Can Small Incentives Have Large Effects? The Impact of Taxes versus Bonuses on Disposable Bag Use

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June 24, 2015

Abstract

This paper examines a simple element of financial incentive design – whether the incentive takes the form of a fee for bad behavior or a reward for good behavior – to determine if the framing of the incentive influences the policy's effectiveness. I investigate the effect of two similar policies aimed at reducing disposable bag use: a five-cent tax on disposable bag use and a five-cent bonus for reusable bag use. While the tax decreased disposable bag use by over forty percentage points, the bonus generated virtually no effect on behavior. These results are consistent with a model of loss aversion.

Introduction

When can small incentives have large effects on behavior? Standard economic theory suggests that financial incentives aimed at encouraging desirable behaviors or discouraging harmful behaviors will be effective only if the magnitude of the incentive exceeds the costs an individual associates with changing his behavior. While in practice financial incentives can take the

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form of either a fee for bad behavior or a reward for good behavior, the standard model suggests that individuals should respond similarly to the two types of incentives provided that they are of the same monetary amount. In contrast, evidence from the field of behavioral economics suggests that individuals perceive losses more strongly than gains, implying that a fee would be more effective than a reward of the same size (Kahneman and Tversky, 1979). A growing body of research aims to document this gain-loss asymmetry using field data in a variety of contexts.[1] This paper contributes to this literature by investigating whether the framing of an incentive has an impact on the incentive's effectiveness through the evaluation of two real-world policies in the Washington Metropolitan Area aimed at reducing the use of disposable shopping bags: a five-cent tax on disposable bag use and a five-cent bonus for reusable bag use.

Designing policies to reduce disposable bag consumption is a topic of growing policy relevance. Concern over the environmental impact of plastic bags has prompted several governments across the world to regulate the use of disposable bags; many countries in Europe, Asia, and Africa require grocery stores to charge a fee for each bag the store provides. In 2010, Washington, D.C. became the first city in the United States to pass legislation calling for grocery stores to tax customers for the use of disposable bags. Two years later, Montgomery County, Maryland, which neighbors Washington, D.C., also passed a law requiring a five-cent tax per disposable bag. Similar legislation has been passed in several counties and cities in California, Colorado, and Washington.

While these laws were the first policies in the US to tax disposable bags, they were not the first policies to offer financial incentives that discouraged disposable bag use. Prior to the implementation of the tax, several stores in the area offered their own incentive to reduce the use of disposable bags: a five-cent bonus for reusable bag use. If disposable and reusable bags are substitutes, standard models predict that the tax policy and the bonus policy should have the same impact on bag use since both policies provide customers a five-cent incentive for using a reusable bag instead of a disposable bag. However, if customers are loss-averse,

[1]Recent work includes research in education (Field (2009); Fryer et al. (2012); Levitt et al. (2012)), tax compliance (Engström et al. (Forthcoming 2015); Rees-Jones (2014)), worker productivity (Hossain and List (2012)), and sports (Allen et al. (2014); Pope and Schweitzer (2011)). For an overview of related literature, see DellaVigna (2009).

in that they adjust their behavior more in response to losses than to gains, a bonus is likely to be less effective than a tax of the same magnitude.

Despite the growing popularity of policies that incentivize reusable bag use, rigorous empirical work measuring the effectiveness of such policies has been lacking. To assess the impact of these policies, I collected a unique data set on individual-level consumption of disposable and reusable bags by observing shopping behavior of grocery store customers in the Washington Metropolitan Area.[2] The data set contains information on bag use for over 16,000 customers during the months before and after the implementation of the Montgomery County tax. Using variation in incentive policies across time and location, I investigate whether the framing of the incentive influences the policy's effectiveness.

I find that, while 82 percent of customers in Montgomery County used at least one disposable bag per shopping trip prior to the tax, this fraction declined by 42 percentage points after the tax was implemented. Additionally, customers who continued to use disposable bags after the tax used fewer bags per trip, leading to an overall reduction in demand of just over one disposable bag per shopping trip. If each household in Montgomery County were to shop once per week, these effects would imply a reduction of over 18 million disposable bags per year. These results are particularly surprising given the small size of the financial incentive – five cents per bag. Scanner data from a large retail grocery chain also suggests a large decline in disposable bag use in the weeks following the implementation of the tax.

In contrast to the overwhelming impact of the five-cent tax, I find that a five-cent bonus for reusable bag use had almost no impact on disposable bag use. Using cross-sectional variation in policies across stores, I find that customers shopping in stores that offered a bonus policy were almost as likely to use a disposable bag as in stores that offered no financial incentive – 82 versus 84 percent, respectively. Taken together, these results are consistent with a model of loss aversion. Using a simple model of reference-dependent preferences, I estimate a coefficient of loss aversion that is roughly twice the size of those previously found in the literature.

While these results are consistent with a model in which customers are loss-averse, there

[2]The Washington Metropolitan Area includes the city of Washington, D.C. as well as several counties in Maryland, Virginia, and West Virginia. The data collected for this paper includes stores in Washington, D.C. and two neighboring counties: Montgomery County, Maryland, and Arlington County, Virginia.

are other reasons why the tax could have been more effective than the bonus. I address several competing explanations using survey data from over 1,600 shoppers collected before and after the implementation of the Montgomery County tax. First, I measure whether there are differences in awareness of the two policies that could cause the asymmetric response to the incentives. While customers are less aware of the bonus than the tax, the differences in awareness cannot account for the difference in response to the two policies. The survey also suggests that customer attitudes toward disposable bag use and pollution regulation did not change after the tax was implemented, suggesting that it is unlikely that the results are driven by a shift in social norms. I also explore alternative models in which customers derive utility from receiving disposable bags for free or exhibit tax-averse behavior.

This paper is organized as follows. Section I reviews the history of disposable bag regulations. Section II presents two models of the customer's choice to bring a reusable bag. Section III describes the data sources used in the empirical analysis. Section IV presents estimates of the impact of the tax and bonus policies in the Washington Metropolitan Area. Section V discusses possible explanations for the difference in responses to the two policies. Section VI considers alternative models of reference dependence and measures the coefficient of loss aversion. Section VII concludes.

I. Background on Disposable Bag Regulations

Plastic shopping bags were first introduced to American grocery store customers in the 1970s and are now used in almost every store in the United States. Clapp and Swanston (2009) report that Americans consume 100 billion plastic bags each year, with worldwide estimates reaching as high as 1.5 trillion. While these plastic bags are often recyclable, the Environmental Protection Agency (EPA) estimated that only 5.2 percent of plastic bags in the United States in 2005 were actually recycled (USEPA, 2006).

In an effort to reduce pollution, policymakers have passed a variety of policies to curb disposable bag consumption. Starting in the early 2000s, several countries in Europe, Asia, and Africa implemented policies that required retailers to charge customers for their plastic

bag use.[3] In response to the District Department of the Environment report on water pollution levels in Washington, D.C. (DDOE, 2008), the Anacostia River Cleanup and Protection Act created a law that made D.C. the first city in the United States to charge a fee for the use of disposable bags. As of January 1, 2010, all food retailers in the district were required to charge five cents per single-use plastic or paper bag at the point of purchase. One to two cents of the tax went to the retailer to cover costs associated with the tax's implementation while the remainder entered a fund dedicated to cleaning up the Anacostia River.

Inspired by D.C.'s policy, Montgomery County, Maryland, which borders D.C. to the northwest, passed a similar initiative called the Carryout Bag Law. As of January 1, 2012, all retail establishments in Montgomery County were required to charge a five-cent tax for each disposable bag that a customer used.[4] Proceeds from the tax enter the county's Water Quality Protection Charge. Similar bills have been suggested in other jurisdictions in the Washington Metropolitan Area, but none had passed as of this date of this study.[5]

While these policies were two of the first laws in the United States that required customers to pay a tax for disposable bag use, they were not the first policies to include financial incentives to encourage reusable bag use and discourage disposable bag use. Prior to the implementation of either tax, several retail chains across the country offered their own incentives to reduce disposable bag use: financial rewards for customers who used reusable bags. In the Washington Metropolitan Area, half of the grocery stores with the largest market share offered customers a five-cent bonus for each reusable bag used in lieu of a new disposable bag. The bonus operated much like the tax, but rather than paying five cents for each disposable bag, the customer's final bill was credited five cents for each reusable bag the customer used.

[3]Researchers have evaluated the effects of plastic bag regulations in South Africa (Hasson, Leiman and Visser, 2007; Dikgang, Leiman and Visser, 2012), Ireland (Convery, McDonnell and Ferreira, 2007), and China (He, 2010) and find large effects of the policies. However, these policies were implemented countrywide causing these evaluations to suffer from a lack of a counterfactual.

[4]Unlike in D.C., the Montgomery County tax applies to all retailers, not just those selling food or alcohol.

[5]More recently, jurisdictions in other parts of the country have passed similar legislation. For example, Seattle passed a five-cent bag tax in July of 2012 while several counties in California charge 10 cents for paper bags and ban plastic bags altogether.

II. Modeling Responses to Financial Incentives

Consider a customer who is choosing whether to use a disposable or reusable bag. Customers have idiosyncratic preferences for bag use and incur a utility cost from bringing a reusable bag, c_i, which can be positive (for example, a psychological cost for remembering to bring a bag) or negative (for example, a warm glow from helping the environment). For simplicity, customers must use one of the two types of bags and require only one bag. Let w_i denote consumer i's wealth and let b_i indicate whether the consumer brings a reusable bag. Assume that utility is additively separable between c and w so that when there is no external incentive, utility for consumer i can be defined as $U_{N,i}(w_i, b_i) = u(w_i) - b_i c_i$. Now suppose that customers are subject to a tax of magnitude x for using a disposable bag. The individual's utility function then becomes $U_{T,i}(w_i, b_i) = u(w_i - (1 - b_i)x) - b_i c_i$. Similarly, if we consider a policy where customers receive a bonus of x for using a reusable bag, the utility function becomes $U_{B,i}(w_i, b_i) = u(w_i + b_i x) - b_i c_i$.

Consumers will bring a reusable bag when the benefit of doing so exceeds the costs: $b_i = 1 \iff U_i(w_i, 1) \geq U_i(w_i, 0)$. The table below outlines this condition under different policies. If no financial incentives are provided, customers will bring a bag if $0 > c_i$, i.e., if they derive a personal benefit from bringing a reusable bag. If customers are charged a tax for disposable bag use, they will bring a reusable bag if the decrease in utility they suffer from having to pay the tax is larger than the cost of bringing a reusable bag. Similarly, if customers are awarded a bonus for reusable bag use, they will bring a reusable bag if the utility gain from receiving the bonus is larger than the cost of bringing a reusable bag.

