Economic forces drive political polarization

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August 31, 2023

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Abstract

Climate policy is among the most polarizing issues in US party politics. That polarization is a relatively new phenomenon. We here develop a model that explains polarization based on underlying economic trends. Rising incomes bring parties' economic policies closer together. That pushes parties to try to distinguish themselves by increasingly focusing on non-economic identity politics. The analysis also shows a potential path forward: framing climate primarily as an economic policy issue that puts distributional implications (and remedies) front and center.

JEL codes: *D63, H23, P16, Q52, Q54*
Keywords: *Political economy, parties, elections, values, climate policy*

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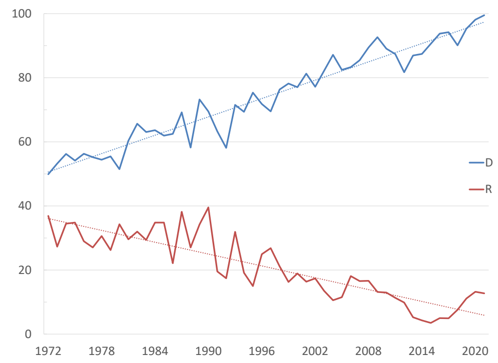
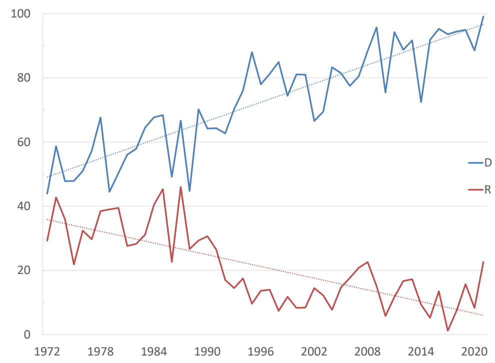
1 Introduction

Climate change and other environmental policies more broadly are among the most polarizing political issues in the United States and elsewhere. That had not always been the case. The 1970s saw the passage of a dozen major environmental laws supported by Democrats and Republicans alike, many signed into law by Republican President Richard M. Nixon. The Clean Air Act Amendments of 1990, too, passed with large bipartisan support—with votes of 401-21 in the House of Representatives and 89-11 in the Senate, signed into law by Republican President George H.W. Bush. Today, climate change and environmental protection are hyper-partisan issues, as evidenced by ever more divergent League of Conservation Voters (LCV) scores across parties. Figure 1 shows LCV scores for members of the U.S. House of Representatives and the Senate over five decades (Shipan and Lowry, 2001; Nelson, 2002).



(a) U.S. House of Representatives



(b) U.S. Senate

Figure 1: League of Conservation Voters (LCV) scores, averaged across Democrats (D) and Republicans (R), from 1972 to 2021.

That polarization threatens to undermine democratic norms and institutions, including trust in facts and science itself (Oreskes, 2021). Trust in scientific institutions by Democratic party supporters is at an all-time high, while that by Republicans is at an all-time low (John Burn-Murdoch, 2022). Polarization of party policies, in turn, raises policy uncertainty, hampering investment decisions. In the case of climate policy, this uncertainty can lead to delays in passing and implementing policies, in turn raising costs in form of stranded assets and systemic financial risk for businesses and households alike.

Political economists and scientists have discussed various causes of polarization on the political "demand side" such as the changing role of media and especially social media (Allcott and Gentzkow, 2017; Allcott et al., 2019; Bail et al., 2018; Tucker et al., 2018), the changing role of education (Gethin et al., 2022), and rising economic inequality (Roemer, 2006; Buisseret and Van Weelden, 2022; Buisseret and Van Weelden, 2020), the latter including in the context of climate policy(McCright and Dunlap, 2011). On the political "supply side," explanations have focused on ever more sophisticated gerrymandering and other party tactics (McCarty et al., 2009). We here focus on the role of economic forces on the supply side, proposing and examining analytically a novel channel of income growth (and indirectly inequality) on party polarization.

A rise in income on the one hand and in income inequality and campaign contributions by th emost affluent voters on the other changes the division of a multidimensional voter space such that the non-economic ideological cleavage—from immigration to identity politics, gun laws, abortion, and, in our analysis, climate policy—gains in weight. We show theoretically how this pivot from the economic to the non-economic dimension can be explained via either economic growth or rising campaign contributions by the highest income groups alone, and with both combined.

We then apply the model to climate policy directly, showing how rising income levels raise climate policy polarization and resulting uncertainty as long as the climate issue is predominantly perceived as ideological. Our model shows that party polarization on climate, and the resulting climate policy uncertainty, decreases if it is primarily perceived and discussed as an economic policy issue. Defining climate as an economic policy issue also brings to the fore distributional aspects of climate policy, such as compensatory measures for carbon prices, and the potential for compromise.

Our model shows how rising income and inequality reduces the importance of economic differences and increases the role of the ideological ones. As the dividing line between parties tilts it increasingly separates the two voter groups along values rather than incomes. In doing so, we focus on the 'supply' side, keeping individual voters' preferences constant. That makes our model stand out vis-à-vis other, complementary explanations that focus on 'demand' and, thus, rely on changing preferences over time. Here voters' preferences remain fixed, while those of parties change in their attempt to appeal to voters. Parties that seek to maximize the welfare of their supporters and their own chance of winning elections adjust their platforms. Economic polarization decreases, ideological polarization increases.

We first introduce the formal political economy model in Section 2.1, before showing how it can be used to explain increased polarization (Section 3). We then apply the model to climate policy in Section 4, before suggesting possible ways forward for research and policy alike.

