Believers vs. Deniers: 
Climate Change and Environmental Policy Polarization

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September 3, 2019

Abstract

This paper theoretically studies the consequences of partisanship with an application to environmental policy. We model an election between a right-wing and a left-wing candidate who strategically propose environmental policies to gain the support of an electorate divided based on their climate change beliefs and productive assets. While environmental regulations imply a trade-off between a cleaner environment and higher incomes for all voters, climate change believers care relatively more about reducing pollution and high-asset voters care relatively more about mitigating economic costs. Voters view the left-wing candidate as more effective in addressing environmental challenges, whereas her right-wing opponent is perceived as the better candidate to deliver relief from the economic burden of regulations. In equilibrium, there exists policy divergence and the right-wing candidate always proposes the more pro-industry policy. We find that equilibrium policies become more pro-industry as high-asset climate change deniers become an electorally more important voter group through greater size in the electorate or greater homogeneity of their socioeconomic ideologies. Higher asset inequality has the same pro-industry effect as long as high-asset voters dominate low-asset ones in electoral clout.

Keywords: Partisanship; Environmental regulations; Downsian competition.

JEL Classification: D72, D78, H23.
1 Introduction

The environmental policy positions of the Democratic and Republican parties in the U.S. have steadily become more polarized during the past decades. According to data from the League of Conservation Voters, while Republican and Democrat members of the House of Representatives voted pro-environment for related legislation respectively 30 and 60 percent of the time in 1970, these figures have been reported respectively as 5 and 94 percent in 2016.¹ A similar trend can be observed in the executive branch: Recent environmental initiatives of the Trump Administration include dismantling the provisions of the Endangered Species Act, which was signed into law by another Republican president in 1973, and proposals by the Environmental Protection Agency to lower vehicle emissions standards enacted under President Obama with bipartisan support.²

In this paper, we study the electoral drivers of environmental policy polarization with a focus on the partisan divide between believers and deniers of climate change. Our goal is to understand how various electoral trends have pushed the environmental policy positions of the two parties in opposite directions. More specifically, we ask “Which factors lead to more pro-environment or pro-industry environmental policies?,” “How do the parties’ socioeconomic ideologies and heterogeneity of the voters’ ideological preferences affect their choices?,” “Does income inequality play a role?,” and “Can partisanship pertaining to climate change explain the polarization observed in Congressional votes?”

To address these questions, we model an election between two candidates who compete for the support of an electorate that is divided into four voter groups based on the amount of assets they own (high or low) and their climate change beliefs (believer or denier). Candidates are defined by their fixed socioeconomic ideologies, which may represent their stands on traditional electoral issues such as welfare programs or immigration. In addition, each candidate strategically chooses an environmental policy in order to maximize her vote share. While candidates’ socioeconomic ideologies matter to all voters, environmental policy is salient for only a fraction of the electorate. Based on the candidates’ platforms consisting of their socioeconomic ideologies and environmental

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¹The figures for the Senate paint a similar picture: Starting from similar percentages of pro-environment votes in 1970 (approximately 30 percent for Republicans and 50 percent for Democrats), Republican senators’ pro-environment votes constituted 14 percent of their votes on environmental legislation in 2016, while this figure is 94 percent for Democratic senators. See the National Environmental Scorecard compiled by the League of Conservation Voters at “scorecard.lcv.org” for detailed data. An analysis can also be found in Karol, D., “Party Polarization on Environmental Issues: Toward Prospects for Change,” Niskanen Center Research Paper.

policy proposals, voters vote sincerely for their preferred candidate.

When evaluating the impact of a proposed environmental regulation, voters for whom environmental policy is salient face a trade-off between a cleaner environment and higher incomes. However, climate change believers emphasize the environmental benefits of regulation more compared to the deniers and high-asset voters are affected by its economic costs more than the low-asset voters. Thus, the income-environment trade-off a voter faces is specific to the voter group he belongs to. In addition, to capture the possibility that voters’ evaluations of environmental policies might also be candidate-specific, we assume that voters view the candidate with the relatively left-wing socioeconomic ideology as more effective in addressing environmental challenges due to her closer ties to environmental advocacy organizations. At the same time, the right-wing candidate is accepted as the better candidate to mitigate the economic cost of regulations through relatively lax enforcement due to her perceived proximity to the fossil fuel industry.\footnote{The candidate-specificity of the income-environment trade-off voters face is a novel feature of our model that differentiates it from the more standard Downsian models.}

In equilibrium, candidates propose different policies since they impact the voters’ income-environment trade-offs differently on the margin. Specifically, while a marginally stricter environmental regulation implies a greater increase in environmental utility when proposed by the left-wing candidate due to stronger enforcement, a marginal deregulation leads to a greater increase in economic utility when proposed by the right-wing candidate. Consequently, the left-wing candidate always proposes the relatively pro-environment (and the right-wing candidate always proposes the relatively pro-industry) policy in equilibrium. As each candidate maximizes a weighted sum of support from the four voter groups in the electorate, the incentive to capitalize on their respective advantages with the voters leads them to resolve the income-environment trade-off in the direction of their own competency.

After characterizing the candidates’ equilibrium policies, we perform comparative statics exercises to gauge the effects of various electoral trends that can be captured by the model’s parameters. Our results indicate that an increase in the homogeneity of the socioeconomic ideologies of the low-asset climate change believers or a decrease in this homogeneity for high-asset climate change deniers (for whom environmental policy is salient) unambiguously results in more pro-environment policies from both candidates. On the other hand, how equilibrium policies respond to shifts in ideological homogeneity among low-asset climate change deniers or high-asset climate change believers depends on the exact income-environment trade-off voters face from each candidate.

We show that a positive shock to the voters’ assets always leads to more pro-industry
policies as voters’ economic concerns gain prominence vis-a-vis environmental ones. This finding implies that how greater asset inequality, driven both by an increase and a decrease in the value of assets held respectively by high-asset and low-asset voters, affects environmental policies depends on the relative total electoral importance of high-asset to low-asset voters: When the former dominate the latter in electoral importance, determined by a combination of their size in the electorate and homogeneity of socioeconomic ideologies, greater asset inequality leads to more pro-industry policies in equilibrium.\textsuperscript{4} Thus, in highly unequal societies with a large fraction of low-asset voters, we expect greater asset inequality to pull equilibrium policies in a pro-environment direction.

With regards to the effects of partisanship, our model yields no equilibrium policy effects in response to a change in the fraction of the electorate that vote solely based on the candidates’ socioeconomic ideologies as long as this shift affects the voter groups equi-proportionately. These are the voters for whom environmental policy is not a salient electoral issue. While such a change captures electorate-wide partisanship that diminishes the importance of the candidates’ specific policy proposals, another form of partisanship that is specific to the issue of climate change can account for the above-discussed evidence on environmental policy polarization. In particular, an increase in the relative ideological homogeneity of climate change believers to deniers can generate the observed polarization. This is consistent with evidence that is discussed in more detail during the analysis that indicates a concentration of Democratic voters in the camp of climate change believers and Republican voters in the camp of climate change deniers, along with an exodus of moderate Republicans from climate change denialism.

The rest of the paper is organized as follows: We discuss the related literature in the following section, followed by the presentation of the model in Section 3. Section 4 contains the main equilibrium characterization. Based on this characterization, Section 5 presents our results on the policy effects of various electoral trends, including partisanship. Section 6 concludes.

\section{Related Literature}

This paper aims to contribute to the literature on political polarization with a focus on environmental policy. Introducing partisanship that is specific to the issue of climate change as a driver of environmental policy is a novelty of our application. In addition,\textsuperscript{4} Likewise, when low-asset voters dominate high-asset ones in electoral importance, greater asset inequality leads to more pro-environment policies.
we aim to contribute to the theoretical literature on polarization by introducing a novel source of candidate differentiation within a Downsian model.

