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Regional Heterogeneity in Preferences for Environmental Regulation and the Effect of Pro-environment Voting on Toxic Emissions

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Abstract

In this paper, I use county-level measures of pro-environment voting from the U.S. House of Representatives as a proxy for regional heterogeneity in preferences of citizens for more or less regulation in order to estimate their effect on toxic air emissions at a local level. Even though constructing county-level voting scores from congressional district scores requires a degree of approximation in counties that lie partially in multiple districts, the fact that county lines do not change with the decennial Census allows for measures of emissions activity in specific locations over time when using panel data spanning more than ten years. The results suggest that allowing for regional heterogeneity in preferences at the county level can explain within-state variation in toxic emissions where state-level aggregates fail to identify such a relationship.

Keywords: League of Conservation Voters; Toxics Release Inventory; Regulation

JEL classification: Q53; Q58

1 Introduction

The structure of the air quality regulatory environment in the United States is such that minimum federal standards are set by the Environmental Protection Agency. Federal standards could include maximum allowable ambient concentration of certain pollutants or requirements of the technology that must be employed by new or existing firms. Over time, the enforcement of federal standards has become the responsibility of local enforcement agencies. Hence, at the local level there exists heterogeneity in the degree of enforcement of these federal standards. Sometimes heterogeneity is imposed on specific areas because of non-compliance of federal standards. It can also exist because citizens have a preference for a cleaner environment and those who cannot afford it themselves will prefer greater regulatory stringency at the local level in order to obtain it. The primary objective of this paper is to investigate the effect of citizen preferred greater regulatory stringency on the level of emissions within counties using pro-environment voting at the national level as a proxy for these attitudes.

One of the challenges researchers face when analyzing the effects of environmental regulation on air emissions is the choice of measurement used to describe the regulatory environment. The absence of direct measures of regulation forces researchers to rely on proxies and certain assumptions to describe regulatory stringency. One indirect measure that has been used is congressional voting records on environmental issues which, assuming that votes in Congress reflect attitudes of constituents, acts as a proxy for citizen attitudes towards a tighter regulatory climate. Common practice in the literature is to use state averages of votes from the U.S. House of Representatives or U.S. Senate as a proxy for community attitudes. It seems reasonable to assume that a county-level voting score would be a better proxy for the local regulatory environment than voting scores at the state level, because aggregation at the state level fails to identify which communities in the state are pro-environment. This is important because within each state there are “green” counties and counties that care comparatively little about the environment. An independent organization known as the League of Conservation Voters (LCV) keeps scorecard records on pro-environmental voting behavior of both U.S. Representatives and U.S. Senators. Using these scores provides a measure of how each politician voted and is assumed to proxy how much each community or county values the environment, regardless of how many pro-environment bills are actually passed at the national level.

Several studies have attempted to link measures of citizen attitudes toward pollution to regulatory stringency and its impact on firm behavior. For example, Henderson [16] considers state attitudes toward pollution as measured by the fixed-effect term from a fixed-effects regression with pollution abatement expenditures as the dependent variable. This fixed effect measures the degree to which states either “over spend” or “under spend” on abatement activity with overspending being associated with pro-environment attitudes. He identifies measures of time-invariant attitudes toward pollution and finds that a 1-percent increase in abatement expenditures leads to a 0.04-0.05 percent improvement in air quality measures. Gray and Shadbegian [13] evaluate temporal and cross-sectional variation in state-level aggregates of League of Conservation Voting (LCV) records and find that the share of a firm's production arising at the state level is negatively related to LCV scores. Gray [12] also uses state-level aggregates of LCV scores as a measure of attitudes towards pollution and finds that firm births across states are negatively related to LCV scores. Terry and Yandel [26] link TRI and LCV scores in a 50-state cross-sectional analysis in which they examine the effect of 1988 average LCV rating for each state's two senators on the 1992 level of stack air emissions reported by the TRI. They find a negative, but insignificant coefficient on the LCV score variable.

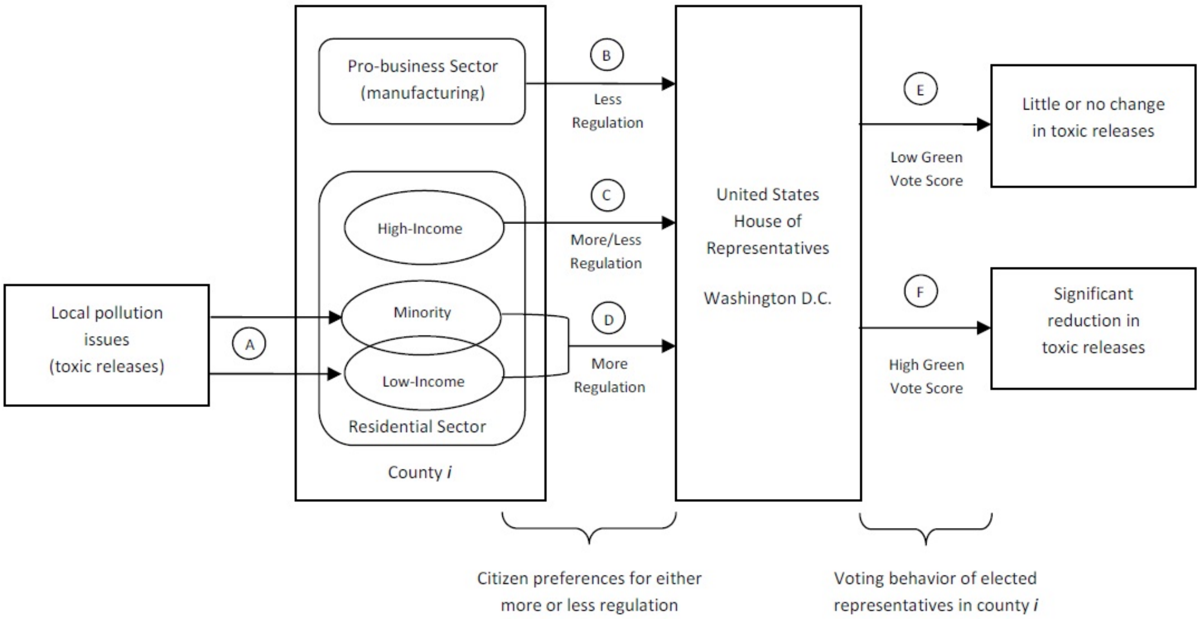
While findings from the previous studies that measure attitudes at the state level have been consistent, to my knowledge, no study has used LCV from the U.S. House of Representatives to explore the impact of voter attitudes at the county level. This paper is the first to create county-level scores for pro-environment voting by mapping congressional district scores to the county level and creating weighted scores for counties that partially lie in multiple districts. The results suggest that allowing for regional heterogeneity in preferences at the county level can explain within-state variation in toxic emissions where state-level aggregates fail to identify such a relationship. Voting behavior appears to take between one and three years to have an effect on emissions.

2 Conceptual Framework

When firms release toxic emissions as a byproduct of the production process, this creates what is referred to in economics as a negative externality. Negative externalities are costs imposed on nearby residents that are not taken into account in the production decisions of firms. These types of costs lead to an output level that is not socially efficient. Coase bargaining is generally not a possible solution since the number of affected individuals is typically large. Collective action against firms responsible for the negative externalities created by toxic releases could be considered a public good. Many individuals desire better air quality, but few are willing to provide the socially optimal level themselves due to the free-rider problem. According to the basic economic theory on public goods, the marginal private benefits of contributing to collective action are much less than the marginal social benefits at the point where the marginal private costs and benefits are equal leading to an under provision of the public good. Recognizing that clean air benefits society and that it will not be provided by individuals, the government must choose the appropriate level of air quality and provide it by regulating emissions.

