

# Does It Pay To Incentivize Recycling? An Economic Analysis of Bottle Bill Laws

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## Abstract

This study examines bottle bill laws to determine if providing monetary incentives for recycling affects recycling participation rates. It also analyzes the extent to which a state's bottle bill law influences people to recycle who would not normally recycle in the absence of a bottle bill law. Additionally, it compares bottle bills to other recycling programs to see which program has the greatest effect on recycling participation rates. The study finds that providing monetary incentives for recycling makes a significant difference in recycling participation rates. This report finds that, for both 1990 and 2007, having a bottle bill greatly impacts the recycling rates within a state. Another monetary incentive program, the pay-as-you-throw program, also resulted in an increased rate of recycling in the year 1990.

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## **INTRODUCTION**

In 2008, Americans generated 250 million tons of waste. Out of that waste, they recycled or composted approximately 83 million tons of material, from paper to plastic bottles to aluminum cans, equivalent to a national recycling rate of 33%. This 33% rate for 2008 represents a steady increase in the amount of waste recycled over the past two decades. In 1990, the percentage of generated waste recycled in the United States was 16.2%; just less than half of what it is today. Due to increased concern, awareness and education around the country regarding the side effects of landfills and what happens to waste once it leaves a household, along with an increasing concern for global climate change, recycling rates have spiked in recent years. This increase in recycling rates comes at the same time the total amount of solid waste generated is dramatically growing. This means that, in order for recycling rates to continue to increase, they not only have to surpass the previous year's total by millions of tons, but they must grow in overall tonnage at a faster rate than the growth of waste generated.

Recycling in the United States is not covered by a national law with a consistent policy. Instead, recycling is implemented through state and local governments across the country. All states have recycling laws in one shape or another. The most common recycling program in the U.S. is voluntary curbside pickup. For curbside pickup, residents are asked to separate out recyclable materials including newspapers, aluminum, and glass containers into separate recycling bins supplied by the locality, to supplement their garbage cans, which are picked up by the local or state workers on a scheduled day. This type of recycling program is by far the easiest for residents as all they have to do is

separate out the recyclable materials and place them in a separate bin that they can put out on the curb along with garbage bins.

Curbside pickup is not only the most convenient recycling program for residents, it is also the fastest growing program in the United States. At the end of 1988, there were approximately 1,050 curbside recycling programs in the U.S. At the end of 1991, this number had increased over 250% to a total of 3,955 curbside recycling programs in the United States. (Glenn 50) By the end of 2001, the United States maintained over 9,709 curbside recycling programs across the country. (Simmons 36) Over the next few years, the U.S. experienced a modest decline in total curbside recycling programs to 7,689 by the end of 2004. This decline is thought to be partially a result of localities combining their individual recycling programs to create larger county run or state run recycling programs.

The second most common recycling program in the United States is found in eleven states across the country: California, Connecticut, Delaware, Hawaii, Iowa, Maine, Massachusetts, Michigan, New York, Oregon and Vermont. Each of these states has passed a recycling law that established a deposit system on all beverage containers, which is known as a bottle bill. Each of the eleven state's bottle bill is slightly different. Commonly, the state will charge five cents extra as a "deposit" on beverage containers, and this deposit will be returned to the consumer when the beverage container is returned to a recycling center. Each state also has slightly different rules on what materials are covered by its bottle bill. For example, Delaware imposes a five cent deposit on all beverage containers under two quarts, excluding aluminum, while Michigan's bottle bill

includes a ten cent deposit that covers all airtight metal, glass, paper, or plastic containers under one gallon. (Resource Guide)

My thesis examines recycling policy initiatives across different states, with particular respect to bottle bills. I am asking this question: Does it pay to provide incentives for recycling? In other words, do states that pay people the 5 or 10 cents to recycle experience higher participation rates in recycling programs than states that just have ordinary curbside pickup? I also investigate if bottle bills are more (or less) effective in influencing individuals to recycle who don't naturally recycle. I also examine how bottle bills with a clear monetary incentive, compared to other recycling programs, succeed at motivating individuals to recycle.

Recycling is a very important aspect of the future of the United States and the world. As global climate change continues to be at the forefront of issues facing the world today, recycling is one of the few easy things that people anywhere can do without a change to their lifestyle. Harvesting data about recycling is important for states and countries to be able to implement the smartest and most efficient policies and reduce dangerous greenhouse gases including carbon dioxide.

## **LITERATURE REVIEW**

Over the past twenty years, there has been a growing body of research on recycling policy initiatives. Researchers have conducted studies on the effectiveness of existing policies and analyzed the economic benefits of recycling. Recycling is one of the easiest ways that individuals can make a major difference in the efforts to combat global climate change. Not only does recycling prevent landfills from overflowing and releasing poisonous toxins into the ground, recycling helps preserve the scarce natural resources that are rapidly being depleted by one time use. Understanding how to encourage the highest participation rates for recycling will not only help environmentally, but states may be able to raise additional money at a time when their overall revenues are very low. Studying the economics of recycling allows policy makers to bring positive change to their state, both environmentally and economically.

