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State Hazardous and Solid Waste Taxes: Understanding Their Variability

Robin Jenkins and Kelly Maguire

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Understanding their Variability

Robin R. Jenkins and Kelly B. Maguire[1]

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[1] The views expressed in this paper are those of the authors and do not necessarily represent those of the U.S. Environmental Protection Agency. No official Agency endorsement should be inferred. The authors appreciate the conscientious research assistance by Tristan Harris and Rebecca Toseland. Contact information: Robin Jenkins (jenkins.robin@epa.gov or 202-566-2292 or 1200 Pennsylvania Ave., NW (MC 1809T), Washington, DC 20460).

ABSTRACT

There is substantial evidence that hazardous and solid waste facilities are located disproportionately in communities of color. While there are many potential explanations, one contributing factor might be that policy makers treat waste facilities differently, depending on the racial makeup of the facilities' host communities. On a larger scale, policies targeted at waste facilities might also vary according to the racial make-up of entire constituencies (not just of host communities). This paper examines hazardous and solid waste taxes set by state governments and how those taxes vary according to the racial consistency of the entire state as well as within communities located inside a 3 kilometer radius of waste facilities. We also pose a set of alternative explanations for the variability in state waste taxes, including the extent of negative externalities, inter-jurisdictional competition, revenue-seeking behavior and the interplay between state and local governments. We find no evidence that policy makers consider the racial makeup of the community immediately surrounding the waste facilities when setting taxes. We do, however, find that the percent of the population in the state that is Black varies negatively with the tax rates even after controlling for income levels and voting behavior. Other important determinants of waste taxes are the percent of the state that votes, other state taxes, and inter-jurisdictional competition.

KEYWORDS

Hazardous waste, municipal solid waste, state waste taxes, environmental justice

SUBJECT AREAS

(7) solid waste; (8) hazardous waste; (60) distributional effects

1. Introduction

Waste facilities, especially those handling hazardous waste, have long been a focus of investigation by the environmental justice literature. Early findings of racial disparities in areas hosting these facilities (United States General Accounting Office 1983, Bullard 1983, United Church of Christ Commission for Racial Justice 1987) have been confirmed repeatedly (see Banzhaf 2009 for a list of publications).[2] Perhaps most recently, in 2007 the United Church of Christ Commission for Racial Justice updated its 20-year-old landmark investigation into the correlation between race and the locations of hazardous waste disposal facilities (Bullard, et al. 2007). The update concludes that neighborhoods surrounding hazardous waste facilities continue to have higher proportions of people of color (56%) than non-host neighborhoods (30%).[3]

While there are many potential explanations for why waste facilities are disproportionately located in communities of color, one contributing factor might be that governments treat waste facilities differently, depending on the racial makeup of the facilities' host communities. One can postulate a variety of motivations for differential treatment including policy makers' perceptions of different levels of political engagement depending on race, or discriminatory attitudes. Putting aside the motivations, disproportionate siting could be the outcome if policy makers are inclined to give disincentives to waste facilities depending on the racial make-up of host neighborhoods.

[2] For a recent paper that does *not* find evidence of discrimination, see Wolverton (2009). Ringquist (2004) systematically assesses the correlation between race and environmental risk by conducting a meta-analysis of 49 environmental justice studies. He concludes there is "ubiquitous evidence of environmental inequities based upon race."

[3] The differences in race are more pronounced after narrowing the host area studied to a small 3 kilometer circle, as opposed to examining the host census tract without regard to the tract's size or boundary in relation to the waste facility's location (Bullard, et al. 2007).

On a larger scale, policies might also vary according to the racial make-up of entire constituencies (not just of host communities). Policy makers might treat waste facilities differently depending on the racial consistency of their districts, if they attribute different preferences to different races, or because of discriminatory attitudes.

The purpose of this paper is to examine one tool – taxation – that is increasingly used by state policy makers and whose implementation, ceteris paribus, should serve as a deterrent to waste facilities. Specifically, we examine the determinants of state taxes charged per unit of solid and hazardous waste managed. Across states, these taxes are highly variable and depend on the type of solid or hazardous waste, the management method (e.g., disposal or incineration), the size of facility, and a variety of other factors. This variation has potential to improve efficiency as states provide disincentives for the categories of waste or the waste management methods that their constituents find most objectionable. Alternatively, these taxes might reflect the motivations described above that result in discrimination. We explore whether the race of host neighborhoods and the race of the overall state are potential determinants of waste taxes. If such taxes are set differently depending on race, this could contribute to disproportionate siting of waste facilities.