	Utility Function	Condition to Bring a Bag
No Incentive	$U_{N,i}(w_i, b_i) = \begin{cases} u(w_i) - c_i & if\ b_i = 1 \\ u(w_i) & if\ b_i = 0 \end{cases}$	$0 > c_i$
Tax	$U_{T,i}(w_i, b_i) = \begin{cases} u(w_i) - c_i & if\ b_i = 1 \\ u(w_i - x) & if\ b_i = 0 \end{cases}$	$u(w_i) - u(w_i - x) > c_i$
Bonus	$U_{B,i}(w_i, b_i) = \begin{cases} u(w_i + x) - c_i & if\ b_i = 1 \\ u(w_i) & if\ b_i = 0 \end{cases}$	$u(w_i + x) - u(w_i) > c_i$

Should we expect that customers will have the same response to a bonus and a tax of

the same size? The following section presents two models with different predictions for the relative effectiveness of the tax and bonus policies.

A. Neoclassical Model

In this paper, I consider the effect of tax and bonus policies with a very small x, i.e., five cents. Standard economic theory predicts that if c_i is also very small, a small financial incentive could still have a large effect on behavior, i.e., small incentives will be effective as long as demand for disposable bags is elastic.

Suppose that customers maximize utility over wealth and that utility is strictly increasing and weakly concave in wealth ($u'(w_i) > 0$ and $u''(w_i) \leq 0$). Then customers will derive less utility from a gain in wealth than from a loss of the same magnitude due to the curvature of the utility function and the proportion of customers bringing a reusable bag will be larger under the tax policy than under the bonus policy. However, Rabin (2000) demonstrates that individuals must be approximately risk-neutral over small stakes in order for expected-utility models to imply reasonable levels of risk aversion over large stakes. His calibrations suggest that the consumption value of a dollar should not change significantly over changes in wealth up to \$1000. Given that the incentives considered in this study are only five cents per bag, it is reasonable to assume that utility is linear, i.e., $u(w_i) = \gamma w_i$, over the change in wealth caused by these incentive policies. With this assumption, the conditions under which customers would bring a reusable bag under the tax policy and under the bonus policy are exactly the same (see table below).

	Utility Function	Condition to Bring a Bag
No Incentive	$U_{N,i}(w_i, b_i) = \begin{cases} \gamma w_i - c_i & if\ b_i = 1 \\ \gamma w_i & if\ b_i = 0 \end{cases}$	$0 > c_i$
Tax	$U_{T,i}(w_i, b_i) = \begin{cases} \gamma w_i - c_i & if\ b_i = 1 \\ \gamma(w_i - x) & if\ b_i = 0 \end{cases}$	$\gamma x > c_i$
Bonus	$U_{B,i}(w_i, b_i) = \begin{cases} \gamma(w_i + x) - c_i & if\ b_i = 1 \\ \gamma w_i & if\ b_i = 0 \end{cases}$	$\gamma x > c_i$

B. Reference-Dependent Model

Prospect theory, developed by Kahneman and Tversky (1979), proposes that, while utility is defined in terms of net wealth, value is defined in terms of deviations from a reference point (i.e., gains and losses). This model suggest that individuals perceive losses more strongly than gains of the same size, a phenomenon referred to as loss aversion. Consider a simple reference-dependent utility function where utility is linear in wealth but with a kink at a reference point, w^*:

$$u(w_i) = \begin{cases} \gamma(w_i - w^*) & if\ w_i > w^* \\ \alpha\gamma(w_i - w^*) & if\ w_i \leq w^* \end{cases}, \text{where } \alpha > 1.$$

If an individual's reference point is his wealth level in the absence of any incentive policy, then the conditions for using a reusable bag simplify to the equations in the following table.

	Utility Function	Condition to Bring a Bag
No Incentive	$U_{N,i}(w^*, b_i) = \begin{cases} -c_i & if\ b_i = 1 \\ 0 & if\ b_i = 0 \end{cases}$	$0 > c_i$
Tax Policy	$U_{T,i}(w^*, b_i) = \begin{cases} -c_i & if\ b_i = 1 \\ -\gamma\alpha x & if\ b_i = 0 \end{cases}$	$\gamma\alpha x > c_i$
Bonus Policy	$U_{B,i}(w^*, b_i) = \begin{cases} \gamma x - c_i & if\ b_i = 1 \\ 0 & if\ b_i = 0 \end{cases}$	$\gamma x > c_i$

Since $\alpha > 1$, this model predicts that customers are more likely to bring a reusable bag when the financial incentive takes the form of a tax rather than a bonus. The following sections empirically test whether customers respond similarly to the two policies, as predicted by neoclassical theory, or if customers exhibit behavior consistent with a model of loss aversion.

III. Data

To assesses the relative effectiveness of the tax and bonus policies, I use a unique data set on bag use in the Washington Metropolitan Area around the implementation of the Montgomery

County, Maryland tax. To collect the data, researchers stood by the exit of a grocery store and recorded individual-level data on the number and type of bags each customer used,[6] as well as visually-assessable demographic characteristics, such as sex and race, of all customers exiting the store during the sample period. Researchers visited a given store in thirty minute shifts, randomizing the time and location of the visit. The visits took place between eleven in the morning and eight at night during weekdays only. Each store received an average of ten visits for a final sample of 16,251 individual customers.

The sample period began approximately two months before and ended two months after the implementation of the tax on January 1, 2012.[7] The sample includes data on bag use from sixteen stores, spanning three different counties, each with a different tax policy regime. Eight stores were located in Montgomery County, Maryland (where there was a tax policy change during the sample period), four stores in Washington, D.C. (which implemented a tax two years before data collection began), and four stores in Arlington County, Virginia (which had proposed a bag tax, but never passed one).[8] See Figure 1a for a map of sample stores by county.

The sample stores in this data set vary not only in whether they charge customers a tax for disposable bag use, but also whether they reward customers for reusable bag use. The sixteen stores belong to four of the largest chains in the Washington Metropolitan Area, two of which offer five-cent bonuses for reusable bag use. These sixteen stores were chosen to be comparable on all aspects other than bag policy. Comparability is particularly important when estimating the effect of the bonus since, unlike with the tax policy, the bonus policy had been implemented prior to any data collection, so analyses estimating the effect of the bonus rely on cross-sectional variation in store policy. First, all four chains had locations

[6] A disposable bag refers to either paper or plastic single-use bags. I do not consider the two types of bags separately because almost all customers chose to use plastic bags when they were offered. A reusable bag refers to any multiple-use bag. While most customers used standard reusable bags sold by the store, this category also includes shopping carts, backpacks, tote bags, or disposable bags brought from home.

[7] Data in the pre-period was collected from late September to early November of 2011 while data in the post-period was collected from late February to early March of 2012.

[8] The Montgomery County sample stores are located in the cities of Chevy Chase, Bethesda, and Silver Spring, while the Arlington County stores are located in the city of Arlington. These cities border D.C. and are popular communities for those employed in the district. While the city of D.C. is more racially and economically diverse than these suburban commuter cities, the D.C. stores selected for this study are located in the Northwest quadrant of D.C., an affluent area of the city, in order to maintain comparability to the samples from Maryland and Virginia.

in the three counties considered in this sample. Second, sample stores were drawn from neighborhoods with similar demographic characteristics.[9] In fact, most sample stores that offered a bonus were located within a ten-minute walk from a sample store that did not offer a bonus (see Figure 1b for a map of stores by bonus policy). Third, since customers who drive to the grocery store may differ from customers who use public transportation, all sample stores had a parking lot and were also accessible by the Washington Metropolitan Area Transit Authority's Metrorail. Lastly, one of the sample chains that offers a bonus is an organic food chain. Since customers shopping at organic food chains may differ in their reusable bag use, the four sample stores belonging to this chain are dropped from certain analyses. Of the twelve stores remaining stores, half offer a five-cent bonus per reusable bag and half do not. See Table 1 for a list of store and customer characteristics by store.

I use two additional data sets to investigate various mechanisms that might cause customers to respond differently to the tax policy versus the bonus policy. First, I collected in-person surveys of customers as they exited the store after their shopping trip.[10] These surveys were conducted at twelve different locations at two grocery store chains in Maryland, Virginia, and D.C. shortly before and after the implementation of the Montgomery County tax.[11] Data collection took place during September and October of 2011 and March of 2012. The survey yielded a response rate of 56 percent for a total of 1,624 respondents. Respondents completed a two-minute survey that contained questions on how many disposable and reusable bags they used during their shopping trip, awareness of the bonus and tax policies, measures of how much they believed each of these policies did or would encourage them to use a reusable bag, attitudes toward plastic bag use, environmentalism, and government regulation of pollution, and personal demographic characteristics. In order to test customers'

[9]Since one of the main policy changes took place in Montgomery County, an affluent county with a low proportion of racial minorities, stores were selected to match these demographic characteristics.

[10]Researchers approached customers as they exited the store between the hours of noon and six and asked if they would be willing to participate in a short survey for a research project on shopping behavior. If a customer chose not to participate in the survey, the researcher recorded her as a non-respondent and moved on to the next customer who exited the store.

[11]The retail chains are a subset of the chains visited in the main analysis due to store manager cooperation. Many of the same stores visited when collecting the observational data were also used in the survey sample. Researchers collected data at ten of the twelve stores in both the pre- and post-period; however two stores were only visited during one of the two time periods. Exclusion of these two stores does not change the results shown in Section IV.

response to other hypothetical disposable bag regulations, I use data from an online survey administered through Amazon's Mechanical Turk (Mturk), a crowd-sourcing web service.[12]

Lastly, I use transaction-level scanner data from a large retail chain of grocery stores to measure the long-term impact of the tax policy on disposable bag use. The data set includes a ten percent sample of all transactions from eleven stores in Washington D.C. and sixteen stores in Montgomery County in the time period following the implementation of the disposable bag tax in each area. The data set includes transactions from January 1, 2010 (the first day of the D.C. tax) to June 30, 2012. The total sample includes an average between 2,000 and 2,500 transactions per day for each of the two counties. Each transaction includes information on the products purchased, date, and store location. In addition, the data includes a line item indicating if a customer was charged a tax for using a disposable bag.

