The political economy of environmental regulation: the role of lobbying and elections in the US Senate*

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Abstract

How is environmental policy affected by political economy forces? Despite renewed interest in the role of environmental regulation in the energy transition, this question remains largely unanswered. This paper develops an analysis of electoral accountability and influence in policy formation. Specifically, I use a comprehensive dataset on environmentally related votes in the US Senate for 1971-2013 to assess the impact both of electoral incentives and industry contributions on the voting behavior of senators, making use of the staggered structure of senators' elections for identification. I find that the re-election incentive reduces a senator's probability to vote against environmental regulation by between 2% and 3.5%, and this effect is larger the larger environmental support in their state is. Furthermore, the results indicate this effect is driven by republican senators trying to capture pro-environmental vote. Finally, contrary to findings in previous literature, past contributions seem to have a significant impact on voting behavior only toward the end of senators' terms, suggesting pro-industry voting is used to attract more funding but not to reward past contributions. The results have important implications for the political feasibility of environmental regulation.

JEL classification: D72, Q58, C33
Keywords: Electoral accountability, Lobbying, Environmental policy, Panel data

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1 Introduction

Climate change and related environmental challenges already affect economic and financial decisions and are expected to do so even more as the world advances towards decarbonization. While a large economic literature has focused on setting out welfare maximizing policies that promote environmental protection, there is concern that these policies cannot be easily implemented within political systems with agents that differ in preferences and political power. Existing political economy and contract theory literature has showed that political forces have strong impacts on the design of economic policy, and specifically of environmental policy. In many instances however, it is not clear which are the main forces at play - such as voters or special interest groups - and how they interact differently at different points of the political process.

This paper aims at understanding the political economy forces present in the design and passing of environmental legislation. Specifically, I use a comprehensive dataset on environmentally related roll-call votes in the United States (US) Senate for 1971-2013 to assess the impact both of voter preferences and industry contributions on the voting behavior of senators. In order to determine which votes are environmentally related, I use the classification of the League of Conservation Voters (LCV). In the US Senate all senators fulfill six-year terms and one third of senators are up for re-election every two years. This means that at any given point there are senators in the first two years (first generation), third and fourth year (second generation) and last two years (third generation) of their term. I use this staggered structure of senators' elections for identification, and study differences in behavior of senators closer and further from re-election, and how these vary with preferences of the citizens (electoral accountability) or contributions of oil, gas, and mining industry (lobbying impact).

The empirical analysis has a focus on US Senate data for several reasons. Firstly, it was possible to collect a large and detailed dataset, which allows to extend the analysis to several years and explore the panel data structure. Second, the staggered structure of the US Senate, in which senators serve six-year terms and one third of them is up for reelection every two years, allows to identify the impact of an election. Finally, environmental policy has gained an important role in the American political landscape (Hillstrom and Hillstrom, 2010), and thus understanding the political economy aspect of it is of particular relevance. The insights generated however, have more general implications to the political economy of environmental regulation that go beyond the specific setting.

The results show that the electoral incentive has an impact on voting behavior with regards to environmental protection. Specifically, I find that being of the third generation (and thus closer to re-election) decreases the probability of casting an anti-environmental vote by between 1.01 and 1.8 percentage points, depending on the empirical specification. This implies a decrease in the predicted probability of voting against environmental protection of between 2.1% and 3.5%. This effect is larger for larger shares of pro-environmental public opinion, in

line with an electoral accountability motive. When looking at different types of votes, these results are visible for the areas of drilling, lands/forests, water, dirty energy, and transport, arguably some of the most visible issues.

I then investigate whether these effects differ depending on the ideology of senators. Since democrat senators are most likely to have preferences aligned with pro-environmental voters than republican senators, then if changes in voting behavior are due to the re-election incentive to please these voters, this changes should be observed only (or more) for republican senators. My results corroborate this hypothesis.

Finally, I study the impact of contributions from the oil, gas, and mining industries on voting patterns. I compare their impact on senators belonging to different generations, and find that senators receiving larger contributions in the past decrease their probability of voting anti-environment close to elections significantly less. I observe this effect for votes more directly related to the oil, gas, and mining industries, but not for others. There is no significant impact of contributions on the voting behavior of senators that have just been re-elected (of the first generation), which suggests pro-industry voting is used to attract more funding but not to reward past contributions.

This paper extends the empirical literature on lobbying and electoral accountability in two ways. First, by providing an empirical analysis that uses the timing of elections, public opinion data, and campaign contributions to disentangle lobbying and election impacts in the choice of public policy. Second, I add to the literature by studying this issue in the specific context of environmental policy for the rich setting of the US Senate. Despite the interest on the formation of environmental protection legislation, especially in the context of the United States, no such analysis has ever been conducted to the best of my knowledge. The relevant literature is further analysed in Section 2.