Our model is based on the probabilistic voting model of Lindbeck and Weibull (1987) with differentiated candidates as studied in Krasa and Polborn (2010, 2012, 2014) that generates policy divergence within a Downsian framework. Using this framework, we focus on how divisions based on climate change beliefs in the electorate lead to more extreme policies, contributing to the recent and growing literature on political extremism. Among the related studies in this literature are Eguia and Giovannoni (2019), whose model generates strategic extremism as politicians position themselves as an alternative to the status-quo, Buissere and Van Weelden (2019), who study extremism in the form of outsider parties threatening traditional ones, and Karakas and Mitra (2019), who study identity politics as a driver of immigration policy polarization.

There exists a diverse literature on the political economy of environmental policy. This paper builds on the branch of that literature that focuses on the role of elections. For example, Bouton, Conconi, Pino and Zanardi (2019) show that while politicians’ votes reflect their true policy preferences in the beginning of their terms, they move toward the preferences of the single-issue voters as elections near. List and Sturm (2006) argue that politicians strategically manipulate secondary electoral issues such as the environment to attract single-issue voters to their platforms and show that incumbents pursue different environmental policies between the term in which they face re-election and their final term due to term limits. Our paper differs from this literature by taking the office motivation of the politicians as given. Instead, we focus on how they target various voter groups to accomplish their election goal by manipulating environmental policies. Our results on the pro-environment or the pro-industry impact of different voter groups’ electoral clout complement the literature’s more general finding that election motives shape environmental policy.

In addition to the literature on the electoral factors behind environmental policy,
there exists a broader political economy literature on environmental policy that includes, for example, studies on the role played by special interest groups. While our primary focus is the electoral determinants of environmental policy, we also consider the influence of broader forces such as income inequality and climate change awareness.

3 The Model

Two office-motivated candidates compete for the support of a continuum of voters by strategically announcing an environmental policy. In addition, each candidate holds a fixed position on socioeconomic issues. The persistent saliency of issues such as government redistribution in elections along with the candidates’ past experiences in politics imply that their socioeconomic ideologies are immutable before the election. Observing the candidates’ fixed ideologies and environmental policies, voters vote sincerely for their preferred candidate. After the election, the winning candidate implements her platform.

Let $\sigma_j \in \mathbb{R}$ denote the socioeconomic ideology of candidate $j \in \{L, R\}$ such that $\sigma_L < \sigma_R$. This implies that candidate $L$ holds a relatively left-wing ideology on issues such as health care, poverty programs, immigration or gun control, whereas candidate $R$ holds a relatively right-wing ideology on these issues. We denote candidate $j$’s environmental policy by $p_j \in [0, 1]$, where $p_j = 0$ represents the most extreme pro-industry policy such as dismantling all environmental regulations and $p_j = 1$ represents the other extreme through, for instance, the tightest possible controls on polluting industries. In this framework, a moderate policy such as cap-and-trade would lie in between these two extremes.

Voters differ in the amount of capital (physical or human) that they own. Specifically, each voter has a fixed productive asset $\theta \in \{\theta^L, \theta^H\}$, where $\theta^H > \theta^L > 0$, that produces income $y = \theta x_j(p_j)$ for $j \in \{L, R\}$. The function $x_j : [0, 1] \to (0, \infty)$ is twice-differentiable, strictly concave and strictly decreasing in $p_j$ for $j \in \{L, R\}$. Thus, while all voters are economically hurt by environmental regulations, the marginal economic effect of stricter regulations is greater on those voters with more capital.

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8Stern (2018) provides an excellent overview and discussion of the research agenda surrounding the issue of climate change. An earlier overview of the literature on the political economy of environmental policy can be found in Oates and Portney (2003).

9The model could be extended to explicitly consider more than one socioeconomic issue. However, for simplicity, we collapse the candidates’ fixed positions on various socioeconomic issues to a single dimension. The observed correlation between a candidate’s stands on prominent socioeconomic issues such as gun rights or abortion lends support to this simplifying assumption.

10We assume that all income is spent on private consumption.
In addition to their differences in the amount of capital they own, each voter either agrees or disagrees with the statement “Climate change is caused by human activity.” To capture this divide in the electorate, we let each voter belong to either group $h = b$ of believers in human-caused climate change or $h = d$ of the deniers of this fact. In addition to inherent attitudes, factors such as living in an area directly threatened by, for instance, rising sea levels may determine whether a voter belongs to the group of believers or deniers.

Each voter $i$ with capital $\theta$ and climate change position $h$ holds a socioeconomic ideology $\sigma_{i\theta h} \in \mathbb{R}$. While socioeconomic issues are salient for all voters in the sense that the candidates’ fixed positions on, for instance, health care affect all voters’ choices, environmental policy generally represents a secondary issue that only a fraction of the electorate care about. Focusing on those voters who do not care about environmental policy, the utility that such a voter $i$ with capital $\theta$ and climate change position $h$ receives from the election of candidate $j$ is given by $u^j_{\theta h}(p_j; \sigma_j) = -(\sigma_j - \sigma_{i\theta h})^2$. On the other hand, those voters for whom environmental policy is salient face a trade-off between higher incomes and a cleaner environment. Specifically, the utility that such a voter $i$ with capital $\theta$ and climate change position $h$ receives from candidate $j$ conditional on her election can be written as

$$u^j_{\theta h}(p_j; \sigma_j) = -\eta(\sigma_j - \sigma_{i\theta h})^2 + \lambda_h v_j(p_j) + \theta x_j(p_j),$$

where the parameter $\eta > 0$ represents the relative salience of socioeconomic issues to environmental policy and $v_j : [0, 1] \rightarrow (0, \infty)$ for $j \in \{L, R\}$ is a twice-differentiable, strictly concave and strictly increasing function of $p_j$ that captures the voters’ preferences for a clean environment.\textsuperscript{11} We also assume that $\lambda_h v'_j(0) > \theta |x'_j(0)|$ and $\lambda_h v'_j(1) < \theta |x'_j(1)|$ for all $j, h$ and $\theta$.

As observed in equation (1), the parameter $\lambda_h > 0$ for $h \in \{b, d\}$ represents the weight with which voters evaluate the environmental versus the economic consequences of a given policy, where $\lambda_b > \lambda_d$ so that voters who believe in human-caused climate change weigh the environmental implications of any given policy more heavily compared to the deniers. Intuitively, this arises as their position that climate change is caused by human activity prompts the believers to carry a stronger responsibility to address environmental degradation through public policy.

As also observed in equation (1), voters’ evaluations of environmental policies are candidate-specific. Letting $v : [0, 1] \rightarrow (0, \infty)$ and $x : [0, 1] \rightarrow (0, \infty)$ be twice-differentiable and strictly concave functions that are respectively strictly increasing and

\textsuperscript{11}We assume $v''_j(p_j) = x''_j(p_j) = 0$ for all $p_j \in [0, 1]$ and $j \in \{L, R\}$. 

7
strictly decreasing in $p_j$, we define $v_j(p_j) = \beta_j v(p_j)$ and $x_j(p_j) = \mu_j x(p_j)$, where $\beta_j > 0$ and $\mu_j > 0$ for $j \in \{L, R\}$. We assume $\beta_L > \beta_R$ and $\mu_R > \mu_L$ in order to capture the candidates’ different effectiveness in implementing a given environmental regulation. In particular, voters perceive the left-wing candidate as more effective in enforcing and implementing environmental protections due to her closer ties to environmental advocacy organizations. On the other hand, the right-wing candidate’s perceived proximity to the fossil fuel industry and the related special interest groups leads voters to discount the negative economic implications of her proposed regulations as they expect relatively lax enforcement from her administration along with pro-business policies such as corporate tax cuts.

The assumption that $\beta_L > \beta_R$ and $\mu_R > \mu_L$ implies that $v_L(p_L) > v_R(p_R)$ and $x_L(p_L) < x_R(p_R)$ for any given $p_L = p_R$. Thus, for all voters who care about environmental policy, their environmental utility is higher and economic utility is lower from a given policy when it is proposed by the left-wing candidate. Furthermore, this assumption implies $v_L'(p_L) > v_R'(p_R)$ and $x_L'(p_L) < x_R'(p_L)$ for any given $p_L = p_R \equiv p$ so that the difference $v_L(p) - v_R(p)$ is strictly increasing and the difference $x_R(p) - x_L(p)$ is strictly decreasing in $p$.