Of course there many factors other than race that might influence state policy makers' decisions regarding waste taxes. While we are unaware of any studies that have examined the determinants of *solid* waste taxes, there are two studies that have explored the determinants of state hazardous waste taxes, though neither focused on questions of environmental justice. Levinson (2003) used a multi-year data set and found evidence that taxes are set competitively among jurisdictions who are engaged in a "race to the

top" in environmental quality. Sigman (2003) studied taxes for a single year, 1997, and considered inter-jurisdictional competition but emphasized, and found partial support for, environmental costs as a potential determinant of hazardous waste tax rates.

We examine taxes levied by states on the quantity of hazardous waste managed and the amount of solid waste landfilled. Like Levinson (2003) and Sigman (2003) we also consider inter-jurisdictional competition and external costs as factors affecting the variability in state waste taxes. However, we build on these studies by examining a larger set of factors that might be determining state tax rates. In particular we add consideration of factors important to environmental justice. We explore the importance to state tax rates of racial make-up at two scales - the overall state and the specific communities that host waste facilities. We also consider the importance of alternative sources of revenue in the state (i.e., sales and income taxes),[4] and the interplay between state and local government policy. In addition to examining a more comprehensive set of factors that influence hazardous waste taxes, as a contrast we also examine the determinants of municipal solid waste tax rates.

The paper begins with a discussion of the reasons behind solid and hazardous waste facility siting problems and the increasing prevalence of waste taxes. We then explain alternative frameworks for understanding the inconsistency in tax rates across states. We describe our data set and present the results of two econometric models – one for hazardous waste taxes and a second for municipal solid waste taxes. We conclude with a brief discussion.

[4] Sigman (2003) considers a specific state revenue need by exploring the impact on hazardous tax rates of the number of state Superfund sites, figuring that states with more sites will have a greater need for funding. However, she finds no association between the number of sites and hazardous waste tax rates.

2. Background

The Resource Conservation and Recovery Act (RCRA) of 1976 changed the institutions that manage hazardous and solid waste in the United States. RCRA Subtitle C established a cradle-to-grave hazardous waste management process that led to the creation of a new type of industry consisting of firms that treat, store, and dispose of hazardous waste (Jenkins, et al. 2009).[5] These facilities are often considered undesirable because of their association with environmental risks and many communities are opposed to hosting them. Similarly, RCRA Subtitle D, which targets municipal solid waste, required capital intensive technologies such as landfill liners and methane extraction systems that led to a consolidation in the landfill industry. Small local landfills were replaced by large regional ones that faced greater opposition by potential host communities (Jenkins, et al. 2009). Thus, siting difficulties developed for both hazardous and solid waste facilities as an unintentional consequence of RCRA.[6]

The opposition to hosting waste facilities rests at least in part on environmental risk. A significant number of hazardous waste management facilities have been designated RCRA corrective action sites and as such are in need of cleanup action.[7] Old solid waste dumps make up a significant proportion of Superfund sites. Landfills are also associated with truck traffic, odors and other potential declines in quality of life. Both types of facilities can stigmatize a community. Presumably at least partly in response to their undesirability, states began taxing waste facilities.

[5] Not all hazardous waste is managed by treatment, storage and disposal facilities (TSDFs); most is managed by the waste generators themselves.
[6] Presumably siting difficulties were also unanticipated as evidenced by the sparse guidance in RCRA for handling them.
[7] The cleanup activities usually target contamination that occurred prior to the safeguards put in place by RCRA.

Over time waste taxes have become increasingly common. For hazardous waste, most states introduced taxes during the 1980s. Hazardous waste fees were unknown prior to RCRA. But as of 1987, 22 states taxed hazardous waste; in 1990, 31 states did; in 2005 the number had inched up to 33 (Levinson 1999a, Sigman 1996). EPA developed the rules for municipal solid waste management more slowly than the rules for hazardous waste. This is reflected in the timing of the move toward large facilities to which communities were opposed. It is also reflected in the evolution of state mandated waste taxes for solid waste landfills. In 1996, for a sample of 24 states, Jenkins, et al. (2004) identified only 3 states, or 12 percent, that had mandated solid waste taxes. At present, 30 states or 60 percent do.

3. Frameworks for Understanding Tax Variability

We posit five frameworks for understanding waste tax variability. One possibility is that state policy makers imperfectly represent the median voter because of discriminatory attitudes. The question is particularly relevant for policies targeting hazardous waste facilities which, as mentioned, have been a concern of the environmental justice (EJ) "movement" since its inception. Unlike the early EJ papers, we examine tax rates, not siting decisions.