The results have important policy implications. In terms of the timing of introduction of regulation for which there is public support but strong interest group opposition, they imply that in contexts where interest groups are less powerful but still influence decision-making, introducing regulation might be more politically feasible when electoral incentives are higher, particularly if public support reaches a given threshold. Specifically, there might be a scope to limiting campaign contributions to allow for electoral incentives responding to the democratic will to prevail. The insights generated also contribute to explain how some policies are passed in some legislatures but not in others if they have the same support from citizens. Finally, they help understand whether monetary campaign contributions (specifically by powerful industries) have a disproportional impact relative to voters preferences in the passing of regulation, a question that has long been the interest of political scientists. This is particularly relevant for the case of environmental policy, specially for the introduction of environmental regulation that is politically feasible. An effective transition towards environmental sustainability strongly hinges on our grasp of these questions.

The remainder of the paper is organized as follows. Section 2 situates the paper within related

literature. Section 3 presents the data and introduces the different empirical specifications and estimation methods. Section 4 describes the four sets of results, and finally, Section 5 concludes and introduces avenues for further work.

2 Literature

Most of the earlier existing theory on the use of economic policy as an instrument to seek voter support focuses on models with full commitment by downsian politicians: following Downs (1957), candidates are purely office-motivated, and make binding promises as to the amount of spending they offer to voters. Lizzeri and Persico (2001) study a model where two candidates choose between promising the provision of a public good, which gives higher welfare, and redistributing money, which can be targeted to subsets of voters, to identical utility maximizing voters. They find that, not only is there inefficiently low provision of public goods, but also that it differs across electoral systems, since they provide different incentives. Persson and Tabellini (1999) compare two models of political institutions to explain cross-country differences in economic public policy. They study, for one model, differences derived from having a proportional or a majoritarian election rule and, for the other, differences between presidential and parliamentary regimes. Ashworth (2012) reviews the more recent theoretical and empirical literature on how politicians change their policy choices in response to electoral concerns.

Although traditionally, secondary policy issues like environmental policy were seen as being mainly influenced by lobbying, as opposed to electoral concerns, there is a growing literature that focuses on the role of the election incentive in shaping environmental policy. Specifically, List and Sturm (2006) study whether secondary policy issues such as environmental policy are affected by re-election concerns. Focusing on environmental expenditures by United States governors, they find evidence of a strong impact of the prospect of re-election on the choice of environmental spending. In Costa (2018) I argue that not only re-election incentives matter for the choice of environmental expenditures in US states, but this influence varies across the political cycle and could stem from signaling of preferences. Both these studies refer only to state governors' choices in the context of gubernatorial elections.

The literature on The paper also relates to the literature examining the determinants of the voting behavior of US congressmen. This area has examined several issues, such as federal and tax spending (Peltzman, 1985), gun control (Bouton et al., 2014), trade policy (Conconi et al., 2014), or general ideological position (for example Bernhard and Sala, 2006). None of these papers however attempts to put together electoral incentives and the influence of lobbying, relating mainly to the former.

Regarding the latter (i.e., the impact of lobbying in legislators voting behavior), there is widespread consensus that special interest groups have considerable influence over public policy making with regards to secondary policy issues. The New Political Economy literature

(Stigler, 1971, Peltzman, 1976, Becker, 1983) has formalized this idea in models where special interest groups use campaign contributions to promote a preferred policy and politicians accept contributions to maximize their prospects of electoral victory. Grossman and Helpman (1992) use a principal agent setting to model the impact of various lobby groups in determining trade protection by a single politician. The modeling of lobbying influence on policy choice as a common agency game has been followed in subsequent literature. For example, Le Breton and Salanié (2003) develop a common agency game to study policy formation with endogenous lobby formation and uncertain politician preferences. In terms of empirical applications, most of the applied economic literature on the impact of lobbying in secondary policies has focused mainly on trade policy. For example, Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) test the implications of the Grossman and Helpman (1992) model.

3 Empirical Model

3.1 Data

The dataset used covers all votes on environmental issues in the US Senate from 1971-2013, for a maximum of 49 716 observations. It includes data on roll-call votes on environmental legislation, data on senator elections, and data on environmental preferences, and data on contributions by the oil and gas industry. Data on roll-call votes was collected by Kim and Urpelainen (2017c) using information retrieved by the League of Conservation Voters (LCV). The LCV collects information on all legislation related to environmental protection considered in the US Congress. It collects all individual votes and classifies them as pro or against environmental protection.
Figure 1 depicts the total number of roll-call votes in environmental legislation in the Senate by year in gray bars, and the share of anti-environmental votes cast per year in a green line. There were a total of 499 votes in the period. For each vote, each two senators in each state cast a vote.

The LCV classifies the issue area of votes into one ore more of twelve categories: air, clean energy, climate change, dirty energy, drilling, lands/forests, oceans, toxics/public right to know, transport, water, wildlife, and other. The exact definition of what is included in these categories is presented in A.1 in Appendix A.
Figure 2 depicts the total votes by each category included in the sample.[1] The issues with the most votes in the US Senate were lands/forests and dirty energy, while those with the least were oceans and climate change.