2 Model

2.1 Voters

There is a continuum of voters i who differ along two dimensions: their exogenous income $h_i \in [0, \infty[$, which follows a log-normal distribution, and in their otherwise stable preferences for the non-economic value dimension $a_i \in [0, 1]$, with the value 0 assumed as representing the socially-conservative pole and 1 the socially-liberal counterpart. Voters derive indirect utility $u_i(\tau, \kappa)$ for a set of policies (τ, κ), such that:

$$u_i(\tau, \kappa) = h_i(1 - \tau) + P(\tau) - \phi(\kappa - a_i)^2, \tag{1}$$

where τ represents income tax rates and κ policy preferences along the non-economic dimension.

The voters' consumption utility is linear. The economic policy, a proportional income tax τ, funds a public good that yields the same concave utility $P(\tau)$ with

$$P'(\tau) \begin{cases} > 0 & \text{if } \tau < \hat{\tau} \\ < 0 & \text{if } \tau > \hat{\tau} \\ = 0 & \text{if } \tau = \hat{\tau} \end{cases} \tag{2}$$

with $0 < \hat{\tau} < 1$ and $P''(\tau) < 0$ for all voters. Hence, low-income voters prefer a bigger government with higher τ, while high-income voters prefer a less interventionist government with lower τ. At the threshold $\hat{\tau}$, the citizens' marginal utility from public-goods provision turns negative, either due to disincentives from the tax to labor supply and total output, assumptions around the declining effectiveness of the welfare state (Okun, 2015), or both. Without loss of generality, we assume that no household prefers a tax ≥ 1, limiting $\tau < 1$.

The non-economic policy dimension enters as a quadratic disutility term. Voters suffer more the farther the implemented policy κ is from their individual bliss point a_i. The relative salience of the non-economic value issue, represented by ϕ, is the same across all voters.

2.2 Parties

Two political parties $m \in \{D, R\}$ ('Democrats' and 'Republicans') compete in a majoritarian electoral system. Voter i prefers the platform of party D to that of party R *iff* it promises a higher utility:

$$u_i(\tau_D, \kappa_D) > u_i(\tau_R, \kappa_R).$$

The set of swing voters who are indifferent between the two parties, thus, is characterized by $u_i(\tau_D, \kappa_D) = u_i(\tau_R, \kappa_R)$, yielding a straight line that divides the voter space (a_i, h_i):

$$\hat{a}(h_i) = \frac{h_i \Delta\tau - (P(\tau_D) - P(\tau_R))}{2\phi\Delta\kappa} + \frac{\kappa_D + \kappa_R}{2}, \tag{3}$$

with parties distinguishing each other on the economic dimension via different income tax policies:

$$\Delta\tau = \tau_D - \tau_R, \tag{4}$$

and along the non-economic, value dimension via policies we will subsequently define as representing party polarization:

$$\Delta\kappa = \kappa_D - \kappa_R. \tag{5}$$

This allows us to write the slope of the swing-voter line as:

$$\frac{\Delta\tau}{2\phi\Delta\kappa}. \tag{6}$$

We further assume $\tau_D \geq \tau_R$, so that the voters above this line vote for D and below for R (Figure 2). The distribution of voters along the two dimensions h_i and a_i defines the set of swing voters via its influence on the equilibrium party platforms.

2.3 Party factions and political competition

The two political parties compete in a two-dimensional policy space $T \subset R^2$. Analyzing party polarization requires divergence of party platforms $t_D, t_R \in T$, going counter to a Downsian median-voter model on the one hand or a standard probabilistic voting model on the other (Grofman, 2004). Both would lead to converging party platforms

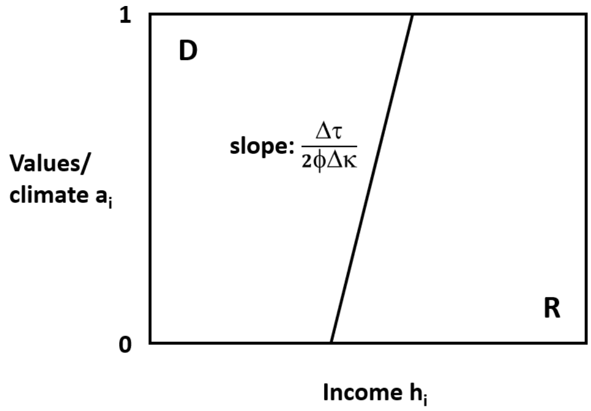


Figure 2: Linear set of swing voters separating the voter space (a_i, h_i)

and fail to explain any polarization.

We here instead assume that each party has two factions: The 'Opportunists' want to maximize the probability of their party winning elections, while the 'Guardians' strive to maximize the average welfare of current party supporters. Each pair of party factions engages in a Nash bargaining game within their own party over the party's platform, while taking the set of policies by the respective other party as given. The equilibrium electoral platforms are then determined in a pure-strategy Nash equilibrium across both parties, on top of the Nash bargaining games between factions within each party. In such a "party unanimity Nash equilibrium" ("PUNE", Roemer 2006), no faction can deviate from the resulting platform without triggering a detrimental adjustment by the other party. The equilibrium platforms diverge because the Guardians within each party represent different sets of voters $H_m, m \in \{D, R\}$. These sets are separated by the swing voter line $\hat{a}(h_i)$ from Equation 3) and contain close to half of the electorate each. The set of party D supporters is:

$$H_D(t_D, t_R) = \{(a_i, h_i)|u_i(t_D) > u_i(t_R)\}.$$

Conversely, $u_i(t_R) > u_i(t_D)$ holds true for supporters of party R.

The resulting aggregate welfare of all supporters of party m, if the policy vector t is realized, is:

$$W^D(t) = \int_{(a_i,h_i)\in H^D} u(t;a_i,h_i)\, d\mathbf{F}(a_i,h_i) = \int_0^\infty \int_{\hat{a}}^1 u(t;a_i,h_i)\, d\mathbf{F}(a_i)\, d\mathbf{F}(h_i) \qquad (7)$$

$$W^R(t) = \int_{(a_i,h_i)\in H^R} u(t;a_i,h_i)\, d\mathbf{F}(a_i,h_i) = \int_0^\infty \int_0^{\hat{a}} u(t;a_i,h_i)\, d\mathbf{F}(a_i)\, d\mathbf{F}(h_i) \qquad (8)$$

for the two parties. The share of party D supporters in the electorate, that is, the probability measure $\mathbf{F}(H_D(t_D, t_R))$ is a discrete number depending on the probability distribution $\mathbf{F}$.

