ECONOMIC INTERESTS, PARTISAN POLITICS, AND ENVIRONMENTAL POLARIZATION[1]

Dean Lueck
Indiana University

Julio A. Ramos Pastrana
Penn State University

Gustavo Torrens
Indiana University

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Abstract Focusing on environmental legislation since 1970s, this paper studies the mechanisms behind party polarization in the US Congress. Three questions guide the analysis. First, why, and how did environmental polarization emerge from initial bipartisanship? Second, why did Republicans become anti-environmental and Democrats pro-environmental? Third, what is the relative role of economic and party forces in explaining environmental polarization? The theoretical framework extends stochastic electoral competition models by incorporating new interest groups into political parties. The model generates a link between the initial composition of the parties, the behavior of new interest groups and the pattern and level of polarization along the new policy dimension (e.g., environment). Our empirical analysis combine data on congressional environmental votes from 1971 to 2016 with data on legislator characteristics, congressional district economic and demographic information, and interest group contributions. The empirical evidence confirms that party polarization emerged over time from initial bipartisanship and suggests that the connection between parties and special interest groups played a crucial role.

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[1] Lueck: lueck@indiana.edu. Ramos Pastrana: julioramos@psu.edu. Torrens: gtorrens@indiana.edu.

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1. Introduction

Focusing on environmental legislation since 1970, this paper examines the puzzle of party polarization in the US Congress. Prior literature shows strong polarization on environmental voting in the US Congress, with Democrats tending to support pro-environmental legislation and Republicans opposing it. The puzzle of polarization stems from three sources. First, environmental polarization has not always been present. At the advent of the modern environmental movement in the 1970s, federal legislation was bipartisan. Second, evidence from the Environmental Kuznets Curve literature (Grossman and Krueger 1995, and Copeland and Taylor 2004) indicates that higher income leads to higher demand for environmental quality, which suggests Republican legislators would be at least as likely to provide support for pro-environmental legislation (as Republican voters have tended to have higher average incomes than Democratic voters). Third, voters tend not to be as polarized as legislators on environmental issues (as indicated in polls such as Gallup (2021), Barber and McCarty (2015).

By examining environmental voting and related political behavior, this paper seeks to identify economic and political causes of party polarization. Three questions guide the analysis. First, why, and how did environmental polarization emerge from initial bipartisanship? Second, why did Republicans become anti-environmental and Democrats pro-environmental? Third, what is the relative role of economic and party forces in explaining environmental polarization?

To address these questions, our theoretical framework extends electoral competition models by incorporating new interest groups into political parties. This framework revives a long-standing view in political science (usually forgotten in formal models) that views parties as coalitions of interest groups that adjust to the emergence of important new interests/issues such as environmentalism. The model considers two parties and several interest groups. Interest groups influence parties through campaign contributions; parties face a trade-off between satisfying less polarized voters and more specialized interest groups who offer contributions. In equilibrium, to maximize the party's electoral success, each party selects a platform that balances these two forces. If an interest group finds it easier to influence one party than the other, in equilibrium, the interest group concentrates its contributions to this party, which induces a bias in the party's platform in the direction favored by the interest group. These partisan (i.e., party-attached) interest groups—with policy preferences more extreme than voters' preferences—transform otherwise standard Downsian model (with convergence to the mean) into a model in which political platforms diverge

and party polarization emerges in equilibrium. Moreover, the model generates a link between the pattern and level of initial party polarization and the pattern and level of polarization when a new policy issue emerges (e.g., environment). Specifically, if parties begin polarized, the groups attached to each party will differ and, hence, when a new political issue emerges, the distribution of preferences over the new issue will tend to be different in each party. As a consequence, each new interest group will end up attached to the party with more aligned preferences among its initial members, which will tend to induce polarization in the new policy dimension.

The model has several theoretical implications about polarization in general and environmental polarization in particular. First, party polarization rises with the importance of contributions for political campaigns, the level of influence of interest groups, and the more partisan the preferences of special interest groups. Second, the more complementary the preferences over the new issue among the existing coalitions within a party, the more likely the party incorporates the new special interest group with such preferences. A corollary of this result is that, initially, preferences over a new issue are more uncertain and, hence, it is less likely that a new special interest group is incorporated to a party and that party polarization emerges. On the contrary, as the issue matures, winners and losers are revealed, preferences over the issue within each party become more complementary and, hence, it is more likely that a special interest group is incorporated to a party and that party polarization emerges. Finally, if the demand for environmental quality rises with income, the richer the existing coalitions within a party, the more likely pro-environmental groups are incorporated into the party. However, the more rural and natural resources-based the existing coalitions within a party, the more likely anti-environmental groups are incorporated into the party.

The model sheds light on the rise, pattern, and mechanism of environmental party polarization in the US. As parties learned more about environmental issues, it became clear that the cost and benefits of environmental legislation were not evenly distributed across voters, regions, and interest groups. The coalitions of interest groups already incorporated into the Republican Party (e.g., more industries associated with natural resources and more rural constituencies) were often negatively affected by environmental legislations; while the coalitions of interest groups already incorporated into the Democratic Party (e.g., less industries associated with natural resources and more urban constituencies) were often positively affected by environmental legislation or, at least, they avoided most of the costs of those initiatives.

Environmental interest groups became more attached to the Democratic Party and anti-environmental interest groups became more attached to the Republican Party, which helps explaining the rise and pattern of party polarization on environmental issues.

To empirically test these theoretical predictions, we combine data on congressional environmental votes from 1971 to 2016 with data on legislator characteristics, congressional district economic and demographic information, and interest group contributions. The empirical analysis confirms a significant (both statistically and economically) and rising over time partisan effect on environmental voting in the US Congress. Economic forces (narrowly defined) seem to play some role in environmental voting. For example, richer districts tend to be associated with "greener" legislators (both among Republicans and Democrats). However, polarized environmental positions are increasingly more attached to the parties. Campaign contributions from interest groups, a key gear in the polarization mechanism, reveal this reality. For example, we show that an increasing share of contributions from "brown" industries go to Republican legislators even when, at the margin, there is almost no room to make a Republican legislator "browner" and there is ample space to change the position of Democratic legislators.

The rest of paper is organized as follows. Section 2 briefly reviews the history of party polarization in the US Congress, the main hypotheses considered in the literature to explain such polarization, and modern environmental polarization in the US Congress. Section 3 develops the electoral competition model, deduces the main theoretical factors explaining party polarization, and applies the model to explain the rise and pattern of environmental polarization in the US Congress. Section 4 describes the data. Section 5 presents the main results. Section 6 summarizes several robustness checks. Section 7 concludes.

2. Party Polarization in the US Congress

This section briefly summarizes the history of party polarization in the US Congress, the main theoretical hypotheses developed to explain the rise in polarization after the 1970s, and the basic trends on the pattern and evolution of party polarization on environmental issues.

2.1. Brief History of Party Polarization in the US Congress

Polarization in the US Congress has a varied history, and its study has occupied a predominant place in the academic research in American Politics in the last two decades (McCarty 2015). In recent years polarization has been present for environmental voting as well as such issues

as reproductive rights and gun control. In these cases, there were also periods of non-polarization. Historically many issues have been polarized, later to became bipartisan or non-partisan. Slavery is perhaps the most striking issue. In early US history all major parties accepted slavery or were 'pro-slavery' but with westward expansion, the admission of new states led to polarization with Democrats favoring slavery and Republicans opposing it. This extreme polarization was manifest in the Civil War, but since that time slavery has been a settled non-issue and hence not polarized (Noel 2012). Women's voting rights has a similar history, first with all parties against, promoted first by Republicans and opposed by Democrats, and ultimately settled with the 19th Amendment in 1920 (McDonagh 1989, Maryland State Archives 2020). Today, many issues are either non-partisan or not particularly polarizing such as agricultural policy and deficit spending. Polarization is a phenomenon that varies widely across issues and over time (Table 1). To understand its origins, growth, and demise, further examination is needed.

Table 1. Party Polarization in US Congress

Issue	Evidence on Polarization	Sources and Comments
Agriculture Policy	No clear evidence of polarization	D'Antonio et al. (2013)
Environment	Polarization develops after 1990. Democrats pro-environmental.	D'Antonio et al. (2013) Kim and Urpelainen (2017)
Foreign Policy	No clear evidence of polarization.	Chaudoin et al. (2010)
Gun Rights	Rise in polarization since the 90s. Democrats pro-gun controls, Republicans pro-gun rights.	D'Antonio et al. (2013) Hare and Poole (2014)
Immigration	Rise in polarization since the 80s. Democrats pro-immigration.	D'Antonio et al. (2013) Hare and Poole (2014)
International Trade	No clear evidence of polarization.	D'Antonio et al. (2013) Che et al. (2020)
Reproductive Rights	Rise in polarization since the 90s. Democrats pro-choice. Republicans pro-life.	D'Antonio et al. (2013) Hare and Poole (2014)
Slavery	No polarization initially in US. Republicans abolitionist, Democrats pro-slavery until after Civil War. No polarization afterwards.	Noel (2012)
Women's Voting Rights	Early 20th century Republicans promoted voting rights; Democrats opposed.	McDonagh (1989), Maryland State Archives (2020)

Notes. D'Antonio et al. (2013) use roll call votes; Che et al. (2020) use pro-trade votes; Hare and Poole (2004) use DW-NOMINATE ideological scores; and Kim and Urpelainen (2017) use League of Conservation Voters scores.

2.2. Alternative Hypotheses to Explain the Rise of Polarization in the US Congress

Four hypotheses have been proposed to explain party polarization in the US Congress after the 1970s. The first, and leading, hypothesis is that the decline of Democratic party dominance in the US South (Layman et al. 2006, Theriault 2006) increased polarization. This legislator replacement theory argues that the partisan realignment of the US South led to a more uniform

Democratic Party in which southern conservative Democrats were no longer elected, while southern Republicans, usually more conservative than their Democratic counterparts, became majority. A second hypothesis argues that polarization is also driven by legislator adaptation, i.e., the change in position of congressional members over their career (Theriault 2006). The idea is that legislators tend to be more moderate when newly elected and become more extreme as they spend more time in office, as they become pressured by party leadership to move closer to their party's mainstream preferences (Fleisher and Bond 2004). A third hypothesis stresses the growing ideological stance of party leaders as well as their control of key congressional decisions such as committee assignments or the congressional agenda (Layman et al. 2006, Barber and McCarty 2015, Canen et al. 2020). A fourth hypothesis (Layman et al. 2006) focuses on divergence in voters and coalitions induced by ideological and policy differences, or socioeconomic conditions and social change.

As suggested by Barber and McCarty (2015), the existing literature leaves three critical questions unanswered. First, there is no clear explanation for the dynamics of polarization in different issues; for example, why certain issues (such as environmentalism) start bipartisan and then become polarized. Second, there is no clear explanation of the pattern of polarization; for example, why the Democratic Party became pro-environment. Third, special interest groups do not seem to be an integral component of the existing explanations of party polarization. By studying partisanship in environmental legislation, this paper addresses these important gaps in the literature.