Hamilton (1995) offers three alternative explanations for how racism might enter into environmental policy: pure discrimination, variations in a population's willingness to pay, and differences in their ability to undertake collective action. Hamilton studies expansion decisions by hazardous waste facilities and finds that household income and a community's propensity to engage in collective action, as measured by the percentage of

the population who votes, are significant determinants. He finds that the percentage of the population that is nonwhite is not significant when collective action variables are included in the model.

A second framework is explored by Sigman (2003) who focuses on the possibility that taxes are correlated with the negative externalities associated with hazardous waste facilities. The variation in state tax rates might simply reflect different external costs. Oates and Portney (2001) review both theoretical and empirical approaches developed by economists to improve our understanding of environmental policy choices. The standard normative theory is for the policy to internalize external costs of pollution and an option to accomplish this is to tax polluting activities at a rate equal to marginal social damages. In practice, policies diverge from this ideal. One positive model to explain actual environmental policy is the median-voter model in which the policy choice reflects the median of the most preferred outcomes of the individuals represented by government. Under certain restrictive conditions, this model predicts a policy outcome that coincides with the normative theory. In the case of hazardous waste disposal facilities and solid waste landfills, the normative and median-voter models suggest that we should expect waste taxes that vary according to the marginal social damages caused by the facilities.

A different argument, not directly related to justice questions, but one that also suggests a wedge between environmental policy choice and welfare costs is offered by Sigman (1996) in a study of the impact of taxes on industrial solvent wastes. Sigman offers the straightforward suggestion that hazardous waste tax rates are determined based

on state revenue needs.[8] Also possible is that states are attempting to acquire a share of waste firms' monopoly profits. To examine this potential motivation, we test the correlation between taxes and firm profitability.

Potentially relevant to any state policy decision is a fourth framework that has evolved to explain inter-jurisdictional tax competition among states and strategic environmental policymaking. Levinson (1999b) highlights two distinct possibilities. On the one hand, states might compete to attract polluting firms by lowering environmental standards in a "race-to-the-bottom." A state may engage in such a policy because of the revenue raised by taxing such a facility. On the other hand, states might compete to deter polluting activity by raising environmental standards in a "race-to-the-top" thereby attracting residents by being "clean." Oates (2001) reviews the limited empirical evidence and concludes that there is more evidence for a race-to-the-top, at least regarding environmental regulation. Confirming this is an empirical paper by Fredriksson and Millimet (2002) that finds that states do incorporate the stringency of environmental policies in neighboring states into their own policies.

Finally, the interplay between state and local levels of government is potentially important. Multiple levels of taxing authority can result in inefficiently high tax rates (Sobel 1997). Jenkins, et al. (2004) find that county and city government host fees for solid waste services are positively correlated with whether or not a state had a mandated tax; states with mandated taxes had higher host fees. The paper asserts that the state mandate signals to local governments that payment from a landfill is indeed a practical possibility. This might work both ways with local government fees serving as a signal to

[8] Slightly different but along the same vein is the possibility that taxes are levied to recoup state governments for their waste management expenses. However, virtually all states impose licensing and registration fees on waste facilities with the explicit purpose of recouping expenses.

state governments so that the latter are more inclined to tax waste. Or the opposite might be more accurate – that state governments try to avoid over taxation by backing off in the presence of local taxes.

To begin to understand which of these alternative frameworks might shed insight into the determinants of waste taxes, we turn to an empirical model suggested by Oates and Portney (2001) and developed by Aidt (1998). In the model, negative externalities are efficiently internalized via regulation as a consequence of competition among interest groups, typically including both environmental advocacy groups and potentially regulated parties. Aidt's model hypothesizes that governments seek to maximize political contributions and the general well being of the electorate. If interest groups truly represent the interests of their own constituencies, policy choices will be efficient.

We apply Aidt's model and assume the affected parties include the general population, environmental interest groups, and industry lobby groups. We include additional variables to test the alternative frameworks for understanding environmental tax policy. Measures of race, income, and voting behaviors are used to gain insight into justice questions. Measures of groundwater use illustrate the importance of negative externalities.[9] We explore the possibility that a state's need for income or its targeting of waste firms' profits might be influential to waste tax rates by including state revenues garnered from other sources and the profitability of disposal facilities. We examine the response of state tax rates to the rates charged by neighboring states to determine any possible correlation; however, our data are for a single year thus our ability to explore inter-jurisdictional reactions is limited. Finally, we examine the interplay between state and local tax setting by accounting for whether facilities are publicly or privately owned.

