

Taxing Bottled Water as an Environmental Policy

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Litter from plastic water bottles is an environmental concern for cities and states throughout the country. One potential policy response to this issue is to implement a consumer tax on bottled water in hopes that the subsequent reduction in total sales translates into less litter. We explore evidence from Washington state to analyze how effective and efficient a consumer tax on bottled water is as an environmental policy.

Lightweight polyethylene terephthalate (PET) bottles—such as those used for bottled water—make up a sizeable share of litter in the United States. These bottles are manufactured using petroleum, do not break down in the environment, and create significant problems for animals both on land and in lakes, rivers, and oceans.

Because of these bottles' negative environmental effects, many cities and states have implemented some sort of policy to reduce litter from PET bottles. For example, California has a 5-cent-per-bottle deposit and refund system. Taking a different approach, the city of Chicago has a 5-cent-per-bottle tax on all bottled water.

Any tax on a consumer good will simultaneously reduce sales of that good and raise tax revenue. Knowing which of these two effects will be stronger depends on consumers' demand for the good. If consumers' demand is elastic, they will greatly reduce the quantity of the good they purchase, and the government will collect relatively little tax revenue. On the other hand, if consumers' demand is inelastic, they won't reduce the quantity they purchase by very much and the government will collect a lot of tax revenue.

In 2010 Washington state imposed a tax on bottled water in order to both reduce bottle litter and raise government revenue. Six months after the tax was imposed, voters rescinded the tax through a ballot initiative. This gives us a unique opportunity to study how consumers respond not only to the introduction of a bottled water tax, but also to its removal. Our findings allow us to assess how effective and efficient a bottled water tax is as an environmental policy compared to a deposit and refund system.

Washington's Tax on Bottled Water

Prior to 2010, bottled water was exempt from sales tax in Washington state. Early that year, Governor Christine Gregoire proposed that the state end bottled water's exemption and begin collecting taxes on bottled water sales. Gregoire cited PET bottles' negative environmental effects as a primary justification for the change.

The Washington legislature ultimately approved the Governor's proposal, and bottled water was subjected to sales tax beginning on June 10, 2010. In response, the American Beverage Association began a \$16 million campaign to overturn the legislature's decision. Ballot Measure 1107, passed by Washington voters on November 2, 2010, did just that. Bottled water thus regained its tax-exempt status on December 2, 2010.

To summarize, bottled water was subject to sales tax in Washington for approximately six months—from June to December 2010. The size of this sales tax varied across different areas of the state and ranged from 6.5% to 9.5%. (State sales tax was a flat 6.5%, but many local municipalities had added additional local sales taxes on

top of that.) The average Washington consumer faced a sales tax around 9%.

Consumer Response

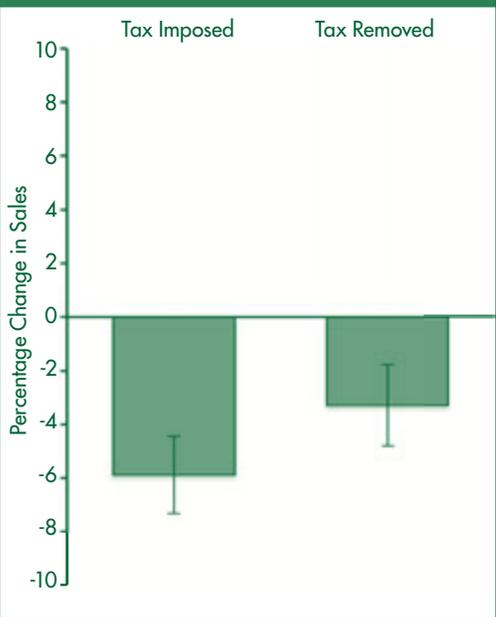
To study how consumers responded to Washington's tax on bottled water, we analyze weekly scanner-level bottled water sales data from a large national retailer. We observe data from over 160 stores in Washington and over 100 stores in Oregon and Idaho. By comparing sales in Washington (where there was a new tax on bottled water) to sales in Oregon and Idaho (where there was no tax change), we are able to isolate the effect of the tax from other forces that might have affected bottled water sales such as weather, seasonality, or sector-specific supply shocks.

We conduct our analysis using sales data starting in January 2007 and ending in May 2012. This allows us to compare how bottled water sales changed during the tax period (June–December 2010) and the post-tax period (December 2010–May 2012) relative to the pre-tax period (January 2007–June 2010) while controlling for observable and unobservable drivers of demand such as local temperature, product-store fixed effects, and shelf prices.