In order to account for public attitudes towards environmental protection in each state, I use a variable constructed by Kim and Urpelainen (2018) and Kim and Urpelainen (2017a)

[1]Note that a vote may belong to more than one category.

Figure 1: Environmental roll-calls and votes, 1971-2013

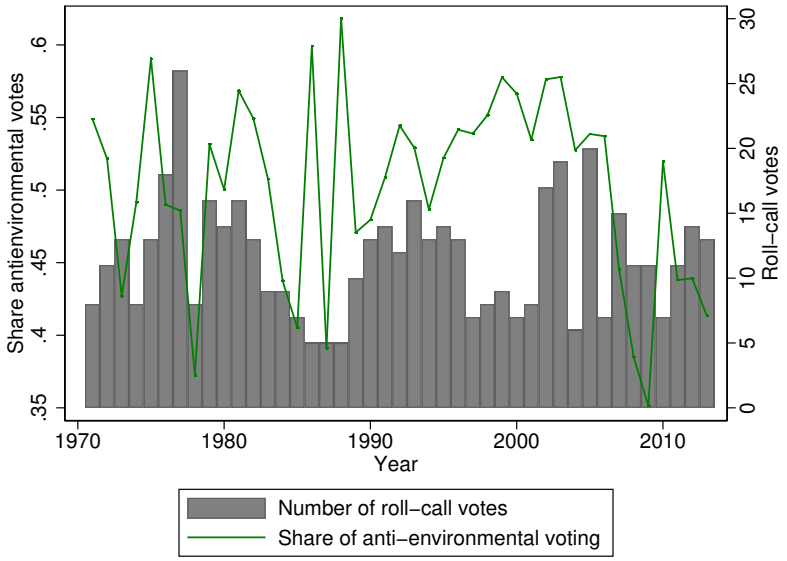
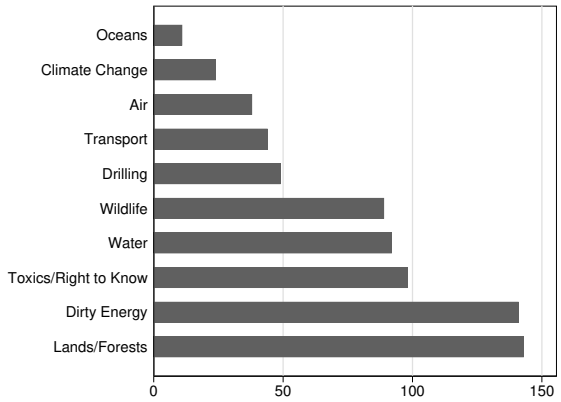
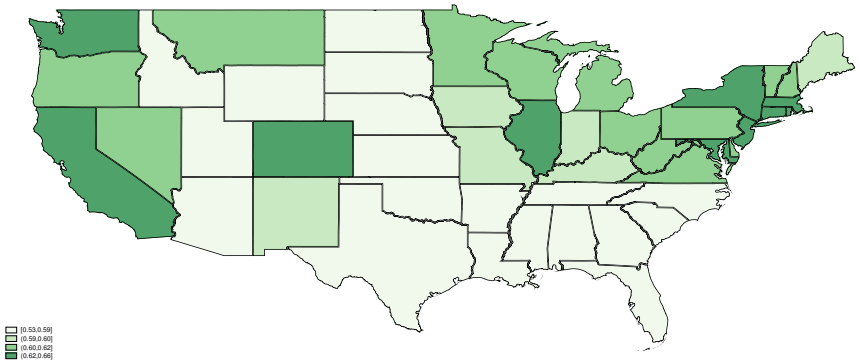


Figure 2: Total votes by theme, 1971-2013



by applying multi-level regression and poststratification techniques to data from the United States General Social Survey, 1973-2012. The variable estimates pro-environmental attitudes in the public in each year in each state. Figure 3 presents the average environmental opinion by state for all the years for which the variable exists (1973-2013).

Figure 3: Environmental bias by state, average 1971-2013



Data on election dates, ideology of senators, and share of vote for each senator was collected from Kim and Urpelainen (2017c) with information provided by the CQ Voting and Elections Collection, and from the United States Senate webpage (www.senate.gov). Following Bouton et al. (2014), I use election dates to classify senators into three generations: those that are in the first two years of the term (first generation), those that are in the third and fourth year (second generation), and those that are in the last two years, and therefore facing a re-election (third generation). The co-existence of a third generation of senators and senators of other generations is the basis of the identification strategy. I compare the behavior across generations of senators for the same vote in order to disentangle differences in behavior across the term.

Using the closeness in votes between the elected senator and the challenger in the following election, I also construct a variable that measures how closely disputed an election is for senators of the third generation. If electoral incentives cause changes in voting behavior then they should do more so when an election is closely disputed.