We assume that environmental policy is not salient for a fraction $\gamma \in (0, 1)$ of the electorate so that they cannot be swayed by a candidate’s environmental policy. For these ultra-partisan voters, only the socioeconomic ideologies of the candidates matter. The remaining fraction $1 - \gamma$ of the electorate care both about a candidate’s ideology and policy. Among these voters who can potentially be swayed by a candidate’s policy, a fraction $n_{\theta h} \in (0, 1)$ have capital $\theta \in \{\theta_L, \theta_H\}$ and belong to group $h \in \{b, d\}$ such that $\sum_{\theta, h} n_{\theta h} = 1$. We assume that the socioeconomic ideologies $\sigma_{i\theta h}$ of these non-ultra-partisan voters $i$ who have assets equal to $\theta$ and climate change position $h$ are distributed according to the continuous cumulative distribution function $F_{\theta h}$ for $\theta \in \{\theta_L, \theta_H\}$ and $h \in \{b, d\}$ that admits the positive density $f_{\theta h}$. In the analysis, we focus for simplicity on the case in which $F_{\theta h}$ represents a uniform distribution.

The candidate-specificity of the functions $v_j(p_j)$ and $x_j(p_j)$ as described above indicates that candidate $L$ has an advantage in delivering a cleaner environment over her opponent $R$ due to her greater perceived effectiveness to tackle climate challenges. At the same time, voters discount the negative economic consequences of environmental regulations when proposed by candidate $R$ relative to candidate $L$. As will be characterized subsequently, the candidates’ equilibrium sorting on the policy spectrum will be determined in part by these perceived differences in what each candidate’s election would imply for the trade-off voters face between greater income and a cleaner environment.
4 Equilibrium

This section characterizes the equilibrium of the model described in the previous section in which candidates compete for the support of voters for whom environmental policy is salient by announcing a policy. Among the ultra-partisan voters who only care about the candidates’ socioeconomic ideologies, all left-wing voters, i.e. voters with socioeconomic ideologies closer to $\sigma_L$ than to $\sigma_R$, vote for candidate $L$ and all right-wing voters vote for candidate $R$. Let $\ell \in (0,1)$ denote the fraction of left-wing voters and let $r \in (0,1)$ denote the fraction of right-wing voters among these ultra-partisan voters such that $\ell + r = 1$. Then, candidate $L$ has a vote share equal to $\gamma \ell$ and candidate $R$ has a vote share equal to $\gamma r$ solely as the result of such partisanship in the electorate. These vote shares are securely held by the candidates. The difference $\ell - r \in (-1,1)$ represents the partisan bias in the electorate for candidate $L$: She enjoys a partisan advantage when $\ell - r > 0$ and a partisan disadvantage when $\ell - r < 0$. Clearly, neither candidate has a partisan advantage when $\ell = r$.

For all other voters who make up a fraction $1 - \gamma$ of the electorate, equation (1) implies that while they clearly receive higher ideological utility from the candidate with the closer socioeconomic ideology, policy utility is candidate-specific. This is because the candidates’ perceived differences in effectiveness in tackling environmental challenges imply that identical policies do not translate into equal policy utilities from the two candidates. Thus, if the two candidates were to propose the same policy, it is not necessarily the case that each voter always votes for the same candidate whose socioeconomic ideology is closer to his. This is summarized in the following remark that focuses without loss of generality on a voter with a relatively left-wing socioeconomic ideology:

**Remark 1.** Consider a left-wing non-ultra-partisan voter with assets $\theta$ and climate change position $h$. If $p_L = p_R \equiv p$ is such that

$$\lambda_h[v_L(p) - v_R(p)]_+ \theta[x_L(p) - x_R(p)] \geq \eta[\sigma_L - \sigma_{\theta h}]^2 - (\sigma_R - \sigma_{\theta h})^2,$$

(2)

then this voter chooses candidate $L$. However, as the common policy $p$ decreases to become more pro-industry, condition (2) may no longer hold as $v_L(p) - v_R(p) > 0$ and $x_L(p) - x_R(p) < 0$ both decrease. Thus, despite facing platforms consisting of identical policies, a voter from either group can switch his vote between the candidates depending on the exact policy proposed.

For policies that are sufficiently pro-industry, the greater policy utility from candi-
date $R$ may dominate a left-wing (non-ultra-partisan) voter’s ideological disutility from voting for the candidate whose socioeconomic ideology he does not prefer. Similarly, the greater policy utility voters receive from candidate $L$ for policies that are sufficiently pro-environment may imply that a right-wing (non-ultra-partisan) voter may nonetheless vote for her despite his ideological dislike. The underlying driver of such behavior when candidates announce identical policies is the candidate-specific way in which voters evaluate the trade-off between a higher income and a cleaner environment associated with environmental policy.

Based on this discussion, we begin the equilibrium characterization by first focusing on the optimal behavior of those voters who are not ultra-partisans. A (non-ultra-partisan) voter $i$ with socioeconomic ideology $\sigma_i\theta_h$ who is indifferent between the two candidates’ platforms is defined as a swing voter with assets $\theta \in \{\theta_L, \theta_H\}$ and climate change position $h \in \{b, d\}$. Our set-up implies that there exist four types of swing voters: low-asset believer, low-asset denier, high-asset believer and high-asset denier. Observing the candidates’ platforms consisting of their socioeconomic ideologies $\sigma_j$ and policies $p_j$ for $j = L, R$, a voter $i$ with assets $\theta \in \{\theta_L, \theta_H\}$ and climate change position $h \in \{b, d\}$ votes for candidate $L$ over $R$ if and only if

$$\eta(\sigma_R - \sigma_i\theta_h)^2 - \eta(\sigma_L - \sigma_i\theta_h)^2 \geq \lambda_h[v_R(p_R) - v_L(p_L)] + \theta[x_R(p_R) - x_L(p_L)].$$ (3)

Based on (3), define the function $\tilde{\sigma}_{\theta h}(p_L, p_R)$ for any given policy pair $(p_L, p_R)$, all voters $i$ with assets $\theta \in \{\theta_L, \theta_H\}$ and climate change position $h \in \{b, d\}$ such that $\sigma_i\theta_h \leq \tilde{\sigma}_{\theta h}$ vote for candidate $L$ and all others vote for candidate $R$.

If there did not exist differences between the candidates in terms of how voters evaluate the income-environment trade-off implied by their policies, i.e. if $\beta_L = \beta_R$
and $\mu_L = \mu_R$, then equation (4) would imply that $\tilde{\sigma}_{\theta h} = \frac{\sigma_{L} + \sigma_{R}}{2}$ for any given $p_L = p_R$, $\theta \in \{\theta^L, \theta^H\}$ and $h \in \{b, d\}$. This is because in the absence of candidate differentiation in how policies translate into voters’ policy utilities, only socioeconomic ideologies would matter to the voters whenever the candidates proposed identical policies. However, when we allow for candidate differentiation that captures each candidate’s respective effectiveness in translating a given policy into either a cleaner environment or a more business-friendly regulatory regime, equation (4) implies the following: If the common policy $p$ is sufficiently pro-environment that $\lambda_h v_R(p) + \theta x_R(p) < \lambda_h v_L(p) + \theta x_L(p)$ holds for a given $h$ and $\theta$, then the swing voter of the voter group with asset $\theta$ and climate change position $h$ exhibits an ideological bias for candidate $R$. This is due to the fact that candidate $L$ yields greater policy utility in this case than candidate $R$ due to her greater effectiveness at delivering a cleaner environment, and being indifferent between the two therefore requires an ideological bias for the latter. Similarly, the swing voter of the same voter group exhibits an ideological bias for candidate $L$ whenever the policy is sufficiently pro-industry that the inequality $\lambda_h v_R(p) + \theta x_R(p) > \lambda_h v_L(p) + \theta x_L(p)$ is true for that group.