We find that, when bottled water was taxed in Washington state, total sales decreased by 5.9% relative to the pre-tax period. Furthermore, when the tax was later rescinded, total sales remained 3.3% below pre-tax levels. Figure 1 summarizes these findings. The solid green line in the center of each bar represents a 95%-confidence interval for each estimated effect.

It is particularly interesting to note that consumer demand for bottled water did not fully rebound to pre-tax levels in the post-tax period. There are several possible explanations for this behavior.

Figure 1. Percentage Change in Washington Bottled Water Sales Relative to the Pre-Tax Period (Includes 95% Confidence Intervals)



In either case, our results suggest that a consumer tax can have a persistent effect on sales even after it is removed.

Exploring Different Tax Rates and Levels of Household Income

Thanks to the richness of our data, we are able to dig deeper into how the tax on bottled water affected different consumer groups in different ways. In particular, we explore (1) how consumers responded to different levels of the tax, and (2) how consumers' responses differed across different levels of household income. We find that the estimates presented in Figure 1 hide significant variation across these groups.

We begin by exploring the effects of different tax rates. Each store in our data is located in a region with its own level of total (state plus local) sales tax. Two of our stores are in an area where the sales tax was 6.5%, and the remaining stores were split between areas with sales tax rates of 8%, 8.5%, 9%, and 9.5%. This allows us to estimate the effect of taxing bottled water for each of these five tax rates separately.

Figure 2 presents our estimates of how consumers responded to the tax on bottled water for each tax rate. The first

thing to note here is that our results in Figure 1 are being driven by consumers in areas with higher tax rates. In particular, on the imposition of a sales taxes of 9% or 9.5%, consumers reduce their purchases of bottled water by 7.3% or 6.6%, respectively. In addition, our estimates for these high-tax consumers are the only ones that are statistically distinguishable from zero at a 95% confidence level. Figure 2 tells a similar story for the removal of the bottled water tax: consumers in high-tax areas continue to buy less bottled water compared to the pre-tax period, while consumers in low-tax areas do not seem to respond to the tax (or its removal) much at all.

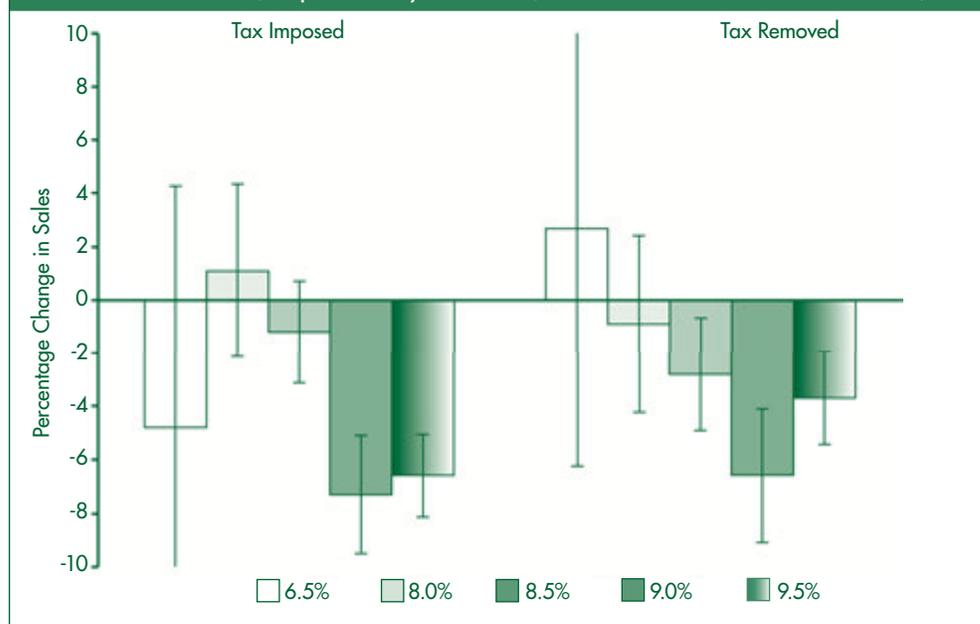
The results in Figure 2 make a lot of sense: the higher the tax, the bigger the consumer response. However, as in the previous section, the fact that sales do not completely rebound after the tax is removed suggests some sort of behavioral response on the part of consumers. This is consistent with recent research on the topic of tax salience. Briefly, researchers have found that consumers do not seem to respond fully to taxes if they do not show up in a product's shelf price. Instead, consumers may actually mis-optimize by relying on imprecise mental rules of thumb or repeated purchasing habits.