There is party uncertainty about actual voter behavior. When parties announce their policy platforms at the beginning of an election campaign, the parties believe that the share of voters who prefer t_D to t_R lies in a range of $[-\epsilon, +\epsilon]$ around $\mathbf{F}(H_D(t_D, t_R))$ with a uniform probability distribution within that range. Without this uncertainty, the winner would be known from the start, or the chances of each party to win would be exactly $\frac{1}{2}$. In either case, spending money on election campaigns to try to convince voters would be pointless. The expected probability of party D to win with platform t_D, if party R plays platform t_R, then is:

$$\pi(t_D, t_R) = \frac{\mathbf{F}(H_D(t_D, t_R)) + \epsilon - \frac{1}{2}}{2\epsilon} = \frac{\int_{(a_i,h_i)\in H^D} d\mathbf{F}(a_i,h_i) + \epsilon - \frac{1}{2}}{2\epsilon}.$$

The winning probability of party R is $1 - \pi$. As a result, each party has a probability of winning the election close to, but not exactly equal to, 50%.

2.4 Party Unanimity Nash Equilibrium (PUNE)

The political competition plays out in two stages: intra- and inter-party competition. Two types of politicians try to influence each party's policies: Opportunists try to maximize the party's vote share primarily to win elections and advance their own career. When facing a given policy platform from the respective of other party, their payoff functions are

$$\Pi_D^{Opp}(t_D, t_R) = \pi(t_D, t_R), \text{ and} \tag{9}$$

$$\Pi_R^{Opp}(t_D, t_R) = 1 - \pi(t_D, t_R), \tag{10}$$

respectively.

Guardians, on the other hand, maximize average utility of their constituents while neglecting the probability of actually getting into office.[2] Their payoff functions are

$$\Pi_D^{Guar}(t_D, t_R) = W^D(t_D), \text{ and} \tag{11}$$

$$\Pi_R^{Guar}(t_D, t_R) = W^R(t_R), \tag{12}$$

respectively.

The two factions of party D now engage in a bargaining game in which the Guardians try to maximize their constituents' welfare while the Opportunists insist on a minimal probability of winning π_0, given that party R plays the platform t_R:

$$\max_{t \in T} W^D(t) \quad s.t. \quad \pi(t, t_R) \geq \pi_0^D \tag{13}$$

Conversely, party R solves the following problem in a similar way for a given platform t_D of party D:

$$\max_{t \in T} W^R(t) \quad s.t. \quad 1 - \pi(t_D, t) \geq 1 - \pi_0^R. \tag{14}$$

The respective strategies are equivalent to maximizing the probability of winning, sub-

[2] An additional interpretation of this behavior could be that the Guardians seek to publicly propagate their agenda, even if they end up not putting their policies into practice. In early versions of the PUNE concept, Roemer (2006) included a third faction, the Reformists, who would maximize expected welfare of their voters. Mathematically, the Reformists are redundant.

ject to a lower bound of the average welfare of the party's constituents.

Following Lee and Roemer (2006), and consistent with Roemer (2006, Chapter 8), a *Party Unanimity Nash Equilibrium* (PUNE) is defined as two party memberships H^D & H^R, two win probabilities π_0^D & π_0^R, and two sets of policies t_D & t_R, such that:

(1) $H^D \cup H^R = H$, while $H^D \cap H^R = \varnothing$,

(2) t_D solves Equation (13), while t_R solves Equation (14), and

(3) for $(a_i, h_i) \in H^D \Rightarrow u(t_D; a_i, h_i) \geq u(t_R; a_i, h_i)$,
while for $(a_i, h_i) \in H^R \Rightarrow u(t_R; a_i, h_i) \geq u(t_D; a_i, h_i)$.

A PUNE guarantees that endogenously formed party membership is stable. Condition (3) states that all voters prefer to continue supporting their respective party. Neither faction of either party can deviate from their policy positions (t_D, t_R) without making the other faction worse off.

The election outcome across parties very much depends on the relative bargaining power of the Opportunists and Guardians within each party. The tuple (π_0^D, π_0^R) reflects that relative bargaining power of the Opportunist faction in each party. Different degrees of relative bargaining power produce different PUNEs. There is a two-dimensional manifold of PUNEs in the policy space $T \times T$.

Roemer (2006) shows that the bargaining game based on equations (13) and (14) yielding PUNEs as solutions can be restated as a weighted Nash bargaining game. Thus, the factions in party D choose the policy vector t that maximizes the Nash product, given that party R plays t_R:

$$\max_{t \in T} (\pi(t, t_R) - 0)^{\alpha} (W^D(t) - W^D(t_R))^{1-\alpha}. \tag{15}$$

The corresponding maximization problem for party R, given that party D plays t_D is

$$\max_{t \in T}((1-\pi(t_D,t))-0)^{\beta}(W^R(t)-W^R(t_D))^{1-\beta}. \tag{16}$$

The parameters $\alpha, \beta \in [0,1]$ denote the relative bargaining power of the Opportunists within their respective parties. The Nash bargaining weights are: $((\alpha,\beta),((1-\alpha),(1-\beta)))$.

3 Shift in the political cleavage

This model now allows us to look to underlying economic forces and their effect on the formation of party platforms in light of intra- and inter-party competition. First, we analyze the effects of growth in average income, while preserving income distribution. Second, we focus on rising income inequality for a given average income—i.e., while decreasing median income. Lastly, we examine both income growth and rising inequality. In all three cases, we show how it contributes to convergence of party platforms on the economic dimension, which in turn exacerbates party polarization along the values dimension.