A study by Ann Carlson, a professor of law at UCLA, examines why people recycle and looks to identify the most effective way to motivate people to participate in recycling efforts. Professor Carlson is of the view that most recycling takes place voluntarily. Even though many states and/or counties mandate curbside pick up recycling programs, these municipalities generally do not require that people participate in these recycling programs. Yet, without any monetary benefit to themselves, individuals participate in these recycling programs at high rates. Part of the reason for this is that many consider recycling “the right thing to do”. People feel better about themselves for recycling because they are doing something for the greater good.

Professor Carlson also discusses two different ways to create incentives for recycling. The first way is by charging a small fee for solid waste disposal. Her theory is

that, by charging customers a small amount per bag of garbage picked up, the theory is that people will be more inclined to recycle what they previously would have discarded as waste, and thus pay less for their garbage removal. Professor Carlson's study notes that prices as low as \$1.00 to \$1.50 per bag led to a noticeable increase in participation and overall rates of recycling in those communities. According to Professor Carlson's article, multiple studies show an increase in the percentage of recycled goods compared to overall solid waste generated in cities that implement fees for bags of garbage collected.

The second type of incentive discussed by Professor Carlson is known as a bottle bill, which is also referred to as a deposit or cash back method of recycling. Professor Carlson states "bottle bills may be the single most effective way to encourage recycling." (Carlson 1293) States with programs that offer cash back for beverage containers experience recycling rates for glass and other materials that are disproportionately high compared to recycling rates for these materials in other states. A bottle bill typically involves a state that charges extra (usually 5 or 10 cents) as a deposit on all containers covered under the bill. When the container is returned to the recycling center, the deposit is returned. The deposit amount does not need to be very high for a bottle bill to be successful. In the 1990s, California's bottle deposit was 2.5 cents per bottle and the glass-recycling rate in California was approximately 80% for most of the decade. Rationally, bottle bills increase the benefits for people to recycle because they are being paid to do so. When doing a simple cost-benefit analysis, individuals will consider deposit money as a benefit that seems more appealing than the costs. However, in the larger picture, a few cents may not be worth the trouble of driving to a recycling center to

drop off the glass bottles one has collected. In particular, at a time when oil prices are surging, it may cost more to drive to the collection station than the money received from recycling.

Unfortunately, bottle bills are very hard to pass. This is because it is difficult to justify charging an extra 5 cents per bottle in the store and expect people to go out of their way to get that money back. A large proportion of people would rather not pay the extra five cents and not have to worry about returning their bottles to collect their deposit. However, if passed, bottle bills have the potential to be very effective. More research is being done across the country on this topic to find out just how effective bottle bills really are since many states are considering implementing bottle bills of their own.

Another study, conducted in 1999 by David Folz at the University of Tennessee, examines the costs and effectiveness of recycling programs across the country during the 1990s. To perform this study, Mr. Folz collected data from surveys mailed out by municipal recycling coordinators. The analysis of the data focuses on local program features and incentives for recycling. The dependent variable in the estimations was change in participation rates of recycling. According to Folz's study, recycling participation rates increased significantly between 1989 and 1996. The estimations showed that incentives for people to participate in mandatory programs are much higher than the incentives to participate in voluntary programs. Folz also found that convenience played a large role in whether people recycle. For example, if someone lives in a locality with a curbside pickup program, they are much more likely to recycle than someone who has to drive to a recycling center to drop off their recyclables. The regression models used by Folz in his study tested to determine the causes for the

changes in participation between mandatory and voluntary programs. In both of the models, the model for mandatory programs and the model for voluntary programs, explained more than half of the variation in recycling participation rates over time. The study also found that mandatory programs that imposed punishments or sanctions for improper recycling were likely to yield considerably lower rates of participation. Therefore, just as positive incentives can result in higher participation rates for recycling, negative incentives can cause lower participation in certain programs.

Folz's study concludes that recycling programs across America are very important and that people in the United States want to participate in recycling. People believe that recycling is the right thing to do, and they do not want to see all their waste piling up in landfills. Folz also emphasizes the importance of convenience, as he concludes that people are going to use whatever recycling method is easiest and simplest for them. Folz's study, like the previous study, concludes that cities with the highest rates of participation were those that had implemented mandatory recycling programs, or mandated distribution of recycling bins for pick up. Folz also notes that these cities had the most expensive programs. The cities that recorded the highest participation rates with the most recyclables were cities that offered curbside pick-up. From an effort standpoint, it is most convenient for people to leave their recyclables outside of their homes, so it is not surprising that these programs experienced the highest participation rates. In cities where curbside pick up was not mandatory and all recycling programs were completely voluntary, the highest participation rates were in communities that had implemented some form of organized efforts amongst themselves.

One interesting conclusion that is not directly related to recycling participation rates, but is important for local and state governments in considering how to proceed with recycling programs in the future, is that on average, recycling costs less than traditional garbage collection techniques. This is important because it demonstrates that regardless of what recycling programs legislators decide to implement, the program will most likely be more economical than solid waste programs without any form of recycling.