IV. The Relative Effectiveness of the Tax and Bonus Policies

A. Tax Policy

As mentioned in the previous section, the primary data set contains individiual-level data on bag use before and after the Montgomery County tax was implemented in sixteen stores across Montgomery County and two control counties: D.C., which implemented a similar tax two years prior to the Montgomery County tax, and Arlington County, which proposed a similar tax, but had not passed the tax. Table 1 contains the mean values of the demographic characteristics of customers in the sample by store. While the three counties vary slightly in their racial composition, all three areas are predominantly white with a similar fraction of female customers. In addition, the demographic composition of shoppers is similar across the two time periods.[13]

Figure 2 presents data on bag use in each of the three counties before and after the

[12]While Mturk participants tend to be younger and more educated than the general population, Paolacci, Chandler and Ipeirotis (2010) show that the sample population is generally representative of the U.S. population and they are able to replicate the findings of several well-known behavioral economics experiments using this subject pool.

[13]See Appendix Table 1 for the mean values of the demographic characteristics by state and time period.

Montgomery County tax was implemented. While reusable bags are the most common substitute for disposable bags, customers may opt to not use any bags at all; therefore, the majority of the analyses presented in this paper will include measures of demand for both disposable and reusable bags to create a complete picture of the changes in behavior as a result of the bag regulations.

Figures 2a and 2b show the percent of customers using any disposable and any reusable bags, respectively. In the pre-period, customers in the Arlington County sample used at least one disposable bag 82 percent of the time while customers in D.C. used a disposable bag only 45 percent of the time. Similarly, Arlington County customers rarely brought a reusable bag when shopping, only 16 percent of the time, compared to 46 percent in D.C. Bag use was very stable across the two periods in each county. In contrast, bag use in Montgomery County changed dramatically after the implementation of the tax. Behavior in Montgomery County during the pre-period resembled that observed in Arlington County, which had no tax policy – 82 percent of customers used at least one disposable bag while only 16 percent brought a reusable bag. However, behavior in Montgomery County in the post-period mirrored the behavior observed in D.C., which did have a tax policy – 40 percent of customers used a disposable bag while 49 percent brought a reusable bag.

Table 2 contains the statistics corresponding to those displayed in the figures as well as means for additional measures of bag use: demand for the two types of bags on the extensive margin (the percent of customers using each type of bag or no bags at all), the intensive margin (how many bags each customer uses given that she uses that particular type of bag), and overall demand (the unconditional number of bags of each type the customer uses). While the effect of the tax seems to be operating primarily through changes in bag use on the extensive margin, customers who continue to use disposable bags after the tax use fewer bags per trip. The data also shows an increase in the proportion of customers choosing not to use any bags at all.

The following model uses a difference-in-differences strategy to evaluate the effect of the Montgomery County tax on bag use controlling for various individual characteristics and

location-level controls:

$$Y_{isdt} = \alpha + \beta MDxPost_{st} + \gamma Post_t + \eta Z_s + \lambda X_i + \delta Q_d + \varepsilon_{isdt}.$$

Y is a measure of bag use, $Post$ is an indicator for individuals observed after the implementation of the Montgomery County tax, $MDxPost$ is an indicator for customers shopping in Montgomery County in the post period, Z is a set of store-level controls, and X is a set of individual-level demographic characteristics for individual i shopping in location s during time of day d at time period t.[14] The coefficient of interest is β, which measures the effect of the tax on bag use in Montgomery County relative to changes in use in the control stores.

Table 3 presents results for the effect of the tax on demand for disposable bags on the extensive margin using different control variables in each specification.[15] The model in column 1 controls only for time period, state, and an indicator for shopping in Montgomery County in the post-period. The results show that the tax caused a decrease in the proportion of customers using at least one disposable bag by 41.7 percentage points. Column 2 adds controls for the available individual-level demographic characteristics, race and gender. If certain demographic groups are more likely to use reusable bags instead of disposable bags, differences in demographics across locations and time periods could bias these results. While non-white and male customers are more likely to use a disposable bag in general, the estimate of the effect of the tax is unchanged by the inclusion of these controls. Column 3 adds controls for time of day, since the behavior or composition of customers may vary throughout the day. Again, the estimates are largely unchanged. Finally, column 4 includes store fixed effects. As with the other controls, the addition of store-level fixed effects has little impact on the estimated effect of the tax.

Table 4 repeats the analysis for the other measures of bag use using the specification from column 4 in Table 3. The outcomes in the first three columns are measures of disposable and reusable bag use on the extensive margin, respectively, as well as a binary measure for using no bags of either type. These results show that the tax led to a decrease in disposable

[14] Time of day is separated into three categories: eleven to one thirty ("Morning"), two to four thirty ("Afternoon"), and five to eight ("Evening").

[15] Regressions presented in this table use a linear probability model to estimate the change in demand. A Probit model yields similar results.

bag use of 42.0 percentage points and an increase in reusable bag use of 32.7 percentage points. In addition, the percent of customers who used no bags at all increased by 11.1 percentage points.[16] When considering the total number of bags used (columns 4 and 5), the tax reduced the number of disposable bags used by just over one bag per shopping trip, cutting the average number of disposable bags used roughly in half.[17]

B. Bonus Policy

This section compares the behavior of customers at stores with different incentive policies. Each sample store falls into one of four policy types. The first type of store provides no incentives for reducing the use of disposable bags. These are grocery store chains that do not offer a bonus and were not required to charge a tax. The second type of store offers a bonus for reusable bag use, but does not charge a tax for disposable bag use. The third type of store does not offer a bonus, but does charge a tax. Finally, the last group of stores both offers a bonus for reusable bag use and charges a tax for disposable bag use, since all of the stores in the sample that provided a bonus prior to the tax continued to provide a bonus after the tax was implemented. Again, if disposable bags and reusable bags are substitutes, bonus-only and tax-only stores offer customers a five-cent incentive for using a reusable bag while bonus-plus-tax stores offer customers a ten-cent incentive for the same behavior.

As mentioned in Section III, the bonus policy was implemented prior to data collection, so the estimation of the impact of the bonus on bag use relies on cross-sectional variation in whether a store chose to offer a bonus for reusable bag use. While the differences in bag use across stores with different incentives may reflect omitted store-level characteristics, these comparisons can still be informative if the customers shopping at bonus and non-bonus stores are similar in terms of their shopping behavior.

A few pieces of evidence suggest comparability of customers across the various store types. As mentioned in Section III, all stores had a parking lot and were also accessible by public

[16] A small fraction of customers used both reusable and disposable bags, which is why the increase in reusable bag use and customers choosing not to use any bags is not completely offset by the decrease in plastic bag use on the extensive margin.

[17] Using a double-hurdle model that combines demand on the extensive and intensive margins to estimate the impact on overall demand yields qualitatively similar, though slightly larger, effects of the tax (see Appendix B).

transportation, were one of the largest four chains in the Washington Metropolitan Area, and had locations in each of the three counties considered in this study. Bonus and non-bonus stores were located within the same neighborhoods, with most bonus stores located within walking distance of a non-bonus store in the sample (see Figure 1b). As a result, customers in the two types of stores had very similar demographic characteristics (see Table 5). Lastly, this analysis excludes observations from the one organic chain, which provided a bonus, since reusable bag use among these customers may not be comparable due to the environmentally-conscious reputation of the company.[18]

Figures 3a and 3b show the fraction of customers using at least one disposable bag or at least one reusable bag, respectively, by policy type with each bar representing a policy-location-period. For example, bonus stores in Montgomery County are included in the bonus-only category in the pre-period and in the bonus-plus-tax category in the post-period. In Figure 3a, an average of 84.3 percent of customers use at least one disposable bag in stores with no incentive policy. This estimate is much higher than that in stores with both a tax and a bonus – only 40.4 percent of customers used a disposable bag in these stores. What is most striking, however, is the comparison of stores that offer only a five-cent incentive but that differ in whether the incentive takes the form of a tax or a bonus. Customers in stores with only a tax used a disposable bag 40.8 percent of the time, similar to customers in stores offering both a tax and a bonus. However, customers in stores that offered only a bonus used a disposable bag 81.9 percent of the time. This estimate is much closer to the percent of customers using a disposable bag in stores that provided no incentive than it is to stores offering an incentive of the *same amount*, but in the form of a tax instead of a bonus.

Figure 3b tells a similar story for the proportion of customers using a reusable bag. Customers shopping in stores with both a bonus and a tax used a reusable bag 47.8 percent of the time, which is similar to, though statistically significantly larger than, the 44.2 percent of customers who used a reusable bag in stores that charge a tax but do not provide a bonus. However, only 15.4 percent of customers brought a reusable bag in stores that offer a bonus only. This estimate is much smaller than that in stores that charge a tax, though only slightly

[18]Reusable bag use in these stores is slightly higher than in the non-organic stores; however, inclusion of these stores leaves the results in this section qualitatively unchanged.

larger than the 13.1 percent of customers who shop at stores with no incentive policies.

While effort was taken to choose stores that had similar characteristics, unobserved differences between bonus and non-bonus stores may bias these results. To investigate the potential magnitude of this bias, suppose that, were it not for the bonus, none of the customers shopping in bonus-only stores would have used a reusable bag. Note that this assumption provides an upper-bound for the effect of the bonus: at most, the bonus increased reusable bag use from zero to 15.4 percent.[19] If I compare this upper-bound estimate to the estimate of the effect of the tax policy found in Section IV.A, the impact of the tax (32.7 percentage points) was still more than twice as large as the impact of the bonus. Therefore, while the comparison of bag use in Figures 3a and 3b is purely cross-sectional, this example shows that even with extreme selection of customers across stores, it is reasonable to conclude that a five-cent tax is considerably more effective at increasing reusable bag use than a bonus of the same amount.[20]

The comparison of bag use by store policy can be repeated using the following econometric model that controls for factors that might confound the simple comparison of means:

$$Y_{isdt} = \alpha + \beta Tax_{st} + \gamma Bonus_s + \eta Z_s + \lambda X_i + \delta Q_d + \varepsilon_{isdt}.$$

Y is a measure of bag demand, Tax is an indicator for whether a store charges a five-cent tax, $Bonus$ is an indicator for whether the store offers a five-cent bonus for reusable bag use, Z is a set of state-level controls, and X is a set of individual-level demographic characteristics for individual i shopping in state s during time of day d at time period t. If I assume that, conditional on these controls, there are no unobservable differences between the customers of bonus and non-bonus stores that would affect their response to the two types of incentives or to their demand in the absence of a bag regulation, then β is the effect of the tax policy and γ is the effect of the bonus policy.