3.1 The Effect of Growth

Income is distributed according to a log-normal distribution: $h_i \sim Lognormal(\mu, \sigma^2)$ with the mean μ and the variance σ^2 of the underlying normal distribution. This is a good representation of real income distributions in democratic high-income countries, such as the U.S. today. Median income is $h_{med} = e^{\mu}$ and mean income is $\bar{h} = e^{\mu+\frac{\sigma^2}{2}}$. We measure income inequality as the ratio of median income to mean income $\frac{h_{med}}{\bar{h}}$. To disentangle the effects of inequality and income growth, we model economic growth by assuming a distribution-preserving proportional increase in every voter's income, i.e. an increase in μ, but no change in σ^2. As a result, the cost of a marginal increase in the proportional tax τ rises and their marginal benefit from the public good (more of which is provided now) decreases for all voters (due to $P''(\tau) < 0$). Consequently, each voter prefers a lower tax rate τ_i^* than before. Proposition 1 summarizes the consequences for the party positions on the economic policy τ:

Proposition 1. Distribution-preserving income growth ($\mu \uparrow$ with σ const.) decreases the polarization of parties on the economic issue: $\frac{\partial \Delta\tau}{\partial \mu} < 0$.

Proof:

Voter i individually prefers the income tax rate τ_i^* that maximizes her utility (1) according to her first-order condition w.r.t. τ

$$\frac{\partial u_i}{\partial \tau} = -h_i + P'(\tau) = 0, \quad P_\tau(\bar{h}(\mu)\tau_i) = h_i.$$

Given the log-normal income distribution (with mean μ and variance σ^2 of the underlying normal distribution), an income quantile $p \in [0,1]$ can be expressed as $exp(\mu + \sqrt{2\sigma^2} erf^{-1}(2p-1))$. This implies that $\frac{\partial h_i(\mu)}{\partial \mu} = h_i$ for all h_i. By dividing the FOC above by $\bar{h}$, we obtain

$$\frac{P_\tau(\bar{h}\tau_i)}{\bar{h}} = \frac{h_i}{\bar{h}} \tag{17}$$

Note that the public-good function $P(\bar{h}\tau)$ is assumed as purely a function of aggregate tax revenues $\bar{h}\tau$. Thus, we can restate (17) as $g(\bar{h}(\mu)\tau_i) = \frac{h_i(\mu)}{\bar{h}(\mu)}$ with $g(\bar{h}\tau_i) := \frac{P_\tau(\bar{h}\tau_i)}{\bar{h}}$. Totally differentiating both sides w.r.t. μ and τ_i yields

$$\frac{\partial g}{\partial \tau_i} d\tau_i + \frac{\partial g}{\partial \mu} d\mu = 0 \tag{18}$$

as $\frac{\partial}{\partial \mu}\left(\frac{h_i(\mu)}{\bar{h}(\mu)}\right) = 0$. The derivative of $g(\bar{h}(\mu)\tau_i)$ w.r.t. τ_i is $\frac{\partial g(\bar{h}(\mu)\tau_i)}{\partial \tau_i} = \frac{P_{\tau\tau}(\bar{h}\tau_i)}{\bar{h}}$. The derivative w.r.t. μ is $\frac{\partial g(\bar{h}(\mu)\tau_i)}{\partial \mu} = \frac{\partial g}{\partial \bar{h}} \cdot \frac{\partial \bar{h}}{\partial \mu} = \frac{\partial g}{\partial \bar{h}}\bar{h} = \bar{h}\frac{\partial}{\partial \bar{h}}\left(\frac{P_\tau}{\bar{h}}\right) = \frac{\partial}{\partial \bar{h}}(P_\tau) - \frac{P_\tau}{\bar{h}}$. In the public-good function $P(.)$, mean income $\bar{h}$ and tax rate τ_i always appear as the product

$\bar{h}\tau_i$. Therefore, we can restate $\frac{\partial g}{\partial \mu} = P_{\tau\tau}\frac{\tau_i}{\bar{h}} - \frac{P_\tau}{\bar{h}}$.

Substituting both derivatives $\frac{\partial g}{\partial \tau_i}$ and $\frac{\partial g}{\partial \mu}$ into 18 and simplifying yields

$$\frac{d\tau_i}{d\mu} = -\frac{\partial g}{\partial \mu} / \frac{\partial g}{\partial \tau_i} = -\tau_i + \frac{P_\tau}{P_{\tau\tau}} < 0 \tag{19}$$

Voter i's preferred income tax rate always decreases with rising μ for $P_\tau > 0$, $P_{\tau\tau} < 0$. To examine how the decrease in the preferred tax rate depends on personal income, we take the derivative of (19) w.r.t. τ_i:

$$\frac{\partial}{\partial \tau_i}\left|\frac{d\tau_i}{d\mu}\right| = \frac{P_\tau P_{\tau\tau\tau}}{P_{\tau\tau}^2} > 0 \quad \text{for} \quad P_\tau, P_{\tau\tau\tau} > 0$$

Thus, the decrease in the preferred income tax rate is higher for those voters and groups of voters who already prefer a higher tax rate before the rise in μ. The Guardians in each party, who drive the divergence of party platforms, prefer a tax rate τ that corresponds to the average income of the respective group (i.e. half) of voters. Therefore, the Guardians of party D prefer a higher tax rate than the Guardians of party R. The same holds true for the resulting overall party policies.