Another similar study, “The determinants of household recycling: a material-specific analysis of recycling program features and unit pricing” by Robin Jenkins et al. looks at the impact of two types of residential recycling programs, curbside recycling and drop off recycling centers. This study examines middle and upper-middle class groups in 20 metropolitan cities across the country. The model used in this study seeks to identify which socio-economic and policy factors are most influential in the amount of effort a household spends on recycling. The equation used is:

$$y^*_{ji} = B_j^1 x_i + e_{ji}$$

where  $y^*$  is the unobserved level of recycling effort and  $i$  is an index of households.  $x_i$  contains the marginal price, the attributes of each recycling program, and socio-economic factors for the household.  $B$  is a vector of coefficients estimated by the maximum likelihood estimation from an ordered logit model. They also assumed  $e_{ji}$  is distributed as a standard logistic function.

This study determined several features of recycling programs that have significant effects on household recycling. The two most significant factors were the availability of local drop-off recycling centers and the existence of curbside recycling. The age of the recycling program also plays a large role in the importance of household recycling

efforts. The effect of the drop-off program variable varies across different recyclable materials. Introducing a local drop-off program to a community with no previous recycling program increases the probability by 42 percentage points that over 95 percent of all glass will be recycled. The study also found a 33-percentage point increase in the probability of recycling bottles used in the household, as well as a probability increase of 19 percentage points for recycling both aluminum and newspapers. These results suggest that building a local recycling drop-off center has a smaller impact on materials such as aluminum and newspapers, which already have unofficial recycling programs in the locality through charities, for example, but a large impact on materials that could not previously be recycled. (Jenkins et al. 310)

The existence of a curbside recycling program also has a positive and significant influence on household recycling. Like drop-off recycling, the significance of curbside recycling varied with the material being recycled. Jenkins et al. found that the probability that a household recycled over 95% of glass and plastic bottles increases by more than 50 percentage points in an area that has curbside recycling. Recycling of aluminum cans increased by more than 40 percentage points and recycling of newspapers increased by approximately 25 percentage points. Replacing a drop-off program with a curbside program also significantly increases recycling rates. Replacing a drop-off program with a curbside program resulted in a 25% increase in the probability of achieving a 95% recycling rate for glass, plastic bottles, and aluminum cans. However, a mandatory recycling program evidences no significant increase over a voluntary curbside recycling program.

A fourth study, “Recycling Behavior: A Multidimensional Approach” by Gonzalo Meneses and Asuncion Palacio focuses on the role of consumers in recycling within a household. This study looks at both the socio-demographic and psychographic aspects of recycling. The authors of this study concluded that each member of the household carries out different responsibilities when it comes to disposing of waste and recycling. In order to do this, the authors handed out personal surveys to a cross-section of 358 individuals. The survey asked questions about recycling on a point scale system. By running a series of regressions, the study concludes that gender has a distinct role in recycling within a household. It concludes that women “bear a greater burden of the recycling role than men” in the household. (Meneses and Palacio 839) The study also looks at age as a factor in recycling within a household. With respect to age, the study concludes that while persons under the age of 23 and over the age of 60 may participate in recycling, the biggest influence within a household come from the age bracket of 31-45. This leads to the conclusion that the most influential people in a household to recycle are of average working age. The further one falls from the average working age, the less influential they become in household recycling. Interestingly, the study also finds that an individual’s formal education does not significantly affect whether that individual influences his household to recycle.

While these questions and conclusions are all very interesting, they only look at certain parts of the question I am trying to answer. The Meneses and Palacio study only looks at the member in a household that has the most influence over the others with regard to recycling. I am interested in taking this study one step further and looking at

the overall recycling participation across the country to see if any of these socio-demographic factors along with monetary incentives determine who is or is not recycling.

A final study, “Cross-national Gender Variation in Environmental Behaviors” by Lori Hunter, Alison Hatch, and Aaron Johnson examines the role of gender in environmental behaviors across 22 different nations. This study examines the public and private environmental behavior of men and women. Data was derived from the International Social Survey Program (ISSP). Six questions are used to gauge public and private environmentally oriented behaviors. The more private manifestations of environmental behavior performed by women often showed up in household-oriented forms such as recycling or driving less, but in ways that they are personally making a difference. The study also concludes that men often exhibit their pro-environmental behavior in a more public way such as protest. According to the authors, one reason for the possible gender differences could be the socialization of women. Women traditionally stayed in house and raised the kids and throughout history have been more behind-the-scenes than men have been. This conclusion will be re-examined as part of the analysis of this paper.