2.3. Modern Environmental Polarization in the US Congress

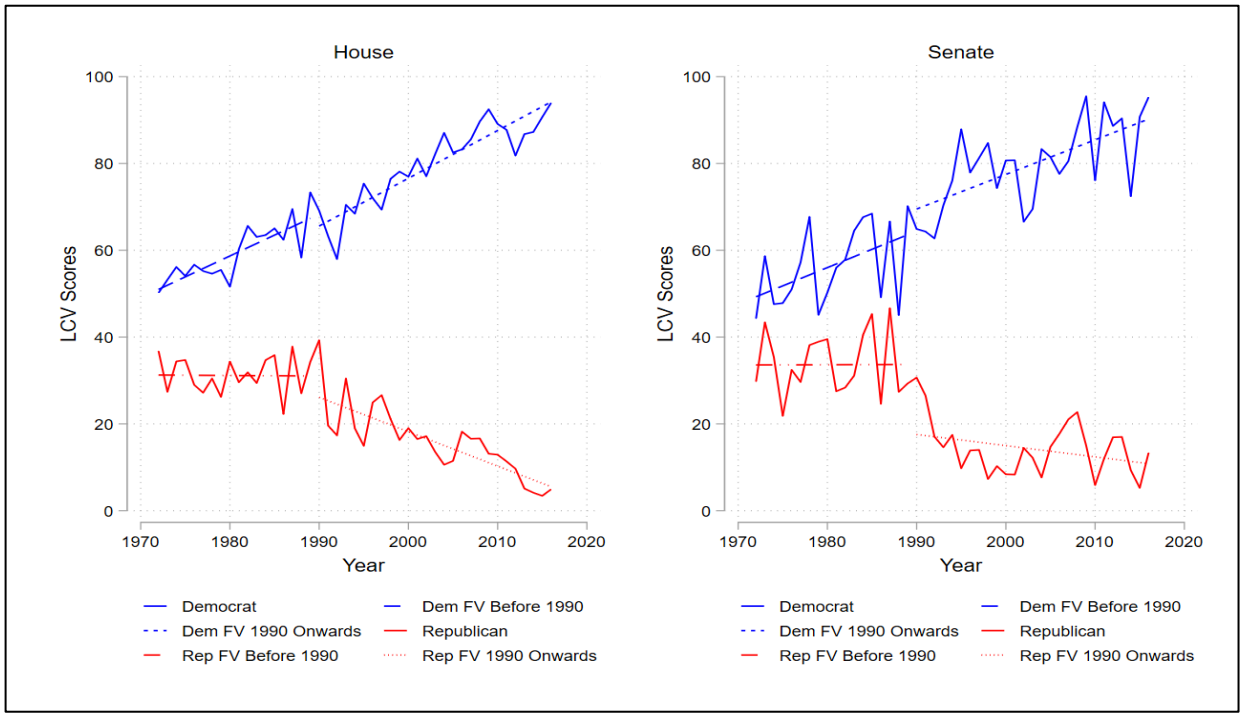
Though environmental issues have bipartisan origins, pertinent voting behavior in both the House and Senate exhibits, over time, a divergence between Democrats and Republicans. Data on voting collected by the League of Conservation Voters (LCV) shows how party environmental voting has changed since the bipartisan 1970s. The League creates an annual score for each legislator based on the percent of pro-environment votes in a set of bills in each legislative session. A 100 is a perfect pro-environment score, while a 0 is a perfect anti-environment score. These scores can be aggregated for the entire legislative body and then segregated by party to illuminate the emergence and extent of polarization. Figure 1 below shows the average LCV score by political party from 1970 to 2018, for the House and the Senate. The figure also shows the fitted linear regression line for periods before and after 1990. Both in the House and the Senate LCV scores

are greater for Democrats, and the difference increases over time and the fitted lines indicate that the rate of polarization has increased since the 1990s. Democrats' LCV scores steadily increase, whereas Republicans' steadily decrease.

Further analysis of these data indicate that polarization is not particular to specific regions or issues. Polarization is present in every region of the country. Democratic LCV scores are consistently greater than Republican ones, and the difference between them becomes larger over time (see Figure 2). Environmental polarization is also observed for specific environmental issues (e.g., the LCV categorizes votes in 12 distinct categories: air, clean energy, climate change, dirty energy, drilling, lands/forests, oceans, other, toxic/public right to know, transportation, water, and wildlife). In every issue LCV scores for Democrats are consistently greater than those for Republicans, and their difference becomes greater as time goes by (see Figure 3).

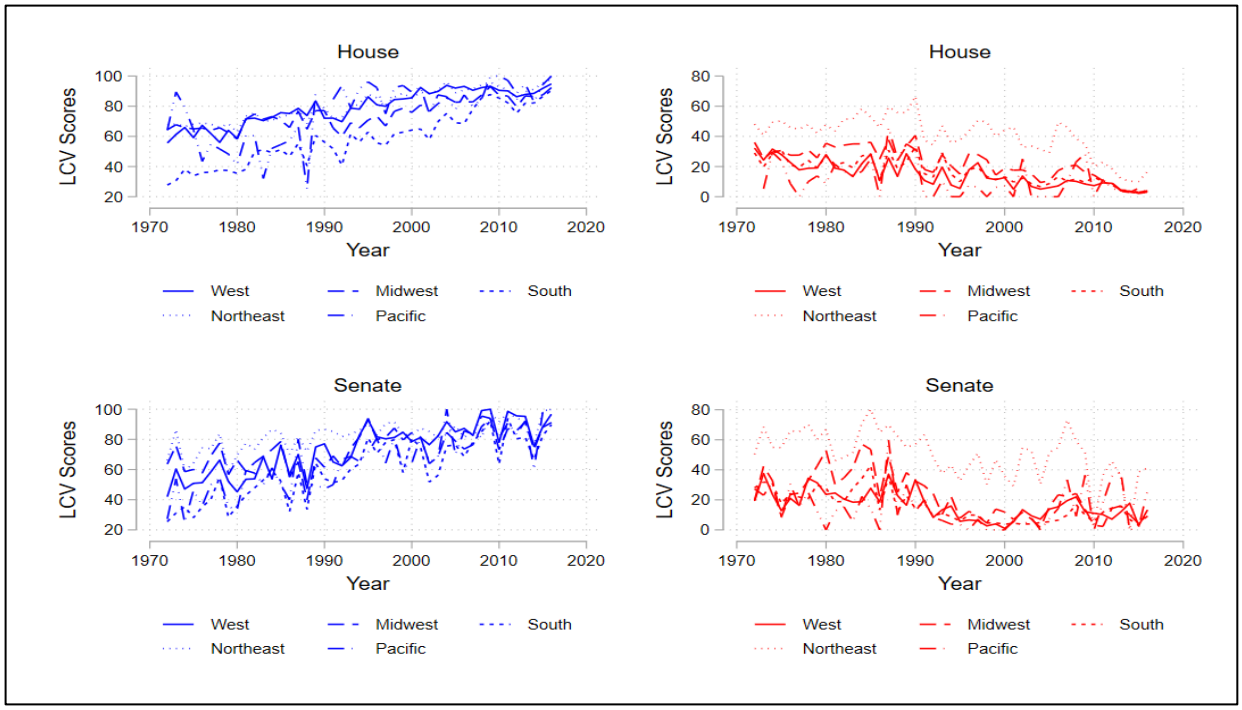
What are the economic and political factors that explain the rise and extent of party polarization in environmental legislation in the US Congress observed in Figure 1? Why did the Democratic Party become more in favor of environmental legislation than the Republican Party? Though there is an extensive theoretical and empirical literature on polarization particularly in political science, the available literature does not provide consistent answers.

Figure 1. Rise in Environmental Polarization in US Congress: LCV Scores Over Time



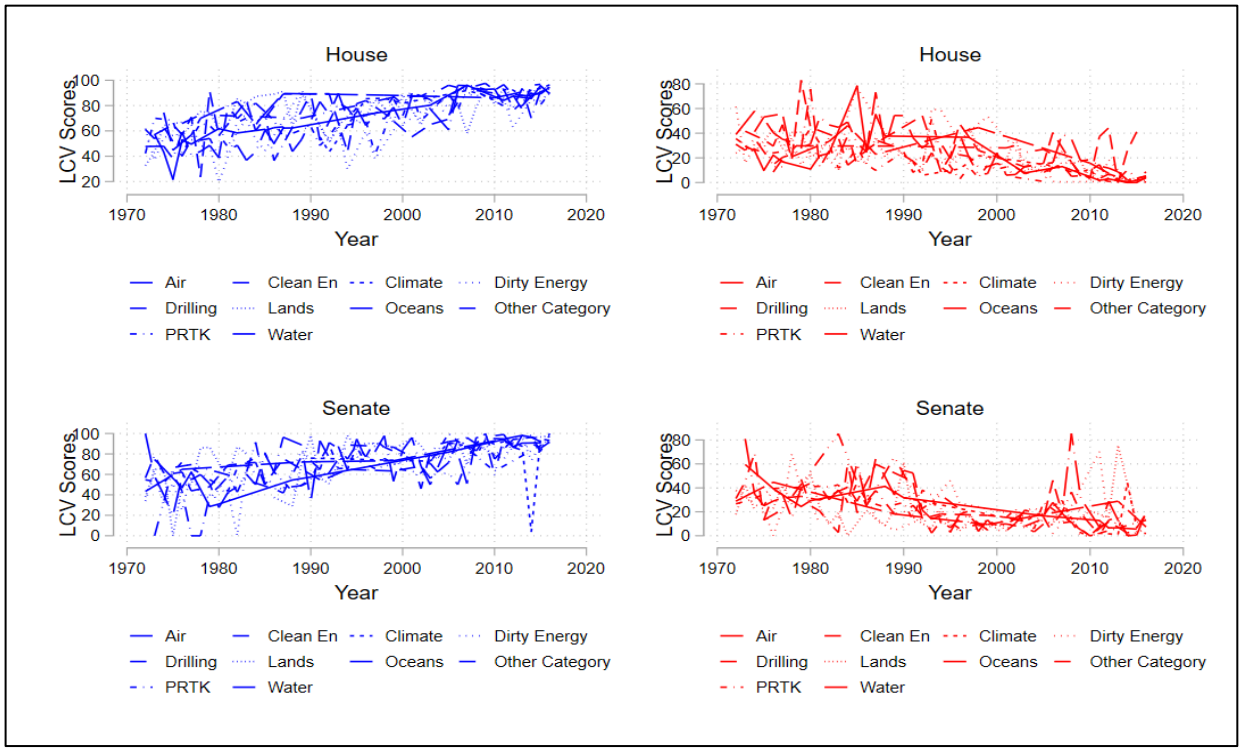
Note. FV = Fitted values From OLS regressions.

Figure 2. Rise in Environmental Polarization in US Congress across Regions



Note. Democrats (left), Republicans (right).

Figure 3. Rise in Environmental Polarization in US Congress across Issues



Note. Democrats (left), Republicans (right).

3. A Model of Party Polarization

This section develops a theoretical model that links new special interest groups with political parties through the existing set of coalitions within each party. In particular, we rely on a probabilistic voting model with party-attached special interest groups developed by Galiani, Schofield and Torrens (2014). We extend this model by introducing the emergence of a new policy dimension (e.g., environmental policy) and study how new special interest group interact with pre-existing political coalitions. Applied to environmental politics, the model explains the emergence and pattern of environmental polarization in the US Congress.

The model combines three theoretical traditions in Political Science. First, we rely on game-theoretic models of electoral competition (see Roemer 2001 and Austen-Smith and Banks 2005 for summaries of the literature); specifically, models that combine elections and lobbying (e.g., Grossman and Helpman 1996 and Schofield and Miller 2007). Second, we incorporate a theoretical tradition that considers parties as coalitions of interest groups (see Levy 2004 for a formal treatment). Third, we rely on the theory of collective action (see Olson 1965, Schelling 1978, and Ostrom 1990 for seminal contributions, and Medina 2007, Dutta, Levine and Modica 2018, and Levine and Mattozi 2020 for more recent contributions). Overlooked in this literature, we stress the connections between new special interest groups and existing political coalitions as a key determinant of how new groups advance their agendas and how the parties react to their presence.

3.1. An Electoral Competition Model of Party Polarization

Our starting point is a stochastic spatial model of electoral competition with special interest groups. A policy is a pair of collective decisions $(x, y) \in [0,1]^2$. For example, x may capture the level of welfare programs and y the level of environmental programs. There are nine groups of voters in the model because we assume three levels of preferences: low (l), medium (m), and high (h) for the two collective decisions (x and y). We denote the set of voting groups by $V = \left\{v = (v_x, v_y) : v_x, v_y \in \{l, m, h\}\right\}$ and $n^v \in [0,1]$ indicates the proportion of voters belonging to group $v \in V$. Naturally, $\sum_{v \in V} n^v = 1$. There are two political parties given by $P = \{1,2\}$ that will implement platforms that are their chosen levels of x and y. The payoff function of a voter in group $v \in V$ when party $p \in P$ implements platform $(x_p, y_p) \in [0,1]^2$ is given by:

$$U^v(x_p, y_p) = u^v(x_p, y_p) + \mu^v c_p + \epsilon_p^v \quad (1)$$

The policy component of a voter's payoff is given by:

$$u^v(x_p, y_p) = \left[\bar{u}_x - \alpha_x\left(x_p - x^{v_x}\right)^2\right] + \left[\bar{u}_y - \alpha_y\left(y_p - y^{v_y}\right)^2\right] \quad (2)$$

where $0 < x^l < x^m < x^h < 1,\ 0 < y^l < y^m < y^h < 1,\ \alpha_x, \alpha_y > 0,\ \bar{u}_x > \alpha_x,$ and $\bar{u}_y > \alpha_y$. Thus, each voter in group $v = (v_x, v_y) \in V$ has a quadratic utility function with most preferred policy given by (x^{v_x}, y^{v_y}).[2] c_p is the campaign contributions received by party p from special interest groups and $\mu^v \geq 0$ captures the importance of contributions relative to policy platforms on the voting behavior of voters in group v (e.g., due to political advertisement). ϵ_p^v is an electoral shock received by voters in group v. We assume that $\epsilon_1^v - \epsilon_2^v$ is uniformly distributed on $\left[-\frac{1}{2\eta^v}, \frac{1}{2\eta^v}\right]$ with $\eta^v > 0$ (Persson and Tabellini 2000). As usual with stochastic spatial models, electoral shocks can be interpreted as competence, valence, or popularity shocks that affect parties. Regardless of the interpretation, the key point is that shocks introduce electoral uncertainty. Also note that the expected value of $\epsilon_1^v - \epsilon_2^v$ is zero, i.e., ex-ante no party has an electoral advantage. The higher the value of η^v, the less dispersed the electoral shock of group v is and, hence, the more voters in group v base their voting behavior on platforms.