Finally, data on the amount of fossil fuel resources by state and PAC donations from the oil, gas, and mining industry were collected by Kim and Urpelainen (2017c) from the Energy Information Administration's State Energy Data System and from OpenSecrets.org, respectively. The fossil resources variable measures state-level per capital energy production from coal, oil and natural gas, measured in million BTU. The amount of PAC contributions from the oil gas and mining industry to each legislator is available only from 1991, and so in estimations including this variable, the sample is reduced to the years 1991-2013.

Table 1 presents summary statistics of the quantitative variables in the sample.

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Anti environment vote	0.477	0.499	0	1	49716
Republican senator	0.479	0.5	0	1	49721
Democrat senator	0.521	0.5	0	1	49716
Share of votes for senator	61.322	10.943	0	100	49311
Close election in third gen	15.46	27.948	0	100	40824
Contribution oil&gas industry	29791.611	41509.079	-125	249400	13458
Pro environmental opinion	0.592	0.075	0.379	0.809	46521
Fossil resource	0.557	1.878	0	19.897	48416
First generation	0.343	0.475	0	1	49716
Second generation	0.332	0.471	0	1	49716
Third generation	0.317	0.465	0	1	49716

3.2 Empirical Strategy

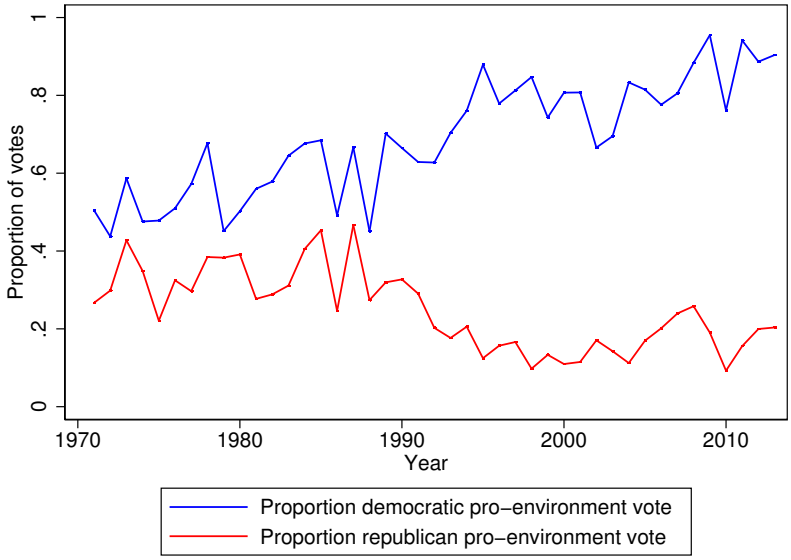
The purpose of this paper is to identify and quantify the impact of electoral incentives and lobbying in voting for environmental legislation. The dependent variable is a dummy variable equal to 1 if a senator i of state j in year t casts a vote classified as against the environment for vote v. The main variable of interest is $gen3$, a dummy variable equal to 1 if a senator belongs to the third generation, which identifies those closer to re-election. If the coefficient associated with this variable is statistically significant then the behavior of senators changes depending on how distant they are to being up for election. The basic empirical specification is thus given by:

$$antienv_{ijtv} = \alpha_1 + \gamma_1 gen3_{ijt} + \alpha_2 Z_{ijt} + \alpha_3 X_{jt} + \eta_j + \rho_t + \epsilon_{ijtv} \tag{1}$$

where $antienv_{ijtv}$ is the dummy for votes against the environment, and $gen3_{ijt}$, the main variable of interest, is equal to 1 for senators belonging to the third generation. Z_{ijt} is a set of senator level variables that affect voting behavior; specifically, PAC contributions from the oil, gas and mining sector to senator i during the previous term in office, $oilgas_{ijt}$, and dummy variable equal to 1 if a senator is a republican and vice-versa, rep_{ijt}. I use contributions in the previous term in order to minimize the endogeneity of the variable with respect to voting choices. X_{jt} is a vector of state level variables affecting environmental voting; specifically, the environmental preference of citizens, $envop_{jt}$, and the state-level fossil fuel resources, $fossilres_{jt}$. Finally, η_j is a state individual fixed effect, ρ_t a year fixed effect, and ϵ_{ijtv} the error term.

I estimate the main regressions using a probit model, and use robust standard errors clus-

Figure 4: Proportion of pro-environment vote by party, 1971-2013



tered at the vote level.[2] The results are qualitatively the same if a LPM is used. In order to investigate the role of electoral incentives, I additionally use the interaction of the environmental preference of citizens, $envop_{jt}$, and the dummy for the third generation of senators, $gen3_{ijt}$. If electoral concerns are causing differences in voting then these should respond to the preferences of the electorate.

If voting behavior changes with electoral proximity, it is possible that these effects vary by area of the issue the vote regards, with more visible issues, such as dirty energy or transportation, presenting larger effects. I thus estimate the same equation while substituting the dependent variable with a variable that measures anti-environmental voting in each of these areas.