After running a series of regressions, the study ultimately concludes that women tend to exhibit their environmental behavior in a more private sphere, while there is no gender variation in public sphere recycling behaviors. The results were significant in 14 of the 22 nations that the study examined, and all significant results showed that women are more likely to perform environmentally friendly behavior in the private sphere. When looking at the public behavior sector, the study estimated five significant results. Three of the significant results showed that women were likely to exhibit public

environmental behavior, while the other two significant results estimated that men were more likely to exhibit public environmental behavior, proving that there is little gender variation in public sphere environmental behavior. When estimating within gender differences and subtracting public from private (meaning that positive values represented a more private environmental behavior) 11 of the 22 countries estimated had significant results and all 11 significant results showed that females present more private environmental behaviors than men. In these models age, education level, employment, and marital status were all included as controls.

My study is unique because it takes a direct look at bottle bill laws. The previous literature addresses who is more likely to recycle and compares recycling policies, but none of the studies takes an in depth look at the bottle bill policy. I am trying to examine how the bottle bill laws in eleven states affect recycling participation to determine if more states should adopt similar policies. This study is also going to examine how a bottle bill law directly affects different groups of people. From the previous literature, we know that certain people are more likely to recycle if left to their own devices. This study will also investigate whether a bottle bill creates incentives for groups of people that would not normally recycle. Finally, for the year 1990, I compare the effects of bottle bills to the effects of drop off facilities, curbside pickup, and pay as you throw programs on the likelihood of recycling.

## **DATA DESCRIPTION**

The data in this study comes from two separate polls by CBS News/The New York Times. The first poll was conducted in March and April of 1990, and the second poll was conducted in April 2007. Although these two polls are not a time-series (the same people are not polled over time), the same relevant questions were asked in both polls. It is important to look at these two polls 17 years apart to allow us to see how the attitudes about recycling have changed across different demographic and personal characteristics over time. The polls used in this study were just two months of ongoing polls conducted through nation-wide telephone surveys. The original intent of the surveys was to evaluate nationwide views of the presidency at the time along with opinions on a variety of different political and social issues. (CBS NEWS 1990 4) All people sampled were adults over the age of 18 and the numbers dialed were generated randomly. Unlike previous studies, which tend to target only people that live in communities with efficient recycling programs, this study is a true cross-section of the United States due to the complete randomness of the telephone dialing.

Due to the length of the polls and the lack of relevance of a majority of the questions asked, only a few of the questions asked in the poll were included in this study. The most important question, and the dependent variable in this study is “Do you separate out newspapers, cans, or glass bottles in your household for recycling, or don’t you?” This dependent variable is measured as a 0,1 dummy variable. If the answer to this question is yes, then that response is assigned a value of 1, but if the answer is no, then it is assigned a value of zero. In 2007, 837 (79.6%) of the 1052 people surveyed responded that they do separate out materials for recycling, compared to 1990 when only

60% (913 out of 1,515) of the people interviewed responded positively to recycling. The increase in the percentage of people answering positively to the question is most likely a result of the emphasis on the environment that has emerged in the past two decades. It is still important to look behind the numbers and examine whether any type of recycling program or any specific demographics are more likely to influence recycling behavior than others.

The goal of this study is to look at incentive programs that influence recycling participation rates. One of the major recycling incentive programs is the Bottle Bill Deposit system. 11 states currently have bottle bill laws. Only the state of Hawaii has enacted a bottle bill after 1990, and there are no respondents in the 1990 poll from Hawaii, so all states that have bottle bills had the system in place across both years of the data set. In 1990, 425 people, or 28% of the people interviewed, lived in states that had a bottle bill system in place. This means that 72% of respondents lived in states that did not have bottle bill laws in effect. The number of respondents that lived in bottle bill states in 2007 is very similar. In 2007, 257 people, or 24% lived in states that have bottle bill laws. In this study, three of the respondents were from Hawaii. Hawaii's bottle bill was passed at the end of 2002 and implemented at the beginning of 2005, so these respondents were included in the results.

The other variables included in this study are gender, race, political affiliation, religion, education, age, income, and urbanity. These variables are used as controls in the experiment and to determine which groups respond in the highest numbers to state bottle bills. A major goal of this study is to try and figure out which groups of people respond

to different recycling incentive programs. Table 1 shows the mean values of all the variables in the experiment.

Table 1  
Average Values of Variables Under the Analysis

<b>Variable</b>	<b>1990</b>	<b>2007</b>
Recycle	60%*	79.6%*
Male	44%	42%
Female	56%	58%
White	68%*	86%*
Black	27%	8%
Other Race	5%	6%
Democrat	38%	32%
Republican	27%	27%
Independent	34%	41%
Protestant	64%	55%
Catholic	21%	22%
Jewish	2%	2%
Other Religion	13%	21%
No High School Diploma	14%	6%
High School Diploma	38%	25%
Some College Education	24%	29%
College Degree or Beyond	24%*	40%*
Age 18-29	23%	9%
Age 30-44	37%	25%
Age 45-64	26%*	42%*
Age Over 64	13%	25%
Income < \$15k	16%	8%
Income \$15k - \$30k	33%*	15%*
Income \$30k – \$50k	28%	17%
Income >\$50k	19%*	54%*
Large Central City (>500k)	11%	7%
Central City (50k – 500k)	24%	21%
Suburbs	34%	46%
Population 10k-50k	6%	1%
Rural	25%	26%
People that live in state with bottle bill law	28%	24%

