Externalities from Recycling Laws: Evidence from Crime Rates

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This paper tests whether laws that encourage bottle recycling and also increase the labor incomes of low-wage workers have the additional effect of reducing petty crime rates. A simple choice theory model of crime participation and labor supply suggests that low-wage workers may substitute time and effort away from illegal activity to legal and remunerative recycling activity. Between 1973 and 2001, eleven states and one city enacted bottle recycling laws, and this paper exploits the variation in the year of implementation of the bottle laws to measure and test for any reduction in crime rates. The results show that city-level petty crime rates in bottle law states are on average 11% lower than city-level petty crime rates in non–bottle law states. Although the primary positive benefits of recycling income go to low-income individuals, the unexpected secondary benefit of lower crime rates affects both high- and low-income individuals. (*JEL* Q50, K40)

1. Introduction

This paper examines the extent to which implementing bottle laws to subsidize recycling programs has a negative effect on petty crime rates. A simple model of crime participation and labor supply suggests that when the wage from legal activity increases we expect to see people substituting their time and effort away from the illegal activity to the legal activity. From this point of view, bottle recycling laws have effects on the incomes of very-low-wage workers that are similar to those of a highly targeted earned income tax credit. This paper uses the variation in

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the year of implementation of state bottle laws to measure and test the effect of improved recycling jobs on petty crime rates.

A "Bottle Law" is a legislation that applies a deposit-refund to the purchase of beverage containers in order to encourage consumer recycling. A deposit-refund program is a consumption tax (paid at the time of purchase) combined with a disposal rebate (paid at the time of disposal). A classic Pigouvian tax requires a consumer to pay a fee at the time of disposal that is equal to the marginal damage caused by the disposal. A deposit-refund program on beverage containers combines a consumption tax with a rebate for recycling. A Pigouvian tax creates an incentive for consumers to dispose illegally. A deposit-refund, on the other hand, creates an incentive for proper disposal. Putting a bounty on trash is the most efficient way of internalizing the external costs of waste disposal.

2. Deposit-Refund Literature

The deposit-refund literature examines at the optimal amount of waste. Economists are interested in making consumers internalize the disposal costs and encouraging the correct disposal through subsidization. The deposit-refund is a tax system that brings society to the optimal amount of waste production. Baumol (1972) examines the Pigouvian tradition in the presence of criticisms stemming from Coase (1960). He shows that a tax on the externality will result in the Pareto optimal level of the externality and that no subsidies are necessary, other than a lump-sum subsidy. Holtermann (1976) shows that it is also possible to achieve Pareto optimality by taxing the externality directly or instead by taxing the end product and subsidizing the inputs that do not increase the externality, while taxing the inputs that increase the externality. Porter (1978) conducted the first cost-benefit analysis of a bottle law. Dinan (1993) the author compares using a virgin material tax to a combined disposal tax and reuse subsidy and concludes that the combined disposal tax and reuse subsidy is theoretically consistent with unit-based pricing. Sigman (1998) compares the use of a virgin materials tax, a deposit-refund program, a recycling subsidy, and recycled content standards in the context of lead recycling. The author finds that the deposit-refund and the virgin materials tax are the best policies because they encourage the recovery of lead and

discourage its consumption. This paper is the first real empirical test of the efficiency gains of a deposit-refund system.

Palmer and Walls (1997) the authors develop a partial equilibrium model to analyze both a deposit-refund system and a recycled content standard and find the deposit-refund policy more efficient than the recycled content standard. Palmer and Walls (1997) use a partial equilibrium model of waste generation and recycling to evaluate the cost-effectiveness of three policies for reducing solid waste disposal. The authors conclude that the deposit-refund is significantly less costly than the other policies modeled although high administrative costs could change that. Fullerton and Kinnaman (1996) use a general equilibrium to find that a deposit-refund policy is optimal in the presence of illegal dumping. Fullerton and Kinnaman (1996) measure the response of households to a unit-based garbage collection fee. The authors found that illegal disposal constituted 28–43% of the total reduction of garbage at the curb. One of the most general models of a deposit-refund program is described in Fullerton and Wolverton (2000).

3. Bottle Laws and Income

An unintended consequence of state bottle deposit laws that promote consumer recycling is the potential increase in the incomes of very-low-wage workers. When states set a deposit on bottles and cans, harvesting recyclables becomes a viable employment for low-income households. In this way, bottle laws subsidize recycling markets. Between 1973 and 2001, eleven states and one city enacted bottle laws. There is considerable anecdotal and statistical evidence that bottle recycling laws increase the income of low-wage workers. While deposit-refund programs are designed to encourage household recycling, there are still a large number of people who discard beverage containers. Many recyclable containers end up as litter, in garbage cans, or in curbside recycling bins. Recyclable containers are then collected by people who are recycling for cash.