Additionally, because American politics tend to be increasingly ideologically polarized, it is important to understand if these electoral incentives are different depending on the ideology of senators. Specifically, since the mid-1980's, democrats have tended to increasingly support environmental protection, while the opposite was true for republican senators (see for example List and Sturm, 2006 and Kim and Urpelainen, 2017b). Figure 4 depicts the proportion of pro-environmental vote for republican and democrat senators by year for the years in the sample, and seems to corroborate this view.

If democrat senators are inherently more prone to environmental protection, it would be expected that even if their voting behavior does not change in election years they are still able to capture the vote of environmentally concerned citizens. Thus if re-election concerns are driving the change in behavior of senators of the third generation, this change should be larger and more visible for republican senators.[3] I thus augment equation (1) with an

[2]The results are unchanged if standard errors are clustered at the state level.

[3]This is an analogous idea to that presented in Bouton et al. (2014) for the behavior of democrat politicians

interaction term between the third generation dummy and the republican dummy.

$$antienv_{ijtv} = \alpha_1 + \gamma_1 gen3_{ijt} + \gamma_2 gen3_{ijt} * rep_{ijt} + \alpha_2 Z_{ijt} + \alpha_3 X_{jt} + \eta_j + \rho_t + \epsilon_{ijtv} \qquad (2)$$

Finally, in order to investigate the impact of lobbying contributions on voting on environmental legislation, I use the interaction of past contributions - that is, contributions given to each senator during the previous term - with the different generations. The literature on the impact of special interests predicts lobbying might occur in order to change the behavior of politicians that are already elected, or in order to increase the election probability of politicians that are more likely to agree with them.[4] Here I abstract from the motivation of contributions by special interests, and focus solely on the impact that these have on the policy choices of senators. If they change their voting choices to reward past campaign contributions there should not be a difference between the different generations of politicians, or, alternatively, we should see a voting choice closer to the interests of lobbies in the beginning of the term. If, on the contrary, they change their voting choices in order to attract further funding that helps increase their re-election prbability, then we should see a significantly different impact of lobby contributions in the third generation senators. In order to assess this, I estimate the following equation:

$$antienv_{ijtv} = \alpha_1 + \gamma_1 gen_{ijt} + \gamma_2 gen_{ijt} * oilgas_{ijt} + \alpha_2 Z_{ijt} + \alpha_3 X_{jt} + \eta_j + \rho_t + \epsilon_{ijtv} \qquad (3)$$

where dummies for each generation are interacted with lobby contributions in separate estimations. The same control variables as in the previous equations are included, and the same estimation methods are used.

4 Results

Table 2 presents the estimation of equation (1). It assesses the impact of electoral incentives in voting behavior by comparing senators in the third generation (closer to re-election) and senators in the first and second generations.[5] Columns (1) and (2) present the estimates of an equation including only the main variable of interest and state and year dummies, first using a linear probability model (LPM) for comparison, then Probit.

In column (3) I include the other control variables, apart from the contributions from the oil, gas and mining industries, to allow us to use the full sample. The coefficient of the main variable of interest is statistically significant at a 1% level of significance. Its marginal effect is -0.0185, which means being in the third generation decreases the probability of a senator to vote against environmental regulation by 1.8 percentage points. This implies that being in the

with respect to gun control regulation.

[4]The change in behavior might occur automatically or because contributions increase access to politicians.

[5]Including a dummy for senators of the second generation did not change the results, as the variable was not statistically significant.

Table 2: The impact of electoral incentives

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation	LPM	Probit	Probit	Probit	Probit	Probit
$gen3_{ijt}$	-0.0187***	-0.0185***	-0.0119***	-0.0118***	-0.0101**	0.168**
	(0.00522)	(0.00494)	(0.00439)	(0.00440)	(0.00495)	(0.0774)
rep_{ijt}			0.337***	0.335***	0.376***	0.376***
			(0.00835)	(0.00816)	(0.00557)	(0.00557)
$envop_{jt}$			-0.0982	-0.164**	-0.345***	-0.262**
			(0.0834)	(0.0834)	(0.121)	(0.127)
$fossilres_{jt}$			0.0114***	0.0112***	0.00575	0.00537
			(0.00273)	(0.00279)	(0.00518)	(0.00522)
$oilgas_{ijt}$					4.89e-07***	5.01e-07***
					(7.46e-08)	(7.40e-08)
$envop_{jt} * gen3_{ijt}$						-0.295**
						(0.126)
Constant	0.488***					
	(0.0335)					
Vote FE	No	No	No	Yes	No	No
Observations	49,716	48,209	45,014	45,014	22,668	22,668
(Pseudo) R-squared	0.021	0.1822	0.286	0.335	0.451	0.452

Dependent variable $antienv_{ijtv}$. All estimations include year and state FE.
Marginal effects presented. Robust standard errors clustered at the vote level.
Significance level at which the null is rejected: ***1%, **5%, *10%.

third generation decreases the probability of an anti-environment vote by 3.8%. Column (4) presents the same equation but including fixed effects for each vote, with the results remaining unchanged.

