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Note: As, instructed, this examination does not have an appendix. All tables are referred to and displayed directly in the text.

Abstract

The purpose of this study is to investigate whether political partisanship affects firms' decision to pollute. An initial hypothesis is that Republican-governed firms pollute more. Using panel data with time fixed effects we *initially* find significant correlation between political party and pollution on a facility-chemical level – with chemicals in facilities in Republican-governed districts emitting over 20 per cent more emissions than Democrat-governed districts. However, when controlling for both entity- and time fixed effects we find no significant correlation between political party and emissions. The same results are found after adjusting for selection bias and utilizing a difference-in-difference model.

Table of Contents

1. Introduction

In this study, we examine the link between political partisanship and firms' decision to pollute. Distinctive for Democrats and Republicans are their different political beliefs and preferences regarding pollution. Typically, Democrats tend to support pollution reduction schemes while Republicans disfavour and thus vote against them.

We investigate whether the elected officials in the 435 congressional districts across each of the 50 U.S. states from the 107th to 114th congress affected industrial pollutions of chemicals regulated under the Clean Air Act. More concisely, the objective of our study is to conclude if industrial pollution in the U.S over approx. the last two decades have been affected by whether a Republican or a Democrat was in power.

To address this research question, we use a two-way (entity- and time-fixed) regression approach, as well as a time-fixed panel data and a difference-in-difference approach. The result depends on political partisanship: we do not find an increase in pollution for districts with a Republican office.

2. Data

We employ three datasets: one that includes data on the elections in the House of Representatives, one that includes data on pollution per facility and chemical, and one that includes data on facility location. We use the dataset on facility location even though it only includes up until the 114th congress. Another option we considered which would allow us to also include the 115th & 116th congress was to link facilities to their respective district by the ZIP code using an external R package[1]. However, U.S ZIP codes can overlap several congressional districts (with potential different political partisanships) and even state lines (Schulze, 2012). Based on this we constrained ourselves to the data set including facility locations.

The first step in the data cleaning and wrangling is to add variables for each congress and their respective election- and start-year. Next, we calculate who won the U.S. House of Representatives elections in each district. We do this by calculating which candidate received the most votes, and based on this, added variables for the two subsequent years where the elected officials represented their district (e.g., the 107th congress was elected in 2000 and met in the two subsequent years). Further, we base our study on elections in the period from year 2000 to 2018 and limit the parties to Republican or Democrats. We also disregard the elections which were held off-cycle, referred to as "special". Unanimous elections are also kept in our data set. Further, we assume that the reporting year is the same year as the emissions occur. The data on facility location are used to create a variable for state, district, and congress as we need to merge the dataset to our main data frame. Finally, we only consider chemicals regulated under the Clean Air Act. As some chemicals are measured in different units[2], we standardize all in the unit of pounds. Finally, we winsorize all relevant variables on a 1 per cent level.

[1] zipcodeR: https://cran.r-project.org/web/packages/zipcodeR/zipcodeR.pdf

[2] Grams and pounds.

Table 1 displays the summary statistics of our main data frame where we split the data between the Democratic and Republic parties that won in each U.S. House of Representatives election. The descriptive table could have been grouped by other variables than the two parties, however, we believe this provides the most insight into the analysis.

Table 1: Descriptive statistics

	DEMOCRAT	REPUBLICAN
Mean emissions	9303.864	10602.896
Sd emissions	35967.21	38561.76
n	272716	366791
First congress	107	107
Last congress	114	114
First voting year	2000	2000
Last voting year	2014	2014

3. Empirical analysis

3.1 Does political partisanship affect pollution?

We initiate our analysis by investigating if a facility is in a republican district and production output result in an increase in pollution. We do this by creating a dummy variable for Republican, equal to 1 if a facility is in a Republican district and 0 (Democrat) otherwise. One candidate for a control variable would for example be facility output, however it is highly likely that this leads to reverse causality bias, hence violating the first least squared assumption[3]. Despite this, we have an extensive data set which we can exploit using panel data regressions with fixed effects. Further, it is important to emphasize that we study pollution on a facility-chemical level and *not* on a facility level. If we were to use panel data based with facility-time as index, we would have to aggregate emissions across chemicals. This would create measurement errors[4], as some chemicals are more toxic per pound emitted than others.