When candidates announce different policies, the fact that each implies a different income-environment trade-off for voters again means that the ideological biases of the swing voters are determined by the difference between the policy utilities from each candidate. This is different from the models in which voters’ policy utilities are not candidate-specific. The following lemma characterizes the non-monotonic behavior of the swing voter ideologies, a consequence of the voters’ income-environment trade-offs:

**Lemma 1.** There exists a threshold policy $\bar{p}_{j\theta h} \in (0, 1)$ for each $j \in \{L, R\}$, $\theta \in \{\theta^L, \theta^H\}$ and $h \in \{b, d\}$ such that the function $\tilde{\sigma}_{\theta h}(p_L, p_R)$ as defined in equation (4) is

- strictly increasing in $p_L$ for $p_L < \bar{p}_{L\theta h}$ and strictly decreasing in $p_L$ for $p_L > \bar{p}_{L\theta h}$;
- strictly decreasing in $p_R$ for $p_R < \bar{p}_{R\theta h}$ and strictly increasing in $p_R$ for $p_R > \bar{p}_{R\theta h}$.

For candidate $L$, Lemma 1 indicates that as her proposed policy becomes more pro-environment while candidate $R$’s policy is held fixed, each voter group’s swing voter ideology exhibits an inverted U-shaped response, first increasing toward more right-wing ideologies and then decreasing to become more left-wing. Intuitively, starting from the most extreme pro-industry policy, more pro-environment policies at which a voter group’s marginal climate concerns still outweigh its economic ones imply greater policy utility for that voter group from candidate $L$, which translate into more right-wing socioeconomic
ideologies for its swing voters. However, as her policy surpasses the threshold policy $p_{L\theta h}$ at which the candidate $L$-specific marginal climate and economic concerns of the voter group with assets $\theta$ and climate change position $h$ exactly offset each other, higher pro-environment policies start to yield lower policy utility for this voter group from candidate $L$, leading to more left-wing ideologies for its swing voters. The same intuition applies to candidate $R$, with higher pro-environment policies leading first to more left-wing and then to more right-wing socioeconomic ideologies for all groups’ swing voters as such policies first increase and then decrease all voters’ policy utilities from candidate $R$.

The threshold policy $\bar{p}_{j\theta h} \in (0, 1)$ that governs the direction in which the swing voter ideology of the voter group $(\theta, h) \in \{\theta_L, \theta_H\} \times \{b, d\}$ changes with candidate $j$’s policy satisfies $\lambda_h v'_{j}(\bar{p}_{j\theta h}) = \theta |x'_j(\bar{p}_{j\theta h})|$. Therefore, it can be observed based on the properties of the functions $v_j(p_j)$ and $x_j(p_j)$ that $\bar{p}_{j\theta d < h} < \bar{p}_{j\theta b d}$ for a given $j$ and $h$, and $\bar{p}_{j\theta b} = \bar{p}_{j\theta d}$ for a given $j$ and $\theta$. These differences in the threshold policies can be traced to the voter group-specificity of the income-environment trade-off voters face when evaluating environmental policies. For instance, the fact that voters who believe in human-caused climate change weigh the environmental implications of a given policy more heavily compared to the deniers implies that their marginal valuation of the positive implications of a more pro-environment policy dominates their marginal valuation of its negative economic consequences for a wider range of policies. This yields higher policy utility for the believers from either candidate in this wider range, leading to the conclusion that the threshold policy at which the change in their swing voter ideology switches direction is more pro-environment.

The analysis of the swing voters indicates that the differences among voter groups are fundamentally due to the different income-environment trade-offs that they face. Furthermore, this trade-off is impacted by the candidate proposing the policy. Based on this discussion, the rest of this section characterizes the candidates’ equilibrium policies that capitalize on their respective strengths with regards to this trade-off.

Given the optimal voting behavior of both the ultra-partisan and other voters from each of the four groups in the electorate, we assume that each candidate $j \in \{L, R\}$ chooses an environmental policy $p_j \in [0, 1]$ to maximize her vote share given by

$$V_L(p_L, p_R) = \gamma \ell + (1 - \gamma) \sum_{\theta, h} n_{\theta h} F_{\theta h}(\tilde{\sigma}_{\theta h})$$

(5)
for candidate $L$, and

$$V_R(p_L, p_R) = \gamma r + (1 - \gamma) \sum_{\theta, h} n_{\theta h}(1 - F_{\theta h}(\tilde{\sigma}_{\theta h}))$$

(6)

for candidate $R$. The following proposition asserts the existence and uniqueness of a pure strategy equilibrium and compares the candidates’ equilibrium policies:

**Proposition 1.** There exists a unique pure strategy equilibrium $(p^*_L, p^*_R)$ such that $p^*_L \neq p^*_R$ only if $\beta_L \neq \beta_R$ and/or $\mu_L \neq \mu_R$. In equilibrium, it is always true that $p^*_R \leq p^*_L$.

As observed in equations (5) and (6), each candidate maximizes a weighted sum of support from the four voter groups in the electorate for whom environmental policy is salient, where the importance attached to each group is determined by a combination of its size and ideological density.\textsuperscript{14} The solution to this maximization problem yields the following intuitive necessary and sufficient condition that implicitly defines candidate $j$’s optimal policy $p^*_j \in (0, 1)$:

$$\sum_{\theta, h} n_{\theta h} f_{\theta h}(\tilde{\sigma}_{\theta h})[\lambda_h v_j'(p^*_j) + \theta x_j'(p^*_j)] = 0$$

(7)

for $j \in \{L, R\}$. If the income-environment trade-off faced by a given voter group was not candidate-specific, then the candidates would find the same environmental policy optimal. However, the candidate-specificity of the functions $v_j(p_j)$ and $x_j(p_j)$ in equation (7) that respectively determine the voters’ evaluations of the environmental and income implications of a policy implies that this need not be the case: As each candidate affects voters differently on the margin, they may announce asymmetric policies in equilibrium.\textsuperscript{15}

Equation (7) implies that each candidate maximizes the policy utility of a “weighted average voter.” In other words, each candidate maximizes a weighted average policy utility that she exclusively faces, where the weights are determined by the voter groups’ size and ideological density. This is due to the fact that the voter group with the greatest combination of size and ideological density delivers the highest marginal support to a candidate in return for a policy change in its preferred direction. Note that if all groups

\textsuperscript{14} More precisely, it is the ideological density of a voter group’s swing voters that contributes to this weight, but recall that we assumed for simplicity that the socioeconomic ideologies within each voter group are distributed uniformly on some interval on $\mathbb{R}$.

\textsuperscript{15} Note that the first part of Proposition 1 holds as an “if and only if” statement for interior equilibrium policies $p^*_j \in (0, 1)$ for $j = L, R$. 

13
had equally homogeneous ideological preferences, then the candidates would be maximizing the simple average of the policy utilities of all voters.\footnote{\(\text{Also notice based on equation (7) that each candidate’s equilibrium policy is homogeneous of degree zero in the voter groups’ ideological densities.}\)} However, the fact that the ideological densities \(f_{\theta h}\) differ across asset and climate change belief groups distorts the candidates’ equilibrium policies away from the ideal policy of the average voter (the aggregate welfare-maximizing policy).

With regards to how candidates sort themselves on the policy spectrum, Proposition 1 indicates that candidate \(R\) never proposes the more pro-environment policy in equilibrium, regardless of the voter groups’ rankings in terms of electoral importance.\footnote{\(\text{Specifically, the electoral importance of a voter group with assets } \theta \text{ and climate change position } h \text{ is represented by the term } n_{\theta h} f_{\theta h}(\bar{\sigma}_{\theta h}). \text{ Also note that our focus is exclusively on those non-ultra-partisan voters for whom environmental policy is salient.}\)} Technically, this result is due to the fact that whenever the candidates are differentiated, candidate \(L\)’s marginal vote share function always lies above that of candidate \(R\) for all policies. Of course, if the candidates are not differentiated in how they affect the voters’ policy utilities, they have the same marginal vote share functions and the equilibrium becomes symmetric.