In order to make the connection between citizen preferences for regulation and voting patterns as a proxy for regulation and ultimately the effect on toxic releases, I construct a model and explain key links with findings from previous studies. The model links four fundamental questions relating how citizen attitudes or preferences for more or less regulation are translated into environmental outcomes through congressional voting. The four questions are 1.) Which groups are most affected by pollution? 2.) Which groups prefer more regulation? 3.) How do legislators decide which way to vote on environmental policy? and 4.) Do voting outcomes lead to reductions in emissions? The purpose of looking at these four questions separately will help show that shirking is less of a concern when using U.S. Representatives' voting as a proxy for citizen preferences at the county level. Also, it is not as simple as assuming that votes either reflect citizen preferences or legislator ideologies, since within counties there are different preferences for or against increased regulation that need to be considered by the legislator. Figure 1 summarizes the key features of the model and I have identified important links which I will refer to as links $A, \ldots, F$.

Figure 1: Conceptual Framework



I consider four groups of individuals whose attitudes or preferences for more or less regulation are likely to influence decisions. These four individual groups are categorized into two larger groups: pro-business sector and residential sector. The residential sector is divided into low-income, high-income, and minority households. It is likely that minority communities are a subset of the low-income classification, but at the very least there is a large intersection of the two groups. The pro-business sector represents anyone who is employed in one of the polluting industries.

The model suggests that the adverse effects of pollution will be primarily present in lower income and minority communities. The designation of high versus low income is somewhat arbitrary and is slightly unclear from the literature what the exact distinction should be regarding who is most affected by pollution. The poverty line could be chosen as the specific means of separating low from high income designation within counties, but it seems at the county level from Figure 2 that the counties most negatively affected by toxic releases are counties with a per capita income slightly higher than the poverty line. Per capita income is sensitive to high income outliers and income distributions are usually right-skewed, which would suggest that those most affected by the pollution are those who may be below the poverty line. Link A in Figure 1 shows that pollution affects lower income and minority populations.

Preferences for more or less regulation vary by group. Those individuals closely associated with business interest will prefer less regulation (link B) since more regulation leads to higher costs of production and lower profit for business owners as well as potential job loss for workers employed in polluting industries. Because business owners do not directly benefit from cleaner air quality, their net benefits will be negative. Most individuals who live in low-income neighborhoods will prefer more regulation (link D in Figure 1) because regulation yields a positive net benefit. They receive the benefits of cleaner air quality, which likely outweigh the costs of slightly higher taxes [1]. The exception to this assumption would be those individuals who live in low-income neighborhoods, but who are employed in the

[1] The increase in costs of regulatory enforcement would be publicly financed through higher taxes, although, given the marginal tax structure, the increase in taxes on low-income households would not be as great as the increase for high-income households

polluting industry. It is assumed that these individuals would prefer job security to more regulation. According to this model, these individuals' preferences would be represented by link B in Figure 1. The preferences of the individuals who live in high-income neighborhoods are uncertain. It is reasonable to assume that these individuals place a high value on environmental quality, but it is unclear whether they prefer regulation as a means of obtaining higher environmental quality. The most likely outcome will be that those who can afford to move to locations with higher environmental quality will self-select into cleaner neighborhoods rather than relying on the government to provide it for them. On the other hand, there may be individuals who prefer a cleaner environment for society as a whole for altruistic reasons and they realize that regulation is one possible means of achieving that objective. These individuals are generally the more educated and realize that better air quality is a public good that is likely to be under produced. Therefore, it is possible that the high-income households could prefer either more or less regulation (link C in Figure 1), even though individuals acting in their own self-interest would simply move to cleaner locations.

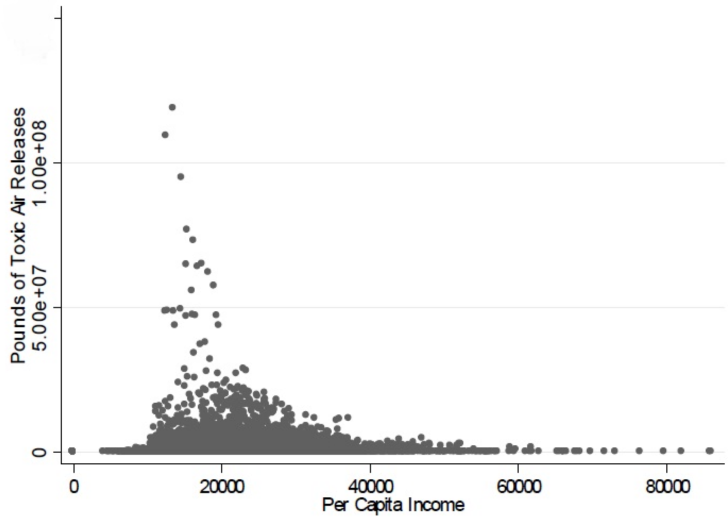
Three likely objectives of career politicians are re-election (do whatever it takes to keep their job), altruism (place high priority on doing what is in their constituents' interests), and contribute their own ideologies to the decision making process (regardless of what constituents want). For those whose main priority is re-election, in order to maximize the likelihood of being re-elected, politicians must be aware of their constituents' interests on various issues. When deciding how to vote, the representative for county i takes into account the preferences of all four groups (shown by links B,C,D in Figure 1), even though they may not all be equally represented. One would expect those groups who are the most organized to communicate their preferences most clearly. Often the most organized are those representing business interests and are frequently found in Washington D.C. lobbying for less regulation. Communities that are less homogeneous, such as minority communities, are less likely to form collective action against polluting industries. The longer the terms of elected representatives, the greater is the likelihood of shirking from the constituents interests, because they are most likely to take into account constituent interests when they are close to re-election. The term length of U.S. Representatives is two years which makes them more accountable to their constituencies than U.S. Senators whose term lengths are six years.

The primary focus of this paper analyzes how voting behavior of U.S. Representatives affects the level of county-level toxic air releases (links E,F in Figure 1). The theory would predict that the more pro-environment the representatives vote the greater the reduction on toxic releases (link F). The argument is that if there is pro-environment voting at the national level, then there must be overwhelming support for more regulation at the county level, especially since the ones most likely to support more regulation are the ones whose voices are least likely to be heard.

2.1 Which groups are most affected by pollution?

There exists a wide body of literature dealing with the question of how community characteristics influence environmental outcomes. Generally, all studies have arrived at the conclusion that the two groups most affected by pollution are low-income communities and minority communities, although most studies argue in favor of either one or the other. The distribution of county-level toxic emissions in Figure 2 shows that there is a very high concentration of toxic releases in counties in which the per capita income level is below $25,000, where Figure 3 shows TRI facilities are generally located in counties with a per capita income level of $30,000 or below.