\* = Greater than 15% increase between 1990 and 2007

It is important to note the starred rows in table 1. The starred rows represent a difference in the percentage of people responding of over 15%. For example, in 1990

there is evidence that having a college degree increases the probability of recycling. By 2007, however, 40% of the respondents had a college degree, compared to 24% in 1990. It is possible that higher level of education in 2007 is responsible for the higher recycling rates. Another interesting statistic is that in 1990 only 19% of respondents had an income over \$50,000, but in 2007, 54% of respondents had an income over \$50,000. This is in part due to inflation, but may also be a factor in the increase in recycling. The increase may be attributable to wealthier individuals being more aware of the benefits of recycling. Finally, a row that is not starred, but which is still an interesting statistic, is the percentage of people that live in the suburbs. In 2007, almost half of the respondents lived in suburbs, which tend to be more affluent areas that could have more resources for better recycling programs. It is important to keep these differences in respondents in mind when looking at the results between 1990 and 2007.

## METHOD AND RESULTS

The model used in this study seeks to identify the effects of recycling policy on recycling participation rates. The model estimated is:

$$\text{Rec}_i = \beta_0 + \beta_1(\text{state law}_i) + \beta_2(X_i) + e_i$$

Recycling participation rates are measured by the question “Do you separate out newspapers, cans, or glass bottles in your household for recycling, or don’t you?” which is answered by a simple yes-no response. Since the response variable is binary, meaning it can only have two possible outcomes denoted in the analysis at 0 and 1, the probit model is employed to estimate the equation. The independent variables included in the basic regression are represented by  $X_i$  and include demographic characteristics including gender, race, and age as well as socioeconomic variables including religious and political beliefs, location, education, and income. When looking at the effect of a bottle bill on the probability of recycling, I first estimate the regression including only the state bottle bill as an explanatory variable:

$$\text{Rec}_i = \beta_0 + \beta_1(\text{bottle bill}_i) + e_i$$

I then re-estimate the regression to include the first set of controls:

$$\text{Rec}_i = \beta_0 + \beta_1(\text{bottle bill}_i) + \beta_2(\text{gender}_i) + \beta_3(\text{race}_i) + \beta_4(\text{age}_i) + e_i$$

I continue to re-estimate the regression adding a new control group each time until I come to the final estimation of the model:

$$\begin{aligned} \text{Rec}_i = & \beta_0 + \beta_1(\text{bottle bill}_i) + \beta_2(\text{gender}_i) + \beta_3(\text{race}_i) + \beta_4(\text{age}_i) + \beta_5(\text{religion}_i) + \\ & \beta_6(\text{politics}_i) + \beta_7(\text{location}_i) + \beta_8(\text{education}_i) + \beta_{10}(\text{income}_i) + e_i \end{aligned}$$

Table 2 shows the econometric results of this model estimation.

Table 2  
The Effect of State Bottle Bills on Recycling in 1990

1990						
	1	2	3	4	5	6
State Bottle Bill	.078 (.005**)	.068 (.015*)	.069 (.014*)	.070 (.014*)	.065 (.026*)	.060 (.041*)
Demographic Characteristics	No	Yes	Yes	Yes	Yes	Yes
Religion + Political	No	No	Yes	Yes	Yes	Yes
Location	No	No	No	Yes	Yes	Yes
Education	No	No	No	No	Yes	Yes
Income	No	No	No	No	No	Yes

p-value in parentheses

\*Significantly different from zero at the .05 level.

\*\* Significantly different from zero at the .01 level.

According to column 1, in 1990, if someone lived in a state with a bottle bill law, then the probability of that person recycling was 7.8 percentage points higher than the probability of someone recycling who lived in a state without a bottle bill. This coefficient is significant at the 1% level of significance. Column 2 presents the coefficient on state bottle bill when demographic characteristics including sex, gender, and age are added to the original regression. The coefficient remains significant (although now at the 5% level of significance) but falls to only a 6.8 percentage point increase over the probability of someone recycling who does not live in a state with a bottle bill law. Column 3 presents the coefficient on the state bottle bill when the respondent's religion and political ideologies were added to demographic characteristics as controls in the regression. The coefficient remains significant at the 5% level of significance and is very similar to column 2 with a probability of recycling that is 6.9 percentage points higher for people that live in a state with a bottle bill than a state that does not have a bottle bill. Column 4

presents the coefficient on the state bottle bill when location (urbanity) is added to the group of controls. The coefficient remains significant at the 5% level of significance and once again increases by one percentage point to make the probability of recycling—if someone lives in a state with a bottle bill and satisfies the characteristics—7.0 percentage points higher than someone who does not live in a state with a bottle bill. Column 5 presents the coefficient on the state bottle bill when the level of education is added to the group of controls. The coefficient on a bottle bill remains significant at the 5% level of significance, but the probability of recycling falls about half a percentage point. The probability of someone recycling who lives in a state with a bottle bill law is now only 6.5 percentage points higher than someone who does not live in a state with a bottle law. Finally, column 6 presents the coefficient on the state bottle bill when a household's income level is added to the group of controls. The coefficient remains significant at the 5% level of significance and shows that, all else held equal, the probability that someone who lives in a state with a bottle bill will recycle is 6.0 percentage points higher than someone who does not live in a state with a bottle bill law.