The intuition for this result lies in the different marginal effects candidates have on the trade-off voters face between higher incomes and a cleaner environment: While candidate \(L\) has an advantage in delivering a cleaner environment due to the stricter enforcement expected of her, her opponent \(R\) is viewed as the better candidate for mitigating the negative economic consequences of environmental regulations. Consequently, each candidate exploits her respective advantage with the voters by leaning deeper into the side of the income-environment trade-off she has greater competency in. For candidate \(L\), this effect results in a relatively more pro-environment policy while yielding a more pro-industry policy for candidate \(R\).

Having described the basic properties of the model’s unique pure strategy equilibrium in this section, we shift our focus in the next section to investigating how changes in various parameters of interest affect environmental policies.

\section{5 Policy Effects of Electoral Trends}

This section presents our theoretical predictions on how equilibrium environmental policies will be impacted by various electoral trends that can be captured by the model’s parameters. First, we analyze the policy effects of changes to voter groups’ electoral
importance, the environmental weights with which candidates’ policies are evaluated by climate change believers and deniers, the candidates’ relative competencies in delivering a cleaner environment versus mitigating the economic cost of regulations, and inequality in asset ownership. Second, we investigate the implications of partisanship both at an electorate-wide level and specific to the issue of climate change.

5.1 Comparative Statics

Our first comparative statics result focuses on the effects of changes to the ideological density \( f_{\theta h}(\tilde{\sigma}_{\theta h}) \equiv f_{\theta h} \) of a voter group with assets \( \theta \in \{\theta^L, \theta^H\} \) and climate change position \( h \in \{b, d\} \):

**Proposition 2.** Candidate \( j \)'s equilibrium policy \( p^*_j \) for \( j \in \{L, R\} \) becomes more pro-environment as \( f_{\theta h} \) increases for a given voter group with \( \theta \in \{\theta^L, \theta^H\} \) and \( h \in \{b, d\} \) if and only if \( p^*_j \leq \bar{p}_{j\theta h} \) in equilibrium.

Proposition 2 states that candidates respond in equilibrium to an increase in the ideological density of a voter group with asset \( \theta \) and climate change position \( h \) by moving their policies in a pro-environment direction if and only if their initial optimal policy falls below the voter group- and candidate-specific threshold \( \bar{p}_{j\theta h} \) established in Lemma 1. Note that greater ideological density increases a voter group’s electoral importance by making its members more susceptible to be influenced by the candidates’ policies. In response, candidates target these voters to a greater extent than before in equilibrium by modifying their policies accordingly. However, the directional change in the candidates’ equilibrium policies may be ambiguous and depends on their position relative to a benchmark policy that is specific both to the candidate and to the voter group whose electoral importance has increased. Thus, while it is possible to observe the candidates’ equilibrium policies adjust in the same pro-environment or pro-industry direction, they can also move in opposite directions.

The determinant of how a candidate’s equilibrium policy responds to an increase in the ideological density of a voter group lies in the exact income-environment trade-off that voter group is facing in equilibrium. Specifically, if candidate \( j \)'s equilibrium policy \( p^*_j \) for \( j \in \{L, R\} \) is such that the inequality

\[
\lambda_h v'_j(p^*_j) > \theta |x'_j(p^*_j)|
\]

is satisfied for the voter group \( (\theta, h) \in \{\theta^L, \theta^H\} \times \{b, d\} \), then the marginal environmental benefit of regulation from candidate \( j \) exceeds its marginal economic cost in equilibrium.
for this voter group. When this voter group experiences an increase in its electoral importance through greater ideological density, each candidate adjusts her optimal policy by weighing this voter group’s income-environment trade-off more heavily in her calculus, which accordingly results in a more pro-environment policy. On the other hand, if the equilibrium is such that \( p^*_j \) for candidate \( j \) does not satisfy inequality (8), then marginal economic concerns from candidate \( j \’s \) policy outweigh environmental ones for this voter group, leading candidate \( j \) to adopt a more pro-industry policy in response to an increase in this voter group’s ideological density.

The candidate-specificity of inequality (8) suggests that while (8) may hold in equilibrium for both \( j = L, R \), this need not be the case. In other words, Proposition 2 indicates that candidates may respond to the greater electoral importance of a voter group by modifying their equilibrium policies in opposite directions. Intuitively, this is due to the fact that while marginal environmental concerns from the policies of one candidate may outweigh economic ones for a voter group, the opposite may be true for the same voter group when evaluating the policies of the other candidate. For instance, while the increase in its environmental utility \( \lambda_h v'_L(p^*_L) \) from a marginally stricter environmental regulation may outweigh the change in its economic utility \( \theta x'_L(p^*_L) \) for a voter group \((\theta, h)\) when the regulation is proposed by candidate \( L \), this may not be the case if the regulation is instead proposed by candidate \( R \).

A candidate’s optimal policy as implicitly characterized in equation (7) implies that the ambiguity in the directional change in equilibrium policies discussed above in response to an increase in the electoral importance of a voter group in fact applies only to a subset of these groups. This is summarized in the following corollary to Proposition 2:

**Corollary 1.** Candidate \( j \’s \) equilibrium policy \( p^*_j \) for \( j \in \{L, R\} \) unambiguously becomes more pro-environment as \( f_{\theta L b} \) increases and more pro-industry as \( f_{\theta H d} \) increases. On the other hand, equilibrium policies \( p^*_L \) and \( p^*_R \) may move in opposite directions in response to a change in \( f_{\theta H b} \) or \( f_{\theta L d} \).

The proof of Corollary 1 is omitted as it follows directly from equation (7) for both candidates. Technically, it is obtained as \( \bar{p}_{\theta H d} < p^*_j < \bar{p}_{\theta L b} \) is always true in an interior equilibrium for \( j \in \{L, R\} \). This implies that the ideal policy of low-asset climate change believers is always more pro-environment than the equilibrium policies that maximize the policy utility of the candidate-specific weighted average voters. Similarly, the ideal policy of high-asset climate change deniers is always more pro-industry relative to the same policies. Thus, when the low-asset voters who believe in climate change become ideologically more homogeneous, both candidates unambiguously offer more pro-environment
policies in equilibrium. Likewise, when the same shock hits the high-asset deniers of climate change, both candidates’ equilibrium policies become more pro-industry.

While the first of these results is obtained due to the fact that low-asset believers in climate change constitute the voter group that enjoys the greatest marginal environmental benefit along with the lowest marginal economic cost from any given regulation proposed by a given candidate, the opposite is true for the high-asset deniers. Accordingly, as each candidate balances the interests of the four voter groups based on equation (7) when choosing her optimal policy, the low-asset believers are inevitably left wanting a more pro-environment policy in equilibrium while the high-asset deniers are left wanting a more pro-industry one.\footnote{Note that this discussion applies only to interior solutions for the candidates’ policy problems. If, instead, the equilibrium is such that \( p_j^* = 0 \) or \( p_j^* = 1 \) for some \( j \in \{L,R\} \), then one of these policies may exactly balance the environmental and economic interests of the low-asset believers or the high-asset deniers.} In contrast, since either marginal environmental or economic interests may be dominant in equilibrium for the other two voter groups, i.e. the high-asset believers and the low-asset deniers, the candidates’ equilibrium responses to an increase in their electoral importance through greater ideological density remain ambiguous as discussed below Proposition 2.

The second comparative statics exercise we perform involves investigating the policy effects of a change to the weight \( \lambda_h \) that a voter group with climate change position \( h \in \{b,d\} \) uses to evaluate the income-environment trade-off implied by a policy proposal. This result is presented in the following proposition:

**Proposition 3.** Candidate \( j \)’s equilibrium policy \( p_j^* \) becomes more pro-environment as \( \lambda_h \) increases for \( j \in \{L,R\} \) and \( h \in \{b,d\} \).