[9]This is one measure that Sigman (2003) found to be significant to state hazardous tax rates.

States governments might avoid some overlap with local government finances by avoiding taxes when facilities are publicly owned. This measure is less than ideal but gives us some sense of how state and local governments interact with regard to waste policy.

4. Data Description

In order to estimate the determinants of state waste tax policy we gathered data for each state on the variables just described as well as on the taxes levied on hazardous waste management and municipal solid waste landfills.[10] All variables are defined in Table 1.

State Waste Taxes

The foundation of our state hazardous waste tax data is a 2005 report by the Army Corps of Engineers (ACE) on state hazardous waste management taxes. The report presents detailed tax data gathered via state web sites and phone interviews with state officials. Each state potentially taxes hazardous waste in a very different manner; for example some states tax by type of waste, whereas others use the management method as a tax base. Based on these raw data, we calculate a weighted average tax rate per ton of hazardous waste for each state where the weights are the tons of waste associated with a particular tax as reported in the 2005 Biennial Reporting System. This measure of taxes more accurately reflects the rate a state receives than the unweighted average tax rate used in previous studies.

[10] We exclude Alaska and Hawaii from the analysis because of their unique geographical location. Alaska taxes neither hazardous nor municipal waste; Hawaii taxes municipal waste only.

We were unable to locate a comprehensive report of taxes levied on municipal solid waste landfills at the state level so we used the same approach as the authors of the ACE report in order to create a dataset of solid waste taxes. We examined state level websites for environmental statutes regarding municipal solid waste taxes. In some cases, particularly if no state tax was found, we confirmed the information using alternative search methods (e.g., Google) for newspaper articles or other information that may point to a state municipal solid waste landfill tax. When solid waste taxes are levied they are applied uniformly to all solid waste generated in the state, therefore it was unnecessary to calculate a weighted tax.

Descriptive statistics are in Table 2. Taxes are levied on hazardous waste by 69 percent of the states and on solid waste by 60 percent of the states. Twenty-one states tax both hazardous and solid waste and eight states tax neither waste stream. As expected the average tax is significantly higher for hazardous waste, $19.84, than for solid waste, $1.34. The average hazardous waste tax for the 33 states that charge a positive amount is $28.86. For the 29 states that charge a solid waste tax the average is $2.21. This is the first evidence that the taxes are in some way compensating for negative externalities given that the risks associated with hazardous waste are typically greater than those associated with municipal solid waste.

Alternative Frameworks

The remaining variables provide insight into the alternative frameworks we posit to explain variation in taxes across states. To examine the importance of justice issues we include race variables at two levels of aggregation: state and local. We measure the

percent of the state that identifies as Black, 11 percent on average, and Hispanic, 9 percent on average. The 20-year-update of the landmark United Church of Christ Commission for Racial Justice study (Bullard, et al. 2007) provides us with our host community race information. They examine demographic information for the year 2000 for the 3 kilometer area surrounding 413 hazardous waste management facilities across the U.S. We adopt their state averages for the percent Black and Hispanic. Across states, on average 20 percent of the residents around hazardous waste sites are Black and 13 percent are Hispanic. We were unable to locate host community demographics for solid waste landfills.

Apart from race, taxes may vary according to the willingness to pay for environmental protection. If so, states with higher household income will have higher taxes. Finally, justice issues may arise because individuals in the state are less likely to participate in the decision-making process. We measure the percent of the population that voted in the 2006 Presidential election and predict that the higher the voting percentage the higher the waste taxes in the state.

To account for efficiency factors, we include four categories of variables: socioeconomics, environmental interest groups, industry lobby groups, and risk. To account for preferences of the general electorate we include two socioeconomic measures – state income levels and age distribution. Strength of environmental interest groups is measured by each state's per-capita contributions to environmental organizations in 2001.[11] States where the waste industry is more concentrated might do a better job at

[11] Contributions are measured by each state's per-capita contributions in the U.S. to environmental organizations between 1988 and 2001, as collected by the National Center for Charitable Statistics' Guidestar National NonProfit Database. We also have each state's share of the total membership in the Sierra Club, but found that the variable measuring contributions was slightly more robust in the models.

lobbying against higher taxes. We include two measures for lobbying effort - the percent of total tons of waste managed by the three largest facilities in the state (i.e., oligopoly variable)[12] and membership in the solid waste industry trade association (i.e., trade variable). Risk is measured by the gallons of groundwater withdrawn in the state, as reported by the United States Geologic Service (USGS) for the year 2000. On average states withdrew 8.41 trillion of gallons of water in 2000. This variable ranged in value from 0.43 to 51.2. We posit that the more groundwater withdrawn in a state the greater potential risk posed by a landfill and therefore the higher the tax rates.