[19] This statement also requires the plausible assumption that no customer uses a disposable bag if and only if the store offers a bonus for reusable bag use.

[20] In fact, one of the more plausible scenarios for selection of customers across stores with different policies is that customers who would choose to bring a reusable bag in the absence of any incentive policy might choose to shop at stores that reward them for doing so. However, this pattern would suggest I am overestimating the causal impact of the bonus policy due to selection.

Table 6 presents the results for disposable and reusable bag use on the extensive margin. Columns 2 and 4 control for demographic characteristics and time of day while columns 1 and 3 do not. As with the evaluation of the tax policy in Table 4, the inclusion of these controls does not change the estimates of the effect of the tax or bonus policies. Customers are significantly less likely to use a disposable bag in stores that charge a tax – 44.5 percentage points lower – whereas customers shopping at stores that offer a bonus program do not differ significantly from those shopping at stores without the program. While customers are significantly more likely to use a reusable bag in both tax and bonus stores than in stores that offered no incentive, the magnitude of difference is much larger in tax stores than in bonus stores – 32.7 versus 2.9 percentage points.[21][22]

V. Reasons for Asymmetric Responses to Taxes and Bonuses

A. Loss Aversion

As mentioned in Section II, standard economic models suggest that the tax and bonus policies should have the same effect on behavior; however, Kahneman and Tversky (1979) suggest that individuals perceive losses more strongly than gains of the same size, i.e., they are loss-averse. Recent evidence from both lab and field experiments support this theory. For example, Fryer et al. (2012) finds that the framing of pay-for-performance bonuses for public school teachers has a significant effect on student test scores – students of teachers who were randomly assigned to receive a bonus that was framed as a loss (all teachers received the bonus upfront, but returned it if their students underperformed) had higher test scores than students of teachers whose bonus was framed as a gain (teachers were rewarded with the bonus only after proving student improvement).[23]

[21] In order to test for possible non-linearities in the effect of the incentives, I include a term for the interaction of the two policies. This term is positive and significant, though small in magnitude, for reusable bag use and insignificant for disposable bag use. This suggests that increasing the total economic incentive to ten cents has little effect on behavior, at least when the additional incentive is framed as a bonus.

[22] In an effort to avoid issues of comparability across stores with different policies, Appendix C includes an additional analysis on how participants of the survey mentioned in Section III reported that they would respond to a *hypothetical* five-cent tax or bonus policy. Twenty eight percent of respondents said that a bonus would influence their decision to use a reusable bag quite a bit. This estimate increased by 31 percentage points when the hypothetical policy was a tax instead of a bonus.

[23] Hossain and List (2012) and Field (2009) use a similar experimental design find evidence of loss aversion in the context of productivity bonuses for factory workers and tuition subsidies for law students entering

If a customer is accustomed to receiving a disposable bag for free (i.e., her reference point is a price of zero), then a policy that charges customers five cents per disposable bag causes her to experience a loss, while a policy that offers a five cent bonus per reusable bag is considered to be a gain. The results presented in Section IV are, therefore, consistent with a model in which customers are loss averse – the tax policy is more effective at reducing disposable bag use than the bonus policy, even if the incentives are financially equivalent. See Section VI for further analysis.

B. Marketing and Awareness

A second reason the tax may have been more effective at changing customer behavior is that consumers were more aware of the tax than the bonus. Individual stores in all locations marketed the two types of incentives in similar ways. Stores that charged a tax posted announcements by the register detailing the rules involved with the new law. Similarly, stores that offered a bonus advertised the policy through announcements posted at the register and on the racks where reusable bags were sold. Additionally, reusable bags for sale were prominently displayed by the register and in other locations throughout the store in all sample stores. However, the tax was highly visible in several additional dimensions. For example, the tax was covered widely in the press in the weeks leading up to its implementation. Therefore, it is possible that the additional marketing involved with the implementation of the tax may have generated a difference in awareness of the two policies.

To investigate possible discrepancies in awareness, I surveyed customers at sample stores about their knowledge of the store's tax and bonus policies. While almost all customers (98 percent) were aware of the tax, only 52 percent of customers in stores that offered a bonus were aware of that program. This under-awareness of the bonus policy could mute the estimate of the effect of the incentive relative to the tax. If I assume that customers who were unaware of the bonus (tax) policy would have responded to the policy in the same way as those who were aware had they know about the policy, then I can rescale the estimate of the effect of the bonus policy from Table 6 to account for under-awareness of the bonus by dividing the estimate by the fraction of customers who were aware of the policy. However,

public interest careers, respectively.

even after rescaling, the effect of the tax on the proportion of customers using a reusable bag was still much larger than the effect of the bonus – 33.4 versus 5.6 percentage points.[24] In fact, in order for differences in awareness to account for the relative effectiveness of the two policies, *no more than nine percent* of customers who would have switched from using disposable bags to using reusable bags had they known about the bonus policy could have been aware of the policy. So while it is clear that differences in awareness contributed to the relative effectiveness of the tax policy, this cannot completely account for the asymmetry in responses to the two policies.

C. Social Norms

Legal scholars have studied a theory referred to as the "expressive function of law," the idea that a law has an effect on behavior independent of the sanction. For example, the law may shift social norms by making a statement about what behavior warrants punishment.[25] This theory would suggest that the tax would have a larger effect on consumer behavior than the bonus since the tax policy was a *law* while the bonus policy was not. It is difficult to rule out the hypothesis that the tax caused a shift in social norms; however, this section provides evidence that suggests that it is unlikely that the results in Section IV are driven by changing norms.

First, the Montgomery County tax was implemented on January 1, 2012, but was passed in May of 2011, over four months before the collection of any of the observational data used in this paper. Survey data from the pre-tax period suggests that just over half of survey respondents in Montgomery County were aware that the law had been approved and that they would soon be charged five cents per disposable bag. The theory mentioned above suggests that individuals adjust their behavior due to the moral statement made by the announcement, not the implementation, of the law. Therefore, the customers who were aware upon announcement of the law should have *already* changed their behavior before the

[24] For an in-depth discussion of these assumptions and the rescaling of estimates for differences in awareness, see Appendix D.

[25] For example, Funk (2007) shows that voter turnout in Switzerland decreased significantly after a mandatory voting law with negligible penalties (less than one dollar) was repealed. Similarly, Galbiati and Vertova (2008) conduct an experiment in which participants play a public goods game that requires players to contribute a minimum amount or pay a small fine for refusing and find that this obligation increases contributions even when the optimal strategy is to free-ride.

collection of the pre-period data; however, I observe a large change in behavior right after the implementation of the tax. Additionally, the Montgomery County tax was not the first tax of its kind in the Washington Metropolitan Area: D.C. passed a similar tax two years prior. Given that the sample draws from stores in areas that are close to D.C., it is likely that many of the customers in the sample had been exposed to the D.C. bag tax prior to the implementation of the Montgomery County tax. The survey data shows that 73.7 percent of respondents in Virginia and 83.7 percent of Montgomery County respondents were aware of the D.C. tax.[26] Again, this suggests that it is plausible that any change in social norms about disposable bag use caused by the passage of these laws took place long before the Montgomery County tax was implemented.

Additionally, I collected survey measures of attitudes toward disposable bag use at seven grocery stores before and after the implementation of the Montgomery County bag tax. This allows me to use the same difference-in-differences strategy as described in Section IV.A to evaluate the effect of the implementation of the tax on these self-reported social norms measures.[27] If the implementation of the tax caused a shift in social norms, the results should show positive and significant estimates of the coefficient on $MDxPost$, the difference-in-difference estimator, for each of these measures. Table 7 presents the results of this analysis. I do not find that any of these measures of social norms significantly change as a result of the implementation of the tax. While the standard errors are rather large, the signs of the different measures are not even in the same direction – for example, the percent of customers reporting that they felt guilty when using a plastic bag increased after the implementation of the tax, while the percent reporting that they felt social pressure to use fewer plastic bags decreased. While these results are by no means conclusive, they provide suggestive evidence that the implementation of the law did not cause a detectable shift in social norms regarding the use of disposable bags.

[26] This question was only asked in the post-period. While this should not affect the validity of the responses from Virginia, the Montgomery County results may be biased upward since they may have learned about the D.C. tax only after the implementation of the Montgomery County tax.

[27] Customers were asked if they felt guilty when they used a disposable bag ("Guilt"), felt social pressure to use fewer disposable bags ("Pressure"), got upset when they saw other customers use too many disposable bags ("Upset"), thought the number of disposable bags they used was wasteful ("Wasteful"), and whether they would support a law that required stores to tax customers five cents for each disposable bag ("Support").

D. Utility from Free Goods

Shampanier, Mazar and Ariely (2007) present an alternative model of reference-dependent preferences in which the benefits derived from receiving a free product are larger than the simple reduction in price. For example, individuals may receive higher intrinsic benefit from receiving free goods or, conversely, may experience lower costs from not having to pay for a non-free good. Note that this model is a specific case of reference-dependent preferences in which customers only exhibit reference dependence when the reference point in question is a customer's wealth when a good is free. Additionally, their model suggests that there is a discontinuous jump in utility at this zero-price reference point rather than a kink. This would imply that a customer's utility should decrease discretely when a store policy shifts from offering no incentive to charging a tax (i.e., when the good is no longer free) by some amount δ:

$$u(w_i) = \begin{cases} \gamma w_i & if\, w_i \geq w^* \\ \gamma w_i - \delta & if\, w_i < w^* \end{cases}, \text{where } \delta > 0.$$

Since the reference point considered in this paper is a customer's wealth when disposable bags are free, this model could also explain the results from Section IV. While my data cannot distinguish between this specific case of reference-dependent preferences or the more general model described in Section II.B nor can it determine whether the change in utility is a kink versus a discontinuous jump, it rejects any model that does not predict asymmetry around this particular reference point.