That each candidate’s equilibrium policy becomes more pro-environment as the weight the voters of a given climate change position use to evaluate the environmental consequences of her policy proposal increases is intuitive. Similarly, a decrease in \( \lambda_h \) implies a greater relative weight on the economic concerns of voters with climate change position \( h \), leading the candidates to move in a pro-industry direction as they position themselves according to the voters’ heightened relative economic concerns.

Such shocks to the parameter \( \lambda_h \) may be triggered as a result of changes to the voters’ inherent attitudes, concerns, or skepticism toward climate change. Alternatively, one may also envision candidate-specific shocks to how voters evaluate the income-environment trade-off associated with environmental policies. For instance, if the right-wing party nominates a candidate with prior business experience in the oil industry, this may lead both the believers and deniers of climate change to put relatively less emphasis...
on the environment and more emphasis on their private consumption when evaluating candidate \( R \)'s policy proposal as they expect even less enforcement. Alternatively, the left-wing party’s nomination of a candidate such as Al Gore with a track record of espousing pro-environment policies, including enacting a carbon tax and signing the Kyoto Protocol, as opposed to any other candidate would lead voters of both climate change positions to evaluate his policies with a greater emphasis on their pro-environment consequences. In the context of our model, such shocks would be captured by changes in the parameters \( \beta_j \) and/or \( \mu_j \), and subsequent changes in the curvatures of the functions \( v_j(p_j) \) and/or \( x_j(p_j) \): A similar analysis as Proposition 3 indicates that candidate \( j \)'s policy changes in a pro-environment direction as \( \beta_j \) increases and/or \( \mu_j \) decreases. Intuitively, as the environmental utility voters receive relative to economic costs increases more steeply as policies change in a pro-environment direction, the candidate capitalizes on her greater perceived competence in delivering a more favorable income-environment trade-off by choosing a higher policy.

In this section’s final comparative statics exercise, we focus on greater asset inequality among the electorate. The following proposition summarizes the equilibrium policy effects of a change to the asset values \( \theta^H \) and \( \theta^L \):

**Proposition 4.** Candidate \( j \)'s equilibrium policy \( p_j^* \) for \( j \in \{ L, R \} \) becomes more pro-industry as \( \theta \in \{ \theta^L, \theta^H \} \) increases. Moreover, candidate \( j \)'s equilibrium policy \( p_j^* \) for \( j \in \{ L, R \} \) becomes more pro-industry as \( \theta^H \) increases and \( \theta^L \) decreases if and only if the condition \( \sum_h n_{\theta^H}f_{\theta^H} > \sum_h n_{\theta^L}f_{\theta^L} \) is satisfied.

Proposition 4 states that candidates respond to an increase in asset values by moving their policies in a pro-industry direction in equilibrium. In contrast to the effect of a higher \( \lambda_h \) weight considered above in Proposition 3, a higher \( \theta \) increases the affected voters’ costs from environmental regulations. Facing voters for whom the economic component of the income-environment trade-off weighs more heavily, candidates announce more pro-industry policies in order to address this shift. Thus, Proposition 4 implies that economic growth that benefits all voters unambiguously leads to more pro-industry environmental policies, regardless of whether this growth results in higher or lower asset inequality represented by \( \theta^H \).

Considering the effects of a pure increase in asset inequality by holding the value of

\(^{19}\)The conclusion that equilibrium policies become more pro-industry in response to an increase in all asset values does not necessarily contradict the observation that developed countries generally adopt more pro-environment policies. For instance, this might be due to the fact that the parameter \( \lambda_h \) for \( h \in \{ b, d \} \) that captures voters’ sensitivity to environmental quality responds positively to economic growth.
total assets constant, which can be observed if and only if $\theta^H$ increases and $\theta^L$ decreases. Proposition 4 implies that the directional changes in the candidates’ equilibrium policies depend on the relative total electoral importance of the high-asset and low-asset voters. When the high-asset voters (consisting of believers and deniers of climate change) dominate the low-asset voters in electoral importance due to a combination of their total size and ideological density, the pro-industry policy direction a higher $\theta^H$ implies dominates the pro-environment pull of a lower $\theta^L$ in equilibrium, resulting in an overall pro-industry change. On the other hand, greater inequality that leaves the total value of assets intact results in more pro-environment policies when the low-asset voters are electorally more important.

In the second part of this section, we focus on the effects of partisanship on environmental policies in order to offer one explanation for the observed gridlock in the efforts to pass a climate bill in the U.S.

### 5.2 Partisanship

We consider two interpretations of partisanship that are potentially relevant for understanding the determination of environmental policies. First, we briefly discuss an increase in electorate-wide partisanship that diminishes the importance of the candidates’ specific policy proposals. In our model, this form of partisanship would be captured by an increase in the value of the parameter $\gamma$ that measures the fraction of the electorate who always vote for the candidate whose socioeconomic ideology is closer to theirs irrespective of her policy proposal. Second, we consider a form of partisanship that is specific to the issue of climate change. In particular, we investigate the policy effects of the size and ideological homogeneity of climate change believers and deniers.

First, consider the form of partisanship due to which a greater fraction of the electorate effectively ignore the candidates’ policies and vote solely based on their socioeconomic ideologies. An increase in this form of partisanship manifested by an increase in the value of $\gamma$ has no equilibrium policy effects as long as it leaves the relative size of each voter group among the non-ultra-partisans intact: Based on equation (7) that implicitly defines candidate $j$’s optimal policy, equilibrium is determined solely by the relative electoral importance of the voter groups and their respective income-environment trade-offs. However, even though the parameter $\gamma$ would have no policy effects in this case, it nonetheless would impact the candidates’ vote shares in equilibrium as can be deduced from equations (5) and (6).

On the other hand, a change in the parameter $\gamma$ that alters the relative sizes of
the four voter groups is expected to create equilibrium policy effects. For example, if a disproportionately larger fraction of low-asset voters become ultra-partisans, for instance due to a new health care law that gains voter attention and disproportionately impacts lower income voters, this leads to decreases in $n_{\theta^L_h}$ and increases in $n_{\theta^H_h}$ for $h = b, d$. Accordingly, candidates’ equilibrium policies respond in the pro-environment or pro-industry direction determined by equation (7), depending on the relative size of climate change believers to deniers and the intensity of their environmental concerns.\footnote{In addition to an increase in the parameter $\gamma$, greater electorate-wide partisanship can also be captured by an increase in the parameter $\eta$, as a result of which the candidates’ fixed socioeconomic ideologies matter more to the non-ultra-partisan voters relative to their policies. While equation (7) implies that an increase in $\eta$ has no policy effects, the fact that it continues to determine the identity of each voter group’s swing voter through equation (4) indicates that it must have vote share effects.}

There exists evidence that voters of all education, age and income groups are increasingly exhibiting partisan voting behavior.\footnote{For example, see Bartels (2000) or McCarty, Poole and Rosenthal (2008).} Thus, our prediction that greater electorate-wide partisanship that proportionately impacts all voter groups has no policy effects runs counter to the evidence of growing policy polarization on environmental issues observed in U.S. politics. As discussed in the Introduction, the votes on environmental legislation taken in the U.S. Senate and the House of Representatives since the early 1970s have gradually become polarized along party lines. While changes in the values of parameters $\gamma$ and $\eta$ can capture electorate-wide partisanship in our model, the fact that they produce no relevant equilibrium policy effects suggests that an alternative form of partisanship that is specific to environmental issues may be behind policy polarization.

