta_j Z_j T + \varepsilon$$

where y represents individual purchases of 16 ounce SSB equivalents before and after the tax.

X_i represents time invariant demographic variables. Z_j represents the variables measuring purchase venue and whether the respondent resides in a VT/NH border county. The time period dummy is T . The interaction terms $Z_j T$ multiply overweight and low income status by time.

The interaction terms $Z_j T$ multiply border county residence and purchase location by time.

The estimates β_i represent the time invariant effects of respondent demographic characteristics.

β_j are the estimates of the effect of border county residence and purchase location pre-tax. δ_0 is

an estimate of the marginal effect of the one cent tax on the entire sample. Because of the prospective nature of the study, δ_0 is not contaminated by other time varying influences on SSB

sales. δ_i are estimates of the effects of overweight and low income post tax. δ_j are estimates of

the effect of border county residence and purchase location post tax. In contrast to a within-

subjects estimate of the effect of cross border shopping and purchase location in a SSB tax

scenario (that measures the difference in sales before and after tax) or a between-subjects

estimate of these variables (that measures the difference in sales for border county residence and purchase location), the DiD estimator represents the difference between the pre-post, within-subjects differences of the treatment and control groups contributed by border county residence and purchase location, controlling for demographic characteristics of the sample.

Because DiD uses interaction effects and (ex-ante) time use data, there is both the possibility of biased estimation of standard errors and autocorrelation (Bertrand, Duflo, & Mullainathan, 2004; Donald & Lang, 2007). Therefore, estimates were obtained using restricted maximum likelihood fixed effects in the mixed model procedure in PASW (SPSS) (Wolfinger, 1994; Wolfinger, Tobias, & Sall, 1994). Researchers estimated several specifications of the model, described below.

Results

Table 2 presents results of the “no switching behavior” scenario. Table 3 presents the switching behavior results. Estimates identified the effect of the tax, venue, and border residence on purchases of SSBs, without adding back the effect of making an alternative choice. In Model 1, only the tax was considered. Models 2 and 3 considered the specific effect of the tax on small retailer sales and the behavior of border county residents (interaction effects). Model 4 accounted for both retail venue and border county residence. Model 5 controlled for demographic characteristics, while Model 6 accounted for the after tax impacts of being overweight and of lower income (interaction effects). Regardless of the specification, parameter estimates were insignificant for all variables except the tax, with one exception. Women were more likely to substitute out of the SSB category compared to men, as shown by the significant, negative coefficient on females in Models 5 and 6, Table 3, for the switching behavior scenario.

Analysis of the first research question showed that smaller retailers and sellers in border counties would be no more or less affected by a SSB tax than any other retailer in the state. Furthermore, the effect of a tax on the intended purchase behavior of low income individuals and those who were overweight showed that their price elasticity was no different than higher income individuals or people who were at a healthy weight. The estimated tax elasticity calculated using data means from Model 6 was -2.0, interpreted as a one percent increase in the price of a 16 ounce SSB lead to a 2.0 percent decrease in quantity demanded. Therefore, the 10.66 percent increase in the price of a 16 ounce SSB from \$1.50 to \$1.66 (penny per ounce tax) led to a 21.3 percent decrease in sales for a retailer, if a consumer decided not to purchase any alternative.

Table 3 shows results to research question 2 regarding switching behavior. The tax elasticity in this scenario was interpreted as the effect of a tax on sales of SSBs mitigated by un-taxed purchases, given a consumer makes an alternative purchase. While the majority of these purchases were other beverages; a minority of respondents reported choosing a non-beverage purchase. The calculated elasticity at the data means was -0.71. The 10.66 percent increase in the price of a 16 ounce SSB from \$1.50 to \$1.66 led to a 7.6 percent decrease in sales for a retailer, accounting for switching behavior.