Table 3  
The Effect of the State Bottle Bill on Recycling 2007

2007						
	1	2	3	4	5	6
State Bottle Bill	.137 (0.00*)	.140 (0.00*)	.133 (0.00*)	.136 (0.00*)	.137 (0.00*)	.136 (0.00*)
Demographic Characteristic	No	Yes	Yes	Yes	Yes	Yes
Religion + Political	No	No	Yes	Yes	Yes	Yes
Location	No	No	No	Yes	Yes	Yes
Education	No	No	No	No	Yes	Yes
Income	No	No	No	No	No	Yes

p-value in parentheses

\*Significantly different from zero at the .01 level.

Table 3 shows the same result for the year 2007. According to column 1, in 2007, if someone lived in a state with a bottle bill law, then the probability of recycling was 13.7 percentage points higher than the probability that someone who lived in a state without a bottle bill will recycle. This coefficient is significant at the 1% level of significance. As I continue to add the control groups to the estimated model in column 2 through column 6, the coefficient on the state bottle bill remains significant at the 1% level and its magnitude stays about the same. With all controls included, the probability of recycling for an individual in a bottle bill state is 13.6 percentage points higher than the probability of recycling for someone in a state without a bottle bill.

The result from these regressions is very clear: living in a state with a bottle bill increases the probability that a person will recycle. The coefficient on the state bottle bill in both 1990 and 2007 remained positive and significant throughout the regressions. Even when all the control groups were added to the regression, the coefficient remained

rock solid. This means that having a state bottle bill really does influence participation rates and increases the probably that someone will recycle.

There is something else very interesting about the coefficients on the state bottle bill over the 17 years. In 1999, 60% of the respondents said they recycled, with 24% of respondents living in states with a bottle bill at the times. In 2007, 80% of the respondents said they recycled, with 28% living in states with a bottle bill. Yet, from 1990 to 2007, the coefficient on the state bottle bill roughly doubled. This means that while the recycling increased about 33% nationally, the difference in the probability in recycling of residents in bottle bill states doubled compared to residents in states without a bottle bill.

As noted earlier, I am also interested in whether the bottle bills have different effects on different groups of people, and whether state bottle bills create incentives for those who do not naturally recycle if the state they lived in did not have a bottle bill law. Based on previous literature, the three control groups that I tested include gender, race and politics. I would like to see who is affected more; men or women, white or blacks, democrats or republicans. To do this, I re-estimated the basic model to include interaction terms between gender and having a bottle bill, race and having a bottle bill, and politics and having a bottle bill. Table 4 shows these results for 1990.

Table 4  
The Effect of the State Bottle on Control Groups

1990							
	1	2	3	4	5	6	7
State Bottle Bill	.099 (.018**)	-0.027 (.569)	.087 (.009***)	.081 (.060*)	-0.044 (.373)	.081 (.017**)	-0.037 (.534)
BB*Female	-0.038 (.509)			-0.031 (.591)			-0.002 (.974)
BB*Repub		.149 (.025**)			.145 (.032**)		.123 (.077*)
BB*Dem		.158 (.012**)			.166 (.009***)		.197 (.003***)
BB*Black			-0.110 (.110)			-0.102 (.150)	-0.143 (.068*)
Controls	No	No	No	Yes	Yes	Yes	Yes

p-value in parentheses

\*Significantly different from zero at the .10 level

\*\*Significantly different from zero at the .05 level

\*\*\*Significantly different from zero at the .01 level

In columns 1 – 3 of table 4, I included interaction terms with sex, political party, and race respectively in the basic model with no controls. For columns 4 – 6 of table 4, I re-estimated the same equations including all control variables listed in the above estimations, and for column 7, I re-estimated again using all of the interaction terms as well as all of the control groups. Although some of the results turned out not to be statistically significant, the estimations regarding political leanings showed some interesting results. According to column 2, both Democrats and Republicans are more likely to recycle if they live in a state with a bottle bill policy than Independents. In fact, at the 5% level of significance, the effect of a bottle bill on the probability of recycling is 15.8 percentage points higher for Democrats than for Independents and 14.9 percentage points higher for Republicans than for Independents. According to column 5, when including the control variables, Democrats and Republicans are still more affected by bottle bills than Independents at the 5% significance level and the magnitudes are pretty

much unchanged. These results persist in column 7, where other interaction terms as well as controls are included. In this case, state bottle bills affect Democratic recycling 19.7 percentage points more than Independents at the 1% significance level. Column 7 also shows that state bottle bills affect blacks differently than whites. Relative to whites in states with bottle bills, blacks' probability of recycling is 14.3 percentage points less. This coefficient is significant at the 10% level. The coefficient on blacks is consistent with the coefficients on other estimations; however, the coefficients were not significantly different from zero in the estimations in columns 3 and 6.