We next explore how consumers with different levels of income respond to the tax on bottled water. While we do not directly observe individual consumers' incomes, we can exploit the fact that different stores in our data are located in areas with different levels of household income. In particular, we match each store to its zip code and find the median household income for that zip code.

We split up our sample into the five national household income quintiles as defined by the 2009 Consumer Expenditure Survey, where the quintiles correspond to after-tax annual household incomes of \$9,956, \$27,275, \$45,199, \$71,241, and \$149,951, respectively. None of the stores in our

First, it is possible that, during the tax period, consumers mentally internalized higher prices for bottled water and did not completely readjust when the tax was removed. Second, it is possible that the political narrative around taxing bottled water raised awareness about PET bottles' negative environmental effects. Consumers may have internalized those messages and reduced their demand for water in plastic bottles.

Figure 2. Percentage Change in Washington Bottled Water Sales Relative to the Pre-Tax Period, Separated by Tax Rate (Includes 95% Confidence Intervals)



data are in first-quintile areas, so we focus on quintiles two through five.

Figure 3 presents how consumers with different incomes responded to the tax on bottled water. The overall pattern remains clear: consumers of all incomes reduce their consumption of bottled water when it becomes taxed, but do not completely restore their consumption to pre-tax levels after the tax is removed.

Beyond this main pattern, figure 3 highlights some interesting differences across consumer income levels. First, since relatively few of the stores in our data are located in fifth-quintile areas, our estimates for the top income group are statistically imprecise. Second, the lack of consumer “rebound” after the tax is removed seems to be driven almost entirely by consumers in areas with fourth-quintile incomes. These upper-middle class households may be particularly responsive to the environmental messaging that initially accompanied the bottled water tax.

Policy Implications

Our analysis shows that, for an average tax increase of approximately 9%, consumers reduced their consumption of bottled water by only about 6%. This suggests consumers have a price elasticity of demand for bottled water in the neighborhood of -0.67. Since consumers’ demand for this good is relatively inelastic, we conclude that a sales tax on bottled water is more effective at raising revenue than it is at reducing consumption and, consequently, litter.

Using some back-of-the-envelope calculations, we estimate that Washington’s tax would reduce the sales of bottled water at our retail chain by approximately 143,000 bottles per year. To put that number in context, we estimate the total number of bottles sold by the chain each year in Washington is over 2.43 million. Also, it is important to note that a sales reduction of 143,000 bottles does not translate into a litter reduction of

Figure 3. Percentage Change in Washington Bottled Water Sales Relative to the Pre-Tax Period, Separated by Quintile of Median Household Income (Includes 95% Confidence Intervals)



143,000 bottles; many PET bottles are already recycled or disposed of as waste.

In contrast to Washington’s tax, refund schemes like California’s deposit and refund system are specifically targeted to controlling litter and are much more effective and efficient at achieving that goal. For instance, in California, 70% of all PET bottles sold in the state are redeemed for a refund. The money for these refunds comes from the 30% of bottles sold that are not redeemed. For only cents per bottle, California achieves a 70% redemption rate while a 9% tax in Washington only reduces bottle sales there by 6%. If the policy objective is solely to reduce PET bottle litter, a consumer tax is a poor mechanism to achieve that goal.

Concluding Thoughts

Bottled water products are coming under ever-increasing scrutiny for their negative environmental impacts. Cities and states across the country are exploring different policy proposals for limiting PET bottle litter and reducing bottled water consumption. Our research suggests that a consumption tax on bottled water is a relatively ineffective and inefficient method for

reducing bottle waste compared to other policy mechanisms such as deposit and refund schemes. However, a tax on bottled water could be effective at raising considerable tax revenue, depending on the size of the relevant tax base.

Stevens, Andrew, Peter Berck, and Sofia Berto Villas-Boas. “Taxing Bottled Water as an Environmental Policy.” *ARE Update* 19(4) (2016): 9-11. University of California Giannini Foundation of Agricultural Economics.

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For additional information, the authors recommend:

- Berck, P., J. Moe-Lange, A. Stevens, and S.B. Villas-Boas, forthcoming. Measuring Consumer Responses to a Bottled Water Tax Policy. *American Journal of Agricultural Economics*.
- Zheng, Y., E. McLaughlin, and H. Kaiser. Taxing Food and Beverages: Theory, Evidence, and Policy. *American Journal of Agricultural Economics*, 95(3) (2013):705-723.