Column (5) presents the estimation of the full basic specification of equation (1). The marginal effect of being close to re-election is now of -1.01 percentage points, which implies a decreased probability of voting against the environment of 2.1%. As expected, the share of pro-environment public opinion in the state has a negative impact on the probability of an anti-environmental vote, and being a republican, the amount of fossil resources in the state, and the amount of contributions by the oil, gas and mining industries for the senator all have a positive impact.[6]

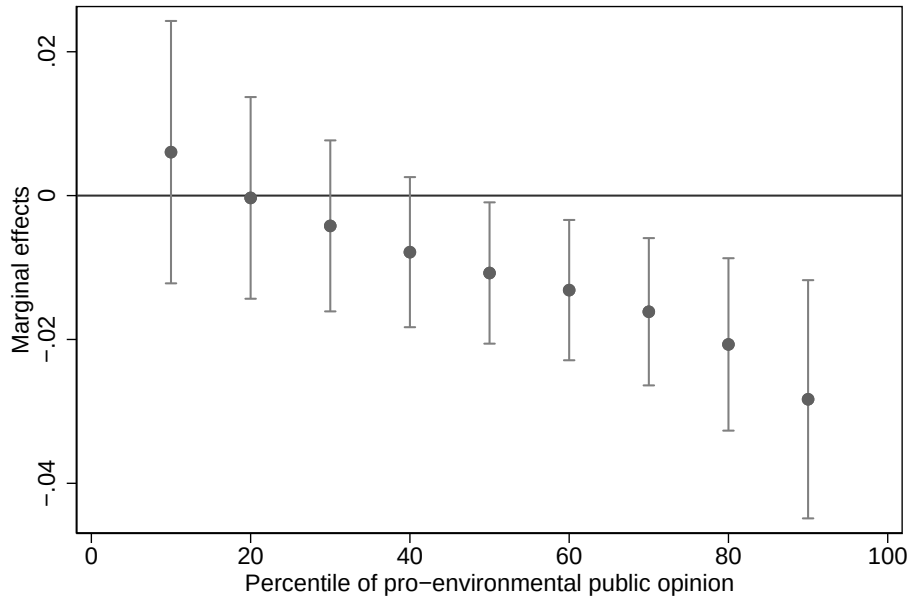
Finally, column (6) introduces the interaction term of public opinion with third generation senators with a negative significant impact. The results imply that an anti-environment vote in the third generation as compared to the other two generations is less likely the higher public opinion regarding the environment is. This is in line with the re-election motive causing the switch in voting behavior prior to elections. Furthermore, it indicates this switch responds to

[6]Although the impact of the amount of fossil resources is only statistically significant in some of the estimations.

voting preferences of voters.

Figure 5 depicts the marginal impact of belonging to the third generation on voting against the environment by percentile of pro-environmental public opinion. The dots are point estimates and the vertical lines represent 95% confidence intervals. Not only is the negative impact visible but the figure also shows that the marginal impact is only statistically significant once public opinion reaches a certain threshold.

Figure 5: Electoral impact and pro-environmental electorate



After establishing that third generation senators behave differently with respect to voting in environmental regulation, I study how this effect is distributed across different areas of environmental policy. Table 3 presents estimations for each of the categories. Since the areas "air", "climate change", and "oceans" had the least number of votes, I aggregated them into one category.

Election proximity decreases significantly the probability of voting anti-environment in the areas of drilling, lands/forests, water, dirty energy, and transport. These are arguably very visible areas to which public opinion is more likely to pay attention. Some of these, like drilling or dirty energy, are also areas that more directly affect some of the most powerful lobbies (specifically, the oil, mining and gas industries).

Table 3: Electoral effect by issue area

	(1)	(2)	(3)	(4)	(5)
Issue	Drilling	Lands	Other	Toxics	Water
$gen3_{ijt}$	-0.00439**	-0.00470**	0.000382	0.000382	-0.00315*
	(0.00213)	(0.00236)	(0.00227)	(0.00227)	(0.00182)
rep_{ijt}	0.0826***	0.126***	0.104***	0.104***	0.0607***
	(0.00686)	(0.00803)	(0.00712)	(0.00712)	(0.00527)
$envop_{jt}$	-0.141**	0.0572	-0.00698	-0.00698	-0.101**
	(0.0549)	(0.0738)	(0.0498)	(0.0498)	(0.0459)
$fossilres_{jt}$	-0.000750	0.00252***	0.00294***	0.00294***	0.00181***
	(0.000944)	(0.000452)	(0.000602)	(0.000602)	(0.000372)
Time FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
Observations	30,242	43,621	43,918	43,918	44,718

	(6)	(7)	(8)	(9)	(10)
Issue	Wildlife	Dirty En.	Clean En.	Air, CC, Oceans	Transport.
$gen3_{ijt}$	0.00125	-0.00437*	0.00254	0.00402	-0.00451*
	(0.00216)	(0.00239)	(0.00241)	(0.00261)	(0.00262)
rep_{ijt}	0.0954***	0.112***	0.0703***	0.0858***	0.0415***
	(0.00745)	(0.00788)	(0.00523)	(0.00618)	(0.00451)
$envop_{jt}$	-0.0454	-0.0249	-0.109**	-0.0630	0.00132
	(0.0535)	(0.0617)	(0.0498)	(0.0552)	(0.0598)
$fossilres_{jt}$	0.00253***	0.00140	0.00245**	0.00209***	0.00128
	(0.000552)	(0.00133)	(0.00121)	(0.000766)	(0.00118)
Time FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
Observations	38,043	46,521	31,747	28,734	26,040

Marginal effects presented. Robust standard errors clustered at the state level.
Significance level at which the null is rejected: ***1%, **5%, *10%.