In order to capture the degree to which the state may need or want to raise revenue by taxing waste we use an indicator variable as to whether or not the state has an income tax and the value of the state sales tax. Our hypothesis is that these taxes would be substitutes for waste taxes and therefore we expect a negative relationship between the income and sales tax variables and the waste tax.

States may tax waste as a means to get a share of firm profits. Thus tax rates may depend in part on waste quantities or the number of waste managers. Several prior studies examine the effect of hazardous waste taxes on the quantity of waste managed (Sigman 1996; Levinson 1999a, 1999b). An intuitive hypothesis is that there is feedback between tax rates and quantities of waste managed.[13] We rely again on the 2005 BRS to estimate quantities of hazardous waste. The 2004 Biocycle Survey is the source for our estimates of quantities of landfilled municipal solid waste (Simmons, et al. 2006). There

[12] To gauge the degree of concentration for hazardous waste we rely on the 2005 Biennial Reporting System (BRS). On average, the three firms managing the greatest quantities of hazardous waste are handling 84 percent of total hazardous waste managed in a state. For solid waste landfills, we estimate concentration based on data from the 2003 Chartwell Information data base. The three landfills accepting the highest quantities of solid waste on average manage 39 percent of total municipal waste disposed of in a state

[13] We address the endogeneity problem in the empirical section.

is much more solid waste managed than hazardous, as expected, although the average number of managers per state is approximately the same for both waste streams – between 32 and 36. Tipping fees are also an indication of firm profits, though we have this information for municipal solid waste landfills only. The average solid waste tipping fee is almost $38.00 per ton, with a range of $17 to almost $100.

We construct two variables to measure inter-jurisdictional competition. One is an indicator variable equal to 0 if all adjacent states do not have a tax law and 1 if any adjacent state has such a law. We also include the unweighted average tax charged by adjacent states. And, we include the tons of waste imported from out-of-state.[14]

Finally, to get a sense of the interplay between state and local governments, for solid waste landfills only from the 2003 Chartwell source we also gathered the percent of landfills privately owned. This is about 30 percent on average but with variation between zero and 90 percent. The measure takes no account of the quantity of waste accepted by these landfills. We expect states taxes to vary directly with the percent privately owned.

5. Econometric Results

To accommodate the censored dependent variable, we use a Tobit model to estimate the determinants of state taxes. A concern is the potential feedback between the quantity of waste managed and the tax, though the direction of the relationship is unclear. A positive relationship suggests that the larger tax base presents an opportunity for greater revenue or that greater waste is associated with higher externalities and perhaps justifies the effort to pass a tax. However, quantities may be lower in the presence of the tax than they would otherwise be or the tax might be set lower with larger quantities

[14] For solid waste landfills, this variable is available only for 35 states.

because a high tax is not needed to raise as much revenue. It could also be the case that firms respond to the taxes by shifting waste disposal activities to other, lower tax, states. Either way, the quantity of waste managed could be endogenous or there may be omitted characteristics of states that are correlated with both the tax rate and the quantity of waste managed.

We test for endogeneity and reject it for both the hazardous and municipal solid waste models, unlike Levinson (1999b). It could be possible that there are features of a state that we are not capturing that result in more or less waste managed (e.g., geologic features). We are unable to include state fixed effects in the model because we only have 48 total observations for each waste stream. However, we can include regional controls under the assumption that omitted variables are likely to be similar across a particular region in the U.S.

Table 3 provides results for both the hazardous and solid waste models, with and without regional controls. For the hazardous model, without regional controls, we find that voting participating and revenue-seeking drive the results. However, the model with regional controls is much more robust. For it, the same categories are important, as well as inter-jurisdictional competition. We find that the more politically active the population, as measured by voting behavior, the higher the taxes. And, importantly, we find that the more Blacks in the state the lower the hazardous waste tax rates. This holds, even while we find no relationship between taxes and the characteristics of the population around host sites.[15] This suggests that taxes are not set to discriminate against host communities but rather that policies vary with the socioeconomics of the entire state

[15] We estimated the models excluding the state race variables but including the race surrounding the host communities and the latter remained insignificant.

constituency. This might indicate discriminatory attitudes, or perhaps policy makers perceive different preferences among constituents depending on the racial mix of the state.