E. Additional Explanations

There are several other possible explanations that may contribute to the difference in responses to the two incentive policies. For example, while both policies offer a five-cent incentive per bag for those who use a reusable bag instead of a disposable bag, the incentives are not symmetric for individuals who choose to use no bag – customers who change their behavior from using a disposable bag to using no bags are five cents richer under the tax policy, but are financially unchanged under the bonus policy. However, the large majority of

customers in the sample use one of the two types of bags rather than carrying their groceries in their arms. Similarly, if reusable bags are larger than disposable bags, the tax policy provides a larger incentive than the bonus policy. As with the asymmetries in awareness in Section V.B, the difference in the size of the two types of bags would need to be substantial – reusable bags would need to be roughly ten times as large as a disposable bag – to generate the results found in Section IV. Another concern is that the behavior of the cashiers may have changed after the tax was implemented, either in how they bagged the groceries or how they reminded customers of the tax policy. While I cannot rule out this mechanism, I did not observe this type of behavior while collecting data at the sample stores. Lastly, recent work by Li, Linn and Muehlegger (2014) and Sussman and Olivola (2011) present evidence that consumers are "tax-averse," which suggests that customers may respond more strongly to the tax simply because it is labeled as a tax and not a fee. While there were no existing policies that charged a fee for disposable bag use that is not framed as a tax, Appendix E presents evidence from an online experiment that elicited participants' responses to a hypothetical store-imposed fee versus a government-imposed tax and finds no differences in responses to the two policies.

VI. Estimating Loss Aversion

A. The Coefficient of Loss Aversion

As mentioned in the previous section, there are several explanations for the asymmetric response to the two incentive policies observed in the data. This section accounts for the differences in policy awareness from Section V.B then uses observational data from Section IV to measure the degree of loss aversion in the population if the remaining asymmetry in responses to the tax and bonus policies were attributed to loss aversion. In the reference-dependent utility function described in Section II.B, α is the slope of the utility function for wealth levels above the reference point (w^*) relative to the slope below the reference point, i.e., the sharpness of the kink in the utility function at w^*. This parameter is often referred to as the "coefficient of loss aversion" (Wakker and Tversky, 1993).

The table below repeats the conditions required for a customer to choose to bring a

reusable bag under the three policies assuming reference-dependent preferences from Section II.B. To connect the model with the data, I divide through by γ so that all variables are in money-metric units. If F is the distribution of c_i, the proportion of customers bringing a reusable bag when there is no incentive, when there is a bonus, and when there is a tax are $F(0)$, $F(x)$, and $F(\alpha x)$, respectively. Recall that we observe these proportions in the data in the previous section.

	Utility Function	Condition to Bring a Bag	% Bringing a Bag	% Bringing a Bag (from Data)
No Incentive	$U_{N,i}(w^*, b_i) = \begin{cases} -c_i & if\, b_i = 1 \\ 0 & if\, b_i = 0 \end{cases}$	$0 > c_i$	$F(0)$	13.1
Bonus Policy	$U_{B,i}(w^*, b_i) = \begin{cases} x - c_i & if\, b_i = 1 \\ 0 & if\, b_i = 0 \end{cases}$	$x > c_i$	$F(x)$	15.4
Tax Policy	$U_{T,i}(w^*, b_i) = \begin{cases} -c_i & if\, b_i = 1 \\ -\alpha x & if\, b_i = 0 \end{cases}$	$\alpha x > c_i$	$F(\alpha x)$	44.2

In order to estimate the coefficient of loss aversion, I need to know the distribution of c_i. Unfortunately, there is nothing in my data that indicates what the distribution of costs (or benefits) associated with bringing a reusable bag looks like in the population. Therefore, the best I can do is estimate α using a plausible range of distributions. For example, if I take a first-order Taylor approximation of $F(.)$ around $F(0)$, the proportion of customers bringing a reusable bag under the tax policy around zero yields the equation $F(\alpha x) \approx F(0) + \alpha x f(0)$. Similarly, I can approximate the proportion of customers bringing a reusable bag under the bonus policy as $F(x) \approx F(0) + x f(0)$. From these two equations, α can be written as the ratio of the increase in reusable bag usage under the tax policy to the increase in reusable bag usage under the bonus policy: $\alpha \approx \frac{F(\alpha x) - F(0)}{F(x) - F(0)}$. Therefore, if I assume that the first-order approximation is exact (for example, if c_i is locally uniformly distributed) then, using the moments in the above table, $\alpha = 14$. Adjusting for the under-awareness of the bonus policy measured in Section V.B decreases the size of the estimated coefficient of loss aversion by about half.

Alternatively, suppose that $F(.)$ is a normal distribution with mean μ and variance σ^2. In that case, given that $x = 5$ cents, and using the moments in the above table, it is

straightforward to compute that $\mu = 56$ cents and $\sigma = 50$ cents. This distribution, after adjusting for under-awareness of the bonus, implies that $\alpha = 5$. This estimated coefficient of loss aversion suggests that a bonus would have to be 25 cents in order to have the same behavioral impact as the 5-cent tax. Previous papers that estimate the coefficient of loss aversion using lab experiments, such as Kahneman and Tversky (1979), have found smaller estimates with an average α of just over 2. While the coefficient estimated here is in the range of previous estimates, this may suggest that other explanations mentioned in Section V could be contributing to the large impact of the tax.

B. Expectations-Based Reference Points

Up to this point, analyses in this paper involving reference-dependent preferences assume that a customer's wealth in the absence of an incentive policy serves as her reference point, i.e., her reference point is her wealth when disposable bags are free. However, work by Kőszegi and Rabin (2006) suggests that reference points are generated by an individual's expectations about their wealth. If a customer believes that disposable bags are free, then a five-cent tax will feel like a loss. Alternatively, if a customer expects to pay a five-cent tax per bag, this theory of reference point formation suggests that she will not experience a loss when paying the tax because she expected to pay the tax. If reference points are indeed based on expectations, this suggests that customers may decrease their disposable bag use before their expectations have adjusted to the new policy (e.g., in the early days of implementation), but that this effect should rebound once customers adjust their expectations.

This section analyzes a new data set, transaction-level scanner data from a large retail chain in D.C and Montgomery County, to estimate the long-term impact of the tax on disposable bag use. This data includes a line item that indicates if a customer was charged a tax during a given transaction which can be used to calculate daily estimates of the fraction of customers using at least one disposable bag following the implementation of the tax.[28]

[28]This data includes information on whether a customer was charged for using a disposable bag during a given transaction which allows me to compute aggregate daily averages of the percent of customers using disposable bags, but are not informative as to the number of bags used by a particular consumer. Additionally, I only have a measure of bag use when a customer is charged a tax, I do not have data on disposable bag use in periods prior to the implementation of the tax or in locations that did not pass a tax policy. Lastly, this particular chain did not offer customers a bonus, so I cannot use this data to analyze the relative effectiveness

The data includes transactions from January 1, 2010 to June 30, 2012 which allows me to track disposable bag use for two and a half years in D.C. and six months in Montgomery County.

Figure 4a plots the percent of customers using a disposable bag in stores located in D.C. starting on the first day of the D.C. tax policy on January 1, 2010.[29] The figure shows that 58.1 percent of customers used at least one disposable bag on the first day the tax was implemented, but that this estimate decreased to 41.5 percent by the last week of the month. The figure does not show a decrease in disposable bag use during the month of January in the two subsequent years suggesting that the decrease in bag use is likely associated with the implementation of the tax and not simply due to seasonal fluctuations in bag use. Figure 4b shows a similar pattern in Montgomery County after the implementation of its tax on January 1, 2012. On the first day of the Montgomery County tax, 39.8 percent of customers used at least one disposable bag, but by the last week in January, this estimate decreased to 26.3 percent.

What is particularly remarkable about this change in behavior is its persistence. While disposable bag use in both D.C. and Montgomery County decreased by roughly 15 percentage points over the first month of the tax, this estimate remained at the new lower level for the rest of the sample period. In contrast, a model of expectations-based reference dependence would predict that bag use would rebound to its pre-tax level once customers grew accustomed to the tax. While these results do not rule out the possibility of such a model – for example, the absence of a rebound effect could be explained by habit formation of using a reusable bag – the data is more consistent with a model of reference dependence in which a customer's reference point is fixed at her wealth level when disposable bags have a price of zero.

of a tax versus a bonus policy.

[29] I drop two days in February 2010 where I observe an unusually low number of transactions due to a blizzard in the area.

VII. Conclusion

This paper investigates the relative impact of two incentives aimed at reducing the use of disposable shopping bags, a five-cent tax on disposable bag use and a five-cent bonus for reusable bag use. I find that the tax policy reduced the overall demand for disposable bags by over half and prompted consumers to substitute to reusable alternatives; this is particularly notable given the relatively small size of the tax itself. The large effect of the tax is also striking given that the bonus had almost no impact of bag use, a result that is consistent with a model in which customers are loss-averse. I present evidence that differences in awareness of the two policies and changes in social norms cannot fully account for my results.

It is interesting to note that the effect of this tax is not only large in absolute terms, but also in comparison to previous estimates of the impact of other types of sin taxes. There are several possible explanations for this discrepancy. First, the elasticity of demand for disposable bags may be substantially greater than the elasticity of demand for other goods – the average consumer may be willing to forgo the convenience of using a disposable bag, but not willing to cut back on her consumption soda or other taxed goods. Second, the visibility of the bag tax, which is prominently displayed at grocery store registers, may help explain why it has had a larger effect than other taxes, which tend to be less salient (Chetty, Looney and Kroft (2009); Goldin (2013)). Third, the large change in demand for disposable bags following the tax may stem from levying a price on a good that had previously been free (Shampanier, Mazar and Ariely (2007)). Finally, even a small initial impact of the tax can generate large effects if the reputational costs of using disposable bags increases by way of a social multiplier (Benabou and Tirole (2011)).

The results have implications for several existing environmental policies. Policies that provide discounts to coffee drinkers who use their own mug may not be as effective as those that charge for the use of a paper cup. Similarly, government programs that award tax credits to customers who purchase environmentally-friendly Energy Star products may be less effective than policies that tax energy-inefficient products. More generally, these findings suggests the importance of accounting for the importance of framing when designing a wide variety of incentives.

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Table 1: Summary Statistics by Sample Store

Store	Obs	Location	Tax	Bonus	Organic	% Female	% White
1	432	DC	x (2010)			60.0	75.5
2	779	DC	x (2010)			62.0	71.6
3	800	DC	x (2010)	x		49.6	33.6
4	845	DC	x (2010)	x	x	65.3	78.1
5	888	MD	x (2012)			53.9	34.3
6	851	MD	x (2012)			53.1	64.0
7	613	MD	x (2012)			64.1	76.7
8	1,528	MD	x (2012)	x		51.7	42.8
9	805	MD	x (2012)	x		66.1	63.5
10	1,264	MD	x (2012)	x		66.0	77.9
11	1,353	MD	x (2012)	x	x	63.5	53.5
12	1,012	MD	x (2012)	x	x	68.8	74.6
13	1,331	VA				51.1	76.0
14	878	VA		x		57.5	76.8
15	1,509	VA		x		54.1	76.7
16	1,363	VA		x	x	59.5	78.7
N	16,251						

Table reports the number of observations per store, store location (Washington, D.C., Maryland, or Virginia), the date the store implemented a five-cent tax per disposable bag, whether the store offered a five-cent bonus per reusable bag, whether the store belonged to an organic market chain, and the fraction of sample members who were female and white, respectively.