Under these assumptions the probability that a voter in group v votes for party p is given by:

$$\begin{aligned} \rho_p^v &= \Pr\left(U^v(x_p, y_p) > U^v(x_{-p}, y_{-p})\right) \\ &= \frac{1}{2} + \eta^v\left\{\left[u^v(x_p, y_p) - u^v(x_{-p}, y_{-p})\right] + \mu^v(c_p - c_{-p})\right\} \end{aligned} \quad (3)$$

The payoff function of party $p \in P$ is given by its expected vote share function S_p (alternatively, we can consider the party maximizes its probability of winning):

$$S_p = \sum\nolimits_{v \in V} n^v \rho_p^v \quad (4)$$

We assume there are four special interest groups given by $G = \left\{g = (g_x, g_y) : g_x, g_y \in \{l, h\}\right\}$. Special interest groups are organizations that represent the preferences of the most extreme group of voters for each issue. In particular, interest group $g \in G$ tries to advance the interest of voter group $v = g$. Moreover, each interest group collects contributions from its members and

[2] More general policy payoff functions can also be considered, but (2) simplifies the presentation.

uses them to support political parties in their electoral campaigns. Each interest group receives a payoff that depends linearly on the policy preferences of the members of the interest group and must pay the cost of collecting the contributions among its members. The interest group maximizes its expected payment net of the costs of collecting contributions. Specifically, the payoff function of interest group g is given by:

$$\mathcal{L}^g = \sum\nolimits_{p\in P}\left[S_p L_p^g - \frac{1}{2}\left(c_p^g\right)^2\right], \text{where } L_p^g = a_p^g n^g u^g\left(x_p, y_p\right) + b_p^g \tag{5}$$

and c_p^g is the contribution that special interest group g makes to party p. Thus, the total contributions received by party p are $c_p = \sum_{g\in G} c_p^g$. In addition, $a_p^g \geq 0$ and $b_p^g \geq 0$ capture how effective interest group g is collecting contributions to support party p's campaign efforts. In particular, $a_1^g > a_2^g$ implies that g is more effective supporting party 1 than party 2.

In this model of parties, voters, and interest groups, events occur in the following order: 1) Parties simultaneously and independently announce their electoral platforms. 2) Special interest group leaders observe these platforms and simultaneously and independently decide their campaign contributions. 3) The parties use these contributions to influence the electorate. 4) Each voter receives a private signal about candidates' quality/competence. 5) Elections are held. 6) The elected candidate implements the announced platform.

Finally, we employ subgame perfect Nash as the equilibrium concept. Since this is a finite game, we solve it through backward induction.

3.2. Equilibrium Platforms and Polarization

The following proposition characterizes the equilibrium platforms (x_1^*, y_1^*) and (x_2^*, y_2^*) selected by the parties.

Proposition 1 *The equilibrium platforms selected by the parties are:*

$$x_p^* = w_p^V \sum\nolimits_{v\in V} w^v x^{v_x} + \left(1 - w_p^V\right) \sum\nolimits_{g\in G} w_p^g x^{g_x} \tag{6}$$

$$y_p^* = w_p^V \sum\nolimits_{v\in V} w^v y^{v_y} + \left(1 - w_p^V\right) \sum\nolimits_{g\in G} w_p^g y^{g_y} \tag{7}$$

where $w^v = \frac{n^v \eta^v}{\sum_{v\in V} n^v \eta^v}, w_p^g = \frac{a_p^g n^g}{\sum_{g\in G} a_p^g n^g}$, *and* $w_p^V = \frac{\sum_{v\in V} n^v \eta^v}{\sum_{v\in V} n^v \eta^v + (\sum_{v\in V} n^v \eta^v \mu^v)^2 \sum_{g\in G} a_p^g n^g}$. *Moreover, the equilibrium expected vote share of party* $p \in P$ *is:*

$$S_p^* = \frac{1}{2} + \sum_{v \in V} n^v \eta^v \left[u^v\left(x_p^*, y_p^*\right) - u^v\left(x_{-p}^*, y_{-p}^*\right)\right] + \left(\sum_{v \in V} n^v \eta^v \mu^v\right)^2 \sum_{g \in G} \left[a_p^g n^g u^g\left(x_p^*, y_p^*\right) + b_p^g - a_{-p}^g n^g u^g\left(x_{-p}^*, y_{-p}^*\right) - b_{-p}^g\right] \quad (8)$$

Proof*: see Appendix A.* ■

The equilibrium platform of each party is a weighted average between the position of voters and the position of the interest groups that contribute to the party. Voters push parties to the center of the policy space, measured by the weighted average of the most preferred policies of each group of voters ($\bar{x} = \sum_{v \in V} w^v x^{v_x}$ and $\bar{y} = \sum_{v \in V} w^v x^{v_y}$). Interest groups, however, push parties to more extreme positions. The relative importance of each group of voters is the same for both parties (with the weight of voter group $v \in V$ given by w^v). However, the importance of voters versus special interest groups (measured by w_p^V), as well as the importance of each interest group within each party (measured by w_p^g), could be different for each party. The model can generate polarized parties when interest groups are partisan, in the sense that each interest group finds it easier to support a different party.

The model suggests (using Proposition 1) the following *definition of polarization* in each policy dimension:

$$Pol_x^* = \frac{x_2^* - x_1^*}{x^h - x^l} \qquad Pol_y^* = \frac{y_2^* - y_1^*}{y^h - y^l} \quad (9)$$

The sign of Pol_x^* indicates the equilibrium pattern of polarization in the x dimension, with $Pol_x^* > 0$ ($Pol_x^* < 0$) indicating that the equilibrium position of party 1 in the x dimension is lower (higher) than the equilibrium position of party 2. The absolute value of Pol_x^* indicates the equilibrium level of polarization in the x dimension, measured as the absolute value of the difference between the equilibrium level of x adopted by the parties relative to the maximum possible difference. Analogous interpretations apply for dimension y.[3]

3.3. Partisan Interest Groups and Polarization

Proposition 1 also identifies the factors that affect the pattern and level of polarization. For concreteness, consider a situation in which the only difference between the parties is that interest

[3] It is also possible to define polarization without reference to the range of preferences.

groups have different costs of influencing the two parties. Further assume that groups that push for low x find it less costly to support party 1 rather than party 2 and interest groups that push for high x find it less costly to support party 2 rather than party 1. A simple specification that formally captures this situation is:

$$a_1^{l,l} = a_1^{l,h} = \frac{\lambda_1 a}{n^{l,l} + n^{l,h}}, a_1^{h,l} = a_1^{h,h} = \frac{(1-\lambda_1)a}{n^{h,l} + n^{h,h}} \quad (10)$$

$$a_2^{l,l} = a_2^{l,h} = \frac{\lambda_2 a}{n^{l,l} + n^{l,h}}, a_2^{h,l} = a_2^{h,h} = \frac{(1-\lambda_2)a}{n^{h,l} + n^{h,h}} \quad (11)$$

where $1 > \lambda_1 > \lambda_2 > 0$ and $a = \sum_{g \in G} a_1^g n^g = \sum_{g \in G} a_2^g n^g > 0$. For this specification (see Corollary 1 in the Appendix A), the equilibrium level of party polarization in each dimension is given by:

$$Pol_x^* = (1 - w^V)(\lambda_1 - \lambda_2) \qquad Pol_y^* = (1 - w^V)(\lambda_1 - \lambda_2)\left(\frac{n^{l,l}}{n^{l,l} + n^{l,h}} - \frac{n^{h,l}}{n^{h,l} + n^{h,h}}\right) \quad (12)$$

where $w^V = \frac{\sum_{v \in V} n^v \eta^v}{\sum_{v \in V} n^v \eta^v + (\sum_{v \in V} n^v \eta^v \mu^v)^2 a}$. Therefore, we obtain the following comparative static results:

Proposition 2 *Suppose that (10) and (11) hold with* $1 > \lambda_1 > \lambda_2 > 0$ *and* $n^{l,l}/(n^{l,l} + n^{l,h}) \neq n^{h,l}/(n^{h,l} + n^{h,h})$. *Then:*

1. $|Pol_x^*|$ *and* $\left|Pol_y^*\right|$ *are increasing in* $1 - w^V$.
2. $|Pol_x^*|$ *and* $\left|Pol_y^*\right|$ *are increasing in* $\lambda_1 - \lambda_2$.
3. $Pol_y^* > 0$ *if and only if* $n^{l,l}/(n^{l,l} + n^{l,h}) > n^{h,l}/(n^{h,l} + n^{h,h})$.
4. $\left|Pol_y^*\right|$ *is increasing in* $|n^{l,l}/(n^{l,l} + n^{l,h}) - n^{h,l}/(n^{h,l} + n^{h,h})|$.

Proof*: see Appendix A.* ■

Proposition 2.1 states that the levels of polarization in both policy dimensions increase with the importance of interest groups relative to voters. We can intuit that voters induce parties to converge to the same platform (the electoral center) while partisan interest groups induce parties to adopt more extreme and different positions. In the model, there are two main channels through which the weight of special interest groups could increase: a rise in the importance of contributions on electoral success (higher μ^v) and a rise in the overall level of influence of interest groups (higher a).

Proposition 2.2 states that the levels of polarization in both policy dimensions increase with the level of partisanship of interest groups in the x dimension. Intuitively, as interest groups that

push for low x received a higher weight in party 1 (λ_1 higher) and a lower weight in party 2 (λ_2 lower), party 1 moves its platform closer to x^l and party 2 moves its platform closer to x^h.

Proposition 2.3 states that, given a pattern of polarization in the x dimension ($Pol_x^* > 0$), the pattern of polarization that emerges in the y dimension is determined by the distribution of preferences over dimension y among the interest groups attached to each party. In particular, $Pol_y^* > 0$ if and only if $n^{l,l}/(n^{l,l} + n^{l,h}) > n^{h,l}/(n^{h,l} + n^{h,h})$. Intuitively, suppose that party 1 assigns a higher weight to special interest group $g = (l, l)$ rather than to $g = (l, h)$ (among the interest groups that favor x^l), while party 2 assigns a higher weight to special interest group $g = (h, h)$ rather than to $g = (h, l)$ (among the interest groups that favor x^h). Then, interest group $g = (l, l)$ ends up relatively more attached to party 1 and interest group $g = (h, h)$ ends up relatively more attached to party 2, which induces a polarization pattern in which party 1 selects a platform with low x and y, while party 2 selects a platform with high x and y. This result is key because it connects the pre-existing coalitions contributing to each party (i.e., interest groups along the x dimension) and how new interest groups along the y dimension will interact with each party. In other words, the pattern of polarization in the x dimension is induced by interest groups that push for lower (higher) x getting attached to party 1 (2), which makes the coalitions attached to each party also different on their preferences over the y dimension. Thus, the pattern of polarization in the y dimension follows from the pattern of polarization in the x dimension.

Finally, Proposition 2.4 states the level of polarization in the y dimension increases with the difference between the distributions of the preferences over dimension y among the interest groups attached to the parties ($|Pol_y^*|$ is increasing in $|n^{l,l}/(n^{l,l} + n^{l,h}) - n^{h,l}/(n^{h,l} + n^{h,h})|$). This is also an important result because it implies that the level of polarization in the x dimension does not mechanically translate into the level of polarization in the y dimension. What matters is how much the preferences over dimension y among the interest groups originally attached to the parties differ, which can vary overtime as groups learn about the costs and benefits of legislative proposals on a new policy dimension.