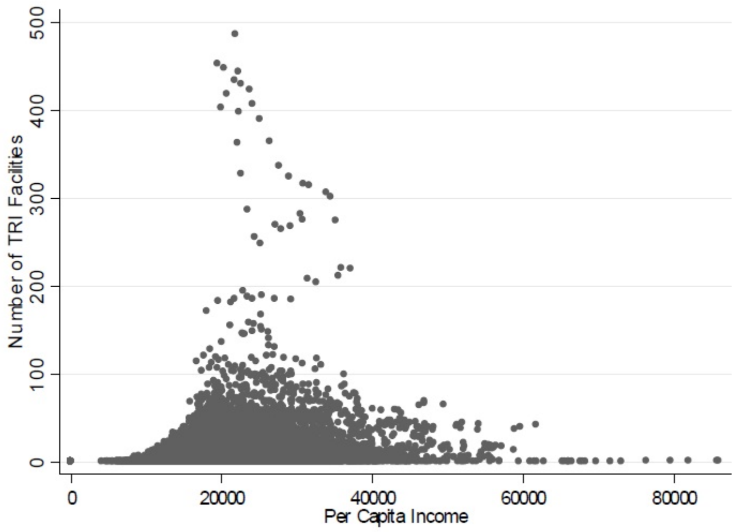
Figure 2: Distribution of Toxic (TRI) Air Emissions by County Per capita Income



A number of studies have analyzed within-county variation in community characteristics to try to identify which groups are the most disproportionally exposed to toxic releases. The following studies have conducted zip code-level analyses and have arrived at varying conclusions: Banzhaf and Walsh [3], Brooks and Sethi [4], Ringquist [25], Arora and Cason [2]. Link A is based on the findings of these papers. For this model, I assume that both low-income and minorities are affected by toxic releases.

According to Banzhaf and Walsh [3], low-income families are the most negatively affected. They conduct an empirical test of the Tiebout [27] hypothesis that individuals sort into communities with optimal bundles of taxes and public goods. Assuming firm location

Figure 3: Distribution of Number of TRI Facilities by County Per capita Income



to be exogenous, they find that the presence of TRI facilities causes the composition of a community to become poorer over time. This is a result of composition effects suggesting that pollution leads to out-migration by the wealthier households and/or in-migration of poorer households and is consistent with the Tiebout hypothesis. They find that racial composition effects are weak. Arora and Cason [2] find evidence of greater releases in poverty stricken neighborhoods, but also find that race is a significant determinant of toxic releases in the nonurban south, but not elsewhere in the country. Kriesel et al [21] find that minorities are not disproportionally exposed to toxic releases, but find some evidence that poor communities are disproportionally exposed to toxic releases. Additional studies from Gray and Shadbegian [14] and Videras [28] draw similar conclusions. Gray and Shadbegian [14] have found evidence that plants in low income communities pollute more, however not in minority communities. Videras [28] also finds that low-income households are more likely to be exposed to environmental hazards and are more likely to benefit from the provision of a cleaner environment.

Ringquist [25] evaluates the claim that TRI facilities are located in poor and minority communities and, after controlling for a variety of background factors, finds that TRI facilities and pollution are concentrated in zip codes with large minority representation. Brooks and Sethi [4] find that minority (or specifically more ethnically diverse) communities are more likely to be affected by pollution due to the lower likelihood of collective action. They also find that only for the highest income groups with annual incomes exceeding $67,000 per year does higher median income imply lower exposure to emissions. It could be that specific groups are targeted when firms emitting hazardous waste make decisions to locate, for instance because of the perception that certain types of communities will be less willing and able to engage in costly collective action against the firms.

2.2 Which groups prefer more regulation?

In this section, a distinction must be made between preferences for cleaner environment and preferences for more regulation. It is generally accepted that most people recognize the health benefits of a clean environment and that it contributes positively to the value of outdoor recreation. Those with the means of affording it will obtain higher environmental quality through such examples as the purchase of homes in the foothills of the mountains, private golf memberships, or eco-tourism. They are likely to prefer less regulation because the benefits do not directly affect them. They will likely face higher taxes as a result and possibly experience a reduction in home values as previously undesirable areas become more in demand. Those who cannot afford a clean environment for themselves will have to rely on the government to regulate and protect their health.

Fischel [8] finds that income, occupation, and education are robust determinants of preferences for environmental quality and that voting on environmental quality is divided along economic and social class lines. Some studies have used referendum data in an attempt to identify how different groups within a region differ in their preferences for regulation. Kahn and Matsusaka [18] using data from sixteen California Initiatives find that environmental goods such as parks appear to be normal goods for people with the mean income level and inferior goods for people with high income. Their findings support the claim that the wealthy can purchase these goods privately and therefore do not prefer public provision of environmental quality which would be provided through higher taxes. Kahn [17] focuses on how changing demographics affect the perceived benefits and costs of regulation, and finds that minorities, youths, the more educated, and those who do not work in polluting industries are more likely to support environmental regulation. Elliot et al [7], using aggregate level determinants of support for environmental protection over a span of two decades, find that as real per capita income increases, support for additional spending on environmental policy increases as well. They obtain public opinion data from both the National Opinions Research Center (NORC) and the Roper Surveys that solicit respondents' views on environmental spending

One concern is, even if individual group preferences are known, the line of communication between the low-income and minority populations and their legislators is unclear. It has been argued that minorities are less likely to form collective action [4] and are therefore less likely to convey their concerns. Because different groups are less likely to bond with members of another minority group, this is even more of a concern when the composition of minority communities is heterogeneous. It is also important to consider the opportunity cost of each individual group's time. Lower income families do not have the luxury of much free time for collective action. Lower paying jobs require more hours of labor to earn money necessary for survival. Therefore, the opportunity cost of lobbying politicians is much higher for low-income families than for those with higher incomes and more free time.

2.3 How do legislators decide which way to vote?

To consider which way a legislator will vote, one must first identify the incentives facing the individual. The incentives will be very different based upon the position of government under consideration. If many of these public officials have chosen this as their career of choice, then it seems reasonable to assume that they would have a strict preference to be re-elected so that they might continue in this line of work. There is also the possibility that certain individuals would like to work their way up to a legislative decision-making position offering them a chance to make their own political ideologies heard. Another possible incentive would be to do whatever is best for constituents, making constituent interest a priority.

Peltzman [24] starts with a basic framework in which voting patterns are a function of ideology of the legislator and the interest of the constituents. Fort et al [9] add in a time-path component to the model which addresses the sensitivity of shirking behavior near re-election time. Since ideology (I) and citizen preferences (P) are not directly observable, all studies that try to estimate these effects on voting patterns have to rely on various proxies. Common proxies for citizen preferences are community economic and social characteristics assumed to be correlated with preferences. For legislator ideology, a number of studies have used either some measure of party affiliation, such as whether they are republican or democrat [2] or voting records by a group such as the Americans for Democratic Action (ADA) [24]. Fort et al [9] treat ideology as an error term which would be the part of the model not explained by community characteristics.

The following equation summarizes the primary factors that influence the way legislators vote on environmental policies and builds upon the models of Peltzman [24] and Fort et al [9].

$$VOTE = f(I, \eta \times P_j) \tag{2.1}$$

$$\eta = \frac{T - \tau}{T} + \psi \tag{2.2}$$

for $j \in \{\text{B, H, L, M}\}$. I represents specific ideology of the representative. P is a vector of preferences for either more or less regulation of group j, where B represents business interests, H represents high income neighborhood residents, L represents low income neighborhood residents, M represents minority neighborhood residents. In Equation 2.2, η is a measure of how much constituent preferences figure in to the legislator's voting decision. T is term length where $T = 6$ for U.S. Senators and $T = 2$ for U.S. Representatives. τ is the number of years before the legislator is up for re-election and decreases with time[3]. Fort et al [9] argue

[2]With the assumption that the more liberal the party affiliation, the more likely they will be to vote pro-environment

[3]$\tau = 0$ in a re-election year

that closer scrutiny at re-election time is expected to tighten the principle-agent relationship, so $\frac{\partial \eta}{\partial \tau} < 0$ implies the closer the representative is to a re-election year, the more closely they would be expected to take into account constituent preferences. ψ is a measure of altruism which is on the interval $[0, 1]$, where 1 means that the legislator cares a lot about doing what is best for their constituents, regardless of whether they are up for re-election or not, and 0 means they do not care at all except for the purpose of being re-elected. η should approach $1 + \psi$ as the legislator gets closer to an election year.