Table 5  
The Effect of the State Bottle on Control Groups

2007							
	1	2	3	4	5	6	7
State Bottle Bill	.123 (.003**)	.122 (.005**)	.145 (.000**)	.125 (.002**)	.125 (.004**)	.142 (.000**)	.120 (.021*)
BB*Female	0.036 (.571)			.026 (.675)			.024 (.306)
BB*Repub		0.041 (.570)			.035 (.631)		.028 (.700)
BB*Dem		0.015 (.846)			.011 (.884)		.031 (.711)
BB*Black			-0.143 (.292)			-0.167 (.235)	-.180 (.239)
Controls	No	No	No	Yes	Yes	Yes	Yes

p-value in parentheses

\*Significantly different from zero at the .05 level.

\*\*Significantly different from zero at the .01 level

Table 5 shows the same results for the year 2007. In 2007, the bottle bill law clearly has a very significant impact on recycling participation. However, unlike 1990, in 2007, bottle bill laws do not encourage any particular group of people to recycle more than any other group. One reason for this could be the nationwide green movement causing more people to recycle across the board, without any one group of people directly affected by having a bottle bill law, as was the case in 1990. One interesting

statistic, however, is that having a bottle bill law in a state still impacts blacks much less than it does whites. Although not significant, the coefficients on the interaction terms are still of the approximate magnitude as they were in 1990, which is disappointing considering how strong of an effect the bottle bill law seems to have on most other people.

This study also looked at the effects of other recycling programs across the country to see if they were any more effective. The other programs include another monetary incentive program commonly referred to as pay-as-you-throw (PAYT). PAYT programs all have slightly different rules, but the main idea of the program is that the more garbage you produce, the more you pay. The incentives occur because these programs do not charge for recycling; instead, as one recycles more, the fees paid for trash collection are reduced. Curbside pick-up and drop off programs were also evaluated in this estimation. Unfortunately, due to limitations in the data, I was only able to run this analysis for the year 1990, but not for 2007. I am only able to use the data from 1990 because I used the respondent's area code, which was only available in the 1990 survey, to find locality/municipality recycling programs. Based on the respondents' area code, I researched in what cities the respondents may potentially live. I then researched those cities' recycling policies for the year 1990.

Table 6  
The Effect of Different Recycling Programs on the Probability of Recycling: 1990

1990		
	1	2
State Bottle Bill	.094 (.001***)	.080 (.007***)
Curbside Pickup	-.095 (.002***)	-.108 (.001***)
Drop-off Center	.007 (.820)	.016 (.625)
Pay-as-You-Throw	.079 (.100*)	.083 (.089*)
Controls	No	Yes

p-value in parentheses

\*Significantly different from zero at the .10 level.

\*\*Significantly different from zero at the .05 level.

\*\*\*Significantly different from zero at the .01 level.

Table 6 presents the results of a regression in which I added dummy variables representing the other three programs. Column 1 shows the results of the economic analysis when recycling is regressed on the explanatory variables (the different recycling policies) without the control variables. The results show that having a state bottle bill is the most effective recycling policy and the probability of people recycling is 9.4 percentage points higher than recycling by someone who does not live in a state with a bottle bill. This estimation is significant at the 1% level. The second most influential recycling policy in 1990 was the Pay-As-You-Throw recycling program. People that lived in a municipality or locality with a PAYT program in 1990 had a probability of recycling that was 7.9 percentage points higher than people that lived in an area that did not have a PAYT program. This is very interesting because it appears that the two recycling policies that provide direct monetary incentives seem to be by far the most effective policies in attracting people to recycle in 1990. One reason for this could be that monetary incentive policies tend to be advertised much better than programs that

don't offer money as incentives. Also, localities and states that had progressive recycling policies in the 1990s may have been home to more people that cared about recycling and environmental issues before they became widespread like they are today. Column 1 also shows that only having a drop off center for recycling does not have a significant influence on recycling participation rates. As shown in table 6, the results for column 2 once the control groups are added to the estimation are very similar to column 1.

Perhaps the most interesting result from the table is the coefficient on curbside pick-up recycling programs. According to the existing literature and common sense, one would think that curbside recycling programs would encourage relatively high recycling participation rates due to the convenience of simply placing a separate bin next to the garbage on waste pick-up days. However, in the estimation, curbside pick up programs show a decreased probability that people will recycle by 9.5 and 10.8 percentage points for column 1 and column 2 respectively. These numbers are both significant at the 1% level. One possible explanation for this is that in 1990, curbside recycling programs were still just beginning to form, and were mostly small efforts implemented in areas where recycling was desperately needed. As a result, people may not have known how the curbside recycling programs worked and how to take advantage of the recycling pickup. A second possible explanation, and probably a more likely explanation, is measurement error. The process of figuring out what recycling program applied to the respondents in 1990 was not an exact science. The information that was most usable in this regard was the respondent's area code. Based on their area codes, I researched the cities in which the respondents may potentially live. I then researched those cities' recycling policies for the year 1990. However, area codes cover a wide range of cities and surrounding areas. It is

possible that a respondent lived in a locality without a curbside recycling program, but because of the area code in which they lived, may have been counted as living with a curbside-recycling program.

