The political economy of climate policy

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Abstract

This paper analyzes the political economy of climate policy in a simple framework with asymmetric information between voters and politicians. Two parties are engaged in electoral competition and announce policy platforms. An environmental catastrophe (e.g., a tipping point in the climate system) is approaching with some probability that depends on the state of nature. Climate policy can reduce this probability. Each party receives a private signal about the true state of nature, whereas voters possess little information and only know the prior probability distribution. We analyze under what conditions parties can reveal their private signals truthfully to the voters under electoral competition, and when the implemented policy is optimal, given the available information.

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1 Introduction

To tackle the issue of global warming, efforts of all countries are needed. To achieve this goal, countries try to negotiate a comprehensive climate treaty since two decades (with little success so far). However, even when countries negotiate about climate policy internationally, they have to implement the policies that are needed to reduce their emissions domestically. To this end, parties need to design their policies in a way that makes them acceptable to a majority of voters in their country. While countries’ incentive to free-ride on the efforts of other countries may be an obstacle to international cooperation, effective climate policy may be jeopardized also by inefficiencies that arise in the communication and decision processes within countries. It is hard to imagine a country that plays an active role in stabilizing the earth’s climate system when voters in this country do not agree that active climate policy is useful.

Given the large consensus among climate scientists about anthropogenic climate change, the widespread disagreement about the issue in public debates seems like a puzzle. E.g., Sen. Bernie Sanders, a 2016 Democratic presidential candidate, said recently on HBO: “One of the embarrassments that goes on in this country today is that we have a major political party called the Republican Party that is rejecting what the overwhelming majority of scientists are saying... That is, of course, climate change is real and caused by human activity... That’s an issue we’re going to talk about a whole lot.”\(^1\)

The goal of this paper is to shed light on the emergence of climate policy in a country where voters are a priori poorly informed about the issue of climate change. While parties can hire experts to evaluate the necessity for investments in climate stability, an individual voter does not have the necessary resources (in particular time) or incentives to become informed about every single policy dimension. However, the voter may infer the experts’ signals that parties have received by observing their announced policy platforms. We analyze a setting in which two parties (or candidates) compete for office in an election. We assume that parties are committed to their announced policy platforms, so that the winner implements its announced platform after the election.

Heidhues and Lagerlöf (2003) show that in such a setting, parties may be unable to convey their private knowledge to the voters via their announced platforms because each party has an incentive to pander to the voters’ preferred policy, given their prior belief about the true state of nature. In a setting with a binary policy space (‘to build a bridge or not’), they show that there exists no symmetric equilibrium in which each party follows its private signal by announcing the active policy if and only if this is in the voters’ interest (according to the private signal that the party has received).

In the context of climate policy, parties often disagree about the issue of climate

change. This indicates that pandering alone may be insufficient to explain the observed policy divergence between parties. Our model, therefore, extends the framework developed by Heidhues and Lagerlöf (2003), to make it more suitable for an analysis of the issue of climate change. In particular, in contrast to some other policy decisions, a country’s investment in climate protection is clearly not a binary choice. We model parties’ policy platforms as continuous decision variables. It turns out that this extension drastically changes the nature of electoral competition in the game. In particular, whereas in the binary setting of Heidhues and Lagerlöf there is always a strict preference for either the active or the inactive policy (except in the knife-edge case where voters’ belief is such that both policies are equally good in expectation), in our model there is a continuum of policies that are equally good from the voters’ perspective, for any given belief. These policies are located symmetrically around the “neutral” policy – voters’ most preferred policy given their prior belief. When parties’ equilibrium strategies contain policies that are located symmetrically around the neutral policy, the “natural” bias (towards an active or inactive policy) that drives the results in Heidhues and Lagerlöf’s model vanishes.