In terms of revenue-seeking our results show that sales taxes substitute for waste taxes. In states generating more revenue from sales taxes there are lower hazardous waste taxes. And, in the model with regional controls we find that the more waste managers in the state the higher the tax rates, perhaps an effort by states to gain a share of profits.

We find that states also consider inter-jurisdictional competition. Home state taxes move in the opposite direction of the neighbor's taxes. That is, when neighbors have a high tax the home state has a lower tax and vice versa. This coefficient is difficult to interpret given the cross-sectional nature of the data but suggests that states consider neighbors' taxes when setting their rates.

Turning to the model of municipal solid waste taxes, the variation in the dependent variable is much smaller than in the hazardous tax variable thus the estimation is not as robust. Similar to the hazardous model we find evidence that environmental justice factors, revenue-seeking behavior, and inter-jurisdictional competition affect tax rates. Like the hazardous tax model the more Blacks in the state the lower the tax rates. Again, this may indicate discriminatory behavior on the part of policy makers, or a different in how preferences of constituents are perceived depending on the demographics in the state. We have no information on host community demographics and therefore are unable to assess whether it is correlated with state solid waste taxes.

Unlike the hazardous waste model, the percent of the population that voted is not significant.

Regarding revenue-seeking behavior, we find that taxes matter, but in the direction that is opposite to the hazardous model. Recall that the state solid waste tax levels are far lower than the hazardous tax levels. Thus they do not substitute for taxes from other sources. We find again that inter-jurisdictional competition matters, but it is through whether or not the neighbors have a tax instead of the tax rate. Again, given our lack of time series data, we take this finding as merely suggestive that neighbors' taxes matter.

6. Discussion

We find that hazardous waste taxes vary positively with constituents' past voting behavior but that solid waste taxes do not. Hazardous waste is associated with greater risk and there is perhaps a higher level of aversion to hosting its disposal facilities compared to solid waste landfills. This might explain why state policy makers are more sensitive to public preferences and inclination toward collective action when setting hazardous taxes.

Unlike the results in Hamilton (1995), even controlling for voting behavior, the percent Black at the state level persists as significantly correlated with hazardous and solid waste taxes. Perhaps this is indicative of discrimination. This result could also reflect policy makers' perceptions of differences in preferences, real or otherwise, across races. We find no evidence that policy makers consider the racial makeup of the community immediately surrounding the waste facilities when setting taxes. At least for

hazardous waste, taxes do not vary according to the race of the host community. Thus, state waste taxes do not seem to be directly contributing to the differential siting of waste facilities identified time and again in the environmental justice literature. The more aggregate finding that tax rates vary according to state racial consistency, however, could potentially contribute to racial disparity in siting. The importance of race at the state level might be a result of discriminatory attitudes, or it might suggest that policy makers seem to attribute, rightly or wrongly, different preferences depending on race.

Our results are consistent with those of Shadbegian and Gray (2009) who set out to discover whether state environmental enforcement activity is correlated with the demographics of neighborhoods hosting plants. Their results show little evidence of disparities in enforcement. Thus two state policy mechanisms – environmental enforcement and waste taxes – are uncorrelated with EJ variables at the neighborhood level.

Unlike Sigman (2003) we do not find that greater dependence on groundwater leads to higher waste taxes. However, we find some evidence that states rely on waste taxes as a revenue source and, like Levinson (2003) we find that neighboring state's policy choices are important.

In addition to exploring the factors that are important to waste tax rates, our findings also lend insight into the larger question of what determines state policies that impose environmental requirements that exceed federal mandates. In some sense, waste taxes can be viewed as stringency in environmental policy beyond what is required by federal legislation through RCRA. We find that the stringency of at least this one environmental policy does not depend on the race of the community directly shouldering

the negative externalities. We do find however, that it varies according to the racial makeup of the entire state, and that the state's race matters even after accounting for voting behavior and income.

Further research might investigate the factors that influence preferences by citizens regarding waste taxes and other environmental issues. One consideration might be the tax burden of waste taxes, which is probably fairly diffuse. Hazardous waste generators are often in the chemicals and petroleum sectors, both industries that produce intermediate inputs. By the time the tax is passed along to consumers, it is likely to be diffused throughout many different products.[16] At first glance, the connection between solid waste taxes and the consumer might seem more direct, but most households pay for waste services through flat fees or indirectly through property taxes. Thus the much smaller solid waste tax is also not typically directly experienced by consumers. How then do consumers perceive the desirability of waste taxes in particular and environmental taxes, generally? Does this perception vary by race? Perhaps future research addressing this question can lend insight into our own findings.