3.4. Application to Environmental Legislation in the US Congress

Our model sheds light on the rise and pattern of environmental US party polarization. With the onset of the environmental movement in the 1970s, the environment slowly became a political

issue. Initially, there were no clear winners and losers from environmental initiatives or at least the proportion of expected winners and losers were similarly distributed between both parties. Consequently, bipartisan support for some pro-environmental legislation prevailed, such as the Endangered Species Act (ESA) of 1973. In our model, this corresponds with a period in which $[n^{l,l}/(n^{l,l}+n^{l,h})]-[n^{h,l}/(n^{h,l}+n^{h,h})]$ was probably low and, hence, Pol_y^* was low.

Over time, environmental policies with clear positive net benefits and no clearly identified losers diminished and the costs of environmental programs became clear. For example, as the ESA was implemented, landowners often faced high regulatory costs (Lueck and Michael 2003). More generally, it became clear that the cost and benefits of environmental legislation were not evenly distributed across voters, regions, and interest groups. On one hand, the coalitions of interest groups already incorporated into the Republican Party (e.g., more industries associated with natural resources and more rural constituencies) were often negatively affected by environmental legislations. On the other hand, the coalitions of interest groups already incorporated into the Democratic Party (e.g., less industries associated with natural resources and more urban constituencies) were often positively affected by environmental legislation or, at least, they avoided most of the costs of those initiatives. Environmental interest groups became attached to the Democratic Party and anti-environmental interest groups became attached to the Republican Party. Consequently, party polarization on environmental issues arose. In our model this corresponds with a period in which $[n^{l,l}/(n^{l,l}+n^{l,h})]-[n^{h,l}/(n^{h,l}+n^{h,h})]$ was likely growing and, hence, Pol_y^* increased as well.

Once interest groups became more partisan organizations, pro- and anti- environmental positions became a routine component of party stances. Subsequently, higher levels of party discipline on the issue were expected and implemented. In some cases, however, local, and regional factors were so strong that some legislators preferred to break party lines, something less common as party polarization consolidated. The increasing cost of campaigns may also help explain the rise and consolidation of polarization as parties became more dependent on campaign contributions. In our model, the increasing cost of campaigns corresponds to an increase in μ^v, which leads to higher Pol_y^*. Finally, as the parties became more focused on different constituencies (e.g., Republicans representing more rural districts and Democrats more urban districts), the divergence in the preferences of the coalitions of interest groups forming the parties also increased.

This difference in preferences corresponds to increases in $\lambda_1 - \lambda_2$ and $[n^{l,l}/(n^{l,l} + n^{l,h})] - [n^{h,l}/(n^{h,l} + n^{h,h})]$, both leading to higher Pol_y^*.

4. Data

Table 2 below summarizes our data (for more details refer to Appendix B).

Dataset	Variables	Sources
Enviro Votes	LCV Scores	League of Conservation Voters
	Legislation passed the Senate, passed the House, was vetoed by the President, or was made into law; and name of the bill's sponsor	Congress's website
Legislator Characteristics	Committee chairs and party leaders	Charles Stewart Data Page (MIT)
	Age, years served, gender, party rank	Biographical Directory of the United States
Electoral Results	Margin of victory, share of votes	MIT Election Lab
Party Platforms	Party positions and statements	Manifesto Research on Political Representation
Interest Groups	Number of interest groups, contributions, and lobbying efforts	Center for Responsive Politics
Legislative District	Population, income, sectoral information	US Census

Environmental voting data: These data come from the League of Conservation Voters (LCV) and Congress's website. The LCV, a political advocacy organization assisting politicians with 'pro-environment' values and goals, has tracked environmental voting in the US Congress since 1970 via its National Environmental Scorecard (League of Conservation Voters 2021). Each Congressional member is given an annual score from 0 to 100 based on the percentage of LCV-determined pro-environment votes during a congressional session. The US Congress's website provides additional information on environmental votes that was added to data on the legislative actions considered by the LCV. In addition to information on the bill's sponsor, Congress's website also provided information on whether the legislation passed the Senate, passed the House, was vetoed by the President, or was made into law.

Politicians' characteristics: These data were gathered from the Charles Stewart Data Page (MIT) and the Biographical Directory of the United States (BDUS). The Charles Stewart Data Page (MIT) identified the presiding committee chairs and party leaders for each year. From BDUS we collected data on politicians' birth years, gender, and first year/last year in a branch of Congress.

Electoral results: These data come from MIT Election Lab which provides electoral results for every election since 1976 to 2018 for both the House and the Senate.

Party platforms: These data come from the Manifesto Project Database compiled by the Manifesto Research on Political Representation (MARPOR). The database includes information about parties' manifestos since 1945 for 50 countries, including the US.

Interest groups: These data come from the Center for Responsive Politics (CRP) which makes data available from lobbying disclosure reports filed with the Secretary of the Senate's Office of Public Records. The data covers the period 1998 to present. In addition, the CRP also provides data about interest groups; campaign contributions are categorized by industry and include both individual and political action committee (PAC) contributions.

Legislative district characteristics: Via the US Census, a dataset is created for each legislator in each year on a vote for a specific bill. The dataset includes legislators' characteristics (e.g., age, party rank, committee assignments) and electoral results. As we collect new data this dataset will also include campaign contributions and lobbying for each specific bill as well the amount received by each legislator in each specific year.

Table 3 provides a sample of summary statistics. As can be seen from the 1980 and 2010 means, many variables experience significant time variation.

Table 3. Sample of Summary Statistics Indicating Significant Time Variation (1972-2016)

Variables	Observations	Mean	1980 Mean	2010 Mean	SD	Min	Max
House Districts							
LCV Score	19,507	47.85	45.04	57.87	34.39	0	100
Fraction Republican	19,477	0.54	0.62	0.59	0.50	0	1
Income ($1,000)	19,447	35.87	9.63	64.64	24.69	0.03	134.8
Politician Age	19,468	53.24	49.64	57.37	10.52	26	96
Freshman	19,507	0.15	0.18	0.13	0.35	0	1
% Black	19,483	0.12	0.11	0.13	0.15	0.00	0.92
% Employment in Manufact	19,389	0.08	0.10	0.05	0.04	0.01	0.53
% Real Estate	19,045	0.02	0.03	0.01	0.01	0.00	0.12
Senate Districts							
LCV Score	4,514	47.18	45.61	47.55	35.05	0	100
Fraction Republican	4,449	0.52	0.59	0.59	0.50	0	1
Income ($1,000)	4,516	23.75	9.80	39.43	13.81	3.317	69.31
Politician Age	4,516	58.75	54.44	63.43	10.41	31	100
Freshman	4,516	0.06	0	0.05	0.24	0	1
% Black	4,516	0.09	0.08	0.10	0.09	0.00	0.40
% GDP Manufacturing	4,516	0.16	0.20	0.11	0.08	0.02	0.39
% GDP Real Estate	4,516	0.16	0.14	0.18	0.05	0.06	0.42

Note. Due to data availability, "income" refers to median income at the electoral district and GDP per capita at the state level.

5. Empirical Analysis

This section presents our main empirical results. First, we present clear evidence of a causal partisan effect on environmental voting in the U.S. Congress. Second, we empirically explore the mechanisms behind this effect.

5.1. Evidence of Party Polarization

The challenge of identifying the effect of political partisanship on environmental voting lies with electoral districts or states; either might have a Democrat or a Republican as Congressperson or Senator, respectively, due to unobservable factors. To overcome this problem, we follow the literature on the effects of political partisanship (Lee 2001 and 2008, Ferreira and Gyourko 2009 and 2014, and Beland 2015) and use a regression discontinuity design (RDD). The RDD compares the voting decision of legislators in electoral districts (Congress) or states (Senate) where Democrats closely won against electoral districts or states where Democrats closely lost (i.e., a Republican won). Lee (2001, 2008) shows that this strategy exploits quasi-random variation thus, approximating a randomized experiment.

Specifically, following Ferreira and Gyourko (2009), Beland (2015) and Beland and Unel (2018), we estimate the following specification:

$$\begin{aligned} LCV_{dt} = \beta_0 + \beta_1 Rep_{dt} + \gamma_1 MV_{dt} + \gamma_2 MV_{dt}^2 + \gamma_3 MV_{dt}^3 + \\ +(\gamma_4 MV_{dt} + \gamma_5 MV_{dt}^2 + \gamma_6 MV_{dt}^3) * Rep_{dt} + Z_{dt} + \varepsilon_{dt} \end{aligned} \quad (13)$$

where LCV_{dt} is the LCV score in district d in year t, Rep_{dt} is a dummy variable that takes the value of 1 if in district d and year t there is a Republican in office, MV_{dt}= $Vote\ share_{dt}^{Rep} - Vote\ share_{dt}^{Dem}$ is the margin of victory in district d in year t, Z_{st} includes year fixed effects, as well as state and regional fixed effects for the House and the Senate, respectively, and ε_{dt} is a random error. We follow the literature and include a cubic polynomial of MV_{dt} and the interaction of each term of the polynomial with Rep_{dt} (Lee and Lemieux 2010).

The parameter of interest is β_1 and we interpret it as the effect of electing a Republican legislator rather than a Democrat legislator on environmental voting measured by legislator' LCV score. That is, β_1 is the pure political partisanship effect on environmental voting. We expect β_1 to be negative and to increase (in absolute value) over time.

Table 4 shows the results of estimating equation (13). Column 1 shows the estimation employing the whole sample, while columns 2-8 show the estimates for 8 subsamples

corresponding to each presidential administration, from Nixon to Obama. As can be seen, Republican Members of Congress and Senators have a smaller LCV score than Democrats (about 42 points in the House and 66 points in the Senate). In addition, columns 2 to 9 show that polarization has increased over time.

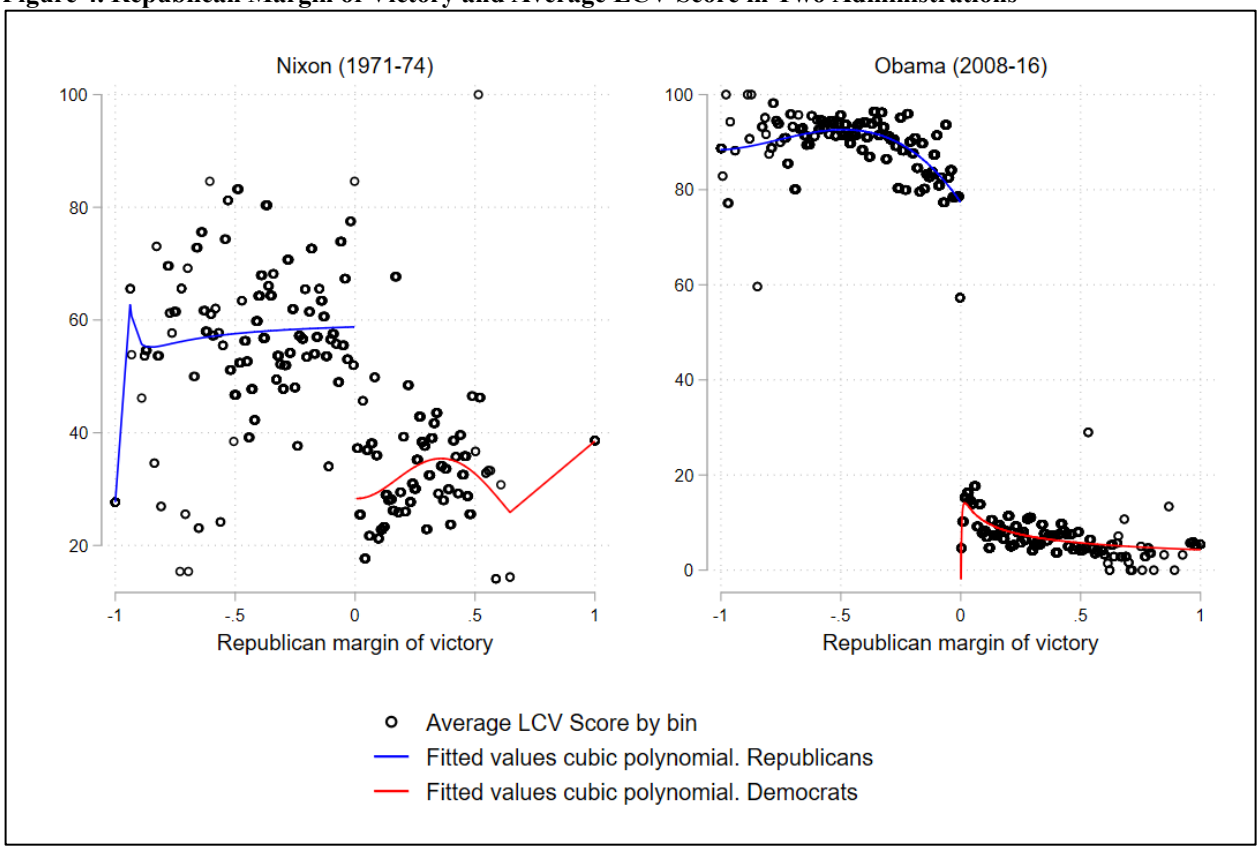
The rise in polarization can be seen graphically too. In Figure 3, we divide the sample in two subsamples corresponding to the presidential administrations of Richard Nixon and Barack Obama. The horizontal axis shows the Republican margin of victory, and the vertical axis shows the average LCV score by small margin of victory intervals (0.01). Each dot corresponds to the average LCV score in a specific interval, and the solid lines show the predicted values from the cubic polynomial fit without covariates. As can be seen, the discontinuity in the average LCV score between House Republicans and Democrats is not visible during the Nixon administration. However, there is a clear discontinuity in the average LCV score between Republicans and Democrats in the Obama administration. Results for the Senate (not presented here) display the same pattern as the House.