Furthermore, while authors often assume that parties have either pure office-holding motives (e.g., Heidhues and Lagerlöf 2003, Kartik et al. 2015, ...) or are primarily policy-motivated (e.g., Schultz 1996), our model allows for both types of motivation. While the winning party obtains a fixed utility premium, each party also prefers an efficient over an inefficient policy to be implemented, irrespective of whether the party wins the election or not. Via a parameter, the relative strength of these motives can be adjusted in our model. Callendar (2008) demonstrated with the help of a model that office-motivated candidates are favored in electoral competition, but policy-motivated candidates nevertheless win a significant fraction of elections. This indicates that a model which focuses only on one type of motivation may be too restrictive. Indeed, we find that some of our results hold only if both types of motivation are present.

Our results indicate that there exist equilibria in which parties are able to convey their private information truthfully to the voters. Introducing an equilibrium refinement similar to the Intuitive Criterion (Cho and Kreps, 1987), we can narrow the set of equilibria in our model. Symmetric equilibria in which parties convey their private information exhibit anti-pandering (see Kartik et al., 2015). In this case, policies are too extreme. While the social optimum under symmetric strategies, given the information structure of the game, should implement policies that are closer to the neutral policy in order to account for the possibility that parties receive conflicting signals, in equilibrium parties announce policies that are optimal only when both parties receive identical signals. While symmetric equilibria are always insufficient to implement the first-best outcome, we demonstrate that under some conditions there exist asymmetric equilibria that successfully aggregate all available information, and where policies close to first-best are implemented.
Related Literature:
Leslier and Van der Straten (2004) analyze a model related to Heidhues and Lagerlöf (2003), but assume that also voters (as well as each of the parties) receive a private signal. The authors show that in equilibrium, parties truthfully reveal their signals, if voters possess sufficiently precise information. Felgenhauer (2012) extends the model of Heidhues and Lagerlöf (2003) by assuming that there exists a third, uninformed party that voters can elect. This party always chooses the policy platform that conforms to voters’ preferences given their prior belief. Hence, this party behaves populistically. Although this party does not receive any signal about the true state of the world that goes beyond the voters’ prior, the authors show that in the presence of this uninformed party, there exist equilibria that efficiently reflect the private information of the informed parties.

Kartik et al. (2015) present a model with a continuous policy space that is related to Heidhues and Lagerlöf (2003). Unlike in our model, these authors assume that the true state of the world is also drawn from a distribution with a continuous support, and that signals are continuous. Furthermore, as in Heidhues and Lagerlöf (2003), also Kartik et al. (2015) assume that candidates are purely office-motivated. They show that parties are able to convey their information truthfully to the voters. However, the equilibrium exhibits anti-pandering, that is, policies are too polarized, as compared with the social optimum. As a result, the welfare of the voters cannot be higher (in expectation) than in a situation in which only one candidate (or one candidate’s information) is available. The idea behind the assumption of a binary signal space in our model is that communication between experts and parties is limited (e.g., due to experts’ incentives to under- or to overstate climate risks or because parties cannot process too detailed information), so that experts are not able to send more sophisticated signals in a credible way to parties. Under such a coarse communication structure, the only information that an expert can convey to a party is whether an approaching climate catastrophe is “likely” or not. Similar to Kartik et al. (2015), we identify a symmetric equilibrium with anti-pandering. In this equilibrium each party sets its policy platform as a social planner would, if the planner received two signals, and both of them are equal to the private signal of the party. In contrast to Kartik et al. (2015), we allow parties to be motivated also by the implemented policy, and analyze also asymmetric equilibria. We demonstrate that under certain circumstances, there exist equilibria that aggregate the available information efficiently.