Table 2 here

Table 3 here

Fifty-two percent of consumers said their behavior would not change and 20 percent said they would “buy nothing”. Twenty-eight percent would switch their purchase to another beverage or item. Of these, 28 percent indicated a switch to water, 27 percent to an untaxed juice beverage, 20 percent to coffee, 9 percent to milk, 7 percent to a diet beverage, and 9 percent to a non-beverage item. This cursory look at switching behavior indicated that a majority of consumers (56 percent) who do not purchase a SSB after the tax, would choose no calories (nothing) or a no- or lower-calorie beverage (water, diet beverage). Because we have no data on the calories in the juice consumers would purchase, caloric additions to coffee, or whether a non-beverage item includes a food choice higher in calories than a 16 ounce SSB, we cannot infer whether these choices would result in lower or higher calorie choices for the remaining 44 percent of consumers.

Discussion

Based on this study, a SSB excise tax would reduce demand for SSBs, performing as intended by proponents of SSB excise taxes. We found no evidence that a penny per ounce excise tax would lead to relatively lower sales in smaller and border county retail venues, and therefore possible business closings or loss of jobs compared to any other retailers in the state. Results also suggested that lower income consumers and overweight/obese consumers do not have different price sensitivities compared to higher income and healthy weight consumers.

Calculated elasticities were within ranges of other studies. With no purchase substitution, the estimated tax elasticity of -2.0 was higher than the -1.2 used by the Rudd Center’s SSB tax revenue calculator, but within ranges found in other studies (Andreyeva et al., 2010; Yale Rudd Center for Food Policy and Obesity, 2012). The estimated tax elasticity accounting for beverage

substitution, -0.71, was consistent with studies that utilized data which allowed the separation of SSBs from diet drinks and other untaxed beverages (Smith et al., 2010; Yang & Chiou, 2010). With regard to beverage substitutes, Block et al. (2010) also found substitution into coffee, but not water. That study was inconclusive about substitution into diet drinks. Our study found no elasticity differences for lower income consumers, similar to findings by Finkelstein et al. (2010). Smith et al. (2010) estimated no difference in the decreased calories purchased by low- versus high income consumers subject to a tax. Four studies across a broad range of foods found no elasticity difference between lower and higher income consumers (Huang & Lin, 2000; Nederkoorn et al., 2011; Park, Holcomb, Raper, & Capps, 1996; Raper, Wanzala, & Nayga, 2002).

Strengths and Limitations

This study used a random sample representative of a single state that has proposed a SSB excise tax and a quasi-experimental approach to investigate the size of the excise tax (price) elasticity of demand for SSB under a penny per ounce tax scenario. Results showed that the tax had no differential effect on consumers who make the majority of their purchases at a small retailer or live in a border county. Strengths of the study included the ability to separate SSB from other types of beverages, control for individual consumer characteristics, specifically account for small retailer and border county effects, and directly test the policy intervention of an excise tax using a proposed penny per ounce tax. Because no state has implemented an actual excise tax, it was impossible to use ex-post analysis. Our assumption that, on average, consumers switch to a like priced beverage appears not to be a weakness, given the price findings of the USDA's Economic Research Service (Todd, Leibtag, & Penberthy, 2011) with respect to the higher prices of milk and juice compared to carbonated beverages and the lower prices of water and our findings that

28 percent of beverage switchers would choose water while 42 percent would switch to a diet beverage or water.

Potential weaknesses of the study include results that were based on the population of one state and one package size, and the prospective nature of the data. Future research might consider other types of retail venues, include other sizes of beverage containers, and investigate samples from other regions or states.

Conclusions

We know of no other study specific to an excise SSB tax that estimated border and retailer size impacts on SSB demand. This study provides evidence suggesting that the economic/cross border arguments opposing SSB excise taxes as a policy instrument to help decrease the obesity problem in the U.S. may not have a strong empirical basis. Other research has found no adverse effects on the job sector using the case of tobacco taxes (Chaloupka et al., 2011; Warner, Fulton, Nicolas, & Grimes, 1996).