Table 4. RDD Estimates of Party on Environmental Voting

Variables	(1) Full Sample	(2) Nixon (71-74)	(3) Ford (74-76)	(4) Carter (76-80)	(5) Reagan (80-88)	(6) G. H. Bush (88-92)	(7) Clinton (92-00)	(8) G. W. Bush (00-08)	(9) Obama (08-16)
	Dependent Variable = LCV Score								
					House				
Rep_{dt}	-44.6***	-29.1***	-45.7***	-29.9***	-32.6***	-45.2***	-48.1***	-51.3***	-62.7***
	(1.668)	(5.94)	(4.80)	(4.36)	(3.17)	(5.45)	(3.23)	(4.03)	(3.02)
Observations	19,477	1,302	862	1,733	3,458	1,730	3,468	3,465	3,459
R-squared	0.660	0.448	0.550	0.509	0.570	0.604	0.711	0.834	0.925
					Senate				
Rep_{dt}	-48.4***	-35.7***	-44.5***	-45.3***	-32.4***	-49.0***	-73.1***	-57.1***	-71.6***
	(2.72)	(12.89)	(9.95)	(7.03)	(6.83)	(6.68)	(5.43)	(6.10)	(5.40)
Observations	4,268	207	194	374	791	388	768	779	767
R-squared	0.617	0.387	0.491	0.469	0.454	0.576	0.806	0.749	0.882

Note: All estimates come from equation (12). All models include a cubic polynomial in margin of victory, and its interaction with the dummy variable for Republican legislator, year fixed effects, and state and region fixed effects for the House and Senate, respectively. Heteroskedasticity-robust standard errors clustered at the legislative district level (district for House and state for Senate) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.

Figure 4. Republican Margin of Victory and Average LCV Score in Two Administrations



Notes. Unit of analysis is district-year pairs.

To sum up, there is clear empirical evidence of a causal partisan effect on environmental voting in the U.S. Congress, with Republican legislators being systematically less pro-environment than Democratic legislators. Moreover, the magnitude of the effect is statistically as well as economically significant and rising overtime.

5.2. On the Mechanisms Leading to Party Polarization

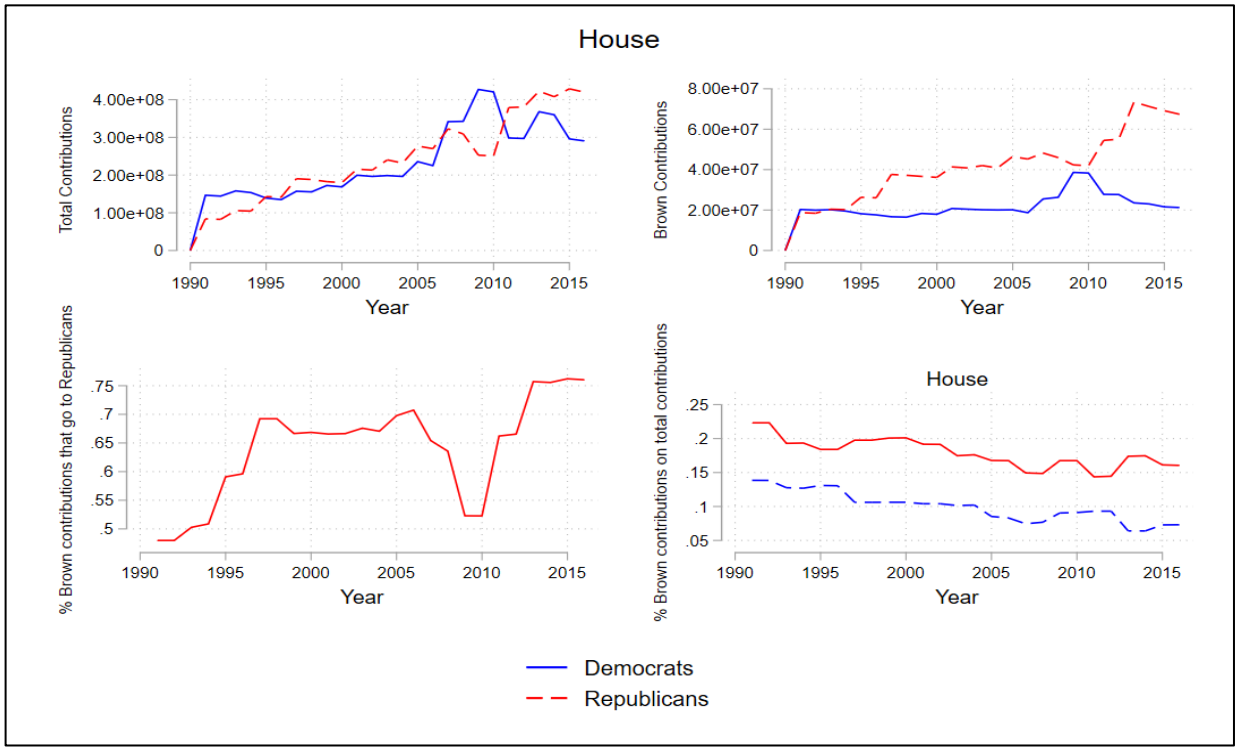
Next, we explore the mechanisms behind party polarization on environmental issues. Our model suggests that interest groups and campaign contributions play a key role to explain the pattern and evolution of party polarization. Therefore, we begin examining campaign contributions.

Figure 5 shows campaign contributions over time. Total contributions received by legislators rise over time, but there is no systematic difference on total contributions received by Republican and Democratic legislators, either for the House or the Senate (see top left panels in Figures 5a and 5b). On the contrary, when we focus the attention on brown contributions,

Republican legislators have a clear advantage.[4] A higher share of brown contributions goes to Republican legislators than to Democratic legislators (see bottom left panels in Figures 5.a and 5.b). Moreover, brown contributions represent a more important source of funding for Republican than Democratic legislators (see bottom right panels in Figures 5.a and 5.b). Note, however, that the importance of brown contributions declines overtime for both parties.

Overall, the contribution data shown in Figure 5 are consistent with our theoretical prediction on the pattern of party polarization. Brown interest groups tend to contribute relatively more to Republican than Democratic legislators, which induces Republican legislators to be less prone to support pro-environmental legislation.

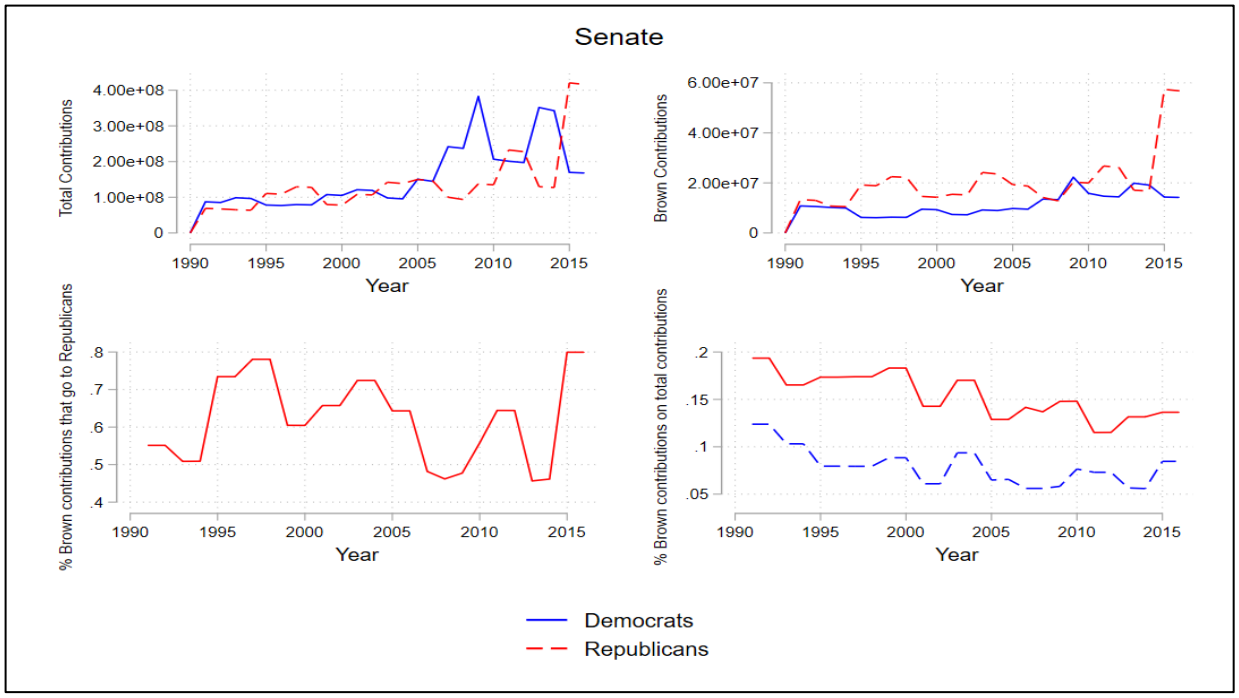
Figure 5.a Contributions (House)



Note. Total contributions and Brown contributions are expressed in real terms (2012=100, Implicit Price Deflator).

[4] We define brown contributions based on the industry classification made by Center for Responsive Politics (opensecrets.org). We consider contributions from the following industries to be brown: agriculture; energy, natural resources and environment; construction & public works; manufacturing; and the subsectors: environmental policy, mining unions, and energy-related unions (non-mining).

Figure 5.b Contribution (Senate)



Note. Total contributions and brown contributions are expressed in real terms (2012=100, Implicit Price Deflator).

To further explore how "brown" contributions affect environmental voting we also estimate the following RDD model:

$$LCV_{dt} = \beta_0 + \beta_1 Rep_{dt} + \beta_2 BC_{dt} + \beta_3 (Rep_{dt} * BC_{dt}) + \\ + \gamma_1 MV_{dt} + \gamma_2 MV_{dt}^2 + \gamma_3 MV_{dt}^3 + (\gamma_4 MV_{dt} + \gamma_5 MV_{dt}^2 + \gamma_6 MV_{dt}^3) * Rep_{dt} \\ + (\gamma_4 MV_{dt} + \gamma_5 MV_{dt}^2 + \gamma_6 MV_{dt}^3) * BC_{dt} + Z_{st} + \varepsilon_{gt} \quad (14)$$

where BC_{dt} are the "brown" contributions received by the legislator of district d in time t. The parameters of interest are β_1, β_2, and β_3. We expect β_1 to be negative (a pure partisan effect) and β_2 to be negative as higher contributions from "brown" interest groups make legislators from both parties less willing to support pro-environmental legislation. Regarding the interaction term, the sign of β_3 is ambiguous. If "brown contributions" have a relatively bigger effect on Democratic legislators than on Republican legislators, then we expect β_3 to be positive. That is, "brown" contributions make a Democratic legislator to vote more aligned with a Republican one. On the contrary, if "brown" contributions have a relatively bigger effect on Republican legislators than on Democratic legislators, then we expect β_3 to be negative. That us, more "brown" contributions enlarge the difference between Republican and Democratic legislators.