The six-year term length of U.S. Senators makes them less accountable to their constituents, at least for the first three to four years of their term, compared to U.S. Representatives who serve only two-year terms and are more dependent on keeping constituents satisfied for frequent re-elections. Therefore, U.S. Representatives should echo the voices of their constituents much more closely than U.S. senators. The key assumption here about the link between LCV scores and regulatory behavior is that if counties are putting pressure on their politicians at the national level, then they are most likely putting equal, if not greater, pressure on their local politicians and regulators to implement stricter regulations.

The question of shirking has been addressed by a number of papers in the literature. Peltzman [24] argues that shirking should not be a concern. Liberals and conservatives tend to appeal to voters with certain incomes, education, and occupations, and draw contributions from different interest groups. Because of these systematic differences, rationalizing voting patterns does not require relying on explanations that involve shirking. Only on social policy issues (abortion, school prayer, and so on) did ideology play a prominent role.

Kalt and Zupan (1984) [19] find that both constituent interests and legislator ideology are important factors. They find evidence that within a principal-agent relationship legislators operate with enough slack to vote according to their own ideological tastes. Kalt and Zupan (1990) [20] use an ideological residual which is consistent with a liberal-conservative ideological spectrum and that is shown to respond to slack in the principle-agent relationship. Hamilton [15] concludes that the theory of rational political ignorance can help explain legislator preferences for policy instruments to control pollution. Legislators from districts with more toxic emissions face trade-offs in support within their districts, because proposed environmental policies often increase the costs of polluting industries, but reduce the risks to residents from exposure to hazardous chemicals. Gilligan and Matsusaka's [10] findings provide support for the hypothesis that logrolling leads representatives to spend more than their constituents would like. Durden et al [6] find that legislators may be viewed as representing strong, well organized interest groups' preferences in exchange for direct and indirect political currency. Goff and Grier [11] believe the question of whether legislators fail to represent their constituencies is currently unanswered by the literature, and cannot be answered by models making cross-sectional comparisons of the voting behavior of U.S. Senators.

2.4 Do voting outcomes lead to reductions in emissions?

Once the votes in Congress have been passed, the question of what effect they have on environmental outcomes naturally arises. It should be understood that their effect is really not a direct effect, but rather a proxy for increased regulatory stringency at the local level based upon the preferences of the citizens for a tighter regulatory climate. A limited number of studies have analyzed the effect of voting on environmental outcomes, but have only done so at the state-level. There is naturally room for further investigation if the study attempts to analyze this question at a more localized unit observation, which is the primary objective of this paper.

Gray and Shadbegian [13] use state-level aggregates of League of Conservation Voting (LCV) records to find that the share of a firm's production arising at the state level is negatively related to LCV scores. They use LCV scores as their principle index of regulatory stringency because of the time-series variation. Gray [12] also uses state-level aggregates of LCV scores as a measure of attitudes towards pollution and finds that firm births across states are negatively related to LCV scores. Terry and Yandel [26], link TRI and LCV scores in a 50-state cross-sectional analysis in which they examine the effect of 1988 average LCV rating for each state's two senators on the 1992 level of stack air emissions reported by the TRI. They find a negative, but insignificant coefficient on the LCV score variable.

3 Data

3.1 League of Conservation Voters

The League of Conservation Voters [22] is an independent organization which tracks congressional voting records on environmental issues. The annual scorecards report the percentage of pro-environment votes cast by each legislator in a given year. Voting in favor of all possible environmental policies would earn a score of 100 and voting against all policies would earn a score of 0. There are scores reported for both U.S. Representatives and U.S. Senators. Every year there are roughly seven different votes cast by Senators on such topics as Gulf drilling and farm conservation funding. For Representatives there are somewhere between twelve and sixteen votes cast each year on such topics as EPA enforcement, Arctic drilling, fuel economy, and energy efficiency. Each representative is given a score from 0 to 100 with 100 being the most pro-environment. To identify variation in standards at the county level I use the LCV scores of U.S. Representatives.

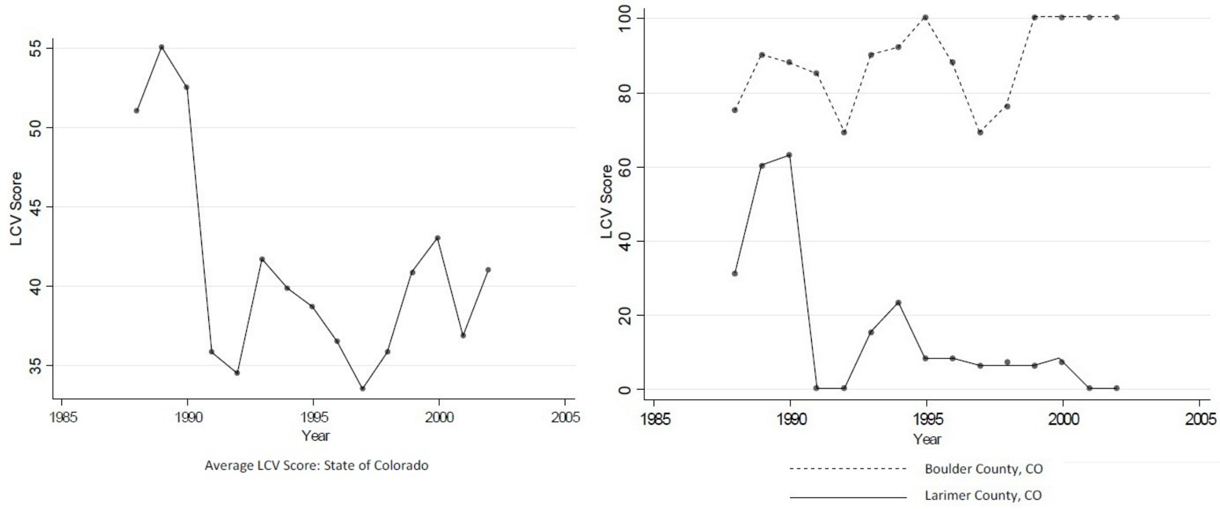
The League of Conservation Voters issues scorecards on a yearly basis starting in 1970. The scorecards previous to 1989 become slightly problematic because they are calculated bi-annually. Therefore 1987 and 1988 would share the same score. Another issue with the data is that the Speaker of the House votes at his or her discretion, so there are no votes recorded for those districts that are represented by the current Speaker of the House.

3.2 County level versus state or congressional district level

Due to the nature of aggregation, using state averages of U.S. House or Senate voting as a proxy for community standards fails to identify which communities in the state are pro-environment, because within each state there are pro-environment counties and counties that care very little about the environment. For example, Figure 4 shows the average LCV score for the state of Colorado from 1988 to 2002. Based on this trend it appears that Colorado is not very pro-environment. However, Figure 4 also shows two counties in Colorado that are quite different: Boulder County which is very pro-environment and Larimer County which is not.