Table 2: Bag Use Before and After the Montgomery County Bag Tax

	D.C.		Maryland		Virginia	
	Pre	Post	Pre	Post	Pre	Post
	(1)	(2)	(3)	(4)	(5)	(6)
Extensive Margin						
Disposable	44.5	45.7	81.7	39.6	82.2	80.8
	(49.7)	(49.8)	(38.6)	(48.9)	(38.3)	(39.4)
Reusable	46.0	46.6	15.9	49.2	16.3	17.2
	(49.9)	(49.9)	(36.5)	(50.0)	(36.9)	(37.7)
No Bags	14.9	11.3	5.7	15.4	4.7	4.8
	(35.6)	(31.7)	(23.2)	(36.1)	(21.1)	(21.5)
Intensive Margin						
Disposable	2.23	1.76	2.32	1.76	2.37	2.14
	(2.17)	(1.43)	(2.05)	(1.43)	(2.02)	(1.82)
Reusable	1.63	1.52	1.67	1.66	1.79	1.65
	(1.07)	(0.95)	(1.14)	(1.09)	(1.27)	(1.15)
Overall Demand						
Disposable	1.00	0.81	1.90	0.70	1.95	1.73
	(1.82)	(1.31)	(2.06)	(1.25)	(2.04)	(1.84)
Reusable	0.75	0.71	0.26	0.82	0.29	0.28
	(1.09)	(1.00)	(0.76)	(1.13)	(0.84)	(0.78)
N	1,207	1,649	3,799	4,515	2,006	3,075

Table reports the fraction of using a bag (extensive), average number of bags used among users (intensive), and unconditional average number of bags used (overall) for each type of bag.
Standard deviations in parentheses.
Customers using both types of bags are counted in both categories.
"Pre" and "Post" refer to the sample periods before and after the implementation of the Montgomery County tax.

Table 3: Effect of Tax Policy on Disposable Bag Use

	(1)	(2)	(3)	(4)
MDxPost	-0.417***	-0.417***	-0.419***	-0.420***
	(0.014)	(0.014)	(0.014)	(0.014)
Post	-0.005	-0.003	-0.002	-0.002
	(0.010)	(0.010)	(0.010)	(0.010)
MD	0.001	-0.013	-0.009	
	(0.010)	(0.010)	(0.010)	
DC	-0.362***	-0.372***	-0.372***	
	(0.011)	(0.011)	(0.011)	
Black		0.100***	0.100***	0.099***
		(0.009)	(0.009)	(0.009)
Other Non-White		0.025**	0.025**	0.025**
		(0.010)	(0.010)	(0.010)
Female		-0.068***	-0.067***	-0.066***
		(0.007)	(0.007)	(0.007)
Afternoon			0.005	0.003
			(0.008)	(0.008)
Evening			0.027***	0.026***
			(0.008)	(0.009)
Store FE	No	No	No	Yes
N	16,251	16,251	16,251	16,251

Robust standard errors in parentheses.

Outcome variable: probability of using at least one disposable bag.

Column 1: controls for store county.

Column 2: adds individual demographics (race and sex).

Column 3: adds fixed effects for shopping trip time-of-day.

Column 4: adds store fixed effect.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Effect of Tax Policy on Disposable and Reusable Bag Use

	Extensive Margin			Number of Bags Used	
	Disposable	Reusable	No Bags	Disposable	Reusable
	(1)	(2)	(3)	(4)	(5)
MDxPost	-0.420***	0.327***	0.111***	-1.009***	0.579***
	(0.014)	(0.013)	(0.009)	(0.056)	(0.029)
Post	-0.002	-0.002	-0.006	-0.169***	-0.031
	(0.010)	(0.010)	(0.006)	(0.041)	(0.021)
Black	0.099***	-0.102***	-0.001	0.103***	-0.219***
	(0.009)	(0.009)	(0.006)	(0.035)	(0.018)
Other Non-White	0.025**	-0.057***	0.022***	-0.019	-0.163***
	(0.010)	(0.010)	(0.007)	(0.038)	(0.019)
Female	-0.066***	0.153***	-0.061***	0.116***	0.305***
	(0.007)	(0.007)	(0.005)	(0.027)	(0.014)
Afternoon	0.003	0.031***	-0.024***	0.176***	0.058***
	(0.008)	(0.008)	(0.006)	(0.032)	(0.018)
Evening	0.026***	0.009	-0.032***	0.236***	-0.014
	(0.009)	(0.008)	(0.006)	(0.033)	(0.017)
Store FE	Yes	Yes	Yes	Yes	Yes
N	16,251	16,251	16,251	16,251	16,251

Robust standard errors in parentheses.

Outcome variables: probability of using at least one bag or no bags (extensive margin) and number of bags used for disposable and reusable bag demand, respectively.

All regressions control for individual demographics (race and sex), shopping trip time fixed effects (afternoon and evening; morning omitted), and store fixed effects.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Demographic Characteristics by Bonus Policy

	Bonus Stores (1)	Non-Bonus Stores (2)
Female	57.1	56.1
	(49.6)	(49.6)
White	62.6	65.7
	(48.4)	(47.5)
Black	22.6	20.6
	(41.8)	(40.5)
N	6,784	4,894

Table reports mean values of each demographic characteristic for stores that provide a bonus (column 1) and stores that do not (column 2).
Organic stores are excluded from the analysis.
Other non-white race omitted.
Standard deviations in parentheses.

Table 6: Effect of Tax vs. Bonus Policy on Bag Use

	Disposable		Reusable	
	(1)	(2)	(3)	(4)
Tax	-0.445***	-0.445***	0.329***	0.327***
	(0.011)	(0.011)	(0.011)	(0.011)
Bonus	-0.009	-0.013	0.026***	0.029***
	(0.008)	(0.008)	(0.008)	(0.008)
MD	-0.003	-0.015	0.001	0.014
	(0.009)	(0.010)	(0.009)	(0.009)
DC	0.057***	0.041**	-0.027	-0.008
	(0.017)	(0.017)	(0.017)	(0.017)
Black		0.102***		-0.102***
		(0.010)		(0.010)
Other Non-White		0.027**		-0.064***
		(0.011)		(0.011)
Female		-0.055***		0.150***
		(0.008)		(0.008)
Afternoon		0.013		0.033***
		(0.010)		(0.009)
Evening		0.032***		0.011
		(0.010)		(0.009)
F-stat	949.19	946.44	465.23	471.99
prob>F	0.00	0.00	0.00	0.00
N	11,678	11,678	11,678	11,678

Robust standard errors in parentheses.
Outcome variable: probability of using at least one disposable bag (columns 1 & 2) or at least one reusable bag (columns 3 & 4).
Tax is an indicator for whether a store charges a five-cent tax per disposable bag. *Bonus* is an indicator for whether a store offers a five-cent bonus per reusable bag.
All regressions control for store county, individual demographics (race and sex), and shopping trip time-of-day fixed effects.
The F-stat is associated with the test of equality between the tax and bonus coefficients.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Change in Social Norms after Implementation of Tax Policy

	(1) Guilt	(2) Pressure	(3) Upset	(4) Wasteful	(5) Support
MDxPost	0.072	-0.059	0.027	-0.103	0.040
	(0.073)	(0.073)	(0.063)	(0.074)	(0.068)
Post	-0.036	0.044	0.052	-0.133**	-0.042
	(0.056)	(0.056)	(0.048)	(0.057)	(0.050)
MD	-0.074	0.087	0.006	0.003	0.019
	(0.069)	(0.069)	(0.055)	(0.071)	(0.067)
DC	0.087	0.113**	0.023	-0.088	0.120**
	(0.055)	(0.056)	(0.048)	(0.056)	(0.052)
Female	0.220***	0.102***	0.108***	0.032	0.169***
	(0.035)	(0.035)	(0.031)	(0.036)	(0.035)
White	0.068*	0.064	-0.033	-0.008	0.063
	(0.040)	(0.040)	(0.036)	(0.041)	(0.041)
Age	0.008	0.007	-0.007	0.002	-0.006
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Age Squared	-0.000**	-0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
>=High School	-0.086*	0.004	0.007	-0.046	-0.066
	(0.044)	(0.044)	(0.042)	(0.046)	(0.048)
Income<$50k	-0.040	-0.008	0.023	-0.090**	-0.058
	(0.043)	(0.042)	(0.039)	(0.043)	(0.045)
Dep Var Mean	0.388	0.319	0.263	0.369	0.733
N	743	742	742	742	685

Robust standard errors in parentheses.

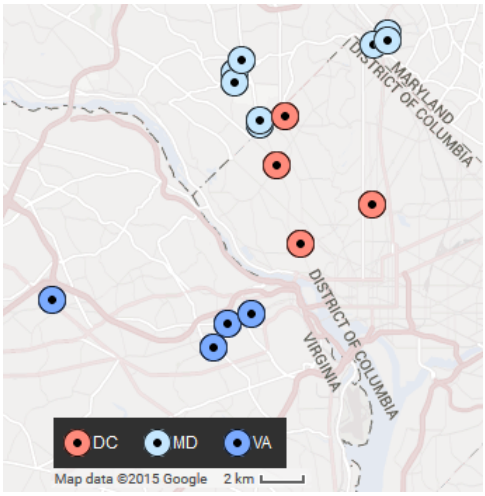
Outcome variable: probability of responding affirmatively to the social norms survey question. Respondents were asked if they felt guilty when they used a disposable bag ("Guilt"), felt social pressure to use fewer disposable bags ("Pressure"), got upset when they saw other customers use too many disposable bags ("Upset"), thought the number of disposable bags they used was wasteful ("Wasteful"), and whether they would support a law that required stores to tax customers five cents for each disposable bag ("Support").