Professional recyclers are people who recycle bottles and cans that they did not purchase. For example, Teresa Gowan surveyed homeless men in San Francisco and recorded stories about how they adopted this profession.[1] In "Homeless in America," Ronald Paul Hill and Mark

1. Gowan (1997).

Stamey describe recycling bottles and cans as "probably the first choice of homeless persons seeking money." Estimates of recycling income vary widely by location.[2]

Ashenmiller (2009) uses unique survey data to show that cash recycling is an important part of the income of the working poor. The paper finds that 12% of all households and 26% of primarily Spanish-speaking households, with an income less than $10,000, recycle beverage containers for cash. The recycling income earned represents 7% and 9% of their annual income, respectively. In addition, professional recyclers (people recycling material that they did not purchase) generate between 36% and 51% of all recycled materials captured by the bottle law that would not have been captured by the existing curbside recycling program in Santa Barbara at the time of the survey.[3] In short, deposit-refund recycling laws may both improve resource allocation using the appropriate Pigouvian tax and simultaneously increase the income of very-low-wage workers. The results in this paper suggest that these laws may also have beneficial unintended effects on petty crime rates.

4. Crime Rates and Wages

While bottle laws have been shown to increase the income of low-wage workers, a number of papers have argued that declining wages and employment opportunities contribute to the involvement of unskilled workers in criminal activity. Phillips, Votey, and Maxwell (1972) use the Federal Bureau of Investigation (FBI)'s Uniform Crime Reports (UCR) urban crime rates from 1953 to 1970 to estimate an empirical model. They conclude that changing labor market opportunities for youth in this time period is sufficient to explain the increase in youth crime rates. Freeman (1996) uses the UCR and the National Crime Victimization Survey to compare the predicted number of crimes, based on high incarceration rates, to the actual number of crimes reported. He argues that the propensity to commit crime has increased between the years 1977 and 1992. He suggests that the economic incentives for crime may be sufficiently large to play a role in the rise in criminal propensity.

2. Hill and Stamey (1990) or Conroy (1998).

3. For more detail on the impact of the bottle law on recycling, see Ashenmiller (2009).

Grogger (1998) uses data from the National Longitudinal Survey of Youth (NLSY) to estimate a time-allocation model in which consumers face parametric wages and diminishing marginal returns to crime. The author's estimates suggest that youth behavior is responsive to price incentives and that falling real wages may have been an important determinant of rising youth crime during the 1970s and 1980s.

Raphael and Winter-Ebmer (2001) use the UCR to estimate the effect of unemployment rates on crime rates using a panel of state-level data from 1971 to 1997. They find that 82% of the decline in the larceny rate and slightly more than 40% of the decline in the overall property crime rate can be attributed to the decline in unemployment. Gould, Weinberg, and Mustard (2002) use county-level panel data, 10-year changes from Census data, and individual-level data from the NLSY to examine the relationship between crime and labor market conditions for men with low education levels. They find that wage trends explained more than 50% of the increase in both property and violent crime indices over their sample period, 1979 to 1997. Machin and Meghir (2004) use regional panel of police data from England and Wales to investigate how changes in wages at the bottom end of the wage distribution affect crime rates. They find that increased wages reduce crimes.[4]

The question remains then, do bottle laws reduce crime by raising the effective wage for low-skill individuals? The following section addresses the mechanism by which a deposit-refund program raises wages and the evidence that low-wage and low-skill workers participate in the subsidized recycling market.

5. A Model of the Supply of Professional Recycling

The supply of professional recyclers includes people who recycle part time or full time. Full-time recyclers are people for whom the recycling wage is higher than any market wage they could earn. This would include people who are unemployable, people who are on some form of government aid that restricts their ability to work in the conventional labor force, or people with very poor job market opportunities, such as

4. Mehlum et al. (2006) estimates the causal effect of high rye prices on crime in nineteenth Century Bavaria, Germany using rainfall to instrument for rye prices, they find a moderate but significant effect of poverty on property crime.

addicts or the homeless. Part-time recyclers are underemployed, meaning they face a restriction on the number of hours that they can work at their labor market job. A moonlighting model can be used to describe this decision. In this model, people can only work a fixed amount of time even though they might prefer to work longer. If the constraint on their wage labor is binding, they can accept a second job at a lower wage to increase their utility.