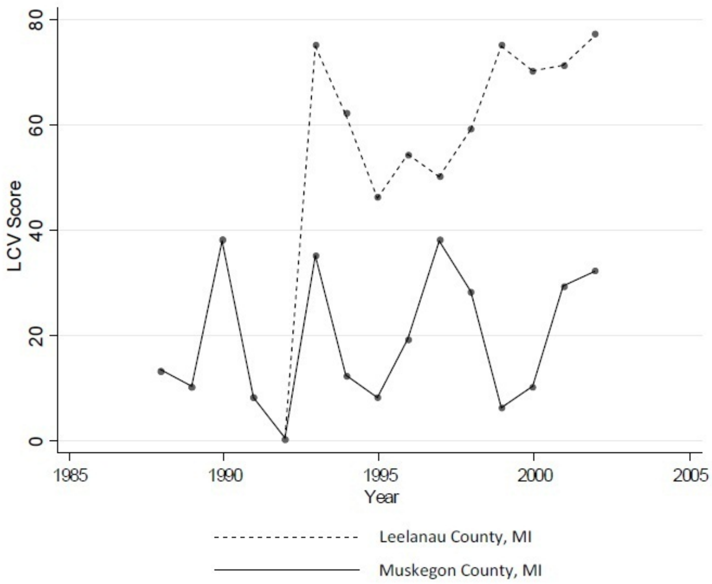
While congressional districts are a more localized unit of observation than state-level, one thing is problematic when using them in a panel data set. Congressional district lines

Figure 4: Time Trend of Colorado LCV Scores



are redrawn every decennial Census. Figure 5 shows the LCV scores for two Michigan counties, Leelanau County and Muskegon County, from 1988-2002. Both counties are in Congressional District 9 from 1988-1992 based on the 1980 Census, but after district lines are redrawn for the 1990 Census, Leelanau County is designated as District 1 and Muskegon is designated as District 2 from 1993-2002. In Figure 5, when Leelanau County was in the same district as Muskegon County, the LCV scores were relatively low compared to the LCV scores after the switch to District 1. Any county can experience this same drastic variation as preferences change or when new legislators are elected who may have significantly different environmental goals relative to their predecessor. The key objective is to find a more localized unit of observation that does not change boundaries over times (or at least very rarely in the case of county lines).

Figure 5: LCV Trends for Leelanau and Muskegon Counties, MI

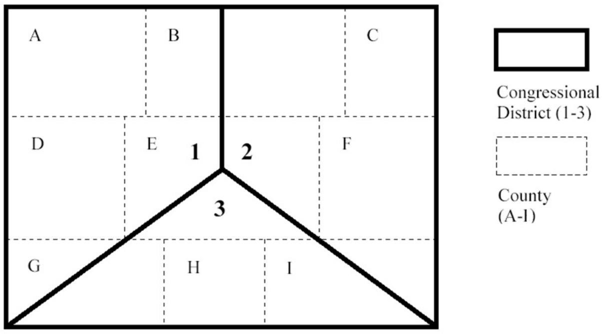


3.3 Constructing county-level measures

When constructing county-level measures of LCV scores for the U.S. House of Representatives, which are available at the congressional district level, two challenges arise: district lines are redrawn every ten years based on the decennial Census and a number of counties lie partially in multiple districts. The Census lists each congressional district and which counties are represented by that district. Most counties are completely contained within a single district, but there are 454 counties which belong to multiple districts. To illustrate, consider the hypothetical state in Figure 6 which has nine counties (A-I) and three congressional districts (1-3). Counties A, C, D, F, and H all lie within a single district, while counties B, G, and I lie in two districts, and county E lies in all three districts.

The Census provides the population of each county in a congressional district. Making a list of all counties, I record which districts are in each county and calculate what percentage

Figure 6: Congressional District to County Mapping



of the county's population is in each district. Therefore, for counties that resemble county E in Figure 6, I construct a weighted LCV score for each county that lies in multiple districts by multiplying the LCV score from each district by its percentage of the county. Counties that are completely contained within a district simply assume the score of that district. This procedure must be done for every ten-year Census period. I construct a panel of county-level LCV scores from 1988 to 2002 based on the 1980 Census (for years 1988-1992) and the 1990 Census (for years 1993-2002).

3.4 Toxics Release Inventory

The Toxics Release Inventory (TRI) is a publicly available database that can be obtained directly from the EPA. The data was retrieved using the EPAs Risk Screening and Environmental Indicators (RSEI) program version 2.1.2 (August 2004) [1]. This database contains data on point source (stack), fugitive, and direct water emissions as well as off-site transfer of toxic pollutants. Total pounds of emissions are reported, but the data also includes hazard and risk scores. Hazard scores are constructed by multiplying the pounds released by the chemicals' toxicity weight. Risk-based scores combine the surrogate dose with toxicity weight and population estimates. The temporal coverage of this data ranges from 1988 to 2002 and is available at the facility level. For the purpose of this paper I use pounds of stack air emissions aggregated to the county level. The number of TRI reporting facilities is provided by the RSEI program used to obtain data on emissions.

3.5 Additional Data

Per capita income data were obtained from the Bureau of Economic Analysis [23] and population density data were obtained jointly from the U.S. Census Bureau [5] and the Risk-Screening Environmental Indicators [1]. Both were available at the county level annually from 1988 to 2006.

4 Empirical Specifications

The primary objective of the empirical model is to examine what effect congressional voting on environmental policies has on toxic emissions at a local level. With that focus in mind, if toxic releases are to decrease, the second objective of the model is then to identify whether it is due to facilities leaving the county or shutting down because of increased regulatory stringency (extensive margin) or whether firms reduce their emissions by decreasing production or installing or upgrading abatement technology because of increased regulatory stringency (intensive margin). The third objective of the model is to run the same empirical analysis using both county-level and state-level data to compare the results in order to see if anything is to be gained from taking advantage of within-state variation.

The most similar empirical specification to this study is the one used by Terry and Yandle (T-Y) [26] in an attempt to identify a relationship between LCV scores and toxic releases (TRI). However, there are key differences between the two studies[4]. T-Y conduct their study at the state level while this study is conducted at the county level. T-Y use the average voting records of the two U.S. Senators in each state and this study uses voting records from U.S. Representatives constructed at the county level. The T-Y study is a cross-sectional analysis and this study takes advantage of panel data. While T-Y have a larger number of control variables than I do in this study, it is necessary when conducting a cross-sectional analysis to include as many relevant variables (time-variant and time-invariant) as possible, otherwise the estimation will suffer from omitted variable bias.

The advantage of panel data is that time-invariant variables can be differenced out using a first-differences model or time demeaned using a fixed-effects model, which greatly reduces the required number of variables for estimation, while not leading to omitted variable bias. That being said, there are still time-variant variables that I feel would be relevant to this study, but I was unable to obtain at this time. Assuming no serial correlation in the error terms, I use a fixed-effects estimation strategy. In the absence of serial correlation, fixed effects are more efficient than first-difference estimation. Generally, first-differences would be employed when a lagged value of the dependent variable is used as a regressor.

One concern with estimation is the potential endogeneity between LCV and TRI emissions. While it is possible that a higher LCV score will lead to a reduction in emissions, it

[4]Terry and Yandle use LCV scores as one of a number of key explanatory variables. Their study does not place the primary focus on LCV scores

also seems reasonable to assume that higher emissions levels could cause greater concerns about pollution and therefore higher LCV scores. T-Y also recognize this potential identification issue and they use the 1988 average of Senators LCV scores to explain TRI in 1992 (a four-year lag). In an attempt to identify the causal relationship between LCV scores (or more precisely the standards for which they proxy) and pollution, I treat previous years' LCV scores as the independent variable to test whether there is an effect on the current level of pollution, since current pollution should not have any causal effect on LCV scores in years prior to the current time period. Following that line of reasoning, I construct one- to five-year lagged LCV scores for at least 10 years in order to explain the effect of these scores on TRI emissions as well as how long before these policies would be effective. I construct a 15-year panel data set which includes the years 1988-2002 and includes the top fifty percent of TRI emitting counties, due to the large number of counties with zero emissions (743 counties) over the fifteen year period. The dependent variable is total pounds of stack air emissions from the TRI. The key explanatory variable is the county-level measure of LCV scores, which has been constructed as previously described.