Table 5 presents the results of estimating equation (14). In line with our expectations, even after controlling for "brown" contributions, there is still a partisan effect. Republican legislators

have a smaller LCV score than Democrats (about 59 points in the House and 66 points in the Senate). Also aligned with theoretical expectations, both in the House and the Senate, polarization increases as "brown" contributions per capita increase. Finally, the estimated effect of the interaction term (Rep_{dt}*Real Brown Contributions per Capita) is positive, which indicates that "brown" contributions tend to have a relatively bigger effect on Democratic legislators than on Republican legislators.

One possible interpretation for a positive β_3 is that Republican legislators already have very low LCV scores and, hence, there is not much room for additional "brown" contributions to reduce their LCV scores even further. On the contrary, Democratic legislators have very high LCV scores and, therefore, "brown" contributions might be more effective pushing them to reduce their LCV scores. Table 6 suggests that this is indeed the case. We divided the sample between Republican and Democratic legislators and run a regression of LCV scores against "brown" contributions. Note that the estimated coefficients for Republicans are much lower than for Democrats (both in the House and Senate). In other words, a Republican legislator who receives more "brown" contributions is marginally "browner", but a Democratic legislator who receives more "brown" contributions becomes substantially "browner".

Table 5. Heterogenous effects: Brown Contributions

Variables	(1) House	(2) Senate
Rep_{dt}	-59.61***	-66.04***
	(2.53)	(3.27)
Real Brown Contributions per Capita	-40.98***	-19.72**
	(5.91)	(8.41)
Rep_{dt}*Real Brown Contributions per Capita	33.97***	18.97**
	(7.16)	(9.14)
Observations	11,126	2,375
R-squared	0.8056	0.7884

Notes: All estimates come from equation (14). Both models include a cubic polynomial in margin of victory, and its interaction with the dummy variable for Republican legislator, year fixed effects, and state and region fixed effects for the House and Senate, respectively. Heteroskedasticity-robust standard errors clustered at the legislative district level (district for House and state for Senate) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.

Table 6. Brown Contributions by Party

	House		Senate	
	(1)	(2)	(3)	(4)
Variables	Republicans	Democrats	Republicans	Democrats
Dependent Variable=LCV Score				
Real Brown Contributions per Capita	-5.79***	-37.72***	-0.85	-21.25***
	(1.64)	(5.08)	(1.55)	(6.06)
Observations	5,550	5,576	1,182	1,193
R-squared	0.4593	0.4813	0.3808	0.2851

Note: All models include margin of victory, year fixed effects, and state and region fixed effects for the House and Senate, respectively. Heteroskedasticity-robust standard errors clustered at the legislative district level (district for House and state for Senate) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.

The findings in Tables 5 and 6 seem to indicate that anti-environment special interest groups could gain influence increasing their contributions to Democratic legislators. Note, however, that it is still the case that Republican legislators are much less prone to support pro-environmental legislation than Democratic legislators, which gives anti-environment special interest group powerful incentives to support the campaign efforts of Republican candidates. In other words, although "brown" contributions can make a Democrat legislator "browner", they will never make her as "brown" as a Republican legislator.

5.3. Income and Economic Structure

Our model also implies that income and the economic structure could also affect environmental voting. In particular, we expect that richer districts tend to elect "greener" legislators, while districts in which relatively "brown" activities are more important tend to elect "browner" legislators. Table 7 suggests that income is indeed associated with legislators with higher LCV scores. Moreover, note that for the House the estimated coefficient for Republicans is higher than for Democrats. One possible explanation is that Democratic legislators already have very high LCV scores and, hence, there is not much room for additional income to make them even "greener". On the contrary, Republican legislators have very low LCV scores and, therefore, there is more space for income to change their behavior toward environmental legislation. Table 8 suggests that the importance of primary activities (e.g., agriculture, mining) tend to be associated with legislators with lower LCV scores.

Table 7. Income and Environmental Voting

	House		Senate	
	(1)	(2)	(3)	(4)
Variables	Republicans	Democrats	Republicans	Democrats
Dependent Variable=LCV Score				
log(Income)	15.67***	11.53***	6.42	15.91
	(3.38)	(2.30)	(11.60)	(10.49)
Observations	8,901	10,518	2,053	2,215
R-squared	0.5067	0.5003	0.4648	0.4302

Note: Due to data availability, "income" refers to median income at the electoral district and GDP per capita at the state level. All models include margin of victory, year fixed effects, and state and region fixed effects for the House and Senate, respectively. Heteroskedasticity-robust standard errors clustered at the legislative district level (district for House and state for Senate) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.

Table 8. Economic Structure and Environmental Voting

	House		Senate	
	(1)	(2)	(3)	(4)
Variables	Republicans	Democrats	Republicans	Democrats
Dependent Variable=LCV Score				
Agriculture	-256.90***	-565.29***	-89.04**	-99.82**
	(55.83)	(66.30)	(43.31)	(46.75)
Construction	-278.86***	-25.19	2.30	53.11
	(91.09)	(67.55)	(35.35)	(51.25)
Manufacturing	-28.80	-62.93***	10.45	-5.92
	(18.82)	(18.64)	(8.10)	(11.78)
Mining			-11.99*	-89.46***
			(6.91)	(29.64)
Observations	8,869	10,490	2,045	2,198
R-squared	0.5074	0.5293	0.4749	0.4583

Note: For the House, variables refer to percentage of people employed in a determined sector. For the Senate, variables refer to the percentage of GDP in that sector. All models include margin of victory, year fixed effects, and state and region fixed effects for the House and Senate, respectively. Heteroskedasticity-robust standard errors clustered at the legislative district level (district for House and state for Senate) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.

5.4. Party Forces

Our model highlights the role of special interest groups to explain the rise and pattern of party polarization and implicitly assumes that legislators just follow the party line. This is of course an oversimplification. The evidence on internal party differences regarding environmental legislation seems to be mixed. As Table 8 shows, for the Republican party leaders as well as freshmen are associated with lower LCV scores (both in the House and Senate). On the other hand, for the Democratic party there is no clear difference in the voting behavior of leaders or freshmen,

except in the House, where freshmen are associated with higher LCV scores. In any case, nothing indicates that parties face internal pressures to move to the electoral center.

Table 9. Party

	House		Senate	
	(1)	(2)	(3)	(4)
Variables	Republicans	Democrats	Republicans	Democrats
Dependent Variable=LCV Score				
Leader	-9.62***	2.69	-9.00***	4.43
	(2.41)	(3.14)	(2.77)	(3.63)
Freshman	-1.33**	2.33***	-4.12**	-0.89
	(0.55)	(0.69)	(1.83)	(1.79)
Observations	8,886	10,524	2,053	2,215
R-squared	0.5011	0.5035	0.4717	0.4216

Note: All models include margin of victory, legislator's age, year fixed effects, and state and region fixed effects for the House and Senate, respectively. Heteroskedasticity-robust standard errors clustered at the legislative district level (district for House and state for Senate) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.

6. Robustness Checks

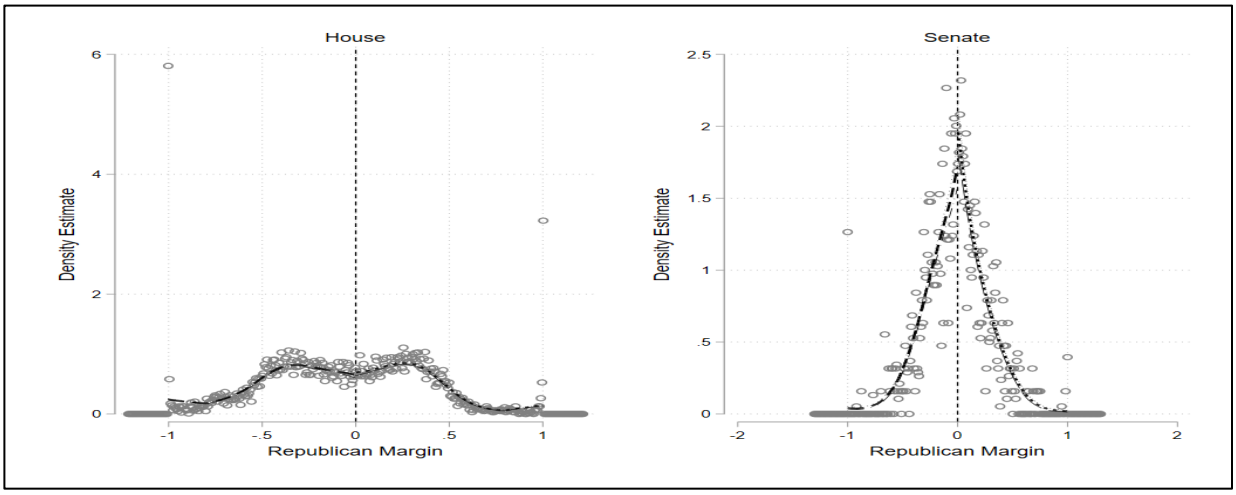
This section summarizes several robustness checks (for more details refer to Appendix C).

6.1. Validity of the RDD

One of the main assumptions of the RDD is that candidates cannot perfectly manipulate the election results to become the winners of the election. To test this assumption, we estimate McCrary's (2008) manipulation test.[5] As can be seen from Figure 6, there are no unusual jumps in the running variable around the cutoff, suggesting that politicians do not have precise control over the election results.

[5] The bandwidth and bin-size are chosen following McCrary's (2008) automatic bandwidth selection procedure.

Figure 6. McCrary's (2008) Manipulation Test

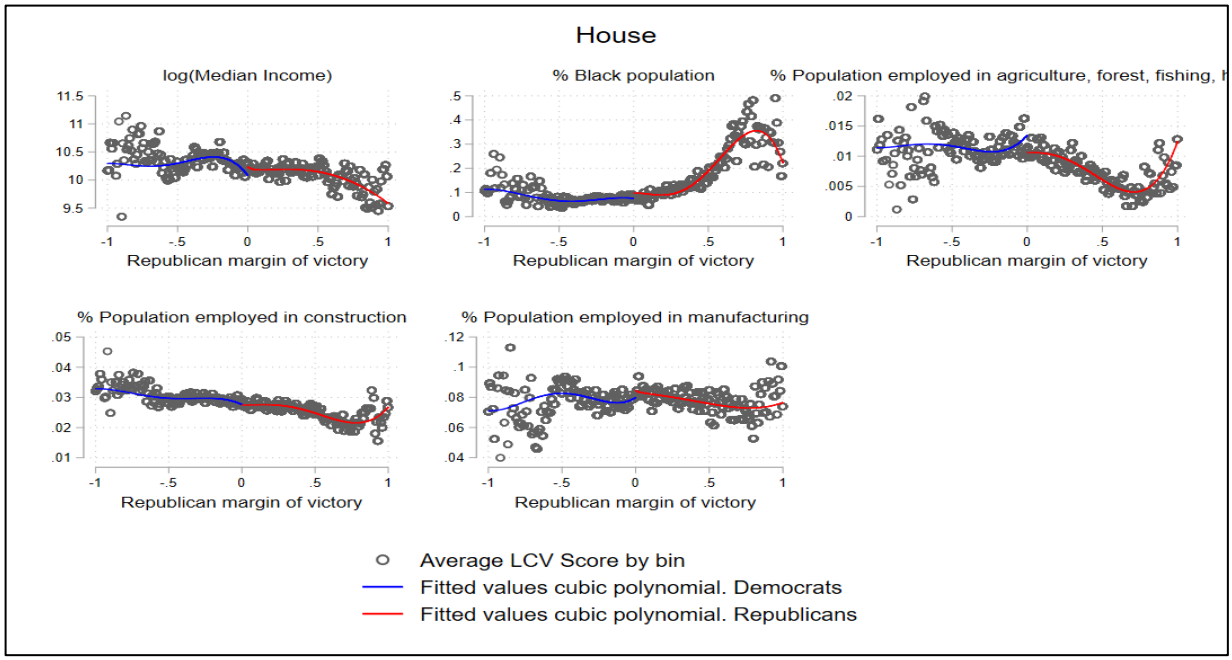


Note. Kernel density function estimated based on McCrary (2008) for the House (left) and the Senate (right).

The RDD also requires that no other variables do not exhibit a discontinuity at the cutoff. To test this assumption, we plotted several economic variables from each electoral district or state for the House and the Senate, respectively.[6] Results are presented in Figures 7.a and 7.b. As can be seen, there are no discontinuities in any of the variables.