Retailers adapt when faced with price increases and sales decreases on particular items, compensating by stocking their shelves with alternatives. The marketplace is already seeing the beverage industry respond to public health concerns by reducing SSB serving sizes, and with the introduction of reformulated, lower calorie products (American Beverage Association, 2012b; Grocery Manufacturer's Association, 2012). Consumers and businesses are constantly faced with fluctuating prices and a changing product mix. Consumers, producers, and sellers adjust accordingly. We expect that this will be the case if a penny per ounce excise tax is passed on SSBs.

Ethics

The study was approved by The University of Vermont's Institutional Research Board as an exempt project under Section 45 CFR 46.101b of the Federal Policy for the Protection of Human Subjects and was conducted in accordance with the Belmont Report's guidance for ethical principles for research involving humans as subjects. Participants' verbal implied consent was obtained by their voluntary agreement to participate as randomly-selected survey participants.

References

- American Beverage Association. (2012a). News Releases & Statements. Retrieved July 27, 2012, from <http://www.ameribev.org/news--media/news-releases--statements/more/259/>
- American Beverage Association. (2012b). We Deliver. Retrieved July 18, 2012, from <http://www.deliveringchoices.org/#top>
- Andreyeva, T., Long, M., & Brownell, K. (2010). The impact of food prices on consumption: a systematic review of research on the price elasticity of demand for food. *Am J Public Health*, 100(2), 216-222.
- Ashenfelter, O., & Card, D. (1985). Using the longitudinal structure of earnings to estimate the effect of training programs. *Rev Econ Stat*, 67(4), 648-660.
- Athey, S., & Imbens, G. (2006). Identification and inference in nonlinear difference-in-difference models. *Econometrica*, 74(2), 431-497.
- Barnhill, A. (2011). Impact and ethics of excluding sweetened beverages from the SNAP program. *Am J Public Health*, 101(11), 2037-2043.
- Bertrand, M., Duflo, E., & Mullainathan, S. (2004). *How Much Should We Trust Differences-in-Differences Estimates?* *Q J Econ*, 119(1), 249-275.
- Block, J., Chandra, A., McManus, K., & Willett, W. (2010). Point-of-purchase and education intervention to reduce consumption of sugary soft drinks. *Am J Public Health*, 100(8), 1427-1433.
- Block, J., & Willett, W. (2011). Can taxing sugary soda influence consumption and avoid unanticipated consequences? *Choices*, 26(3). Retrieved from <http://farmdoc.illinois.edu/policy/choices/20113/2011314/2011314.html>
- Brownell, K., Farley, T., Willett, W., Popkin, B., Chaloupka, F., Thompson, J., & Ludwig, D. (2009). The public health and economic benefits of taxing sugar-sweetened beverages. *N Engl J Med*, 361(16), 1599-1605.
- Brownell, K., & Frieden, T. (2009). Ounces of prevention- the public policy case for taxes on sugared beverages. *N Engl J Med*, 360(18), 1805-1808.
- Capitol Hill Research Center. (2009). *The Negative Economic & Employment Implications of New York's Proposed Beverage Excise Tax*. .