To estimate the effect of pro-environment voting on overall toxic releases using an ordinary least squares fixed-effects framework, I estimate the parameters of the following equation

$$TRI_{it} = \alpha_0 + \alpha_1 LCV_{it-l} + \mathbf{X}_{it}\boldsymbol{\beta} + \delta_1 d1989_t + \ldots + \delta_{14} d2002_t + \gamma_i + \epsilon_{it} \tag{4.1}$$

where TRI_{it} represents the measure of total pounds of TRI stack air emissions in county i in year t. LCV_{it-l} is the pro-environment voting score for county i in year $t-l$ where $l \in \{1, \ldots, 5\}$ denotes the year lag. $\mathbf{X}_{it}$ is a matrix of control variables which includes population density and per capita income. To control for year effects that affect all counties, I include $d1989_t$,...,$d2002_t$ as dummy variables for years 1989-2002. The term γ_i is the county fixed effects, containing all factors within a given county that do not vary over time. To remove γ_i, I use time demeaning which is the fixed effects transformation model. ϵ_{it} is the idiosyncratic error term.

If toxic releases are decreasing as a result of higher LCV scores, the second objective of the empirical model is to identify whether this decrease is due to facilities leaving the county or shutting down because of increased regulatory stringency (extensive margin) or whether firms reduce their emissions by decreasing production or installing or upgrading abatement technology because of increased regulatory stringency (intensive margin). The second part of the model combines two specifications to analyze the effect of pro-environment voting on the number of TRI reporting facilities per county as well as per facility emissions. The panel data set is the same as above using years 1988-2002 and the top fifty percent of TRI emitting counties, however, in these specifications the dependent variables are the number of TRI reporting facilities per county and pounds of TRI stack air emissions per facility per county. To find out whether toxic releases are decreasing due to fewer facilities (extensive margin) or lower per-facility emissions (intensive margin), I estimate the parameters of the following two equations

$$Facilities_{it} = \alpha_0 + \alpha_1 LCV_{it-l} + \mathbf{X}_{it}\boldsymbol{\beta} + \delta_1 d1989_t + \ldots + \delta_{14} d2002_t + \gamma_i + \epsilon_{it} \quad (4.2)$$

$$Emissions/Facility_{it} = \alpha_0 + \alpha_1 LCV_{it-l} + \mathbf{X}_{it}\boldsymbol{\beta} + \delta_1 d1989_t + \ldots + \delta_{14} d2002_t + \gamma_i + \epsilon_{it} \quad (4.3)$$

using an ordinary least squares fixed-effects framework where $Facilities_{it}$ represents the measure of TRI reporting facilities in county i in year t. $Emissions/Facility_{it}$ is per-facility emissions in county i in year t. LCV_{it-l} is the pro-environment voting score for county i in year $t-l$ where $l \in \{1, \ldots, 5\}$ denotes the year lag. $\mathbf{X}_{it}$ is a matrix of control variables which includes population density and per capita income. $d1989_t, \ldots, d2002_t$ are dummy variables for years 1989-2002. The term γ_i is the county fixed effects term and ϵ_{it} is the idiosyncratic error term.

To address the third objective of comparing the county-level results to the state-level results, I repeat the estimation of equations 4.1, 4.2, and 4.3 using the state-level aggregates of the variables used in the county-level analysis. The state-level TRI measure (TRI_{jt}) is total pounds of TRI stack air emissions in state j in year t. The state-level TRI facilities measure ($Facilities_{jt}$) is the sum of all TRI reporting facilities in state j in year t. The state-level per-facility emissions ($Emissions/Facility_{jt}$) is total pounds of TRI stack air emissions in state j in year t divided by the total number of reporting facilities for that state in year t. The state-level LCV score (LCV_{jt-l}) is the average of the voting scores of the Representatives from all Congressional Districts in the state for each of $l \in \{1, \ldots, 5\}$ lags. Also included are the dummy variables for years 1989-2002 and the γ_j state fixed effects term. ϵ_{jt} is the idiosyncratic error term.

5 Results

The objectives of the empirical model are 1.) to estimate the effect of pro-environment voting on toxic emissions at a local level, 2.) to identify whether emissions are decreasing due to firm exodus (extensive margin) or a reduction in per-facility emissions (intensive margin), and 3.) to compare the results from county-level analysis and state-level analysis. The estimation results of Equation 4.1 for both county- and state-level measures are summarized in Table 1 for the one to three year lags and Table 2 for the four to five year lags.

Table 1: First Specification - Aggregate TRI Stack Air Emissions

	Total Pounds (County)	Total Pounds (State)	Total Pounds (County)	Total Pounds (State)	Total Pounds (County)	Total Pounds (State)
LCV_{t-1}	-1,251.759*	-31,085.81				
	[557.0398]	[42,501.11]				
LCV_{t-2}			-1,280.403*	-19,852.57		
			[549.6646]	[44,346.65]		
LCV_{t-3}					-1,157.845*	-52,967.85
					[553.8702]	[46,287.1]
Population Density	-1,187.114**	770,888.9**	-1,088.286**	775,656.2**	-932.9411**	799,375.8**
	[364.5939]	[152557.4]	[349.8771]	[160,789.6]	[348.6618]	[174,099]
Per Capita Income	-10.19399	-2,055.13**	-1.91313	-2,019.077**	.7322885	-1,997.423**
	[8.590981]	[605.2238]	[8.511845]	[623.136]	[8.751781]	[656.6381]
Constant	1,361,096**	2.20e+07*	1,136,484**	1.87e+07	1,013,004	1.59e+07
	[219,159.7]	[1.11e+07]	[216,944.6]	[1.17e+07]	[149,374.8]	[1.25e+07]
Observations	21,686	700	20,137	650	18,588	600
R^2	0.0134	0.1938	0.145	0.1927	0.0161	0.1997

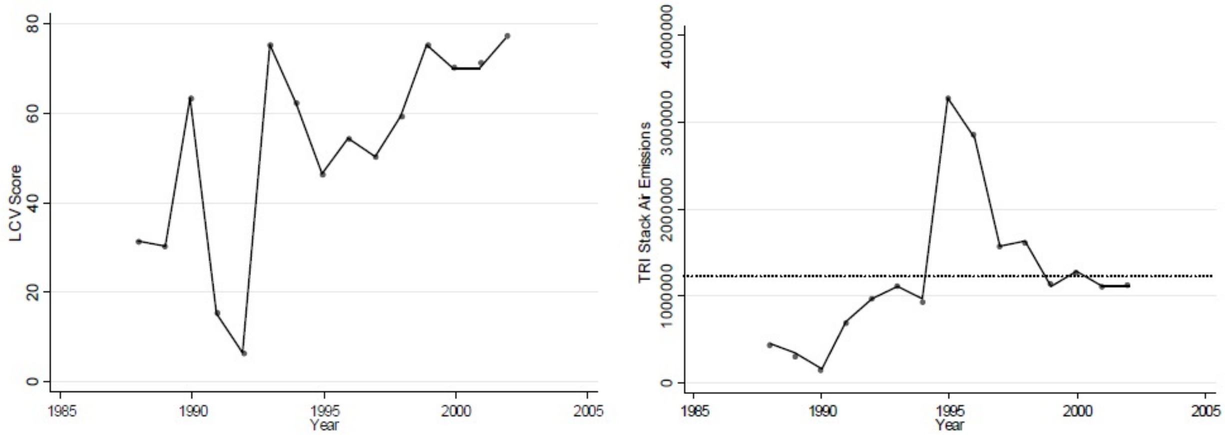
Standard errors in brackets
* significant at 5% level; ** significant at 1% level