## CONCLUSIONS

Over the past 20 years, recycling has become an integral part of society. This is obvious, both when looking at the numbers in this study and when taking a look around the world. World leaders and major corporations all over the globe have jumped on the 'green' bandwagon in mission statements as well as campaigns, and the people are following. In 1990, only 60% of people interviewed in the CBS News / New York Times polls responded that they actively separate out recyclables from their garbage. By 2007, this number had grown to 80% of respondents acknowledging that they separate out recyclables from the trash.

One policy initiative that has made a large impact in recycling participation is the bottle bill. In 1990, 66% of the people living in a state with a bottle bill responded positively when asked if they recycled. However, in 2007, 90% of the people living in a state with a bottle bill responded positively when asked the same question. This is an increase from 6% (66% compared to 60%) to 10% (90% compared to 80%) above the national average of recycling.

An econometric analysis of recycling participation rates and the influence of a state having a bottle bill law shows similar results. The probability of recycling for someone that lived in a state with a bottle bill law in 1990 was between 6.0 and 7.8 percentage points higher than someone who did not live in a state with a bottle bill. By 2007, this number had essentially doubled to between 13.3 to 14.0 percentage points more likely. This is very interesting, and there may be a couple of different reasons that cause this jump. The first possibility is that the bottle bill law is a very effective program

because the deposit system provides enough incentive to influence people to recycle who wouldn't recycle if there were no bottle bill program in the state.

Another possibility for the high participation rates for states with bottle bill laws is that the states with bottle bills including California and some states in the northeast are, in general, more progressive in terms of environmental issues. Because these states tend to take a more progressive stance on environmental issues, the people that live in the states are more likely to be well versed in environmental issues. Therefore, one could argue that the people living in states with bottle bill laws are predisposed towards recycling whether or not there was a bottle bill law. Whichever argument you believe, one fact is clear: people that live in states with a bottle bill have a probability of recycling that is 14 percentage points above the probability of recycling for people that don't live in a state with a bottle bill law.

It was also very interesting to see that the second most successful recycling program was another monetary incentive program, the pay-as-you-throw program. According to some behavioral economists, small monetary incentives (such as the pay-as-you-throw program or even the state bottle bill program) can often times deter its targeted demographic due to the small amount being offered. However, through econometric analysis, I have shown that monetary incentive programs, as small as the incentive may be, really do have a significant effect on people when it comes to recycling.

In today's culture, there is a large emphasis placed on the environment and the need to change to make our future livable. Given the literature, and the results of this study and others like it, it is surprising that more states have not already followed the path of the 11 states that currently have bottle bills as state laws. These 11 states see

statistically significant higher rates of recycling than states that do not have a bottle bill law. The last state to implement a bottle bill was Hawaii in 2005. Prior to that, no new states had added a bottle bill since California enacted a bottle bill law in 1986 that was implemented in 1987. Today, there are a handful of states that are considering enacting bottle bill laws in the near future. Based on this study, if states are concerned about doing the ‘right thing’ environmentally, then passing a bottle bill is an important step in the right direction.

## APPENDIX

Coefficients for Full Set of Variables in Column 6 of Tables 2 and 3

VARIABLE	1990	2007
State Bottle Bill	.060 (.041**)	.136 (.000***)
Female	.032 (.218)	.025 (.317)
White	-.146 (.025**)	.168 (.003***)
Black	-.266 (.000***)	.085 (.120)
Age 30-44	-.018 (.609)	.013 (.788)
Age 45-64	.021 (.580)	.008 (.859)
Age Over 64	.046 (.308)	.002 (.971)
Democrat	.011 (.734)	.052 (.084*)
Republican	-.070 (.040**)	-.057 (.066*)
Catholic	.047 (.151)	.057 (.055*)
Jewish	-.008 (.934)	.107 (.295)
Central City 50K-500K	.007 (.874)	.050 (.369)
Suburb	.018 (.686)	-.010 (.844)
Community 10k-50k	.072 (.274)	-.040 (.921)
Rural	.067 (.160)	-.073 (.210)
High School Diploma	.027 (.495)	.006 (.917)
Some College Experience	.108 (.013**)	.047 (.386)
College Degree or beyond	.121 (.008***)	.061 (.274)
Income \$15k-\$30k	-.036 (.333)	.006 (.881)
Income \$30k-\$50k	.022 (.589)	.000 (.994)
Income Over \$50k	.006 (.904)	.055 (.183)
R <sup>2</sup>	.032	.073
Number of Observations	1515	1051

p-value in parentheses

\*Significantly different from zero at the 10% level.

\*\*Significantly different from zero at the 5% level.

\*\*\*Significantly different from zero at the 1% level.

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