- Chaloupka, F., Powell, L., & Chriqui, J. (2011). Sugar-sweetened beverage taxation as public health policy-lessons from tobacco. *Choices*, 26(3). Retrieved from <http://farmdoc.illinois.edu/policy/choices/20113/2011315/2011315.html>
- Chetty, R., Looney, A., & Kroft, K. (2009). Saliency and taxation: theory and evidence. *Am Econ Rev*, 99(4), 1145-1177. doi: 10.1257/aer.99.4.1145
- Defense Commissary Agency. (2012). About Us. Retrieved July 27, 2012, from http://www.commissaries.com/about_us.cfm
- Donald, S., & Lang, K. (2007). Inference with difference-in-differences and other panel data. *Rev Econ Stat*, 89(2), 221-233.
- Duffey, K., Gordon-Larsen, P., Shikany, J., Guilkey, D., Jacobs, D., & Popkin, B. (2010). Food price and diet and health outcomes: 20 years of the CARDIA study. *Arch Intern Med*, 170(5), 420-426.
- Edwards, R. (2011). Commentary: soda taxes, obesity, and the shifty behavior of consumers. *Prev Med*, 52(6), 417-418.
- Faulkner, G., Grootendorst, P., Nguyen, V., Andreyeva, T., Arbour-Nicitopoulos, K., Auld, M. C., . . . Windmeijer, F. (2011). Economic instruments for obesity prevention: results of a scoping review and modified delphi survey. *Int J of Behav Nutr and Phys Act*, 8, 109.
- Finkelstein, E., Zhen, C., Nonnemaker, J., & Todd, J. (2010). Impact of targeted beverage taxes on higher- and lower-income households. *Arch Intern Med*, 170(22), 2028-2034.
- Grocery Manufacturer's Association. (2012). Product Reformulation. Retrieved July 18, 2012, from <http://www.gmaonline.org/issues-policy/health-nutrition/providing-innovative-and-healthy-choices/product-reformulation/>
- Hanewinkel, R., & Isensee, B. (2007). Access to cheaper cross-border cigarettes may decrease smoking cessation intentions in Germany. *Tob Control*, 16(1), 70-71.
- Huang, K. S., & Lin, B. (2000). *Estimation of Food Demand and Nutrient Elasticities From Household Survey Data*. Washington, DC: Economic Research Service.
- Infogroup. (2011). Vermont Random Landline Telephone Sample. Retrieved January 15 <http://infogroup.com/our-services/list-services.aspx>
- Johnson, R. (2011). Caloric sweetened beverage taxes: the good food/bad food trap. *Choices*, 26(3). Retrieved from <http://farmdoc.illinois.edu/policy/choices/20113/2011319/2011319.html>
- Kelly, P. (2012, July 18). Don't sugarcoat it: Chicago's new(est) tax. Retrieved from <http://illinoisreview.typepad.com/illinoisreview/2012/06/dont-sugarcoat-lit.html>
- Kolodinsky, J., & Desisto, T. (2012). *A household production approach to overweight: a model and preliminary estimates*. Paper presented at the American Council on Consumer Interests 2007 Annual Conference. <http://www.consumerinterests.org/2007Proceedings.html>
- Lakhdar, B. (2008). Quantitative and qualitative estimates of cross-border tobacco shopping and tobacco smuggling in France. *Tob Control*, 17(1), 12-16.
- National Automatic Merchandising Association. (2012). Key Issues. Retrieved July 18, 2012, from <http://www.namavoice.org/key-issues/sugar-sweetened-beverage-tax>
- National Institutes of Health. (1998). *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report*. Retrieved from <http://www.ncbi.nlm.nih.gov/books/NBK2003/>.
- Nederkoorn, C., Havermans, R., Giesen, J., & Jansen, A. (2011). High tax on high energy dense foods and its effects on the purchase of calories in a supermarket. An experiment. *Appetite*, 56(3), 760-765.
- Park, J. L., Holcomb, R. B., Raper, K. C., & Capps, O. J. r. (1996). A demand systems analysis of food commodities by US households segmented by income. *Am J of Agr Econ*, 78(2), 290-300.
- Powell, L., & Chaloupka, F. (2009). Food prices and obesity: evidence and policy implications for taxes and subsidies. *Milbank Q*, 87(1), 229-257.