The model starts with a utility maximization problem, where utility is a function of leisure (ℓ) and consumption (x). There is a constraint on time such that total hours that can be worked (T) must equal the sum of the number of hours spent on recycling (R), wage labor (L), and leisure (ℓ). The budget constraint for the model is: ($wL + sR = x$) where (s) is the hourly recycling wage, x is a composite consumption good with a price of 1, w is the hourly wage in the labor market, and $\overline{H}$ is the maximum number of wage hours that can be worked at the labor market job. This model assumes that people value their time recycling in the same way that they value their time working at their labor market job so that $U_R = U_L$.

The maximization problem is:

$$\text{Max}_{L,R,x} \qquad U(T - R - L, x)$$

$$s.t. \qquad wL + sR = x, \quad \overline{H} \geq L, \; L \geq 0, \text{and } R \geq 0$$

The first-order conditions yield the result that, when the hours constraint is not binding, a worker will choose only to recycle when the recycling wage is higher than the labor market wage ($s > w$) and will choose both to recycle and work at a wage job if the recycling wage is equal to his market wage ($s = w$). Alternatively, a worker may choose both to recycle and work at a wage job when the market wage is higher than the recycling wage ($s < w$) if he faces a binding restriction on the number of hours worked.[5] These workers would prefer to work more hours at their

5. Phillips and Votey (1984) look at black women's incentives to commit crime. They model the labor market participation of the women with constraints on their time. A woman is considered overemployed if in order to take a job she must work more hours than she would prefer to work. A woman is considered underemployed if the jobs that she can obtain are inadequate to provide her with the income that she needs for the hours she is able to work. They find that the empirical evidence is consistent with the theoretical expectation that workers might be tempted by crime either as a solution to underemployment or overemployment.

market wage, but because they are not able to do that they are willing to recycle even though their recycling wage is less than their market wage.[6] The theoretical model reveals the economic incentive for low-wage workers to recycle.

6. Data

The data used are a panel of 10,133 cities with observations running from 1970 to 2000. These cities represent all U.S. cities with a population over 1000 in the year 1970.[7] The data on crime are taken from the UCR issued by the FBI. These are available annually on a city-level basis for seven types of crime: murder and nonnegligent manslaughter, forcible rape, assault, robbery, burglary, larceny, and motor vehicle theft. For the purpose of this paper only, the crime data for larceny are used. In particular, the property crime data for larcenies under $200 in value are used. The data include only reported crimes, which greatly understates the true crime rate. In addition, when multiple offenses occur in the commission of a single crime, the FBI only records the most serious of these offenses. This means that all of the larcenies reported in these data involved no violence. Data on the number of sworn officers are also taken from the FBI UCR. Sworn officers carry a gun and have the power of arrest; other police employees do not. The property crime rate is the annual reported crime rate per 1000 people for larcenies under $200 in value. The police officer rate is the total number of police officers per 1,000 people.

In addition to the data on police and crime, a number of state-level demographic, government spending, and economic variables are included in the regressions. The state-level data are from the Statistical Abstract of the United States. These data are available annually, and the variables

6. An alternative model would be to assume diminishing marginal returns to recycling. In this situation, you could also find recyclers who were willing to work both at recycling and at their labor market wage. They would recycle until the value of the marginal product of their recycling wage was equal to their labor market wage or their other nonmarket wages. This might fit the homeless recyclers who are often doing multiple activities for cash: recycling, panhandling, etc...

7. The results of the model are not sensitive to the population rule chosen. Restricting the data to include only crimes committed starting in 1977 has no impact on the results.

include the unemployment rate, the percent of a state's population that is black, the percent of the state's population that lives at or under the poverty line, the average income, the average state welfare payments, and the percentage of the population aged between 18 and 24. When this sample is restricted to cities with a population over 1000 during the entire sample period, it includes 9771 cities.

Another important characteristic of crime data is the wide variation of crime rates across cities. Edward L. Glaeser et al. (1996) examine this issue in detail. They find that less than 30% of the variation in cross-city crime rates can be explained by local characteristics. In this paper, they argue that either the unobserved heterogeneity across cities is much higher than the observed heterogeneity or that the decision to commit a crime in a city is highly city dependent. This is particularly true for auto theft and larceny. For this reason, the model is specified using city fixed- effects combined with state-level variables and additionally with the available city-level variables. Using city fixed-effects and state-level demographic and economic variables enables the analysis to include many more cities.