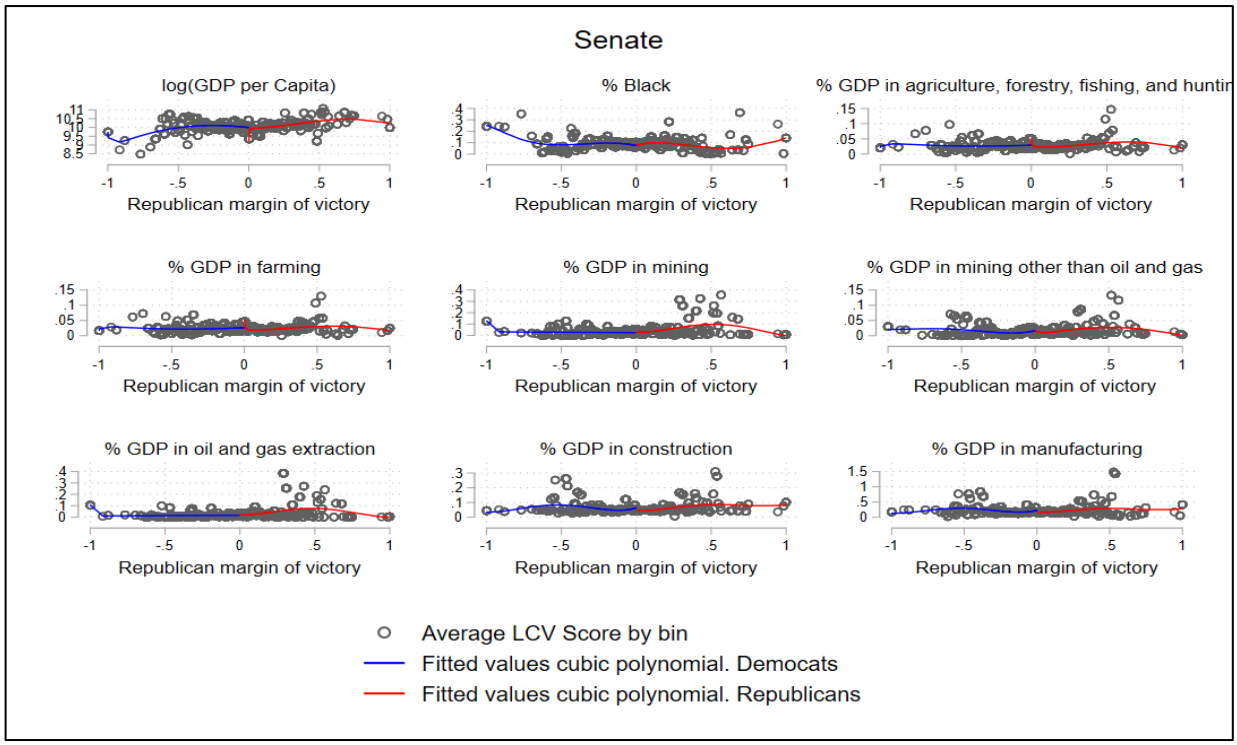
[6] For the House we plotted the logarithm of median income, the proportion of black individuals in the electoral district, and the proportion of individuals working in agriculture, forestry, and fishing; construction; and manufacturing. For the Senate we plotted the logarithm of GDP per capita, the proportion of black individuals in the state, and the percentage of GDP in agriculture, forestry, fishing, and hunting; farming; mining; mining other than oil and gas; oil and gas; construction; and manufacturing.

Figure 7.a House Covariates



Notes. Unit of analysis is district-year pairs.

Figure 7.b. Senate Covariates



Notes. Unit of analysis is state-year pairs.

6.2. Alternative Specifications and Confounding Factors

Following Beland (2015), we check the robustness of our results to different specifications of the RDD model. In particular, we consider polynomials of different orders for the margin of victory and re-estimate equation (12). Results do not change (see Table 10). We also include potential confounders (see Table 11). Our estimates suffer little change when the model includes the log of median income in the district and the percentage of black population in the district in the case of the House, and the log of GDP per capita and the percentage of black population in state in the case of the Senate. These control variables also include their third order polynomial with margin of victory, and its interaction with the republican legislator dummy.

Table 10. Robustness of RDD Estimates to Alternative Polynomials

VARIABLES	(1) First Order	(2) Second Order	(3) Third Order (Baseline)	(4) Fourth Order
			House	
Rep_{dt}	-62.663***	-58.553***	-59.614***	-57.491***
	(1.907)	(2.169)	(2.530)	(2.757)
Rep_{dt}*Real Brown Contributions per Capita	24.606***	26.694***	33.965***	39.165***
	(6.127)	(6.680)	(7.164)	(7.636)
Real Brown Contributions per Capita	-35.422***	-38.039***	-40.980***	-46.987***
	(5.330)	(5.727)	(5.912)	(6.594)
Observations	11,126	11,126	11,126	11,126
R-squared	0.804	0.805	0.806	0.806
			Senate	
Rep_{dt}	-67.360***	-64.964***	-66.041***	-69.053***
	(2.846)	(3.083)	(3.266)	(4.145)
Rep_{dt}* Real Brown Contributions per Capita	17.571**	17.145*	18.969**	24.501*
	(7.743)	(9.554)	(9.144)	(12.265)
Real Brown Contributions per Capita	-19.869***	-19.520**	-19.722**	-24.929**
	(7.061)	(8.605)	(8.407)	(11.109)
Observations	2,375	2,375	2,375	2,375
R-squared	0.786	0.788	0.788	0.789

Notes: Estimates from column (1) come from a model that includes a linear polynomial in margin of victory, and its interaction with the dummy variable for Republican legislator. Estimates from column (2) come from a model that includes a quadratic polynomial in margin of victory, and its interaction with the dummy variable for Republican legislator. Estimates from column (3) come from a model that includes a cubic polynomial in margin of victory, and its interaction with the dummy variable for Republican legislator (baseline model from equation 14). Estimates from column (4) come from a model that includes a quartic polynomial in margin of victory, and its interaction with the dummy variable for Republican legislator. All models include year fixed effects, and state and region fixed effects for the House and Senate, respectively. Heteroskedasticity-robust standard errors clustered at the legislative district level (district for House and state for Senate) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.

Table 11. Robustness of the RDD Estimates to Potential Confounders

Variables	(1) Baseline	(2) log(Income)	(3) % Black
		House	
Real Brown Contributions per Capita	-40.980***	-40.670***	-40.247***
	(5.912)	(5.548)	(5.953)
log(Median Income)		20.905***	
		(2.655)	
Republican	-59.614***	27.600**	-60.564***
	(2.530)	(13.928)	(2.706)
Republican* Real Brown Contributions per Capita	33.965***	36.646***	33.182***
	(7.164)	(6.799)	(7.175)
Republican* log(Median Income)		-22.873***	
		(3.712)	
% Black Population			15.518*
			(9.305)
Republican * % Black Population			20.249
			(14.320)
Observations	11,126	11,126	11,126
R-squared	0.806	0.820	0.808
		Senate	
Real Brown Contributions per Capita	-19.722**	-17.348**	-21.915**
	(8.407)	(8.456)	(9.067)
log(GDP per Capita)		19.533*	
		(10.185)	
Republican	-66.041***	-101.915***	-67.999***
	(3.266)	(24.896)	(4.335)
Republican* Real Brown Contributions per Capita	18.969**	17.746*	21.664**
	(9.144)	(9.280)	(9.885)
Republican* log(GDP per Capita)		-10.941	
		(7.174)	
% Black Population			-18.600
			(31.707)
Republican * % Black Population			20.408
			(29.205)
Observations	2,375	2,375	2,375
R-squared	0.788	0.796	0.789

Notes: The three models include a cubic polynomial in margin of victory, and its interaction with the dummy variable for Republican legislator, year fixed effects, and state and region fixed effects for the House and Senate, respectively. The model in column (3) includes the logarithm of median income for the House, and the logarithm of GDP per Capita for the Senate as control variable. The model in column (4) includes the percentage of black population in the district or state for the House and Senate, respectively, as a control variable. Heteroskedasticity-robust standard errors clustered at the legislative district level (district for House and state for Senate) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7. Conclusions

We have explored the mechanisms behind the rise and pattern of party polarization on environmental issues in the US Congress. From a theoretical perspective, our model stresses the connection between the pre-existing set of coalitions within each party and the new interest groups associated with environmental issues. The available empirical evidence is consistent with our theoretical predictions.

Although we have concentrated on environmental legislation, similar ideas most likely apply to other political issues. Indeed, this project is embedded in a broader research agenda with the following two general party polarization questions: 1. What are the economic and political factors that explain the life cycle of political issues? For example, why do some political issues emerge bipartisan and then become polarized? 2. Why and how do some political issues settle and disappear as a political dimension, while others persist as polarized?

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Appendix A: Proof of Theoretical Results

In this appendix we present the proofs of all the theoretical results in Section 3.

Lemma 1 *Given* a_p^g *and* b_p^g *for* $g \in G$ *and* $p \in P$ *and platforms* (x_p, y_p) *for* $p \in P$*, the contributions of the special interest groups are* $c_p^g = \sum_{v\in V} n^v \eta^v \mu^v \max\{L_p^g - L_{-p}^g, 0\}$*, while the difference in the contributions received by the parties is given by* $c_p - c_{-p} = \sum_{v\in V} n^v \eta^v \mu^v \sum_{g\in G} (L_p^g - L_{-p}^g)$.

Proof: The payoff function of special interest group $g \in G$ is given by:

$$\mathcal{L}^g = \sum\nolimits_{p\in P} \left[S_p L_p^g - \frac{1}{2}\left(c_p^g\right)^2 \right]$$

where $S_p = \frac{1}{2} + \sum_{v\in V} n^v \eta^v \left[u^v(x_p, y_p) - u^v(x_{-p}, y_{-p})\right] + \sum_{v\in V} n^v \eta^v \mu^v (c_p - c_{-p})$, $L_p^g = a_p^g n^g u^g(x_p, y_p) + b_p^g$, and $c_p = \sum_{g\in G} c_p^g$. Therefore:

$$\mathcal{L}^g = \sum\nolimits_{p\in P} \left\{ \begin{matrix} \frac{1}{2} + \sum_{v\in V} n^v \eta^v \left[u^v(x_p, y_p) - u^v(x_{-p}, y_{-p})\right] \\ + \left(\sum_{g\in G} c_p^g - \sum_{g\in G} c_{-p}^g \right) \sum_{v\in V} n^v \eta^v \mu^v \end{matrix} \right\} L_p^g - \sum\nolimits_{p\in P} \frac{1}{2}\left(c_p^g\right)^2$$

Taking the first and second derivatives of $\mathcal{L}^g$ with respect to (c_p^g, c_{-p}^g) we have:

$$\frac{\partial \mathcal{L}^g}{\partial c_p^g} = \sum\nolimits_{v\in V} n^v \eta^v \mu^v \left(L_p^g - L_{-p}^g\right) - c_p^g, \qquad \frac{\partial^2 \mathcal{L}^g}{\left(\partial c_p^g\right)^2} = -1, \qquad \frac{\partial^2 \mathcal{L}^g}{\partial c_p^g \partial c_{-p}^g} = 0$$

Thus, $\mathcal{L}^g$ is an strictly concave function of (c_p^g, c_{-p}^g). Hence, the c_p^g that maximizes $\mathcal{L}^g$ is given by:

$$c_p^g = \sum\nolimits_{v\in V} n^v \eta^v \mu^v \max\{L_p^g - L_{-p}^g, 0\}$$

Finally, adding up the contribution of all interest groups to each party, we have:

$$c_p - c_{-p} = \sum\nolimits_{v\in V} n^v \eta^v \mu^v \sum\nolimits_{g\in G} \left(L_p^g - L_{-p}^g\right)$$