- Raper, K. C., Wanzala, M. N., & Nayga, R. M. J. (2002). Food expenditures and household demographic composition in the US: a demand systems approach. *Appl Econ*, 34(8), 981-992.
- Robert Wood Johnson Foundation. (2012). Bridging The Gap. Retrieved July 18, 2012, from http://www.bridgingthegapresearch.org/research/sodasnaack_taxes/
- Rogers, R. (2012, May 14). Richmond to consider placing 'soda tax' before voters. Retrieved from http://www.contracostatimes.com/california/ci_20622206/richmond-consider-placing-soda-tax-before-voters
- Shumlin will oppose soda tax. (2012, August 15). *Vermont Public Radio*. [Radio News Program]
- Smith's message to lawmakers: Don't raise taxes. (2012, August 14). *Vermont Public Radio*. [Radio News Program]
- Smith, T., Lin, B.-H., & Lee, J.-Y. (2010). *Taxing Caloric Sweetened Beverages: Potential Effects on Beverage Consumption, Calorie Intake, and Obesity*. (100). Washington, DC: Economic Research Service.
- Stanford, D. (2012, March 13). Anti-obesity soda tax fails as lobbyists spend millions: retail. Retrieved from <http://www.businessweek.com/printer/articles/13944?type=bloomberg>
- Study linking sugar, obesity revives interest in soda tax. (2012, August 17). *Vermont Public Radio*. [Radio News Program]
- Temple, J., Johnson, K., Archer, K., LaCarte, A., Yi, C., & Epstein, L. (2011). Influence of simplified nutrition labeling and taxation on laboratory energy intake in adults. *Appetite*, 57(1), 184-192.
- The Business Council of New York State. (2012). What's New. *Joint Legislative Health Committee* Retrieved August 3, 2012, from <http://www.bcnys.org/whatsnew/testimony/2010/TaxOnSugarBeverages0201.htm>
- Todd, J., Leibtag, E., & Penberthy, C. (2011). *Geographic Differences in the Relative Price of Healthy Foods*. Washington, DC: Economic Research Service.
- Todd, J., & Zen, C. (2010). Can taxes on calorically sweetened beverages reduce obesity? *Choices*, 25(3). Retrieved from <http://farmdoc.illinois.edu/policy/choices/20103/2010307/2010307.html>
- Tosun, M., & Skidmore, M. (2007). Cross-border shopping and the sales tax: an examination of food purchases in West Virginia. *BE J Econ Anal Poli*, 7(1), 63.
- University of Vermont Center for Rural Studies. (2012). Vermonter Poll. Retrieved July 30, 2012, from <http://www.uvm.edu/crs/?Page=projects/vtpoll.html&SM=projects/projectssubmenu.html>
- US Census Bureau. (2012). 2010 Decennial Census. Retrieved June 31 <http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>
- Vermont Grocers' Association. (2012). About Us. Retrieved August 1, 2012, from <http://www.vtgrocers.org/about>
- VT administration to oppose soda tax. (2011, August 16). Retrieved from http://articles.boston.com/2011-08-16/news/29893038_1_soda-tax-cent-per-ounce-tax-sugar-sweetened-beverages
- Warner, K., Fulton, G., Nicolas, P., & Grimes, D. (1996). Employment implications of declining tobacco product sales for the regional economies of the United States *JAMA*, 275(16), 1241-1246.
- Wolfinger, R. D. (1994). An introduction to mixed modeling with the SAS-STAT MIXED procedure. In F. Faulbaum (Ed.), *SoftStat '93, Advances in Statistical Software 4* (pp. 585-592). Stuttgart-Jena-New York: Gustav Fischer.
- Wolfinger, R. D., Tobias, R. D., & Sall, J. (1994). Computing Gaussian likelihoods and their derivatives for general linear mixed models. *SIAM J Sci Comput*, 15(6), 1294-1310.
- Yale Rudd Center for Food Policy and Obesity. (2012). Hot Topics. Retrieved July 18, 2012, from http://yaleruddcenter.org/hot_topics.aspx
- Yang, C.-C., & Chiou, W.-B. (2010). Substitution of healthy for unhealthy beverages among college students. A health-concerns and behavioral-economics perspective. *Appetite*, 54(3), 512-516.