In Table 2 column (1) we run a regression with time fixed effects[5] to control for unobserved variables that are constant across entities but evolve over time (Stock & Watson, 2020). Such omitted variables could for example be national emissions regulations and laws that all facilities in the U.S. share. In this regression (column 1) we find that emissions in states with republican leadership has 23.9 per cent higher emissions than democratic states (note the dependent variable is logged). In column (2) however, we control for both entity and time-fixed effects[6]. This is to control for omitted variables that are constant over time but vary across facility-chemical level (such as industries and technology of the facilities)[7]. Controlling for two-way fixed effects we find that chemical emissions from facilities with republican

[3] Conditional distribution of the residual given the independent variable has a mean of zero. The simultaneous bias occurs because facilities with a higher output most likely also emit more pollution.

[4] Violates least squared assumption 1, the conditional distribution of the residual given the independent variable has mean zero.

[5] Entity-fixed effects is used as well, but not displayed in paper due to constraint on number of models per table.

[6] Facility-***chemical***-time fixed effects, *not* facility-time fixed effects. E.g., one facility can emit 188 different chemicals which all have a different grade of impact on the environment. As a result of using panel data set with facility and time there would be duplicated facility-time values, as each facility has multiple chemicals in each period.

[7] For example, a facility which emits a lot of the chemical Toluene might be in the industry of manufacturing paints or lacquers. While a facility which omits little of Toluene might be in the industry of toy manufacturing. This omitted unobserved variable which we not explicitly account for can create bias in our regressions.

leadership is 3 per cent lower than those with democratic leadership. This is a significant difference from the time-fixed effects model, and show the omitted variable bias the model in column (1) has.

Table 2: Effect of political partisanship on pollution

	Dependent variable:		
	log(emissionAir)		
	(1)	(2)	(3)
Republican	0.239***	-0.030***	
	t = 9.384	t = -3.497	
Treatment			0.469***
			t = 9.260
Treatment*After			0.020
			t = 1.082
Observations	639,507	639,507	152,810
Note:			*p<0.1; **p<0.05; ***p<0.01

To further study the question of how political partisanship affect pollution we construct a difference-in-difference (DiD) model (column (3)) to estimate the effect of a *change* in political partisanship. The DiD model gives a more granular view of the differences between pollution under Republicans in office versus Democrats. For the DiD model we consider the 111th and 112th congress. We use this period because it represents the largest change in the United States House of Representatives in our data (U.S. Office of the Historian, 2022), and the Republican Party won majority – see Figure 1[8] on the next page. Based on this, we create a treatment group where we define the treated group as facilities that went from Democratic to Republican rule.

We define the control group as facilities in districts under Democratic rule that does *not* change ruling party. Further, it is reasonable to assume that there is a parallel trend between the groups, based on the similarities of the observations in the data set[9]. Column (3) shows that the DiD

[8] The Republican increased their number of districts by 56.

[9] All facilities in the data set are related to companies classified as mining, manufacturing, utilities, waste management or wholesale trade that produce more than 25.000 pounds of toxic chemicals a year (Fowler, L, 1910).

effect is 2 per cent for firms that goes from Democratic to Republican rule – however, the significance of the DiD variable is small. A final point to be made for all regression models is that the population is most likely not randomly sampled and cannot be said to be IID[10] – we deal with this bias in Table 3. Note that we use robust standard errors as errors cluster on the dimension of chemicals.