A model in which parties are primarily policy-motivated is introduced by Schultz (1996). In contrast to our approach (as well as Heidhues and Lagerlöf (2003), Loertscher (2012), Kartik et al. (2015)), Schultz (1996) does not assume that parties are uncertain about the true state of the world (only voters are). The author allows for the case where parties’ preferences are polarized (distorted away from the median voter’s preferences) and shows that in this case, only non-revealing equilibria fulfill a criterion similar to the
Intuitive Criterion. Also in our model, a similar refinement criterion is used to narrow the set of equilibria. We focus on the case where parties’ preferences over policies are aligned with voters’ preferences. However, the winning party also obtains a fixed utility premium for getting into office. Martinelli (2001) analyzes a model in which parties with polarized preferences care about the implemented policy. Voters and parties receive noisy signals about the true state of the world. In contrast to our model (as well as Heidhues and Lagerlöf (2003) and other authors), the authors assume that both parties receive the same signal. Parties are committed to implementing their policy proposals. In contrast to Schultz (1996) the author finds that voters can infer the parties’ signal even if parties’ preferences are very polarized.

Similar as in our model, Alesina and Cukierman (1990) allow parties to be motivated both by the implemented policies as well as by getting into office. In this model, voters are uncertain about the preferences of parties, rather than about the implemented policy that would be best for them (i.e., the true state of the world). The authors show that a party that holds office in a first period prefers to remain ambiguous, i.e., its preferences are not fully revealed to the voters. Banks (1990) assumes that candidates (with polarized preferences about the implemented policy) announce policy positions (as in our model), but the winner can implement a policy that deviates from the announced position (although this is costly). The author shows that in contrast to a standard Downsian model, not all types of candidate adopt the median announcement. Feddersen and Pesendorfer (1997) assume that voters are uncertain about the true state of the world and each voter obtains a private signal. However, the alternatives from which voters can choose are exogenously fixed and not determined via electoral competition. Gratton (2013) demonstrates in a similar framework that when policies are determined endogenously via electoral competition, voters can coordinate their votes and induce candidates to adopt the optimal policy in each state, even when voters possess arbitrarily imprecise information.

An application of a political economy approach to climate change is presented by Shapiro (2014). In this model, a journalist reports on expert opinion to a voter who can choose a policy. Two competing parties can make investments that influence the journalist’s opinion. The author argues that the model may help to explain persistent public ignorance on climate change. Our model cannot capture the influence of media on voters’ opinion on climate change. Instead, we focus on the relevance of electoral competition in the context of climate policy. Strömberg (2004) analyzes how media firms provide information to different groups of voters. The author finds that the media provide more news to large groups. This affects the nature of electoral competition in the model, where the winning party implements a number of programs, each of which benefits a different group of voters.

\footnote{A refinement criterion similar to our’s as well as the one by Schultz (1996) is introduced also in Loertscher (2012).}
2 Model

We consider the political economy of climate policy in the context of a (potential) environmental catastrophe, that may e.g. reflect the presence of a threshold or ‘tipping point’ in the climate system. If the catastrophe occurs, a damage of $D > 0$ is incurred by society. Otherwise, the environmental damages caused by the emission of greenhouse gases are (for simplicity) assumed to be zero.

Suppose there are two states of the world: $G$ (‘good’) and $B$ (‘bad’). The true state of the world is denoted by $W$, so $W \in \{G, B\}$. In the good state there is no approaching catastrophe, so early action to prevent the catastrophe is not warranted. In the bad state, there is an approaching catastrophe; in that case, the probability that the catastrophe occurs can be reduced by exerting some costly effort $x$ to lower the emissions.

We will consider two variants of the model. In the basic version of the model, which serves us as a benchmark case, the effort $x$ can take on only one of two values: $x \in X_{bm} = \{0, 1\}$, where $x = 0$ means that no costly effort is exerted against climate change, while $x = 1$ means that an effort is implemented. In the full version of the model, we assume that society can implement any effort $x$ in the interval $X_{full} = [0, 1]$. Given that $W = B$, the probability that the catastrophe occurs is then $1 - x$, while it is zero when $W = G$.

Hence, in the benchmark case with binary action space, a catastrophe never occurs when an early effort is exerted, while it occurs with probability 1 when no effort is exerted and the state of the world is ‘bad’ ($W = B$).