To analyze climate change-specific partisanship as a driver of equilibrium policy polarization, we turn to Figure 1, which summarizes the registered voters’ beliefs about the causes of climate change based on the most recent data from the Yale Program on Climate Change Communication and the George Mason University’s Center for Climate Change Communication.\footnote{See Politics & Global Warming, March 2018, Yale Program on Climate Change Communication and George Mason University Center for Climate Change Communication.} The data indicates that while 41 percent of registered voters deny human activity as the primary cause of climate change, the share of Republicans in this group of voters is similar to the share of Democrats among the voters who believe in human-caused climate change. Specifically, even though a greater share of Democrats believe in human-caused climate change than Republicans, only 16 percent of liberal Democrats and 30 percent of moderate/conservative Democrats deny human-caused climate change, while these figures are 74 percent and 45 percent respectively for conservative and liberal/moderate Republicans.\footnote{The percentages in Figure 1 are based solely on the sample of registered voters who have expressed a partisan affiliation in the survey. These voters constitute 84 percent of the sample, of which 58 percent}
significant increase in the percentage of Republicans (mostly from their moderate wing) who believe in human-caused climate change and support environmental-friendly policies such as limiting carbon dioxide emissions from power plants even at the expense of higher electricity prices. For instance, the percentage of moderate Republicans who accepted human responsibility for global warming has increased 14 percentage points from 41 percent in the last year alone.

This evidence points to two related trends that are shaping the politics of climate change: First, the size of climate change deniers in the electorate is decreasing as voters increasingly accept the conclusions of climate science. Second, as Republican voters are switching their climate change positions from being deniers to believers, they are leading a disproportionate decrease in the Republican majority in the camp of climate change deniers compared to the corresponding decrease in the Democratic majority within climate change believers. This is driven by the fact that there already exist fewer climate change deniers than believers in the electorate. Overall, these trends illustrate that both the relative size and relative ideological homogeneity of climate change believers and deniers are changing simultaneously.

Within our model, holding group sizes constant, an increase in the relative ideological homogeneity of climate change believers would result in policy polarization as long as the candidates are sufficiently differentiated in terms of their impacts on the income-environment trade-off that voters face. Under this condition, the intuition for greater policy polarization lies in the candidates’ relative strengths in addressing the voters’ environmental and economic concerns: When both candidates’ policies respond in a pro-environment direction, candidate $L$ capitalizes on the voters’ perception of her as the better candidate to address environmental problems by moving in a pro-environment direction to a greater extent than candidate $R$ does, thereby increasing polarization. In
contrast, when the policy direction is pro-industry for both candidates, this implies that candidate $R$ now takes advantage of her relative position as the more business-friendly candidate to increase her voter targeting more than candidate $L$ finds optimal. Finally, if candidate $L$ is pushed in a pro-environment direction while candidate $R$ is pushed in a pro-industry one, then greater polarization results readily.

Similarly, an increase in the relative size of climate change believers to deniers, holding the homogeneity of their socioeconomic ideologies constant, would also result in greater policy polarization under the same condition of sufficient candidate differentiation. Note that whether the trend we are considering concerns the voter groups’ relative size or ideological homogeneity, the initial equilibrium policies would dictate the direction of the change in each candidate’s equilibrium policy according to Proposition 2 and Corollary 1 as long as the changes affect both low-asset and high-asset voters.

The evidence on environmental policy polarization discussed in the Introduction indicates that the Democrats in the U.S. have moved in a pro-environment direction while the Republican votes have taken a pro-industry turn over the past decades. Our results suggest that the Congress’s inability to pass a climate bill in the U.S. has been a result of increased polarization between the parties’ environmental policy stands, which can itself be traced to changes in partisanship that takes the form of ideological homogeneity among both climate change believers and deniers. As discussed in the above paragraph, this effect materializes as each candidate takes advantage of the electoral importance of the voter group that puts more value on her relative strength by moving in their preferred direction to a greater extent than the other candidate.

6 Conclusion

This paper studied the electoral determinants of environmental policy when voters are afflicted by partisanship. Using a Downsian model of electoral competition with differentiated candidates, we assumed that the left-wing candidate is viewed by the voters as more effective in addressing environmental challenges while the right-wing candidate is viewed as better at mitigating the economic cost of regulations due to their differences in enforcement zeal. The model focused on partisanship that is specific to the issue of climate change according to which voters are divided based on whether they believe in or deny human-caused climate change.

The main results imply that a shift in climate change-specific partisanship according to which climate change believers become more numerous and relatively more ideologi-
cally homogeneous would lead to greater polarization of the two parties’ environmental policies, which is consistent with evidence from Congressional voting. We show that the left-wing candidate always proposes the more pro-environment policy and that both candidates’ policies move in a pro-environment direction as environmental issues gain prominence or as the voters’ assets decrease in value. Furthermore, we find that greater asset inequality that leaves the total value of assets intact results in more pro-industry policies if and only if the high-asset voters dominate the low-asset ones in electoral importance.

Analyzing the electoral consequences of partisanship that pertains specifically to the voters’ climate change beliefs, this paper provides a theoretical foundation for understanding the Congress’s inability to pass a climate bill in the recent decades. Our results suggest that facilitating the passage of a climate bill by moving the parties’ strategic environmental policy positions in a pro-environment direction requires decreasing the relative size of climate change deniers through, for instance, targeted ads on the validity of climate facts. However, our results also imply that targeting the voters’ economic concerns by investing in the economic potential of green technologies, thereby reducing the economic anxiety voters associate with environmental regulations, would also achieve a pro-environment objective.
References


[31] Yale Program on Climate Change Communication and George Mason University Center for Climate Change Communication. (March 2018). Politics & Global Warming.
Appendix

Proof of Lemma 1. Since the functions $v_j(p_j)$ and $x_j(p_j)$ are twice-differentiable for $j \in \{L, R\}$, the swing voter function $\tilde{\sigma}_{\theta h}(p_L, p_R)$ as defined in (4) is also twice-differentiable for $\theta \in \{\theta^L, \theta^H\}$ and $h \in \{b, d\}$. Given $\lambda_h v_j'(0) > \theta|x_j'(0)|$ and $\lambda_h v_j'(1) < \theta|x_j'(1)|$ for all $j$, $\theta$ and $h$ by assumption, and

$$\frac{\partial \tilde{\sigma}_{\theta h}(p_j, p_{-j})}{\partial p_j} = \frac{\lambda_h v_j'(p_j)}{2\eta(\sigma_j - \sigma_{-j})}$$

(9)

for $j \in \{L, R\}$, $\theta \in \{\theta^L, \theta^H\}$ and $h \in \{b, d\}$, it follows from the Intermediate Value Theorem and the strict concavity of the functions $v_j(p_j)$ and $x_j(p_j)$ for $j \in \{L, R\}$ that there exists a unique policy $\tilde{p}_{\theta h} \in (0, 1)$ for each $j$, $\theta$ and $h$ such that $\lambda_h v_j'(\tilde{p}_{\theta h}) = \theta|x_j'(\tilde{p}_{\theta h})|$. Thus, for candidate $L$, we have for any given $\theta$ and $h$ that $\frac{\partial \tilde{\sigma}_{\theta h}(p_L, p_R)}{\partial p_L} > 0$ for all $p_L < \tilde{p}_{L\theta h}$ and $\frac{\partial \tilde{\sigma}_{\theta h}(p_L, p_R)}{\partial p_R} < 0$ for all $p_L > \tilde{p}_{L\theta h}$. For candidate $R$, this implies for any given $\theta$ and $h$ that $\frac{\partial \tilde{\sigma}_{\theta h}(p_L, p_R)}{\partial p_R} < 0$ for all $p_R < \tilde{p}_{R\theta h}$ and $\frac{\partial \tilde{\sigma}_{\theta h}(p_L, p_R)}{\partial p_R} > 0$ for all $p_R > \tilde{p}_{R\theta h}$. Note that the function $\tilde{\sigma}_{\theta h}(p_L, p_R)$ is strictly concave in $p_L$ and strictly convex in $p_R$ for all $\theta$ and $h$ due to the strict concavity of the functions $v_j(p_j)$ and $x_j(p_j)$ for both $j$.

\[ \square \]