[16] Fullerton (1996) provides evidence that environmental taxes have diffuse effects. He examines the effect of nine separate environmental taxes on 41 outputs and finds that only two output prices are affected by more than one percent.

Table 1: Variable Definitions	
VARIABLE	***DESCRIPTION***
STATE CONTROL VARIABLES	
LAW	0=state does not tax waste, 1=state has a waste tax
TAX	Weighted average waste tax per ton
NORTHEAST	CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, VA, WV
SOUTHEAST	AL, FL, GA, KY, MS, NC, SC, TN
MIDWEST	IL, IN, IO, KS, MI, MN, MO, NE, OH, WI
NORTH	CO, MT, ND, SD, UT, WY
SOUTH	AR, LA, NM, OK, TX
WEST	CA, ID, NV, OR, WA
ENVIRONMENTAL JUSTICE VARIABLES	
BLACK	% of population that identifies as Black
HISPANIC	% of population that identifies as Hispanic
HOSTBLACK *(HW only)*	% of population that is Black in areas surrounding hazardous waste sites in state
HOSTHISPANIC *(HW only)*	% of population that is Hispanic in areas surrounding hazardous waste sites in state
INCOME	Median household income per 1000 *(variable only enters model once)*
VOTE	% of citizens who voted in 2006 Presidential elections
EFFICIENCY VARIABLES	
Socioeconomics	
INCOME	Median household income (in 1000s)
KIDS	% population under age 5
Environmental interest groups	
ENVIRONMENTAL	Per-capita contributions in state to environmental organizations in 2001
Industry lobby groups	
TRADE *(MSW only)*	0=state does not have an active chapter of NSWMA, 1=state has an active chapter of NSWMA
OLIGOPOLY	% of total tons managed by three largest facilities in state
Risk	
GW	Trillions of gallons of withdrawals of groundwater in state
REVENUE SEEKING VARIABLES	
Other sources of revenue	
INCTAX	0=state does not have an income tax; 1=state has an income tax
SALES	State sales tax rate
Profitability of facilities	
MANAGE	Quantity of hazardous waste managed or solid waste

	disposed per 100,000 tons
NMANAGE	Number of hazardous waste managers or municipal solid waste facilities
TIPFEE *(MSW only)*	Average tipping fee
INTERJURISDICTIONAL COMPETITION VARIABLES	
NEIGHBOR	% of surrounding states with a tax *(Average across adjacent states of an indicator variable that equals 0 if an adjacent state does not tax waste and 1 if an adjacent state has a mandated state waste tax.)*
NAVGTAX	Average tax across all adjacent states
IMPORT	Tons of waste imported from out-of-state per 100,000
STATE/LOCAL TAX INTERACTION	
PRIVATE *(MSW only)*	% of facilities that are privately owned in state

Table 2: Descriptive Statistics[17]		
VARIABLE	***HAZARDOUS WASTE***	***SOLID WASTE***
TAX and REGIONAL VARIABLES		
LAW	0.69 (0.47)	0.60 (0.49)
TAX	19.84 (56.58) [0, 389.35]	1.34 (1.89) [0, 8.25]
NORTHEAST	0.27 (0.45)	
SOUTHEAST	0.17 (0.38)	
MIDWEST	0.21 (0.41)	
NORTH	0.13 (0.33)	
SOUTH	0.10 (0.31)	
WEST	0.13 (0.33)	
ENVIRONMENTAL JUSTICE VARIABLES		
BLACK	0.11 (0.10)	
HISPANIC	0.09 (0.10)	
HOSTBLACK	0.20 (0.18)	n/a
HOSTHISPANIC	0.13 (0.15)	n/a
INCOME (1000s)	47.32 (7.48)	
VOTE	0.50 (0.07)	
EFFICIENCY VARIABLES		
Socioeconomics		
INCOME	See above	
KIDS	0.07 (0.01)	
Environmental Interest Groups		
ENVIRONMENTAL	2.05 (2.82)	
Industry Lobby Groups		
OLIGOPOLY	0.84 (0.19)	0.39 (0.21)
TRADE	n/a	0.56 (0.50)
Risk		
GW	8.41 (8.44)	
REVENUE SEEKING VARIABLES		
Other sources of revenue		
INCTAX	0.88 (0.33)	
SALES	5.01 (1.82)	
Profitability of firms		
MANAGE (100,000s)	9.13 (22.53) [0, 148.73]	51.38 (58.45) [3.72, 323.99]
NMANAGE	31.96 (32.09) [0, 135]	36.10 (33.22) [2, 189]
TIPFEE	n/a	37.69 (16.30) [16.6, 98]
INTERJURISDICTIONAL COMPETITION VARIABLES		

[17] Means provided; standard deviation in parentheses; range in brackets.