All regressions control for store county and respondent characteristics including sex, race, age, education, and income.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: Map of Sample Stores

(a) By County



(b) By Bonus Policy

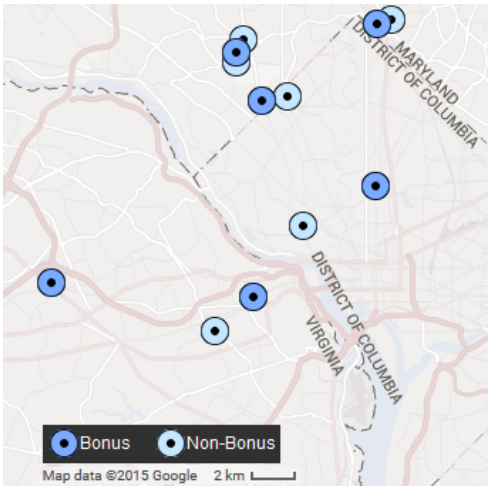
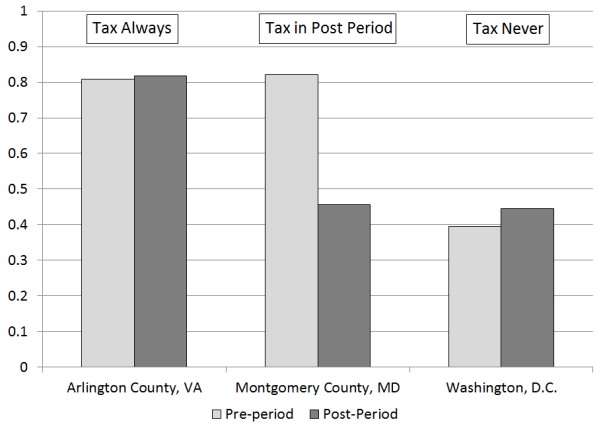


Figure 2: Extensive Margin Bag Use by Location, Time Period, and Bag Type

(a) Proportion of Customers Using a Disposable Bag



(b) Proportion of Customers Using a Reusable Bag

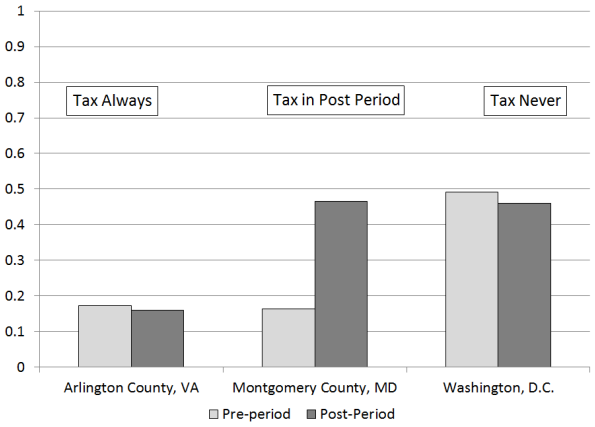


Figure 3: Extensive Margin Bag Use by Store Policy and Bag Type

(a) Proportion of Customers Using a Disposable Bag (b) Proportion of Customers Using a Reusable Bag

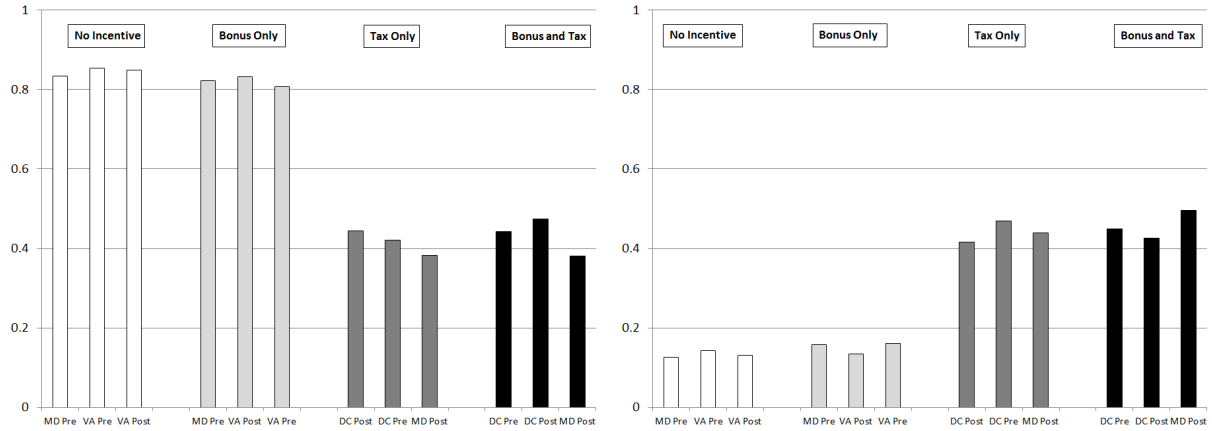
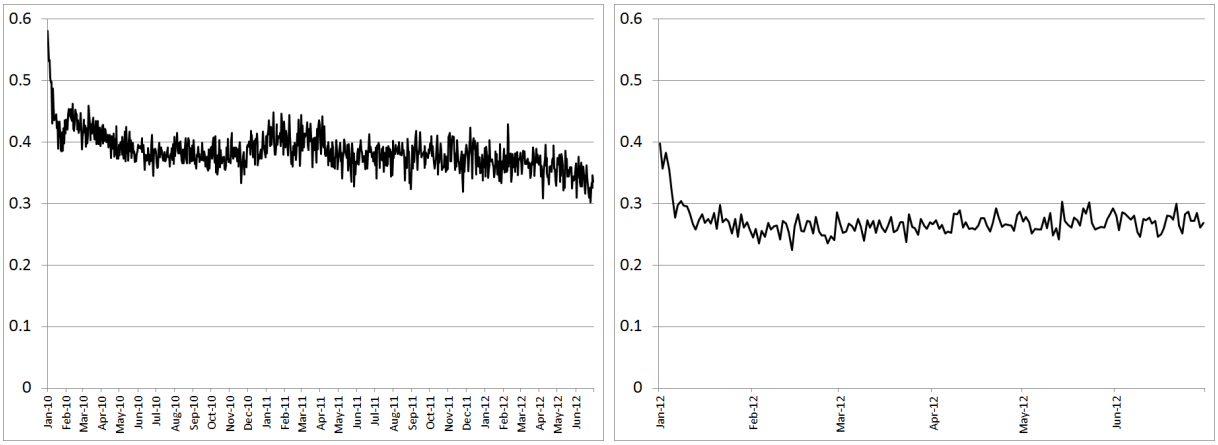


Figure 4: Proportion of Customers Using a Disposable Bag After Implementation of the Tax

(a) Washington, D.C. (b) Montgomery County, MD



Online Appendix

A. Demographic Characteristics by Location and Time Period

Appendix Table 1: Demographic Characteristics

	D.C.		Maryland		Virginia	
	Pre	Post	Pre	Post	Pre	Post
	(1)	(2)	(3)	(4)	(5)	(6)
Female	58.5	59.7	59.8	61.2	53.1	56.9
	(49.3)	(49.1)	(49.0)	(48.7)	(49.9)	(49.5)
White	63.8	63.3	59.3	59.7	77.8	76.6
	(48.1)	(48.2)	(49.1)	(49.1)	(41.6)	(42.4)
Black	23.3	22.0	27.9	26.3	10.1	9.7
	(42.3)	(41.4)	(44.9)	(44.0)	(30.2)	(29.6)
N	1,207	1,649	3,799	4,515	2,006	3,075

Table reports mean values of each variable.
Standard deviations in parentheses.
Pre- and post-periods refers to the sample period before and after the implementation of the Montgomery County tax.

B. Alternative Demand Model

In order to provide an alternative measure of the overall effect of the tax on demand, I combine the extensive and intensive margin estimates following McDonald and Moffitt (1980). I decompose the conditional expectation of demand into its extensive and intensive components:

$$E[y|x] = E[y|x, y > 0] * P(y > 0|x),$$

where y represents demand and x represents the covariates. Using the product rule, the total effect of a change in one of the covariates on demand is given by:

$$\frac{\partial E[y|x]}{\partial x} = \frac{\partial E[y|x, y > 0]}{\partial x} * P(y > 0|x) + \frac{\partial P(y > 0|x)}{\partial x} * E[y|x, y > 0].$$

Estimates of $P(y > 0|x)$ and $E[y|x, y > 0]$ come from the data with each evaluated at the sample mean the covariates and are combined with the regression coefficients in Table 4 and similar estimates of demand on the intensive margin to generate a rough estimate of

the overall effect of the taxes on demand.[30] Appendix Table 2 presents these results. The estimates suggest that the tax decreased the number of disposable bags used by 1.26 bags and an increased the number of reusable bags used by 0.62 bags per customer per shopping trip. These results are qualitatively similar to the results from the linear demand model presented in Table 4.

Appendix Table 2: Effect of Tax Policy on Number of Bags Used

	(1) Disposable	(2) Reusable
MDxPost	-1.260***	0.622***
	0.057	0.033
Post	-0.143***	-0.037*
	0.039	0.022
Black	0.077**	-0.253***
	0.035	0.020
Other Non-White	-0.081**	-0.191***
	0.039	0.021
Female	-0.025	0.307***
	0.029	0.016
Afternoon	0.059*	0.032*
	0.035	0.019
Night	0.129***	-0.032*
	0.034	0.019
Store FE	Yes	Yes
N	16,251	16,251

Robust standard errors in parentheses.
Outcome variables: number of disposable and reusable bags used.
All regressions control for individual demographics (race and sex), shopping trip time-of-day fixed effects (afternoon and evening), and store fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C. Survey Measure of Policy Effectiveness

To investigate the presence of loss aversion without assuming comparability between customers at bonus and non-bonus stores, I surveyed grocery store customers about how they would respond to a hypothetical tax or bonus policy. I asked respondents if a five-cent incentive influenced their decision to bring a reusable bag when shopping at that store,

[30] When calculating standard errors for the aggregate effect, I ignore uncertainty in the sample averages of $P(y > 0|x)$ and $E[y|x, y > 0]$.

randomizing whether the incentive was framed as a tax or a bonus.[31] Participants were instructed to give one of the following five responses: definitely, quite a bit, somewhat, very little, or not at all. Appendix Table 3 presents results of the following linear probability model:

$$Y = \theta_0 + \theta_1 Tax + \lambda X + \varepsilon,$$

where Y is the probability that the survey participant gave a response of "definitely" or "quite a bit" (the top two categories), Tax is an indicator variable which takes the value of one if the participant was asked about a tax policy and zero for a bonus policy, and X is a vector of individual demographic characteristics including gender, race, age, education, and income. Of the customers who were asked about the influence of the bonus program, 28.1 percent responded that the policy would definitely influence their decision or would influence their decision quite a bit. This average is significantly lower – 31.4 percentage points lower – than the proportion of customers who responded similarly when asked about the tax policy.[32]

D. Rescaling Estimates for Differences in Policy Awareness

To determine whether differences in awareness of the tax policy versus the bonus policy could generate the observed difference in demand across stores with different policies, I develop the following model. The analysis in Section IV.B tested the null hypothesis that demand in stores that charge a tax was equal to demand in stores that offered a bonus of the same amount:

$$H_0 : P(Y|NB, T) = P(Y|B, NT)$$

where Y is a measure of bag demand, B and NB indicate the presence and absence of a bonus program, respectively, and T and NT indicate the respective presence and absence of a tax.