Proof of Proposition 1. Since $F_{\theta h}$ is a continuous cdf for $\theta \in \{\theta^L, \theta^H\}$ and $h \in \{b, d\}$, equations (5) and (6) imply that it is sufficient to establish the strict concavity of $V_L(p_L, p_R)$ and $V_R(p_L, p_R)$ in each candidate’s own policy to claim existence of a pure strategy equilibrium. To this end, note that

$$V''_L(p_L, p_R) = \sum_{\theta, h} n_{\theta h} \left[ f_{\theta h}(\tilde{\sigma}_{\theta h}) \left( \frac{\partial \tilde{\sigma}_{\theta h}}{\partial p_L} \right)^2 + f_{\theta h}(\tilde{\sigma}_{\theta h}) \frac{\partial^2 \tilde{\sigma}_{\theta h}}{\partial p^2_L} \right] < 0$$

(10)

is true for all $p_L$ and any given $p_R$, since $f_{\theta h}(\tilde{\sigma}_{\theta h})$ is assumed constant for $\theta \in \{\theta^L, \theta^H\}$ and $h \in \{b, d\}$, and $\tilde{\sigma}_{\theta h}(p_L, p_R)$ is strictly concave in $p_L$ due to the strict concavity of the functions $v_L(p_L)$ and $x_L(p_L)$. Similarly, based on equation (6), the fact that $f_{\theta h}(\tilde{\sigma}_{\theta h})$ is constant for all $\theta$ and $h$ along with the strict convexity of $\tilde{\sigma}_{\theta h}(p_L, p_R)$ in $p_R$ implies that $V''_R(p_L, p_R) < 0$ for all $p_R$ and any given $p_L$. Thus, there exists a pure strategy equilibrium $(\tilde{p}^*_L, \tilde{p}^*_R)$. Its uniqueness follows from the strict concavity of the vote share functions and the fact that the policy game between the two candidates is constant sum.

The necessary and sufficient first-order condition for an interior solution $p^*_j \in (0, 1)$
can be written as
\[ \sum_{\theta,h} n_{\theta h} f_{\theta h}(\bar{\sigma}_{\theta h}) \frac{\partial \bar{\sigma}_{\theta h}}{\partial p_j} = 0 \]  
(11)
for \( j \in \{L, R\} \), which, based on equation (9), becomes
\[ \sum_{\theta,h} n_{\theta h} f_{\theta h}(\bar{\sigma}_{\theta h})[\lambda_h v_j'(p_j) + \theta x_j'(p_j)] = 0 \]  
(12)
for \( j \in \{L, R\} \). Note that if \( \beta_L = \beta_R \) and \( \mu_L = \mu_R \) so that \( v_L(p_L) = v_R(p_R) \) and \( x_L(p_L) = x_R(p_R) \) for any given \( p_L = p_R \), then \( p^*_L = p^*_R \) in equilibrium, since the candidates would both face the same necessary and sufficient condition (12) for optimality. Conversely, if \( p^*_L = p^*_R \equiv p^* \in (0, 1) \) in equilibrium, then the assumed candidate differentiation would imply \( v'_L(p^*) > v'_R(p^*) > 0 \) and \( 0 > x'_L(p^*) > x'_R(p^*) \), contradicting the equilibrium condition that equation (12) must hold for both \( j = L, R \). Note that only the former relationship holds for possible corner solutions, yielding the first part of Proposition 1.

To see that \( p^*_L \leq p^*_L \) is always true in equilibrium, suppose \( p^*_R > p^*_L \). Then, since \( p^*_R > p^*_L \) along with the strict concavity of the functions \( v_j(p_j) \) and \( x_j(p_j) \) for \( j \in \{L, R\} \) imply \( 0 < v'_R(p^*_R) < v'_L(p^*_L) \) and \( x'_R(p^*_R) < x'_L(p^*_L) < 0 \), it follows that \( \lambda_h v'_L(p^*_L) + \theta x'_L(p^*_L) > \lambda_h v'_R(p^*_R) + \theta x'_R(p^*_R) \) for \( h \in \{b, d\} \) and \( \theta \in \{\theta^L, \theta^H\} \). Based on equation (12), this implies \( V'_L(p^*_L, p^*_R) > V'_R(p^*_L, p^*_R) \), contradicting optimality. \( \square \)

**Proof of Proposition 2.** Implicitly differentiating the necessary and sufficient condition (12) for the optimal policy \( p^*_j \in (0, 1) \) with respect to \( f_{\theta h} \) for \( \theta \in \{\theta^L, \theta^H\} \) and \( h \in \{b, d\} \) yields
\[ \frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial f_{\theta h} \partial p_j} + \frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial p^*_j} \frac{\partial p^*_j}{\partial f_{\theta h}} = 0 \]  
(13)
for \( j \in \{L, R\} \). First, note that \( \frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial p^*_j} < 0 \) for \( j \in \{L, R\} \) by the strict concavity of the candidates’ vote share functions. Second, differentiating \( V'_j(p^*_j, p^*_{-j}) \) with respect to \( f_{\theta h} \) by holding \( p_j \) constant yields
\[ \frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial f_{\theta h} \partial p_j} = n_{\theta h}[\lambda_h v'_j(p^*_j) + \theta x'_j(p^*_j)] \]  
(14)
for \( j \in \{L, R\}, \theta \in \{\theta^L, \theta^H\} \) and \( h \in \{b, d\} \). Equation (14) is non-negative for any given \((\theta, h)\) pair if and only if \( \lambda_h v'_j(p^*_j) + \theta x'_j(p^*_j) \geq 0 \), which is true if and only if \( p^*_j \leq \bar{p}_{j \theta h} \), where \( \bar{p}_{j \theta h} \in (0, 1) \) is the threshold policy introduced in Lemma 1 and defined implicitly by \( \lambda_h v'_j(\bar{p}_{j \theta h}) + \theta x'_j(\bar{p}_{j \theta h}) = 0 \). Thus, equation (13) implies that \( \frac{\partial p^*_j}{\partial f_{\theta h}} \geq 0 \) in equilibrium.
for $j \in \{L, R\}$, $\theta \in \{\theta^L, \theta^H\}$ and $h \in \{b, d\}$ if and only if $p^*_j \leq \bar{p}_{j\theta h}$.

**Proof of Proposition 3.** As in the proof of Proposition 2, implicitly differentiating (12) with respect to $\lambda_h$ for $h \in \{b, d\}$ yields

$$\frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial \lambda_h \partial p_j} + \frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial p_j^2} \frac{\partial p^*_j}{\partial \lambda_h} = 0,$$

where

$$\frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial \lambda_h \partial p_j} = \sum_{\theta} n_{\theta h} f_{\theta h} v'_j(p^*_j) > 0 \tag{16}$$

for all $h$ and $j$. Given the strict concavity of $V_j(p_j, p_{-j})$ in $p_j$ for $j \in \{L, R\}$, equation (15) then implies that $\frac{\partial p^*_j}{\partial \lambda_h} > 0$ for $h \in \{b, d\}$ and $j \in \{L, R\}$.

**Proof of Proposition 4.** As in the proofs of Propositions 2 and 3, implicitly differentiating (12) with respect to $\theta \in \{\theta^L, \theta^H\}$ for $j \in \{L, R\}$ yields

$$\frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial \theta \partial p_j} + \frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial p_j^2} \frac{\partial p^*_j}{\partial \theta} = 0,$$

where

$$\frac{\partial^2 V_j(p^*_j, p^*_{-j})}{\partial \theta \partial p_j} = \sum_{h} n_{\theta h} f_{\theta h} x'_j(p^*_j) < 0 \tag{18}$$

since $x_j(p_j)$ is strictly decreasing in $p_j$. Given the strict concavity of the candidates’ vote share functions, equation (17) implies that $\frac{\partial p^*_j}{\partial \theta} < 0$ for $\theta \in \{\theta^L, \theta^H\}$ and $j \in \{L, R\}$. Then, based on equations (12) and (18), candidate $j$’s equilibrium policy $p^*_j$ for $j \in \{L, R\}$ decreases as $\theta^H$ increases and $\theta^L$ decreases if and only if $\sum_h n_{\theta^L h} f_{\theta^L h} > \sum_h n_{\theta^H h} f_{\theta^H h}$ is satisfied.