NEIGHBOR	0.74 (0.21) [0.33, 1]	0.64 (0.28) [0, 1]
NAVGTAX	24.70 (45.63) [1.67, 209.68]	1.41 (1.02) [0, 3.8]
IMPORT	0.88 (1.20) [0, 5.00]	13.47 (21.48) *(note: n=35)*
STATE/LOCAL TAX INTERACTION		
PRIVATE	n/a	0.33 (0.21) [0, 0.9]

1 Means given. Standard deviation in parentheses. Range in brackets.

Table 3: Results				
VARIABLES	***HAZARDOUS WASTE MODELS***		***SOLID WASTE MODELS***	
	No regional controls	Regional controls	No regional controls	Regional controls
SOUTHEAST		58.78 (0.17)		0.24 (0.91)
MIDWEST		20.15 (0.60)		1.37 (0.48)
NORTH		-48.03 (0.34)		-1.07 (0.70)
SOUTH		67.77 (0.17)		-1.66 (0.53)
WEST		181.35*** (0.003)		-1.28 (0.61)
ENVIRONMENTAL JUSTICE VARIABLES				
BLACK	-268.02 (0.19)	-311.93** (0.05)	-14.93*** (0.006)	-15.85** (0.02)
HISPANIC	17.83 (0.95)	-80.79 (0.73)	-6.04 (0.31)	-0.08 (0.99)
HOSTBLACK	122.23 (0.25)	11.07 (0.90)	n/a	n/a
HOSTHISPANIC	57.99 (0.77)	-117.01 (0.49)	n/a	n/a
INCOME	-1.65 (0.41)	1.43 (0.42)	-0.02 (0.77)	-0.03 (0.72)
VOTE	371.25* (0.08)	299.99* (0.09)	-3.61 (0.54)	-5.90 (0.44)
EFFICIENCY VARIABLES				
Socioeconomics				
INCOME	See above	See above	See above	See above
KIDS	2284.01 (0.20)	2769.93 (0.13)	-1.26 (0.99)	-8.14 (0.93)
Environmental Interest Groups				
ENVIRO	5.48 (0.22)	5.45 (0.11)	0.05 (0.73)	0.19 (0.32)
Industry Lobby Groups				
OLIGOPOLY	32.60 (0.62)	33.98 (0.44)	-2.29 (0.39)	-1.25 (0.64)
Risk				
GW	-0.99 (0.64)	0.02 (0.99)	-0.08 (0.42)	-0.09 (0.43)
REVENUE SEEKING VARIABLES				
Other sources of income				
INCTAX	44.90 (0.30)	-1.17 (0.97)	2.32* (0.10)	1.13 (0.49)

SALES	-19.02*** (0.01)	-13.67** (0.03)	0.43* (0.07)	0.31 (0.23)
Profitability of firms				
MANAGE	0.06 (0.92)	-0.02 (0.97)	-0.003 (0.90)	-0.01 (0.74)
NMANAGE	0.67 (0.13)	0.51* (0.09)	0.04 (0.11)	0.03 (0.18)
TIPFEE	n/a	n/a	0.02 (0.60)	-0.002 (0.96)
INTERJURISDICTIONAL COMPETITION				
NEIGHBOR	-55.39 (0.31)	-46.64 (0.30)	-4.23* (0.06)	-5.59** (0.03)
NAVGTAX	-0.13 (0.68)	-1.17*** (0.00)	0.92 (0.11)	1.03 (0.12)
STATE AND LOCAL TAX INTERACTION				
PRIVATE	n/a	n/a	2.47 (0.29)	2.27 (0.34)
Constant	-216.35 (0.30)	-302.78* (0.07)	1.43 (0.83)	6.06 (0.43)
Log-likelihood	-185.54	-170.03	-69.83	-67.90

1 Coefficient values given. P-values in parentheses. *** = significant at 1% level; **=significant at 5% level; *=significant at 10% level.

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