The implemented effort $x$ is determined by the government. We implicitly assume there is only one country, hence, we abstract from environmental externalities and free-rider effects in this model. What we are interested in is how effective a representative democracy is in providing the public good of climate stability, given the uncertainties surrounding the problem (see below). We assume that there are two parties, indexed $i \in \{1, 2\}$, that announce policy platforms $x_i \in X$. Then, an election takes place, and the winning party implements its announced platform. Hence, parties are committed to their announcement (e.g., Heidhues and Lagerlöf, 2003).

Before parties announce their platforms $x_i$, each of them receives a private signal $s_i$ about the true state of the world, $W$. We assume that these signals are binary: $s_i \in \{g, b\}$, where $s_i = g$ indicates a lower probability that a catastrophe is approaching than a signal $s_i = b$. The two parties’ signals $s_1$ and $s_2$ are drawn independently from the same distribution (which, of course, depends on the true state of the world, $W$).

The assumption that signals are binary, while (in the full model) the action space is continuous, deserves some attention. The idea behind this is, that each party hires some expert, but communication between a party and its expert has a coarse structure. The expert can either announce that the situation ‘looks rather good’ (low probability that $W = B$, so that no early action is warranted), or that the situation ‘seems pretty bad’,
which indicates that a higher effort to reduce the probability of the catastrophe occurring may be desirable. We do not allow for a more complex signal of an expert’s belief that \( W = B \). For instance, it could be the case that experts themselves have some incentive to under- or to overstate their own belief that \( W = B \), or that communication is so noisy that no other useful information can be extracted (other than that an approaching catastrophe seems rather or less likely). On the other hand, the assumption that parties can (in the full model) implement an effort level chosen from a continuous action space, seems very natural in the context of climate policy. Indeed, the abatement of emissions is a continuous choice, and a great deal of the policy debate centers around the question to what degree countries should invest in the public good of climate stabilization (which translates into emission targets that clearly do not have a binary structure).³

More specifically, we assume that each party receives a correct signal, conditional on the true state, with probability \( p \in (1/2, 1) \), hence, \( \Pr[s_i = g | W = G] = \Pr[s_i = b | W = B] = p \). We focus on pure strategies.⁴ Hence, a party’s strategy is a mapping from \( s_i \) into \( X \). By contrast, we assume that voters are a priori ignorant about the probability of an approaching climate catastrophe. Hence, we assume that their prior belief (probability) that \( W = G \) is 1/2, that is also the probability with which nature selects \( W = G \) for the true state at the beginning of the game. However, after observing the policy platforms which are simultaneously announced by the two parties, voters update their belief according to Bayes’ rule. We denote the voters’ belief that \( W = G \) after observing \((x_1, x_2)\) by \( \mu \). We assume that all voters have identical preferences.⁵

The cost of implementing an effort of \( x \) to prevent climate damages is given by \( x^2 / 2 \). Voters’ preferences are characterized by the following (expected) utility function:

\[
u(\mu, x) = -\frac{x^2}{2} - (1 - \mu)(1 - x)D.\tag{1}\]

Voters elect the party that offers the policy which yields the higher expected utility to them, given the platforms \((x_1, x_2)\) and voters’ resulting belief \( \mu = \mu(x_1, x_2) \). When both policies lead to the same expected utility, each party is elected with a probability of 1/2.

We assume that parties’ preferences are aligned with those of the voters, except that they may (in addition) have an office-holding motive, which amounts to a fixed utility premium \( f \geq 0 \) for a party that wins the election. Hence, we assume that a party’s expected utility when it is elected with probability 1 is given by \( u(\gamma, x) + f \), where \( x \) is

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³Other papers focus on binary decisions; see, e.g., Heidhues and Lagerlöf (2003). Whether this assumption is appropriate depends on the context. Heidhues and Lagerlöf refer to the ‘classical’ problem of whether or not to build a bridge; in that example, a binary choice seems indeed much more appropriate than in the climate policy context, because the size of the project (and, hence, the costs of the investment) may be physically constrained.

⁴Heidhues and Lagerlöf (2003) analyze also mixed strategies.