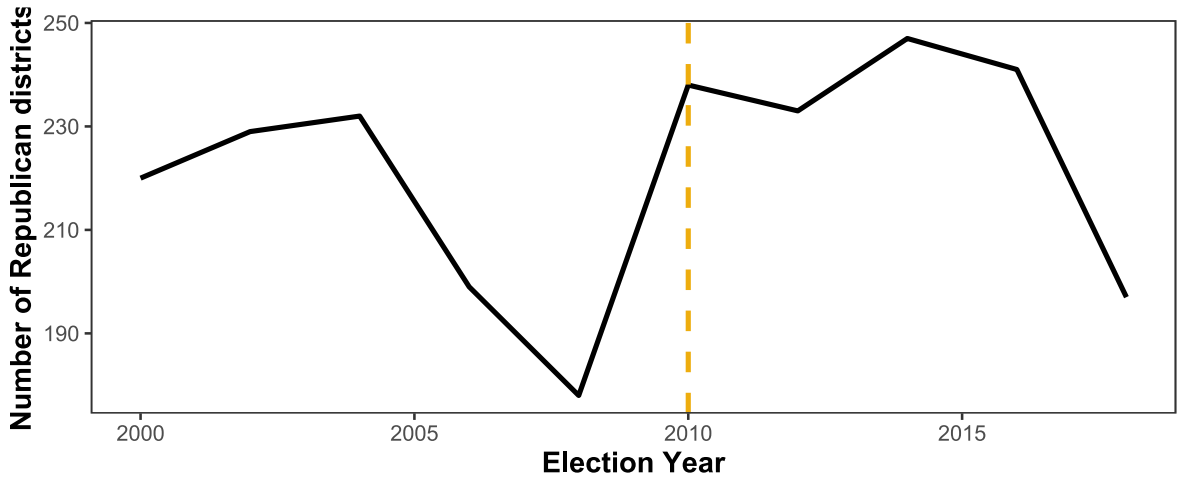

Figure 1: Number of Republican-controlled districts for all election years

[10] Independent and identically distributed.

3.2 Causality

In Table 3 we deal with an important bias of the study – random sampling. We do this by calculating which elections were won on the margin. More specifically, if one party won with a margin of 5 per cent or less[11], the election result can be considered as random. By doing this we remove the selection bias that many districts vote for the same party each year – something which implies that the election outcome was not random as there is autocorrelation. When adjusting for this bias we see dramatically changes in our models compared to Table 2. We find a weak relationship between party and emissions when using time-fixed effects (column 1) – 11 per cent higher emissions for facility-chemicals in republican districts. And zero relationship between party and emissions when using time- and entity-fixed effects (column 2). Lastly, the DiD coefficient is negative, but has zero significance.

Table 3: Causality

	Dependent variable:		
	log(emissionAir)		
	(1)	(2)	(3)
Republican	0.113**	-0.019	
	t = 2.005	t = -0.813	
Treatment			0.542**
			t = 2.182
Treatment*After			-0.135
			t = -0.969
Observations	35,695	35,695	10,860
Note:			*p<0.1; **p<0.05; ***p<0.01

[11] E.g., in Ohio, district 1 in 2008 the democratic candidate won by merely 4.98 percent against the republican candidate (52 vs. 47 percent).

3.3 Are firms shifting pollution from Democratic to Republican districts or vice versa?

In Table 4 we study whether firms that have the majority of their facilities in republican districts reduce pollution in districts that recently has changed partisan control from Democratic to Republican. We do this by creating a dummy variable for political party exposure[12], equal to 1 if a firm has most facilities in a Republican district and 0 if most facilities is in Democrat districts.

To analyse the effect of firm's party exposure on districts that have changed partisan control we use a Difference-In-Difference approach with the same treatment and control group as previously. The treatment group consist of districts that in the election year of 2010 changed from Democrat to Republican control. In the naive OLS regression (column (1)), and in column (2) which is estimated with time-fixed effects, we find that firms with most exposure to Republican districts reduce pollution after the change from Democrat to Republican control. However, when we estimate the same model with entity-fixed effects in column (3), we find no significant correlation between partisan exposure and changes in pollution. In column (1) and (2) we also find that districts in the treatment group increase pollution after changing from Democrat to Republican control.

[12] The dummy variable for firm's exposure to republican controlled districts is created by using the difference between number of facilities in republican-controlled districts and the number of facilities in democrat-controlled districts. The dummy is 1 if the difference is positive and 0 if the difference is negative.

Table 4: Effect of firm's political party exposure on changes in pollution in districts with new partisan control

	Dependent variable:		
	log(emissionAir)		
	(1)	(2)	(3)
Republican Exposure	-1.119***	-1.157***	-0.005
	t = -21.659	t = -21.810	t = -0.458
Treatment	0.509***	0.506***	
	t = 8.542	t = 8.492	
After	0.007		-0.022***
	t = 0.472		t = -3.275
Treatment*After	0.031*	0.036*	-0.017
	t = 1.398	t = 1.635	t = -1.164
Constant	4.771***		
	t = 193.500		
Observations	109,690	109,690	109,690
Note:			*p<0.1; **p<0.05; ***p<0.01

4. Conclusion

In this study the main purpose was to examine the relationship between partisanship and pollution by firms. We constructed a time fixed, and entity-time fixed regressions as well as DiD regressions to establish this relationship. The results from this study show that there is no significant way to say that firms (on a facility-chemical level) in Republican districts emit more than those in Democrat districts when using a time-*facility-chemical* fixed effect regression and DiD. This is *somewhat* contrary to what other studies show (e.g., Fowler & Kettler, 2020), and further studies (if time admitted) with additional data would prove useful in understanding why. Finally, we find that firms with most facilities in Republican districts reduce pollution after the districts change from Democrat to Republican control.

5. References

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