I then focus on the distribution of effects by senator ideology. In order to do this, I estimate a model that includes the interaction of the dummy for a republican senator with a dummy for third generation senators and of the dummy for a democrat senator with the dummy for third generation senators as well as with a dummy for first and second generation senators ($gen12_{ijt}$). The effect of electoral proximity on the behavior of republican senators is captured by the former, while the effect on democrats is found by testing whether $gen12_{ijt} * dem_{ijt}$ and $gen3_{ijt} * dem_{ijt}$ are statistically different for each other.

The first two columns present the estimation without controls apart from time and state fixed effects, and the third estimation includes controls. The estimates for $gen3_{ijt} * rep_{ijt}$ are always negative and significant. Focusing on the specification that includes controls, the results mean a republican politician decreases her probability of voting against the environment when she is

of the third generation by 1.6 percentage points. The tests for the equality of $gen12_{ijt} * dem_{ijt}$ and $gen3_{ijt} * dem_{ijt}$ do not allow to reject their equality, implying the differences in behavior in the third generation senators is only present for republican senators, likely with a view to increase chances of re-election.

Table 4: Partisan electoral incentives

	(1)	(2)	(3)
Estimation	LPM	Probit	Probit
$gen3_{ijt} * rep_{ijt}$	-0.021***	-0.020***	-0.016**
	(0.008)	(0.006)	(0.006)
$gen3_{ijt} * dem_{ijt}$	-0.385***	-0.339***	-0.337***
	(0.023)	(0.009)	(0.009)
$gen12_{ijt} * dem_{ijt}$	-0.379***	-0.335***	-0.335***
	(0.025)	(0.009)	(0.009)
$envop_{jt}$			-0.061
			(0.085)
$fossilres_{jt}$			0.012***
			(0.003)
Constant	0.820***		
	(0.029)		
Time FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Observations	49,716	48,209	45,014

Dependent variable $antienv_{ijtv}$.
Marginal effects.
Robust standard errors clustered at the vote level.
Significance level: ***1%, **5%, *10%.

Finally, I focus on the impact of contributions from the oil, gas, and mining industries on the voting behavior of senators. As explained in Section 3, I use the interaction of contributions made in the previous term with the dummy variables for different generation senators. The results show that senators in the first or in the second generation do not behave differently from senators in other generations depending on the amount of contributions they receive.[7] However, senators in the third generation behave statistically different depending on lobby contributions. Table 5 presents these results.

The dependent variable in the estimation in column (1) is the dummy for an anti-environmental vote for votes in all areas, $antienv_{ijtv}$. The interaction term between contributions and the third generation ($oilgas_{ijt} * gen3_{ijt}$) is not statistically significant, which means senators that received larger contributions in the previous cycle do not behave significantly differently. Because I consider only contributions by the oil, gas and mining industry, I then repeat the

[7] These estimations are available from the author.

Table 5: Lobbying impacts

	(1)	(2)	(3)	(4)	(5)
Issues	All	Dirty	OilGas	NonOG	OilGas
$gen3_{ijt}$	-0.013**	-0.012**	-0.012*	-0.015*	-0.081
	(0.007)	(0.006)	(0.006)	(0.008)	(0.052)
rep_{ijt}	0.376***	0.141***	0.167***	0.316***	0.167***
	(0.006)	(0.017)	(0.017)	(0.015)	(0.017)
$envop_{jt}$	-0.344***	-0.295***	-0.399***	0.150	-0.431***
	(0.120)	(0.093)	(0.103)	(0.129)	(0.107)
$envop_{jt} * gen3_{ijt}$					0.114
					(0.085)
$fossilres_{jt}$	0.006	0.001	0.001	-0.000	0.001
	(0.005)	(0.002)	(0.002)	(0.003)	(0.002)
$oilgas_{ijt}$	4.71e-07***	2.17e-07***	2.40e-07***	2.82e-07***	2.32e-07***
	(7.97e-08)	(4.06e-08)	(4.18e-08)	(5.91e-08)	(4.01e-08)
$oilgas_{ijt} * gen3_{ijt}$	6.52e-08	1.14e-07**	1.44e-07**	6.51e-08	1.55e-07***
	(9.94e-08)	(5.36e-08)	(5.76e-08)	(8.86e-08)	(5.82e-08)
Observations	22,668	22,668	22,668	22,668	22,668