Table 1. Descriptive Statistics^a			
Variable	Label	Mean/Proportion	Standard Deviation
Demographics			
Age	Age in years	57.4	14.97
Female	1= Female; else 0	.56	.50
Low income	Lowest income quartile else 0	.17	.37
Overweight/obese	1=OW/obese; else 0	.50	.50
SSB variables			
Small retailer	1= Makes most purchases at gas station/ convenience/mom and pop stores; else 0	.19	.39
Border county	1= Resides in a border county; else 0	.20	.40
Dependent variable			
Demand16 (before tax)	Weekly 16 ounce equivalent purchases	3.25	3.25
Demand16 (after tax)	Weekly 16 ounce equivalent purchases	1.17	1.31

^a N=181.

Table 2. Mixed Model Estimates: SSB Demand, No Switching^a						
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	3.94 ^c (.42)	4.17 ^b (.47)	4.01 ^b (.47)	4.27 ^b (.52)	3.72 ^b (.72)	3.38 ^b (.84)
Time (tax)	-3.20 ^b (.50)	-3.75 ^b (.56)	-3.16 ^b (.56)	-3.35 ^b (.62)	-3.41 ^b (.49)	-3.02 ^b (.69)
Small retailer	NA	-1.10 (1.04)	NA	-1.15 (1.05)	-.83 (.93)	-.78 (.92)
Small retailer*tax	NA	.85 (1.24)	NA	.83 (1.24)	.90 (.97)	.85 (.96)
Border county	NA	NA	-.39 (1.08)	-.50 (1.08)	-.10 (.96)	-.15 (.95)
Border county*tax	NA	NA	-.22 (1.26)	-.13 (1.28)	-.22 (1.01)	-.17 (1.07)
Age	NA	NA	NA	NA	.00 (.01)	.00 (.01)
Female	NA	NA	NA	NA	.03 (.24)	.03 (.24)
Overweight/obese	NA	NA	NA	NA	-.04 (.24)	.86 (.75)
Overweight/obese*tax	NA	NA	NA	NA	NA	-1.01 (.79)
Low income	NA	NA	NA	NA	.51 (.31)	-.23 (.97)
Low income*tax	NA	NA	NA	NA	NA	-1.01 (1.03)

Abbreviation: NA, not analyzed.

^a N=181.

^b p<=.01.

Table 3. Mixed Model Estimates: Effects on Retailers, Accounting for Switching^a						
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	3.94 ^b (.42)	4.17 ^b (.47)	4.02 ^b (.47)	4.28 ^b (.52)	4.87 ^b (1.20)	4.73 ^b (1.24)
Time (tax)	-1.74 ^b (.58)	-1.65 ^b (.65)	-1.66 ^b (.65)	-1.55 ^b (.71)	-1.83 ^b (.65)	-1.58 ^b (.85)
Small retailer	NA	-1.10 (.65)	NA	-1.15 (1.05)	-1.19 (.93)	-1.16 (.93)
Small retailer*tax	NA	-.41 (1.43)	NA	-.46 (1.43)	-.36 (1.19)	-.40 (1.20)
Border county	NA	NA	-.39 (1.08)	-.50 (1.08)	-.13 (.95)	-.14 (.94)
Border county*tax	NA	NA	-.41 (1.48)	-.45 (1.48)	-.47 (1.25)	-.46 (1.25)
Age	NA	NA	NA	NA	-.01 (.02)	-.01 (.02)
Female	NA	NA	NA	NA	-1.22 ^b (.50)	-1.22 ^b (.49)
Overweight/obese	NA	NA	NA	NA	.41 (.50)	.65 (.74)
Overweight/obese*tax	NA	NA	NA	NA	NA	-.43 (.98)
Low income	NA	NA	NA	NA	-.29 (.95)	-.25 (.96)
Low income*tax	NA	NA	NA	NA	NA	1.08 (1.27)

Abbreviation: NA, not analyzed.

^a N=181.

^b P<=0.01.