In addition to the crime, demographic, and economic data described above, the data include a dummy variable for whether or not a bottle law has been implemented in the state in which the city is located during the observation year. Bottle laws have been passed in California, Connecticut, Delaware, Hawaii, Iowa, Massachusetts, Maine, Michigan, New York, Oregon, and Vermont and Columbia, Missouri. Table 1 shows the states and cities that have enacted bottles laws and the year each bottle

Table 1. States With Bottle Laws When the Laws Were Implemented

Bottle law states	Years implemented
California	1987 to present
Delaware	1983 to present
Hawaii	2002 to present
Iowa	1979 to present
Massachusetts	1983 to present
Maine	1978 to present
Michigan	1979 to present
Columbia, Missouri	1982 to 2002
New York	1983 to present
Oregon	1973 to present
Vermont	1973 to present

law was implemented. None of the states that enacted bottle laws repealed them, but the city of Columbia, Missouri, enacted a city bottle law in 1982 and repealed it 20 years later. Ten of the existing bottle laws were implemented during the time period covered by the sample.

There is little variation in terms of the size of the deposit-refund between bottle law states. During the time frame of the dataset, California's deposit was 2.5 cents, Michigan's deposit was 10 cents, and all the other states had a deposit of 5 cents. The variation in the dataset comes as the states enact their bottle laws over time. For this reason, the dummy variable for bottle law is not based on the value of the deposit. The substitution away from crime comes as a result of the increase in the legal recycling wage. When a bottle law is passed, it increases the recycling wage in that state. However, the size of the deposit does not determine the wage, it is the total amount of recycling collected. The wage is dependent on the number of cans caught per hour. When the deposit is set higher, the number of people choosing to recycle bottles will rise. This means that while each bottle may bring in a higher deposit, the effort it takes to catch each bottle will rise. In this case, it is difficult to know what the resulting change in the wage will be. It could in fact be that at some point a higher deposit would result in a lower wage for people collecting recycling. In this case, we only assume that the bottle subsidizes the recycling wage so that it lies above the recycling wage in the absence of the law. Ashenmiller (2009) uses survey data to estimate an hourly wage for professional recyclers. The average wage for professional recyclers in July 2002 was $6.33 per hour. This was just a bit below the California minimum wage, which was raised from $6.25 to $6.75 on January 1, 2002. Table 2 reports the descriptive statistics for the sample.

7. Estimation and Results

The model is run as a fixed-effects model with controls for years and cities. The basic specification of the model is:

$$\ln CrimeRate_{jt} = \beta_1 B_{jt} + \beta_2 X_{jt} + \lambda_t + \theta_j + \varepsilon_{jt},$$

where B denotes a bottle law, X includes the demographic variables described earlier, λ_t are the year dummy variables, and θ_j are the city fixed-effects. The model is first estimated using least squares. This model is estimated using the Huber White robust standard errors.

Table 2. Descriptive Statistics

	Mean	Standard deviation	Minimum	Maximum
Per capita property crime rate (for larcenies under $200)	25.35	21.17	0.01	638.97
Per capita police officers	1.99	1.25	0.01	91.07
City population	20,238	115,101	1,000	8,008,278
% of population aged 18–24	11.23	1.51	7.56	18.4
State unemployment rate	6.37	2.1	2	18
ln(income per capita)	9.49	0.58	8	18
% Black	11.1	7.46	0.2	71.7
% Below poverty line	12.9	3.71	2.9	33.85
City unemployment rate	5.9	2.59	0.7	25.5
ln(monthly welfare payment)	5.57	0.44	3.85	6.62
Observations	187,929			

Clustering the standard errors by city does not change the results. The model measures the response of petty property crime rates to the increased recycling employment resulting from a state bottle law. Table 3 presents the estimates for five variations of the fixed-effects model. The dependent variable is defined as the natural log of the annual reported crime rate per 1,000 people for larcenies under $200 in value. Columns 1 and 6 includes only year dummies and city fixed-effects. Columns 2 and 7 add the state-level demographics and the natural log of the police officer rate, which is the total number of police officers per 1,000 people. Columns 3 and 8 include some poverty controls. The results are robust regardless of the specification in terms of the variables that control for poverty and race.