This completes the proof of lemma 1. □

Proposition 1 *The equilibrium platforms selected by the parties are:*

$$x_p^* = w_p^V \sum\nolimits_{v\in V} w^v x^{v_x} + \left(1 - w_p^V\right) \sum\nolimits_{g\in G} w_p^g x^{g_x}$$

$$y_p^* = w_p^V \sum\nolimits_{v\in V} w^v y^{v_y} + \left(1 - w_p^V\right) \sum\nolimits_{g\in G} w_p^g y^{g_y}$$

where $w^v = \frac{n^v \eta^v}{\sum_{v\in V} n^v \eta^v}, w_p^g = \frac{a_p^g n^g}{\sum_{g\in G} a_p^g n^g}$, *and* $w_p^V = \frac{\sum_{v\in V} n^v \eta^v}{\sum_{v\in V} n^v \eta^v + (\sum_{v\in V} n^v \eta^v \mu^v)^2 \sum_{g\in G} a_p^g n^g}$. *Moreover, the equilibrium expected vote share of party* $p \in P$ *is:*

$$S_p^* = \frac{1}{2} + \sum\nolimits_{v\in V} n^v \eta^v \left[u^v(x_p^*, y_p^*) - u^v(x_{-p}^*, y_{-p}^*)\right] + \left(\sum\nolimits_{v\in V} n^v \eta^v \mu^v\right)^2 \sum\nolimits_{g\in G} \left[a_p^g n^g u^g(x_p^*, y_p^*) + b_p^g - a_{-p}^g n^g u^g(x_{-p}^*, y_{-p}^*) - b_{-p}^g\right]$$

Proof: Using the results in lemma 1, the payoff function of party p is given by:

$$S_p = \frac{1}{2}\sum_{v\in V} n^v\eta^v\left[u^v(x_p,y_p) - u^v(x_{-p},y_{-p})\right] + \left(\sum_{v\in V} n^v\eta^v\,\mu^v\right)^2 \sum_{g\in G}\left(L_p^g - L_{-p}^g\right)$$

where $L_p^g = a_p^g n^g u^g(x_p,y_p) + b_p^g$. Taking the first of S_p with respect to (x_p,y_p) we have:

$$\frac{\partial S_p}{\partial x_p} = -2\alpha_x\left[\sum_{v\in V} n^v\eta^v\left(x_p - x^{v_x}\right) + \left(\sum_{v\in V} n^v\eta^v\,\mu^v\right)^2 \sum_{g\in G} a_p^g n^g\left(x_p - x^{g_x}\right)\right]$$

$$\frac{\partial S_p}{\partial y_p} = -2\alpha_y\left[\sum_{v\in V} n^v\eta^v\left(y_p - y^{v_y}\right) + \left(\sum_{v\in V} n^v\eta^v\,\mu^v\right)^2 \sum_{g\in G} a_p^g n^g\left(y_p - y^{g_y}\right)\right]$$

Taking the second derivatives of S_p with respect to (x_p,y_p) we have:

$$\frac{\partial^2 S_p}{\left(\partial x_p\right)^2} = -2\alpha_x\left[\sum_{v\in V} n^v\eta^v + \left(\sum_{v\in V} n^v\eta^v\,\mu^v\right)^2 \sum_{g\in G} a_p^g n^g\right] < 0$$

$$\frac{\partial^2 S_p}{\left(\partial y_p\right)^2} = -2\alpha_y\left[\sum_{v\in V} n^v\eta^v + \left(\sum_{v\in V} n^v\eta^v\,\mu^v\right)^2 \sum_{g\in G} a_p^g n^g\right] < 0$$

$$\frac{\partial^2 S_p}{\partial x_p \partial y_p} = 0$$

Thus, S_p is an strictly concave function of (x_p,y_p). Hence, the (x_p,y_p) that maximizes S_p is the unique solution to $\frac{\partial S_p}{\partial x_p} = 0$ and $\frac{\partial S_p}{\partial y_p} = 0$, which is given by:

$$x_p^* = w_p^V \sum_{v\in V} w^v x^{v_x} + \left(1 - w_p^V\right)\sum_{g\in G} w_p^g x^{g_x}$$

$$y_p^* = w_p^V \sum_{v\in V} w^v y^{v_y} + \left(1 - w_p^V\right)\sum_{g\in G} w_p^g y^{g_y}$$

where $w^v = \frac{n^v\eta^v}{\sum_{v\in V} n^v\eta^v}$, $w_p^g = \frac{a_p^g n^g}{\sum_{g\in G} a_p^g n^g}$, and $w_p^V = \frac{\sum_{v\in V} n^v\eta^v}{\sum_{v\in V} n^v\eta^v + (\sum_{v\in V} n^v\eta^v\mu^v)^2 \sum_{g\in G} a_p^g n^g}$. This completes the proof of Proposition 1. □

Corollary 1 *Suppose that* $a_1^{l,l} = a_1^{l,h} = \frac{\lambda_1 a}{n^{l,l}+n^{l,h}}$, $a_1^{h,l} = a_1^{h,h} = \frac{(1-\lambda_1)a}{n^{h,l}+n^{h,h}}$, $a_2^{l,l} = a_2^{l,h} = \frac{\lambda_2 a}{n^{l,l}+n^{l,h}}$, *and* $a_2^{h,l} = a_2^{h,h} = \frac{(1-\lambda_2)a}{n^{h,l}+n^{h,h}}$. *Then, the equilibrium level of party polarization in each dimension is given by:*

$$Pol_x^* = \frac{x_2^* - x_1^*}{x^h - x^l} = (1 - w^V)(\lambda_1 - \lambda_2)$$

$$Pol_y^* = \frac{y_2^* - y_1^*}{y^h - y^l} = (1 - w^V)(\lambda_1 - \lambda_2)\left(\frac{n^{l,l}}{n^{l,l}+n^{l,h}} - \frac{n^{h,l}}{n^{h,l}+n^{h,h}}\right)$$

where $w^V = \sum_{v\in V} n^v\eta^v / [\sum_{v\in V} n^v\eta^v + (\sum_{v\in V} n^v\eta^v\mu^v)^2 a]$.

Proof: Let $a_1^{l,l} = a_1^{l,h} = \frac{\lambda_1 a}{n^{l,l}+n^{l,h}}$, $a_1^{h,l} = a_1^{h,h} = \frac{(1-\lambda_1)a}{n^{h,l}+n^{h,h}}$, $a_2^{l,l} = a_2^{l,h} = \frac{\lambda_2 a}{n^{l,l}+n^{l,h}}$, and $a_2^{h,l} = a_2^{h,h} = \frac{(1-\lambda_2)a}{n^{h,l}+n^{h,h}}$. Then, from Proposition 1, equilibrium platforms are given by:

$$x_1^* = w^V\bar{x} + (1 - w^V)[\lambda_1 x^l + (1-\lambda_1)x^h]$$

$$x_2^* = w^V\bar{x} + (1 - w^V)[\lambda_2 x^l + (1-\lambda_2)x^h]$$

$$y_1^* = w^V\bar{y} + (1 - w^V)\left[\left(\frac{n^{l,l}\lambda_1}{n^{l,l}+n^{l,h}} + \frac{(1-\lambda_1)n^{h,l}}{n^{h,l}+n^{h,h}}\right)y^l + \left(\frac{n^{l,h}\lambda_1}{n^{l,l}+n^{l,h}} + \frac{(1-\lambda_1)n^{h,h}}{n^{h,l}+n^{h,h}}\right)y^h\right]$$

$$y_2^* = w^V\bar{y} + (1 - w^V)\left[\left(\frac{n^{l,l}\lambda_2}{n^{l,l}+n^{l,h}} + \frac{(1-\lambda_2)n^{h,l}}{n^{h,l}+n^{h,h}}\right)y^l + \left(\frac{n^{l,h}\lambda_2}{n^{l,l}+n^{l,h}} + \frac{(1-\lambda_2)n^{h,h}}{n^{h,l}+n^{h,h}}\right)y^h\right]$$

where $w^V = \sum_{v\in V} n^v\eta^v / [\sum_{v\in V} n^v\eta^v + (\sum_{v\in V} n^v\eta^v\mu^v)^2 a]$. Therefore:

$$x_2^* - x_1^* = (1 - w^V)(\lambda_1 - \lambda_2)\left(x^h - x^l\right)$$

$$y_2^* - y_1^* = (1 - w^V)(\lambda_1 - \lambda_2)\left(\frac{n^{l,l}}{n^{l,l}+n^{l,h}} - \frac{n^{h,l}}{n^{h,l}+n^{h,h}}\right)\left(y^h - y^l\right)$$

which completes the proof of Corollary 1. □

Proposition 2 *Suppose that* $a_1^{l,l} = a_1^{l,h} = \frac{\lambda_1 a}{n^{l,l}+n^{l,h}}$, $a_1^{h,l} = a_1^{h,h} = \frac{(1-\lambda_1)a}{n^{h,l}+n^{h,h}}$, $a_2^{l,l} = a_2^{l,h} = \frac{\lambda_2 a}{n^{l,l}+n^{l,h}}$, *and* $a_2^{h,l} = a_2^{h,h} = \frac{(1-\lambda_2)a}{n^{h,l}+n^{h,h}}$, *with* $1 > \lambda_1 > \lambda_2 > 0$ *and* $n^{l,l}/(n^{l,l}+n^{l,h}) \neq n^{h,l}/(n^{h,l}+n^{h,h})$. *Then:1.* $|Pol_x^*|$ *and* $\left|Pol_y^*\right|$ *are increasing in* $1-w^V$*; 2.* $|Pol_x^*|$ *and* $\left|Pol_y^*\right|$ *are increasing in* $\lambda_1-\lambda_2$*; 3.* $Pol_y^* > 0$ *if and only if* $n^{l,l}/(n^{l,l}+n^{l,h}) > n^{h,l}/(n^{h,l}+n^{h,h})$*; and 4.* $\left|Pol_y^*\right|$ *is increasing in* $|n^{l,l}/(n^{l,l}+n^{l,h}) - n^{h,l}/(n^{h,l}+n^{h,h})|$.

Proof: From Corollary 1 we have $Pol_x^* = \frac{x_2^*-x_1^*}{x^h-x^l} = (1-w^V)(\lambda_1-\lambda_2)$ and $Pol_y^* = \frac{y_2^*-y_1^*}{y^h-y^l} = (1-w^V)(\lambda_1-\lambda_2)\left(\frac{n^{l,l}}{n^{l,l}+n^{l,h}} - \frac{n^{h,l}}{n^{h,l}+n^{h,h}}\right)$. Then:

1. $\frac{\partial|Pol_x^*|}{\partial(1-w^V)} = (\lambda_1-\lambda_2) > 0$ since $\lambda_1 > \lambda_2$, $\frac{\partial\left|Pol_y^*\right|}{\partial w^V} = (\lambda_1-\lambda_2)\left|\frac{n^{l,l}}{n^{l,l}+n^{l,h}} - \frac{n^{h,l}}{n^{h,l}+n^{h,h}}\right|$ since $\lambda_1 > \lambda_2$ and $\frac{n^{l,l}}{n^{l,l}+n^{l,h}} \neq \frac{n^{h,l}}{n^{h,l}+n^{h,h}}$. Thus, $|Pol_x^*|$ and $\left|Pol_y^*\right|$ are increasing in $1-w^V$.

2. $\frac{\partial|Pol_x^*|}{\partial(\lambda_1-\lambda_2)} = (1-w^V) > 0$, $\frac{\partial\left|Pol_y^*\right|}{\partial w^V} = (1-w^V)\left|\frac{n^{l,l}}{n^{l,l}+n^{l,h}} - \frac{n^{h,l}}{n^{h,l}+n^{h,h}}\right|$ since $\frac{n^{l,l}}{n^{l,l}+n^{l,h}} \neq \frac{n^{h,l}}{n^{h,l}+n^{h,h}}$. Thus, $|Pol_x^*|$ and $\left|Pol_y^*\right|$ are increasing in $\lambda_1-\lambda_2$.

3. Since $1-w^V > 0$, $\lambda_1-\lambda_2 > 0$, $Pol_y^* = (1-w^V)(\lambda_1-\lambda_2)\left(\frac{n^{l,l}}{n^{l,l}+n^{l,h}} - \frac{n^{h,l}}{n^{h,l}+n^{h,h}}\right) > 0$ if and only if $n^{l,l}/\left(n^{l,l}+n^{l,h}\right) > n^{h,l}/\left(n^{h,l}+n^{h,h}\right)$.

4. $\frac{\partial|Pol_y^*|}{\partial|n^{l,l}/(n^{l,l}+n^{l,h})-n^{h,l}/(n^{h,l}+n^{h,h})|} = (1-w^V)(\lambda_1-\lambda_2) > 0$ because $1-w^V > 0$, $\lambda_1-\lambda_2 > 0$. Thus, $\left|Pol_y^*\right|$ is increasing in $\left|n^{l,l}/\left(n^{l,l}+n^{l,h}\right) - n^{h,l}/\left(n^{h,l}+n^{h,h}\right)\right|$. This completes the proof of Proposition 2. ■