Marginal effects. Robust standard errors clustered at the vote level.
Significance level at which the null is rejected: ***1%, **5%, *10%.

analysis to include the issue areas that these lobbies are likely to be mostly concerned with. I consider these to be drilling, dirty energy, and transportation. Column (2) presents the estimation of the impact on voting in legislation concerning the area "dirty energy" and column (3) legislation in any of the three areas. Column (4) estimates impacts on voting in areas less related to these lobbies (specifically, lands/forests, toxics, water, wildlife, and oceans).
In both columns (2) and (3) the interaction term has a positive and significant impact. This means that although all senators tend to decrease anti-environmental voting in these areas when they are close to re-election ($gen3_{ijt}$ is still negative and significant), for senators receiving larger contributions this difference between election and non-election years is smaller. This implies that senators do not seem to be changing their policies to reward past contributions, at the beginning of their term or equally throughout the term, but focusing on attracting further funding on pre-election periods. This difference is maintained when including the interaction of environmental opinion and the third generation dummy (column 5) but not when focusing on areas not directly relevant for the oil, gas, and mining industries (column 4).

5 Conclusion

Despite increased interest in the political economy behind environmental regulation, comprehensive analyses of voting behavior in the face of both electoral incentives and lobby

contributions are still scarce. In this paper, I conduct an analysis of electoral incentives and lobby contribution impact in the voting of US senators in matters related to environmental protection. The analysis uses a comprehensive dataset that includes 499 roll-call votes in the US Senate from 1971-2013. I use the staggered structure of the Senate, in which one third of all senators are up for re-election every two years, for identification, and then compare differences in voting behavior across senators depending on how close they are to re-election, in order to identify electoral incentives due to electoral accountability or lobbying. I find that the re-election incentive reduces a senator's probability to vote against environmental regulation by over 2%, and this effect is higher when environmental support in their state is high. Furthermore, the results indicate this effect is driven by republican senators trying to capture pro-environmental vote. Finally, contrary to findings in previous literature, past contributions have a significant impact on voting behavior only toward the end of senators' terms, suggesting pro-industry voting is used to attract more funding but not to reward past contributions.

These results have relevance for the timing of introduction of regulation for which there is public support but strong interest group opposition. While senators at the end of their terms are more responsive to preferences of the electorate for this regulation, this responsiveness is lower the stronger interest groups that oppose the regulation are. This means that in contexts where these groups are less powerful but still influence decision-making, introducing regulation might be more politically feasible when electoral incentives are higher, particularly if public support reaches a given threshold.

These findings are particularly relevant in the context of environmental policy, where the introduction of new and effective regulation is essential to ensure the sustainability of energy resources and promote environmental protection. Understanding the political and institutional forces at play is central to designing environmental policy that is both efficient and politically viable. For example, considering the different shares of environmentally concerned voters in different states and the location of powerful industry lobbies is important to understand when best to time the introduction of an environmental protection proposal to maximize the probability of passing it. What is more, understanding under which circumstances campaign contributions alone play a deciding role in policy is central for designing a political process that promotes the democratic will. Finding these thresholds will be the subject of future research.

A possible avenue for further research is to understand the motivation behind lobbying incentives for senators. Specifically, it would be interesting to develop a political economy model that rationalizes the changes in behavior of third generation of senators with respect to lobby contributions as a result of different motivating factors. This would generate further testable implications to discern which of these factors generates the observed change in voting patterns.

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Appendix

A Categories of environmental legislation issues

Table A.1: Categories of environmental legislation issues

Air	Votes on air pollution, including votes related to the Clean Air Act
Clean Energy	Votes on renewable energy and energy efficiency
Climate Change	Votes directly related to global warming pollution and increasing climate resilience for communities and wildlife
Dirty Energy	Votes on polluting energy sources, including conventional fossil fuels like oil, gas, and coal; non-conventional fossil fuels such as tar sands; and harmful energy subsidies for nuclear energy and fossil fuels
Drilling	Votes on drilling onshore and in the waters off the nations coasts
Lands/Forests	Votes addressing both private and public lands and forests, including wilderness designations, federal land management agencies, logging, mining, and grazing
Oceans	Votes on ocean conservation issues, including fisheries management
Other	A broad catch-all category that includes votes on overhauling the regulatory process, sweeping funding cuts, the National Environmental Policy Act, federal appointments and nominations, campaign finance reform, trade, family planning, and eminent domain/takings, among other issues
Toxics/Public Right to Know	Votes on the use of and exposure to toxic chemicals (including pesticides), the publics right to know if they are at risk, and Superfund sites
Transportation	Votes on transportation and vehicle fuels policy, including fuel efficiency standards, biking and walking infrastructure, transit, and rail
Water	Votes on water quality and quantity issues and water pollution, including votes related to the Clean Water Act
Wildlife	Votes on fish (freshwater and saltwater) and wildlife issues, including the Endangered Species Act

Source: League of Conservation Voters