As shown above, this implies that an increase in μ triggers a stronger decrease in τ_D than in τ_R, leading to convergence of economic policies $\Delta\tau \downarrow$ for the two voter groups H_D and H_R. However, the changes in the income levels and in the resulting economic policies τ also modify the SVC and additionally lead to a realignment of some voters, even if climate policies κ are assumed to be constant. To show the implications of the voter realignment, it is useful to express the income levels relative to the respective mean income, i.e., $\frac{h_i}{\bar{h}}$ instead of h_i. The advantage is that the increase in μ does not change the distribution of voters in this space as both h_i and $\bar{h}$ increase by the same factor. This also yields the alternative expression for the SVC: $\tilde{a}\left(\frac{h_i}{\bar{h}}\right) = \left(\frac{h_i}{\bar{h}}\right)\frac{\bar{h}\Delta\tau}{2\phi\Delta\kappa} + \frac{\kappa - D + \kappa_R}{2} - \frac{P(\tau_D) - P(\tau_R)}{2\phi\Delta\kappa}$. We calculate the reaction of the slope of this alternative SVC $\tilde{a}\left(\frac{h_i}{\bar{h}}\right)$ to an increase in

μ (still κ assumed unchanged):

$$\frac{\partial}{\partial \mu}\left(\frac{\partial \tilde{a}}{\partial (h_i/\bar{h})}\right) = \frac{1}{2\phi\Delta\kappa}\frac{\partial}{\partial \mu}(\bar{h}(\tau_D - \tau_R)) = \frac{1}{2\phi\Delta\kappa}\bar{h}\left(\tau_D - \tau_R + \frac{\partial \tau_D}{\partial \mu} - \frac{\partial \tau_R}{\partial \mu}\right)$$

Using (19), this simplifies to

$$\frac{\partial}{\partial \mu}\left(\frac{\partial \tilde{a}}{\partial (h_i/\bar{h})}\right) = \frac{1}{2\phi\Delta\kappa}\bar{h}\left(\frac{P^D_\tau}{P^D_{\tau\tau}} - \frac{P^R_\tau}{P^R_{\tau\tau}}\right) \tag{20}$$

The crucial term $\frac{P_\tau}{P_{\tau\tau}}$ is negative and its absolute value increases in τ depending on the functional form of $P(\tau)$. For instance, it always increases in τ for the functional form $P(\tau) = p_0(\bar{h}\tau)^\theta$ with $\theta < 1$. For the functional form $P(\tau) = p_0\left[(\bar{h}\tau)^\theta - p_1\bar{h}\tau\right]$, which is used for the numerical illustrations, the absolute value of $\frac{P_\tau}{P_{\tau\tau}}$ increases in τ if $p_0 > 2-\theta$. If its absolute value increases in τ, the term $\left(\frac{P^D_\tau}{P^D_{\tau\tau}} - \frac{P^R_\tau}{P^R_{\tau\tau}}\right)$ is negative. This implies that the slope of the SVC becomes flatter, while still dividing the voter type space in two halves. This implies that party D loses some voters with low income (and a low climate preference) to party R and gains voters with high income (and high climate preference) from party R (cf. right-hand panel in Figure 3). This realignment additionally increases (decreases) the average income of party-D (party-R) supporters. As a result, τ_D and τ_R converge even more than without accounting for the voter realignment. $\square$.

As party platforms converge more on the economic dimension with rising income and the slope of the swing voter curve $\frac{\partial \tilde{a}(h_i/\bar{h})}{\partial h_i}$ (cf. Equation (3)) decreases, some voters realign their party support, as illustrated by Figure 3. This realignment affects not only average income of the two voter groups, but also the average climat epolicy preference. The result is summed up by the following proposition.

Proposition 2. Converging party positions on the economic issue ($\Delta\tau \downarrow$), e.g. due to proportional income growth, lead to a realignment of voters that results in a higher party polarization on the climate issue: $\frac{d\Delta\kappa}{d\Delta\tau} < 0$.

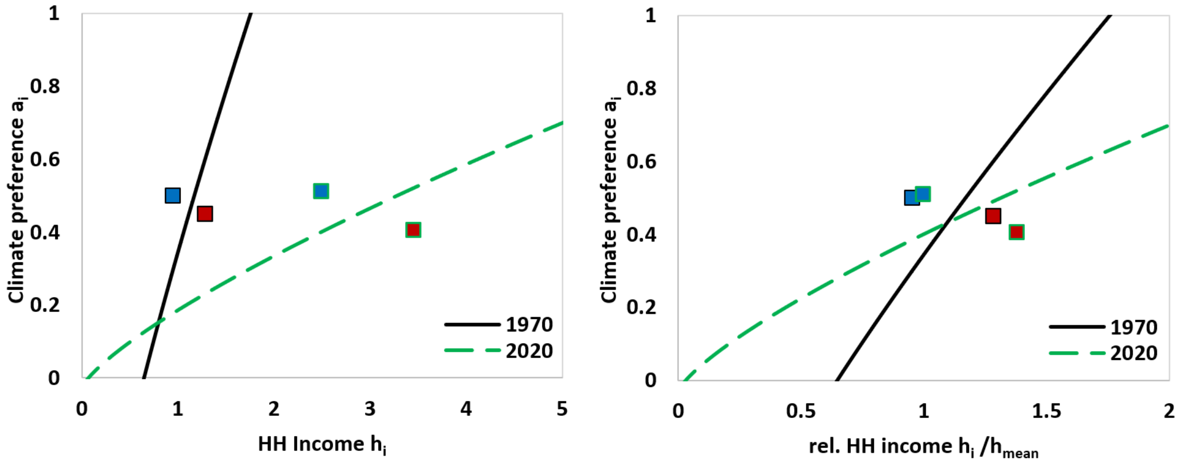


Figure 3: Change in the division of the voter type space due to distribution-preserving income growth. The left panel shows the voter-type space over absolute household income (with mean 1 in 1970 and mean 2.5 in 2020). The right panel shows the voter-type space over household income relative to the respective mean income.

Proof: The effect of voter realignment on the average climate preference in both voter groups is closely related to the effect of voter realignment on average income, as explained in the proof for Proposition 1. The slope of the SVC $\tilde{a}\left(h_i/\bar{h}\right)$ decreases while still separating the voter type space in two halves. As a result, party D loses voters with a low climate preference to party R and in turn gains voters with higher climate preference from party R. Party R experiences the opposite effect. Consequently, party-D (party-R) supporters become on average more (less) environmentalist due to the voter realignment. The Guardians in each party follow this development and prefer more polarized, i.e. more diverging, climate policy positions. This effect carries over to the overall party positions, even though the individual voters' environmental preferences do not change.