[31] This question was phrased as a hypothetical for customers in stores that did not already have the policy or for customers who were previously unaware of the existence of the policy.

[32] The results are qualitatively similar when the dependent variable is the probability that the survey participant responded that the incentive would definitely influence his decision to bring a reusable bag only or when using an ordered probit.

Appendix Table 3: Effect of Hypothetical Tax vs. Bonus Policy on Likelihood of Using Reusable Bags

	(1)
Tax (vs. Bonus)	0.293***
	(0.025)
White	-0.104***
	(0.028)
Female	0.053**
	(0.026)
Age	-0.004
	(0.005)
Age Squared	0.000
	(0.000)
>=High School	0.042
	(0.034)
Income<$50k	0.025
	(0.032)
N	1,279

Robust standard errors in parentheses.
Outcome variable: probability respondent answered "definitely" or "quite a bit" when asked if the five-cent incentive influenced his decision to bring a reusable bag.
Tax is a binary variable equal to one if the incentive was framed as a tax and zero if it was framed as a bonus.
All regressions control for store county and respondent characteristics including sex, race, age, education, and income.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Using language borrowed from the literature on local average treatment effects, I define three types of consumers. "Always-takers" are customers who would use a reusable bag (or not take a disposable bag) regardless of whether the store offers an incentive. "Never-takers" are customers who do not use a reusable bag even if the store provides an incentive. Lastly, "compliers" are customers who bring a reusable bag only if the store offers an incentive to do so.

Using these terms, I reinterpret the components of the null hypothesis. In stores with a tax policy, both the always-takers and the tax policy compliers will bring a reusable bag so $P(Y|NB,T) = P(Always_T) + P(Complier_T)$. Similarly, $P(Y|B,NT) = P(Always_B) + P(Complier_B)$. Since always-takers bring a reusable bag regardless of the store policy and I am assuming that customers in the two types of stores are equivalent, $P(Always_T) = P(Always_B) = P(Always)$. In terms of measures defined in the data, $P(Always)$ is equivalent to $P(Y|NB,NT)$. Using these definitions, I can redefine the null hypothesis as:

$$H_0 : P(Complier_T) = P(Complier_B).$$

That is, the null hypothesis states that the fraction of customers who are compliers with respect to a tax is equal to the fraction of customers who are compliers with respect to a bonus.

Now suppose that not all customers are aware of a store's policy. As seen with the survey data from Section V.B, this is the case for the bonus policy, but not the tax policy. Since always-takers will bring a reusable bag regardless of the store policy, it does not matter whether these customers are aware of the bonus. In contrast, only compliers who are *aware* of the policy will bring their own bags in stores that offer a tax or bonus. In particular, $P(Y|B,NT) = P(Always) + P(Complier_B) * P(Aware_B|Complier_B)$, where $P(Aware_B|Complier_B)$ is the probability that a customer is aware of the bonus program given that he is a bonus complier. So unlike with the tax policy, the effect of the bonus policy may be muted due to under-awareness.

Adjusting for awareness of the bonus policy, a little bit of algebra yields the following null hypothesis:

$$H_0 : P(Y|NB,T) - P(Y|NB,NT) = \frac{P(Y|B,NT) - P(Y|NB,NT)}{P(Aware_B|Complier_B)}$$

While I observe the majority of the components in the equation above in the data, I do not have a measure of awareness of the bonus among compliers since I cannot identify who is a bonus complier in the survey data. Customers who use a reusable bag in bonus stores are either bonus compliers who were aware of the bonus or always-takers. Similarly, customers who do not use a reusable bag in bonus stores are either bonus compliers who were unaware of the bonus or never-takers. However, I can provide plausible bounds on the awareness of bonus policy among bonus compliers using estimates from the survey data. This allows me to determine if my results may simply be driven by the fact that more customers are aware of the tax than the bonus.

Appendix Table 4 presents these results. Estimates in each column assume that 100 percent of customers are aware of the tax policy.[33] In contrast, each column assumes a different value of the awareness of the bonus program among bonus compliers. Case I assumes complete awareness of the bonus policy, a lower bound on the effectiveness of the bonus policy. Case II assumes that the percent of compliers who are aware of the bonus program is equivalent to that of all survey participants shopping in stores with a bonus program, regardless of whether they used a reusable or a disposable bag – 52.0 percent. Lastly, Case III assumes that compliers have an equivalent awareness to that of survey participants who did not use a reusable bag on the day of the survey – 38.0 percent. As mentioned above, this group contains a combination of bonus compliers who were unaware of the bonus and never-takers. If I assume that awareness among the never-takers is no larger than the awareness of bonus compliers, this estimate is an upper bound for the effectiveness of the bonus.

Recall that 84.3 percent of customers used a disposable bag in stores with no incentive policy, 81.9 percent in stores with only a bonus program, and 40.8 percent in stores with only a tax policy (see Panel A of Appendix Table 4). Panel B of Appendix Table 4 presents estimates of the effect of the two policies after adjusting for awareness. In all cases, the estimate of the effect of the tax policy ($P(Complier_T)$) is equivalent to the difference in behavior

[33] While the survey data shows that awareness of the tax policy is slightly less than perfect, I assume 100 percent awareness of the tax in order to provide the most conservative estimates.

between customers at stores with a tax policy and stores that offer no incentive to bring a reusable bag ($P(Y|NB,T) - P(Y|NB,NT)$) – a decrease of 43.5 percentage points. Similarly, Case I assumes that compliers are completely aware of the bonus policy so the estimate of the effect of the bonus policy ($P(Complier_B)$) is equivalent to the difference in behavior between customers at stores with a bonus policy and stores that offer no incentive to bring a reusable bag ($P(Y|B,NT) - P(Y|NB,NT)$) which is 2.4 percentage points. In contrast, Case II and III incorporate the possibility for less-than-perfect awareness of the bonus policy; here the estimate of the effect of the bonus policy becomes $\frac{P(Y|B,NT)-P(Y|NB,NT)}{P(Aware_B|Complier_B)}$. In Case II, 4.6 percent of customers did not use a disposable bag as a result of the bonus program. In Case III, the upper bound of the effect of the bonus, this estimate increases only slightly to 6.3 percent, which is seven times smaller than the estimated effect of the tax. In fact, in order for the effect of the bonus to be as large as the effect of the tax, it would require that only 5.5 percent of bonus compliers were aware of the bonus, which is unlikely given the survey estimates of awareness. Results for the percent of customers using a reusable bag are presented in Columns 4 through 6 and tell a qualitatively similar story. So while differences in awareness may affect the observed impact of the two different policies, it is unlikely that increasing awareness of the bonus policy could account for all of the differential response to the tax and the bonus.

Appendix Table 4: Awareness Adjustment for the Effect of Tax vs. Bonus Policy on Bag Use

Panel A	Disposable	Reusable
	(1)	(2)
Demand Under Different Policies		
No Incentive ($P(Y\|NB,NT)$)	0.843	0.131
	(0.007)	(0.007)
Tax Policy ($P(Y\|NB,T)$)	0.408	0.442
	(0.010)	(0.010)
Bonus Policy ($P(Y\|B,NT)$)	0.819	0.154
	(0.006)	(0.006)

Panel B	Disposable			Reusable		
	Case I	Case II	Case III	Case I	Case II	Case III
	(1)	(2)	(3)	(4)	(5)	(6)
Awareness Among Compliers ($P(Aware\|Complier)$)						
Tax Policy	1.00	1.00	1.00	1.00	1.00	1.00
Bonus Policy	1.00	0.52	0.38	1.00	0.52	0.38
Effect of Policy Adjusted for Awareness ($P(Complier)$)						
Tax Policy	-0.435	-0.435	-0.435	0.311	0.311	0.311
Bonus Policy	-0.024	-0.046	-0.063	0.023	0.044	0.061

Robust standard errors in parentheses in Panel A.

Outcome variable in Panel A: probability of using at least one disposable (reusable) bag.

The effect of policy i, $P(Complier_i)$, is equivalent to $[P(Y|i,Nj) - P(Y|Ni,Nj)]/P(Aware_i|Complier_i)$ for i in $\{Tax, Bonus\}$ and j in $\{Bonus, Tax\}$.

E. Tax Aversion

Recent evidence from the lab and field suggests that individuals are more likely to avoid taxes than other costs of the same amount, i.e., they are tax-averse (Li, Linn and Muehlegger (2014); Sussman and Olivola (2011)). If customers treat taxes differently than other types of incentives, this could generate the differential responses to the tax and bonus policies. Since there were no policies that charged a fee for disposable bag (rather than a tax), I rely on data from a randomized experiment using an online platform, Amazon Mechanical Turk, to test for tax aversion in this context. The survey questions mirror the questions asked in the in-store survey described in Appendix C, in which participants were asked perceived response to a bonus versus a tax. In this survey, participants were randomly assigned to answer how they believed they would respond to a store-imposed fee or a government-imposed tax. Appendix Table 5 presents these results using the same specifications and controls as in

Appendix Table 3. While this analysis should be viewed as merely suggestive due to the hypothetical nature of the questions, the results no difference in the responses of participants in the "tax" group compared to the "fee" group.

Appendix Table 5: Effect of Hypothetical Tax vs. Fee on Likelihood of Using Reusable Bags

	(1)
Tax (vs. Fee)	0.025
	(0.082)
White	0.080
	(0.097)
Female	0.183**
	(0.083)
Age	-0.029
	(0.027)
Age Squared	0.000
	(0.000)
>=High School	0.032
	(0.090)
Income<$50k	0.034
	(0.083)
N	147

Robust standard errors in parentheses.
Outcome variable: probability respondent answered "definitely" or "quite a bit" when asked if the five-cent incentive influenced his decision to bring a reusable bag.
Tax is a binary variable equal to one if the incentive was framed as a tax and zero if it was framed as a fee.
All regressions control for store county and respondent characteristics including sex, race, age, education, and income.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$