⁵Hence, voters can be replaced by a ‘representative voter’. Alternatively, one could assume that both parties have preferences over policies which are identical to that of the median voter.
the implemented policy, and $\gamma = \gamma(s_i)$ is the party’s belief that $W = G$ after observing its private signal: $\gamma(s_i) = Pr[W = G|s_i]$. Given our earlier assumptions about signals, we have:

$$Pr[W = G|s_i = g] = Pr[W = B|s_i = b] = p.$$ 

For later reference, let us also evaluate the following probabilities:

$$Pr[W = G|s_1 = s_2 = g] = Pr[W = B|s_1 = s_2 = b] = \frac{p^2}{p^2 + (1 - p)^2}. \quad (2)$$

Note, that when both parties adopt ‘truthful revealing’ and symmetric strategies, which means that each party $i$ sets platform $x_i = x_g$ if $s_i = g$ and $x_i = x_b \neq x_g$ if $s_i = b$, then in equilibrium it holds that

$$\mu(x_1 = x_2 = x_g) = Pr[W = G|s_1 = s_2 = g] = \frac{p^2}{p^2 + (1 - p)^2},$$

$$\mu(x_1 = x_2 = x_b) = Pr[W = G|s_1 = s_2 = b] = \frac{(1 - p)^2}{p^2 + (1 - p)^2}.$$ 

Since signals are imperfect, the true state is never fully revealed. In any equilibrium and for any realization of parties’ signals, it thus holds that

$$\mu \in \left[ \frac{(1 - p)^2}{p^2 + (1 - p)^2}, \frac{p^2}{p^2 + (1 - p)^2} \right].$$

When contrasting signals are received by the two parties, and again truthful revealing strategies are adopted, then in equilibrium $\mu$ takes on the value

$$\mu(x_g, x_b) = \mu(x_b, x_g) = Pr[W = G|s_1 = g, s_2 = b \text{ or } s_1 = b, s_2 = g] = 1/2, \quad (3)$$

which is equal to the voters’ prior belief since voters do not learn anything about the true state of the world from observing contrasting platforms in a symmetric revealing equilibrium.

Finally, consider party 1’s expectation about the likely realization of party 2’s signal, after observing its own private signal $s_1$. It is captured by the following probabilities:

$$Pr[s_2 = g|s_1 = g] = Pr[s_2 = b|s_1 = b] = p^2 + (1 - p)^2. \quad (4)$$
2.1 Voting behavior

Let us now characterize the voting behavior. Conditional on their belief $\mu = \mu(x_1, x_2)$, voters’ most preferred policy (in $X_{full}$) is:

$$\hat{x} = (1 - \mu)D.$$  \hfill (5)

This follows simply from maximizing (1) over $x$. Let us restrict the size of the damages $D$ so that $\hat{x} \leq 1$ is always satisfied. This requires in particular that $\hat{x} < 1$ holds for the most pessimistic beliefs that can occur, i.e., $\mu = \frac{(1-p)^2}{p^2 + (1-p)^2}$. This leads to the parameter restriction

$$D \leq \frac{p^2 + (1-p)^2}{p^2}.$$  

Let us again consider the case of truthful revealing symmetric strategies. If parties announce different platforms, then considering the case where $x_1 < x_2$, we find that voters prefer policy $x_1$ if

$$u(\mu, x_1) > u(\mu, x_2),$$

which is equivalent to (using (1) and (5))

$$\hat{x} - x_1 < x_2 - \hat{x}.$$  

Hence, party 1 is elected with probability 1 if and only if its announced policy is closer to the most preferred policy, $\hat{x}$.