The increase in climate policy polarization $\Delta\kappa \uparrow$ now additionally contributes to the decrease in the slope of the SVC (cf. (3) and (20)). This reinforces the voter realignment and the resulting further convergence in economic policies τ and divergence in climate policies κ. $\square$.

Low-income voters with a lwo degree of environemntalism (bottom-left corner) switch their vote from party D to party R. Similarly, high-income voters with a high degree of environmentalism (upper-right corner) switch from voting for party R based on economics to voting for party D due to environemtnalism. All the voters which party D loses are less environmentalist than the voters they gain. This shift in the set of party supporters leads the Guardians in the Democratic party to argue more strongly for a more environemntalist position. In the same way, party-R voters are less environmentalist after the realignment, leading to a less environmentalist position on the value issue. Effectively, the difference in the cliamte issue starts to play a stronger role in differentiating the parties.

In addition, the polarization on the economic issue $\Delta\tau$ decreases even further as party D loses some low-income voters and party R loses some high-income voters. Once the polarization on the value issue κ starts to rise, it additionally affects the slope of the swing voter line (3), as $\Delta\kappa$ is in the denominator of the slope. This results in a self-reinforcing feedback loop until a new equilibrium is reached, in which cultural polarization of platforms is higher and economic polarization is lower than before.

3.2 Discussion: The Role of Income Inequality

In the decades since 1970 we have not only seen substantial economic growth in the U.S. (and other OECD countries), but also increasing income inequality. To separate the role of income inequality from the growth effect, we examine a shift toward a more unequal income distribution through an increase in σ^2 while keeping the mean income $\bar{h} = e^{\mu+\frac{\sigma^2}{2}}$ constant. Such a mean-preserving increase in income inequality, thus, implies a decrease in $h_{med} = e^{\mu}$ for a constant $\bar{h}$. The density of voters at the median income is $pdf(h_{med}) = \frac{1}{e^{\mu}\sqrt{4\pi(ln\bar{h}-\mu)}}$. For $\sigma > \frac{1}{\sqrt{2}}$, we have $\frac{\partial pdf(h_i=e^{\mu})}{\partial\mu} < 0$.

A mean-preserving rise in income inequality decreases the average income of the poorer half of the electorate, while increasing the average income of the richer half. This in itself contributes to a divergence of economic policy preferences of the two voter groups

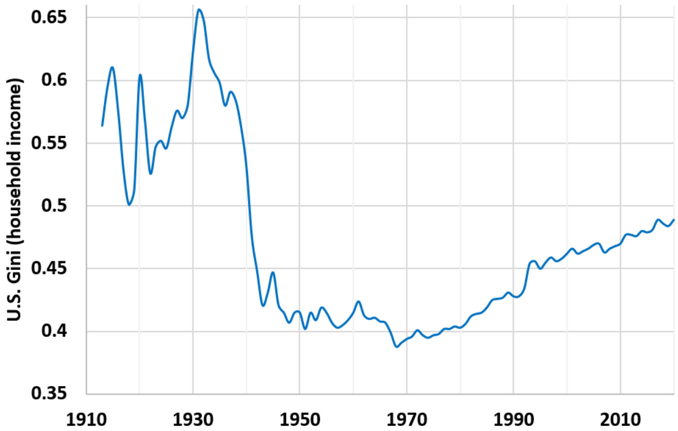


Figure 4: U.S. Gini index over time.

and of the two Guardian factions in both parties. However, a rising concentration of income and wealth at the top of the distribution also expands the resources and the capability of the highest-income groups to make electoral campaign contributions to either party and lobby for their interests. This is likely to raise the weight of these voters in both parties' Guardian factions. The Guardians' resulting ideal economic policies would, therefore, not simply correspond to the average income of their respective supporters. Instead, the economic policy positions of both parties would be distorted in favor of the contributing high-income voters. For party D, however, this distortion would imply a larger decrease in its economic policy position than for party R, similarly to the intuition of Proposition 1. In this context, rising income inequality that fuels symmetric campaign contributions to the parties would contribute to economic policy convergence and climate policy divergence, if the lobbying-induced convergence effect is stronger than the inequality-induced economic divergence effect.

(Formalize...)

3.3 Rising salience of the climate issue and polarization of climate preferences

3.3.1 Salience of the Climate Issue

It seems plausible to assume that a shift of the political cleavage over the long run from economic issues to value issues such as environmentalism changes the relative salience of these policy dimensions. (+empirical evidence...)If we assume an exogenous increase in the salience of the value dimension in the voters' utility function ϕ, we again obtain a decrease in the slope of the swing voter line and the described feedback loop.

Proposition 3. A higher salience of the climate issue ϕ decreases the slope of the swing voter line and, through the resulting realignment of voters, leads to more party polarization on the climate issue ($\Delta\kappa \uparrow$) and less party polarization on the economic issue ($\Delta\tau \downarrow$)

Proof: The slope of the swing voter line (SVL) in a_i-h_i space $\frac{\Delta\tau}{2\phi\Delta\kappa}$ decreases with a rising salience of the climate issue ϕ. The rest of the proof follows the logic of Proposition 2. $\square$.

3.3.2 Polarization of climate preferences

Note, that for this mechanism to work, the distribution of voter preferences on the values dimension does not have to change. All we assume is an exogenous change in the income distribution while the concerned voters' value preferences remain unchanged. If cultural preferences change as well and become more polarized, e.g. due to a growing share of college graduates, then the same self-reinforcing feedback loop occurs, only triggered by an initial increase in $\Delta\kappa$, accompanied by a resulting decrease in $\Delta\tau$ instead of vice versa.