Parameter estimation of Equation 4.1 confirms the expectation that higher LCV scores at the county-level lead to a slight reduction of TRI emissions since the coefficient on LCV_{it-l} is negative and statistically significant at the 5% level for $l \in \{1,2,3\}$. The model predicts that a 1-point increase in LCV score would lead to an overall decrease of TRI emissions per county by roughly 1,200 pounds. Even though this is statistically significant, with an average level of emissions in a county 897,266 pounds, this does not seem to be a very significant effect unless the voter score increased by a very significant amount. An increase in LCV score from 0 to 100 would be expected to decrease toxic releases by 120,000 pounds within one to three years.

With a closer look at the data, I identify counties that experience an increase of at least 50 LCV points to see if the model's prediction would hold true. Three different Michigan counties that fit the criteria offer some verification. A look at the emissions levels of Alpena County shows that it is one of the high-emission counties in the state with an average of 1,222,064 pounds of toxic emissions per year. Figure 7 shows two time trends for Alpena County: LCV scores and the level of TRI emissions over the fifteen-year period. Alpena County experienced a significant increase in LCV score of 69 points from 1992 to 1993 when the 1990 Census lines were redrawn and Alpena switched from District 11 to District 1. The model would predict that an increase in LCV score of 69 points would lead to a decrease of 82,800 TRI pounds within one to three years. From 1995 to 1996, three years after the LCV increase, Alpena County saw a decrease in emissions from 3,260,926 pounds to 2,846,030 pounds (an absolute change of 414,896 for a 12% decrease), which is a fairly substantial change. One year after that change, there was an even larger decrease from 2,846,030 in 1996 to 1,555,671 in 1997 (an absolute change of -1,290,359 for a 45.3% decrease), which is a very significant reduction in emissions.

Other Michigan counties that experienced a significant increase in LCV scores from 1992 to 1993 were Antrim and Delta Counties. Antrim County, with an average level of toxic emissions around 12,758 pounds per year, is a county with a much lower level of toxic emissions than Alpena County. The 69 point increase in LCV score from 1992 to 1993 lead

Figure 7: LCV and TRI Trends for Alpena County, MI



to a decrease in TRI from 15,600 pounds in 1994 to 10,000 pounds in 1995. This absolute change of 5,600 is much less than the model predicts, but given the relatively low level of emissions is a 35.8% decrease, which is a significant reduction in emissions. Delta County with average emissions per year equal to 640,650 pounds also experienced a 69 point increase in LCV score from 1992 to 1993 which lead to a decrease in TRI from 687,850 pounds in 1996 to 538,840 pounds in 1997. This was a 21.6% decrease in emissions.

Estimation of the coefficients on LCV_{jt-l} from Equation 4.1 using state-level measures are not statistically significant, so it seems that county-level measures provide more accurate measures of citizen preferences for regulation. Significance at the county level but not at the state level would suggest that changes are taking place in emissions across counties within states rather than across states because the LCV scores represent local preferences and not preferences for the state as a whole. From Table 7, aggregation to the state level smoothes out the variability such that the maximum absolute change in LCV scores is 53 points, where at the county level the maximum absolute change is 92 points.

The second part of the model decomposes the extensive and intensive margins. From the parameter estimation of Equation 4.2, the number of TRI reporting facilities is predicted to decline as a result of higher LCV scores. From Table 3, the coefficients of LCV_{it-l} for the county-level data are negative and statistically significant at the 1% level for $l \in \{1,2\}$ which would suggest that firms are exiting the counties or shutting down because of increased regulatory stringency. However, the magnitude of the coefficients suggests that LCV is not enough of a factor to cause facilities to exit or shut down at the county level. A one-point increase in LCV score leads to 0.006 fewer facilities at the county level and 0.27 fewer facilities at the state level. This does not seem to have a significant effect at the county level since the maximum increase in LCV score from 0 to 100 would only lead to a 0.6 facility decrease. This is not too surprising given that LCV is an indirect measure of regulatory stringency. Also, the average number of facilities in a county is about 8 and the average change in facilities is -0.006. At the state level there seems to be a small meaningful effect on facility numbers since the coefficient on LCV_{jt-l} is negative and statistically significant at the 5% level for $l = 1$. The model predicts that the maximum increase in LCV score from 0 to 100 in state j would lead to a decrease of 27 facilities.

From the parameter estimation of Equation 4.3, the lack of statistical significance with the exception of the two-year lag on LCV suggests that votes have an effect on per facility TRI emissions and that it takes about two years for these to take effect (Table 5). It appears that firm exodus is the cause of the reduced emissions at the state level, but at the county level very few firms are exiting as a result of the voting pattern. This conclusion of firm exodus at the state level is consistent with many of the studies on firm location decisions which find that strict environmental regulation induces firms to locate in or shift in production to less stringent counties. Given the limitations on firm data it is not possible to identify whether the facilities simply shut down or whether they relocated since only the number of TRI reporting facilities is used. At the county level it may be an indication that there is actual reduction of emissions taking place and not simply a redistribution.

6 Conclusion

The primary objective of this paper is to examine what effect congressional voting on environmental policies has on toxic emissions at a local level. If toxic releases are decreasing, the second objective of the model is then to identify whether it is due to facilities leaving the county or shutting down because of increased regulatory stringency (extensive margin) or whether firms reduce their emissions by decreasing production or installing or upgrading abatement technology because of increased regulatory stringency (intensive margin). The third objective of the model is to run the same empirical analysis using both county-level and state-level data to compare the results in order to see if anything is to be gained from taking advantage of within-state variation.

I use county-level measures of pro-environment voting from the U.S. House of Representatives as a proxy for regional heterogeneity in preferences of citizens for more or less regulation. U.S. Representatives are more accountable to their constituents because of the frequency of re-election and because they represent a smaller geographical region. Even though constructing county-level measures of voting scores requires a degree of approximation in counties that lie partially in multiple districts, the fact that county lines do not change with the decennial Census allows for measures of emissions activity in specific locations over time using panel data spanning more than ten years.

People living in low-income and minority communities are the most directly affected by toxic releases and prefer more regulation since they cannot afford to self-select into cleaner neighborhoods. They are also the groups that are least likely to engage in collective action against polluters or to lobby politicians to make their voices heard. Assuming that legislators take different groups preferences into account when deciding how to vote on different policies, if they are voting more pro-environment at the national level, this indicates that there is overwhelming pressure from those groups at the local as well.

The results show that pro-environment voting scores at the county level are associated with a reduction in TRI emissions within one to three years after the voting has occurred. Significance at the county level but not at the state level would suggest that changes are taking place in emissions across counties within states rather than across states because LCV scores represent local preferences and not preferences for the state as a whole. It appears that firm exodus is the cause of the reduced emissions at the state level, but at the county level very few firms are exiting as a result of the voting pattern. This conclusion of firm exodus at the state level is consistent with many of the studies on firm location decisions which find that strict environmental regulation induces firms to locate in or shift in production to less stringent counties. At the county level it may be an indication that there is actual reduction of emissions taking place and not simply a redistribution. To the best of my knowledge, this paper is the first to construct county-level measures of pro-environmental voting from the U.S. House of Representatives and use them as a proxy for citizen preferences for regulation to determine their effect on toxic releases at a local level.