Any analysis of how a law change affects behavior raises the question of endogeneity. In this case, the concern would be that higher petty crime rates lead a state to pass a bottle law. Because the vast majority of the bottle laws enacted are at the state-level state, dummy variables cannot be included. The strategy used in this paper to test for endogeneity is from Gruber and Hanratty (1995) and Friedberg (1998). In this case, the concern is that other endogenous characteristics of the states are leading to the change in crime. The strategy then is to include a lead dummy variable for whether the law change happened in the previous year. This lead dummy variable assumes a value of one the year before the bottle law is enacted. This test is particularly suitable in the case of a bottle

law because the laws are legislated on average a year before they are implemented. If the lead dummy variable for bottle law is not zero and is statistically significant, this would be evidence that endogeneity might indeed be a problem. The regressions reported in columns 4 and 9 include a lead dummy variable for whether the law change happened in the previous year. While the coefficient of the lead dummy variable is not zero for either specification, it is not statistically significant. In addition, the model is also run using a bottle law dummy variable for the year in which the bottle law is legislated instead of enacted. In this case, the bottle law dummy variable is no longer significant, and the coefficients are between 0.017 and 0.019 for all specifications. These results support the claim that the increased employment available under bottle law regimes does decrease petty crime rates. It is not the case that low petty crime rates lead a state to pass a bottle law.

In Table 3, the bottle law dummy variable coefficient of −0.113 in column 2 represents city-level crime rates in bottle law states that are 11.3% lower than those in non–bottle law states. The bottle law dummy coefficient of −0.150 in columns 5 and 10, estimate the model leaving out cities in New York State, shows that the lower city-level petty crimes in bottle law states are not being driven by the large drop in the New York crime rate. When cities in New York state are eliminated from the sample, the bottle law dummy variable remains significant, and the petty crime rates are on average 15% lower. A similar result follows when Michigan's bottle law is singled out. When Michigan is dropped, the impact on the bottle law dummy variable rises to 12%. Including an interaction term between the state of Michigan and the presence of a bottle law, the only state in which the deposit is above 5 cents, indicates that the effect of the bottle law on petty crime rates is smaller in Michigan cities than other cities. The coefficient on the interaction term is significant at the 5% level and implies a 6% decrease in Michigan's petty crime rates. This is consistent with the idea that the higher level of the deposit in Michigan leads more households to collect their own bottles and cans and leaves fewer for professional recyclers. This effect would reduce the recycling wage.

All of the bottle law dummy variable coefficients are significant at the 1% level. Following research by Bertrand et al. (2004) and Hansen (2007), which calls attention to the problem of serial correlation in state by year panel data, Table 4 reports estimates of all of the models using the

Table 3. Estimating Petty Crime Across Cities, 1970–2000 Using Fixed Effects

Model	1 FE		2 FE		3 FE		4 FE		5 FE	
Bottle law (BL)	−0.316 (0.006)	***	−0.247 (0.006)	***	−0.113 (0.007)	***	−0.116 (0.007)	***	−0.150 (0.007)	***
One-year lead BL dummy							−0.019 (0.012)			
Police officers per cap.			0.412 (0.007)	***	0.376 (0.008)	***	0.376 (0.008)	***	0.375 (0.008)	***
% of population aged 18–24			0.058 (0.003)	***	0.041 (0.004)	***	0.041 (0.004)	***	0.027 (0.004)	***
State unemployment			0.040 (0.001)	***	0.043 (0.001)	***	0.043 (0.001)	***	0.042 (0.001)	***
Ln(income per cap.)			0.575 (0.037)	***	0.383 (0.045)	***	0.383 (0.045)	***	0.294 (0.046)	***
% Black					−0.057 (0.002)	***	−0.057 (0.002)	***	−0.076 (0.002)	***
% Below poverty					−0.017 (0.001)	***	−0.017 (0.001)	***	−0.019 (0.001)	***
ln (monthly welfare)					0.047 (0.015)	***	0.047 (0.015)	***	0.033 (0.015)	**
Year effects	Yes		Yes		Yes		Yes		Yes	
City effects	Yes		Yes		Yes		Yes		Yes	
New York	Yes		Yes		Yes		Yes		No	
Observations	230,544		224,456		187,929		187,929		178,549	
Adjusted R^2	0.647		0.659		0.685		0.685		0.687	

The sample covers 1970–2000 and includes 9,771 cities. The dependent variable is the per capita reported property crime rate for larcenies of value $200 or less. The sample is restricted to cities with a population of at least 1,000 in 1970. The results are not sensitive to the population rule chosen. Robust standard errors are reported. Clustering at the city level does not alter the results. ***Results are significant at the 1% level. **Results are significant at the 5% level.