Proposition 4. More polarized voter preferences on the climate issue lead to more polarized party positions on climate ($\Delta\kappa \uparrow$) and less polarized positions on the economic issue ($\Delta\tau \downarrow$).

Proof:

A more polarized (e.g. more binomial) distribution of climate preferences in the electorate and within each income group provides an incentive for both parties' Guardians factions to push for more extreme (high or low) climate policy positions, implying $\Delta\kappa \uparrow$. This reduces the slope of the swing voter line $\frac{\Delta\tau}{2\phi\Delta\kappa}$ and, thus, triggers a realignment of voters according to the logic of Proposition 2 resulting in even more extreme party positions on climate and less extreme party positions on the economic issue. $\square$.

At each election, there are numerous value issues other than climate that play into voters' decisions: immigration, gun control, abortion, etc. The voters' views may become more polarized on some of these issues, but not on others. Also, some topics may be particularly salient at a point in time. If that happens and the parties' Guardian factions succeed in pushing for more extreme positions on these issues, then this would also contribute to further convergence of the parties' economic stances, as we show in Proposition 4. This convergence on the economic dimension, in turn, contributes to more polarization on, for instance, the climate issue along the lines of Proposition 2, even though the voters' climate preferences remain unchanged. In this way, polarization on one value issue may spill over to the others.

3.4 Voter Turnout

Usually, in liberal democracies, not all citizens with the right to vote do turn out on election day. The share of non-voters is higher among low income groups in the population (and among ethnic minorities). Here, we show that decreasing voter turnout can lead to lower income inequality among the actual voters and, thus, contribute to party convergence on the economic policy dimension. Economic policy convergence, in turn, decreases the slope of the swing voter curve and triggers a realignment of voters in a similar fashion as discussed above and expressed in Propositions 1 and 2.

Proposition 5. Decreasing voter turnout, especially among low-income groups contributes to a realignment of voters that increases party polarization on the climate issue.

Proof. To be added...

4 Numerical illustrations

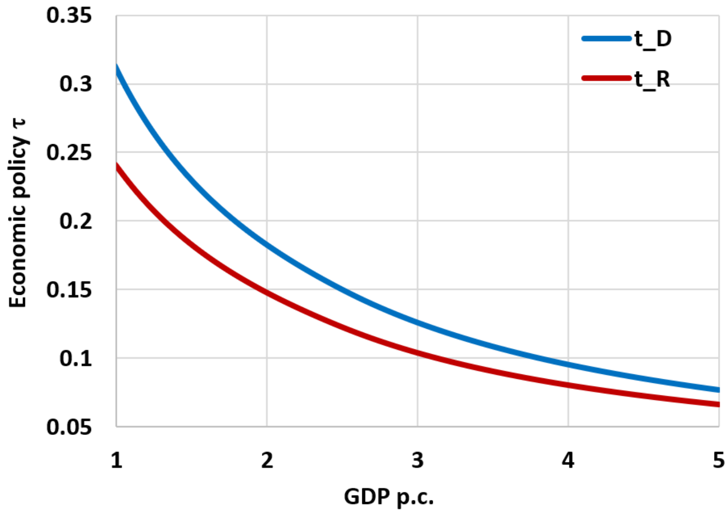


Figure 5: Effect of economic growth ($\mu \uparrow$) on economic policy polarization

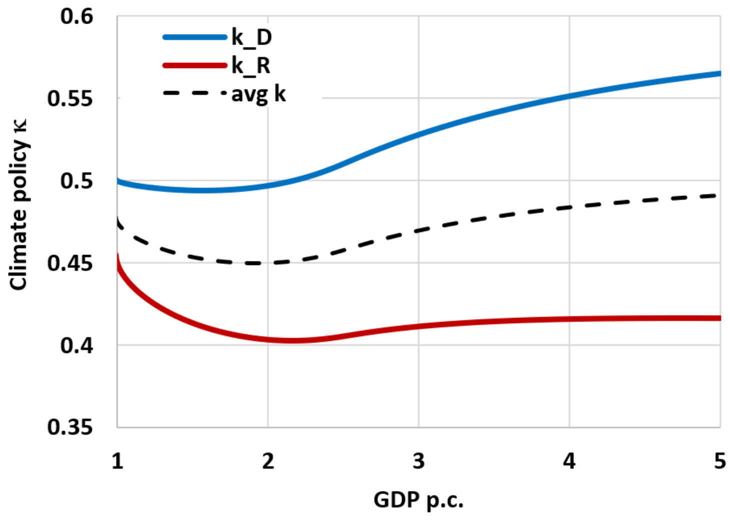


Figure 6: Effect of economic growth ($\mu \uparrow$) on climate policy polarization