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Table 2: First Specification (continued) - Aggregate TRI Stack Air Emissions

	Total Pounds (County)	Total Pounds (State)	Total Pounds (County)	Total Pounds (State)
LCV_{t-4}	-292.1132	-39,842.36		
	[584.833]	[50,135.78]		
LCV_{t-5}			351.4845	-24,848.22
			[608.3921]	[53,974.59]
Population	-801.4225*	784,209.4**	-643.1049	742,870**
Density	[360.2488]	[190,156.6]	[369.4878]	[205,022.7]
Per Capita	3.821785	-2,003.081**	7.534167	-1,917.258*
Income	[9.456469]	[716.7342]	[10.10273]	[781.702]
Constant	919,895.8**	3.31e+07	782,365.5**	1.49e+07
	[240886.2]	[1.93e+07]	[257718.4]	[1.55e+07]
Observations	17,039	550	15,490	500
R^2	0.0172	0.2052	0.0192	0.2120

Standard errors in brackets
* significant at 5% level; ** significant at 1% level

Table 3: Second Specification - Number of TRI Reporting Facilities

	Facilities (County)	Facilities (State)	Facilities (County)	Facilities (State)	Facilities (County)	Facilities (State)
LCV_{t-1}	-.0064565**	-.2726643*				
	[.0014175]	[.138945]				
LCV_{t-2}			-.0040485**	-.1096174		
			[.0014352]	[.1410198]		
LCV_{t-3}					-.0008025	.0329351
					[.0013169]	[.1292357]
Population	-.003496**	-1.407614**	-.0031843**	-1.161869*	-.0017143*	-.6882625
Density	[.0009278]	[.4987421]	[.0009135]	[.511302]	[.000829]	[.4860924]
Per Capita	-.0003801**	-.0101204**	-.0003563**	-.0095558**	-.0003173**	-.0088314**
Income	[.0000219]	[.0019786]	[.0000222]	[.0019815]	[.0000208]	[.0018334]
Constant	18.51549**	579.2247**	17.78268**	573.5837**	14.64258**	518.1246**
	[.5576813]	[36.42761]	[.5664427]	[37.35624]	[.3551524]	[35.00681]
Observations	21,686	700	20137	650	18588	600
R^2	0.0407	0.2636	0.0410	0.2723	0.0393	0.2691

Standard errors in brackets
* significant at 5% level; ** significant at 1% level

Table 4: Second Specification (continued) - Number of TRI Reporting Facilities

	Facilities (County)	Facilities (State)	Facilities (County)	Facilities (State)
LCV_{t-4}	.0014742	.1270258		
	[.0012465]	[.1224663]		
LCV_{t-5}			.0014491	.1236795
			[.0011525]	[.1124741]
Population Density	-.0006295	-.4719102	.0002882	-.2117155
	[.0007678]	[.464494]	[.0006999]	[.4272333]
Per Capita Income	-.000256**	-.0069915	-.0001721**	-.0050948**
	[.0000202]	[.0017508]	[.0000191]	[.0016289]
Constant	14.70237**	513.7995**	12.44256**	406.6307**
	[.5133995]	[47.07535]	[.4882016]	[32.31146]
Observations	17,039	550	15490	500
R^2	0.0353	0.2644	0.0302	0.2646

Standard errors in brackets
* significant at 5% level; ** significant at 1% level

Table 5: Third Specification - Pounds of TRI Emissions per Facility

	Pounds Per Facility (County)	Pounds Per Facility (State)	Pounds Per Facility (County)	Pounds Per Facility (State)	Pounds Per Facility (County)	Pounds Per Facility (State)
LCV_{t-1}	-287.4422	216.4225				
	[254.514]	[286.3277]				
LCV_{t-2}			-585.3194*	351.4873		
			[273.9625]	[270.2497]		
LCV_{t-3}					-564.8615	521.3212
					[291.4394]	[268.7568]
Population Density	78.4251	4,930.769**	78.24086	4,664.9**	81.65865	4,346.673**
	[166.5846]	[1027.771]	[174.3849]	[979.8565]	[183.4613]	[1,010.871]
Per Capita Income	6.647133	-2.362428	7.6604	-3.423442	7.896845	-4.132459
	[3.925258]	[4.07736]	[4.242453]	[3.797407]	[4.605074]	[3.812638]
Constant	28,078.16	-126,538.2	11,493.26	-124,621.8	40,108.17	-115,091.2
	[100,135.1]	[75,067.35]	[108,129]	[71,589.29]	[78,599.1]	[72,799.67]
Observations	21,686	700	20,137	650	18,588	600
R^2	0.0031	0.0958	0.0034	0.0882	0.0034	0.0906

Standard errors in brackets
* significant at 5% level; ** significant at 1% level

Table 6: Third Specification (continued) - Pounds of TRI Emissions per Facility

	Pounds Per Facility (County)	Pounds Per Facility (State)	Pounds Per Facility (County)	Pounds Per Facility (State)
LCV_{t-4}	-192.5812	570.0449*		
	[316.7589]	[287.9047]		
LCV_{t-5}			-9.737556	2 66.4511
			[340.7137]	[294.6373]
Population	78.97808	4,139.443**	82.53677	4,069.3**
Density	[195.119]	[1091.974]	[206.9217]	[1119.181]
Per Capita	9.283586	-4.136407	9.705404	-4.20574
Income	[5.12184]	[4.115846]	[5.657765]	[4.267167]
Constant	-42,096.49	-101,459.6	-59,328.04	-96,950.68
	[130469.5]	[110669]	[144328.3]	[84643.15]
Observations	17,039	550	15,490	500
R^2	0.0032	0.0909	0.0033	0.0907

Standard errors in brackets
* significant at 5% level; ** significant at 1% level

Table 7: Summary Statistics

Top 50% of Emitting Counties (1988-2002)

Variable	Obs	Mean	Std. Dev.	Min	Max
LCV score	23,444	36.89369	29.06418	0	100
TRI pounds (stack air)	23,505	897,266	2,731,773	0	1.19e+08
TRI reporting facilities	23,505	8.5612	18.1613	0	486
Per-facility emissions	23,505	182,606.3	945,129.4	0	6.50e+07
Per-capita income	23,505	19,923.31	5,601.505	7,380	61,759
Population density	23,505	132.4999	555.7981	0	13,582
Δ LCV score	21,866	-.9736862	17.65127	-92	92
Δ TRI pounds	21,938	-15,957.49	892,607.9	-3.39e+07	2.35e+07
Δ TRI facilities	21,938	-.0062905	1.828708	-53	39

States (1988-2002)

Variable	Obs	Mean	Std. Dev.	Min	Max
LCV score (U.S House average)	750	46.30506	24.27527	0	100
TRI pounds (stack air)	750	2.83e+07	2.90e+07	37,296	1.44e+08
TRI reporting facilities	750	284.128	272.5141	3	1252
Per-facility emissions	750	118,420.4	152,150	2,491.004	1,691,254
Per-capita income	750	22,809.8	5,385.068	11,561.27	42,920.69
Population density	750	66.80337	92.02104	.5229201	446.4016
Δ LCV Score	700	-.637406	10.86083	-56	43
Δ TRI pounds	700	-501241.2	8,516,750	-4.12e+07	9.38e+07
Δ TRI facilities	700	.1542857	22.13909	-119	131