Table 4. Estimating Petty Crime Across Cities, 1970–2000 Using GLS

Model	6 GLS		7 GLS		8 GLS		9 GLS		10 GLS	
Bottle law (BL)	−0.304 (0.006)	***	−0.238 (0.006)	***	−0.113 (0.007)	***	−0.114 (0.007)	***	−0.148 (0.007)	***
One-year lead BL dummy							−0.017 (0.012)			
Police officers per cap.			0.408 (0.007)	***	0.376 (0.008)	***	0.376 (0.008)	***	0.374 (0.008)	***
% of population aged 18–24			0.052 (0.003)	***	0.040 (0.004)	***	0.040 (0.004)	***	0.026 (0.004)	***
State unemployment			0.040 (0.001)	***	0.044 (0.001)	***	0.044 (0.001)	***	0.043 (0.001)	***
Ln(income Per cap.)			0.481 (0.028)	***	0.411 (0.033)	***	0.411 (0.033)	***	0.363 (0.034)	***
% Black					−0.057 (0.002)	***	−0.057	***	−0.057 (0.003)	***
% Below poverty					−0.017 (0.001)	***	−0.017 (0.001)	***	−0.019 (0.001)	***
ln(monthly welfare)					0.046 (0.015)	***	0.046 (0.015)	***	0.033 (0.015)	***
Year effects	Yes		Yes		Yes		Yes		Yes	
City effects	Yes		Yes		Yes		Yes		Yes	
New York	Yes		Yes		Yes		Yes		Yes	
Observations	217,364		210,909		178,294		178,294		169,368	
Adjusted R^2	0.675		0.687		0.706		0.706		0.707	

The sample covers 1970–2000 and it includes 9,771 cities. The dependent variable is defined at the per capita reported property crime rate for larcenies of value $200 or less. The sample is restricted to cities that had a population of at least 1,000 in 1970. Robust standard errors are reported. Clustering at the city level does not change the results. ***Results are significant at the 1% level. **Results are significant at the 5% level.

Hansen correction for serial correlation. The bottle law dummy variable coefficient of −0.113 in column 8 represents city-level crime rates in bottle law states that are 11.3% lower than those in non–bottle law states.

While the focus of this paper is on the impact of a state-level bottle law on crime rates, it is also interesting to examine the impact of other law enforcement and socioeconomic variables. Several findings warrant comment. First, the per capita number of police officers is significant and has a positive coefficient. This result is examined in detail in Levitt (1996, 1997). The problem arises because an increased police presence may be a result of more crime and it may also cause crime reporting to increase. However, the bottle law coefficient is not sensitive to the inclusion of this variable in the model. Second, the crime rates fall as the percentage of the population in poverty rises. Third, the crime rates fall as the percentage of black residents rises.[8]

8. Conclusion

Previous studies have shown that households with lower incomes are both more likely to recycle for cash and that they recycle a larger amount than households with higher incomes. This behavior results in an increase in the incomes of households with the lowest income levels. These positive labor market effects are a result of state bottle laws, and they are most easily quantified for people who choose recycling as an employment activity. Economic theory predicts that they will be people who have poor labor market options, the same people who may have higher incentives to commit property crime. This paper shows that the opportunity effect, that is a result of state bottle laws, results in city-level petty crime rates in bottle law states that are on average 11% lower than city-level petty crime rates in non–bottle law states. In this way, the primary positive benefits of these labor market changes go to low-income individuals, but secondary benefits trickle up to higher wage earners.

States often pass bottle laws when economic conditions are favorable. This paper argues that subsidizing recycling markets has positive benefits both through creating jobs for low-income households and through reduced petty crime rates as a result of the opportunity effect. This would suggest

8. This result is found elsewhere in the literature. Among other papers, see Levitt (1997) and Bedard and Helland (2004).

that in fact states may derive higher benefits from passing a bottle law when economic conditions are less favorable than when they are more favorable. The effect of a state bottle law on the labor market may be substantial. State-level public policy decisions should recognize the benefits from both the direct and indirect effects of these laws.

This paper shows that subsidizing recycling markets with a deposit-refund program results in positive societal welfare effects achieved through reduced petty crime rates. While crime rates, especially for petty larcenies, are quite noisy, the effect is pronounced. It is also important to recognize that removing the refund from the labor market would have negative welfare implications not recognized by the current theoretical literature. This effect is an unintended positive consequence of the laws, in addition to the benefits of decreased litter and internalized waste disposal costs that were the intended benefits of the legislation.

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