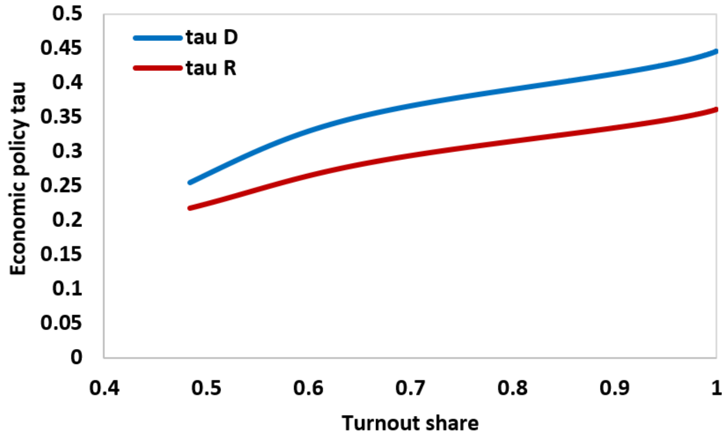


Figure 7: Effect of voter turnout on economic policy polarization

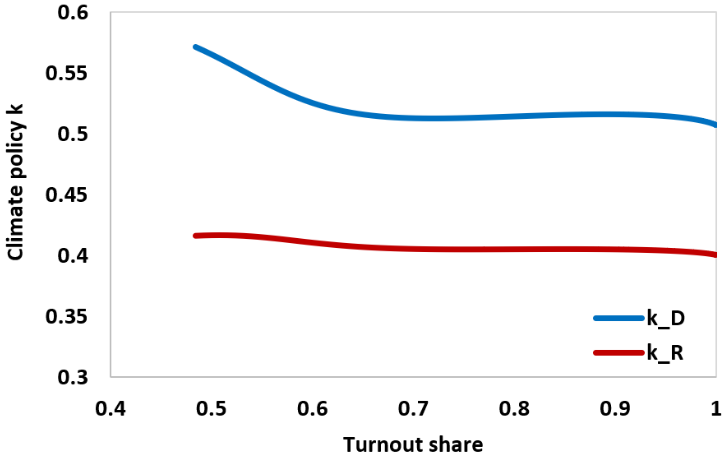


Figure 8: Effect of voter turnout on climate policy polarization

Calibrated numerical illustration to be extended ...

5 Conclusion

To be added ...

Appendix

A Model Details

A.1 Nash bargaining interpretation of PUNE

If Opportunists and Guardians do not agree on a policy platform in party D, then party R wins the election with certainty and the Opportunists' payoff is zero, while the Guardians' payoff is the average welfare in the case of enactment of party R's policy vector t_R. The same logic holds for party R. If there is a weighted Nash bargaining solution, then it must be PUNE. On the other hand, when there is a PUNE, then it is exactly the solution to a corresponding weighted Nash bargaining game if $ln(\pi(\cdot, t_R))$ and $ln(W^D(\cdot) - W^D(t_R))$ are concave functions on T and if $ln(1 - \pi(t_D, \cdot))$ and $ln(W^R(\cdot) - W^R(t_D))$ are concave functions on T (cf. "Assumption A" in Roemer (2006, p. 157)).

A.2 Differential Characterization of PUNEs

There is a convenient differential characterization of PUNEs as formulated by (**??**) and (**??**) the simplicity of which is very useful for the numerical calculation of PUNEs (cf. Roemer (2006, Section 8.4)). For a policy pair (t_D, t_R) to be a PUNE, the following equation[3] must hold for party D[4]

$$\nabla_{t_D} W^D(t_D) = -\lambda^D(t_D, t_R)\nabla_{t_D}\pi(t_D, t_R) \tag{21}$$

[3] Note that the Del or nabla operator ∇_{t_D} indicates a derivative with respect to a vector, in this case t_D, so that $\nabla_{t_D} = \left(\frac{\partial}{\partial \tau_D}, \frac{\partial}{\partial \kappa_D}\right)$ and $\nabla_{t_R} = \left(\frac{\partial}{\partial \tau_R}, \frac{\partial}{\partial \kappa_R}\right)$.

[4] For taking the derivative of party D's winning probability $\pi(t_D, t_R)$ with respect to the vectors t_D and t_R derivatives of $\hat{a}(t_D, t_R; h_i)$ are needed. Since $\hat{a}(t_D, t_R; h_i)$ is a quite complicated function (cf. **??**), its derivatives are taken numerically in the simulation which is the basis for the analysis section **??**.

with $\lambda^D(t_D, t_R) := \frac{\alpha}{1-\alpha} \frac{\Delta W^D(t_D)}{\pi(t_D, t_R)}$; and for party R

$$\nabla_{t_R} W^R(t_R) = \lambda^R(t_D, t_R) \nabla_{t_R} \pi(t_D, t_R) \tag{22}$$

with $\lambda^R(t_D, t_R) := \frac{\beta}{1-\beta} \frac{\Delta W^R(t_R)}{\pi(t_D, t_R)}$. Equations (21) and (22) provide a set of $2T = 4$ equations for $2T + 2 = 6$ unknowns $(\tau_D, \tau_R, \kappa_D, \kappa_R, \alpha, \beta)$. The system of equations is numerically solvable for given Nash bargaining weights (α, β).

This differential formulation of PUNE is along the lines of Roemer (2006). In the case of party D, the weighted Nash bargaining game is defined by a maximization of the Nash product, as stated in (**??**) in Section 2.4

$$\max_{t \in T} (\pi(t, t_R) - 0)^\alpha (W^D(t) - W^D(t_R))^{1-\alpha}$$

Applying logs yields

$$\max_{t \in T} \alpha \, ln(\pi(t, t_R)) + (1 - \alpha) \, ln(\Delta W^D(t))$$

with $\Delta W^D(t) = W^D(t) - W^D(t_R)$. For maximization, the gradient w.r.t. the policy vector t is taken and set to zero

$$\frac{\alpha}{\pi(t, t_R)} \nabla_t \pi(t, t_R) + \frac{(1 - \alpha)}{\Delta W^D(t)} \nabla_t W^D(t) = 0$$
$$\nabla_t W^D(t) = -\frac{\alpha}{1 - \alpha} \frac{\Delta W^D(t)}{\pi(t, t_R)} \nabla_t \pi(t, t_R)$$

Defining $\lambda^D(t, t_R) = \frac{\alpha}{1-\alpha} \frac{\Delta W^D(t)}{\pi(t, t_R)}$ yields the equation

$$\nabla_t W^D(t) = -\lambda^D(t, t_R) \nabla_t \pi(t, t_R)$$

In the same way, the corresponding maximization problem for party R from (**??**) is

$$\max_{t \in T}((1 - \pi(t_D, t)) - 0)^{\beta}(W^R(t) - W^R(t_D))^{1-\beta}$$

can be transformed to

$$\nabla_t W^R(t) = \lambda^R(t_D, t)\nabla_t \pi(t_D, t)$$

with $\lambda^R(t_D, t) = \frac{\beta}{1-\beta}\frac{\Delta W^R(t)}{(1-\pi(t_D,t))}$

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