In the binary case, and again assuming truthful revealing symmetric strategies (so $x_i = x_g = 0$ if $s_i = g$ and $x_i = x_b = 1$ if $s_i = b$), we thus find that no action is taken when both parties receive the ‘good’ signal ($s_1 = s_2 = g$). This action is optimal from the voters’ perspective if $Pr[W = B|s_1 = s_2 = g]D < 1/2$, because the remaining probability that the catastrophe occurs (even though both signals are ‘good’) is, then, too small to justify the investment cost in climate stability, which is equal to 1/2 when $x = 1$. Using (2), this yields the condition:

$$\frac{(1-p)^2}{p^2 + (1-p)^2}D < \frac{1}{2},$$

and in the binary case we will always assume that this condition holds. If $s_1 = s_2 = b$ then action is taken, and this is optimal from a welfare perspective if $Pr[W = B|s_1 = s_2 = b]D > 1/2$, hence if

$$\frac{p^2}{p^2 + (1-p)^2}D > \frac{1}{2},$$

and in the binary case we will also assume that this condition always holds. Finally, if $s_1 = g$ and $s_2 = b$, or $s_1 = b$ and $s_2 = g$ then the pro-active party is elected if $D/2 > 1/2$. 


(since $P_r[W = B | s_1 \neq s_2] = 1/2$), hence, if

$$D > 1.$$  

The knife-edge case where $D = 1$ holds exactly, will be neglected.

More generally, we express the voting behavior by a function $\sigma(x_1, x_2)$, which is the probability for electing party 1 when parties announce platforms $(x_1, x_2)$. Of course, in any pure-strategy equilibrium, $\sigma$ can only take on the values 0, 1/2, and 1. $\sigma(x_1, x_2)$ crucially depends on the function $\mu(x_1, x_2)$, so results will, among other things, depend on assumptions about out-of-equilibrium beliefs (see below).

### 2.2 Social optimum

Before we proceed with the analysis of parties’ platform choices, let us briefly characterize the social optimum, given the informational constraints. This social optimum would be obtained if both parties’ signals were made public, and voters could directly choose their most preferred policy in $X_{full} = [0, 1]$, given their updated belief about the probability that $W = G$.

When $s_1 = s_2 = g$, then $\mu = \frac{p^2}{p^2 + (1 - p)^2}$ (see (2)), so that (by (5)) the optimal policy is

$$x^*_{gg} = \frac{(1 - p)^2}{p^2 + (1 - p)^2} D.$$  

(6)

Similarly, when $s_1 = s_2 = b$ then the most preferred policy is

$$x^*_{bb} = \frac{p^2}{p^2 + (1 - p)^2} D.$$  

(7)

And finally, when signals differ then the optimal policy is

$$x^*_{gb} = D/2.$$  

(8)

This is also the optimal policy from the voters’ perspective if no signal is revealed to them, so that their belief coincides with the prior ($\mu = 1/2$).

For later reference, it is also useful to characterize the optimal policy when only one of the two signals is revealed (say, signal $s_1$). Then we obtain

$$x^*_{g} = (1 - p)D$$  

(9)

for the case where $s_1 = g$, while in the case where $s_1 = b$ the optimal policy is

$$x^*_{b} = pD.$$  

(10)
Figure 1: Socially optimal platform choices with one public signal \((x^*_g, x^*_b)\), and with two public signals \((x^*_{gg}, x^*_{bb}, x^*_{gb})\); for \(D < 1\).

Figure 1 illustrates the above platform choices.

### 2.3 Parties’ optimization behavior

In a PBE (Perfect Bayesian Nash Equilibrium), party \(i\) chooses its policy platform \(x_i\) so as to maximize its expected utility, given the strategy of the other party: \(x_{-i}(s_{-i})\). Assuming that party 2 adopts strategy \(x_2(s_2)\), and that voters respond to platform choices \((x_1, x_2)\) with beliefs \(\mu(x_1, x_2)\) that lead to an optimal voting probability for party 1 of \(\sigma(x_1, x_2)\), the expected utility of party 1, \(U_1(x_1, s_1, x_2(\cdot), \sigma(\cdot, \cdot))\), given that it received signal \(s_1\) and chooses policy platform \(x_1\), is given by

\[
E_{s_2|s_1}[\sigma(x_1, x_2(s_2)) (u(\gamma(s_1, s_2), x_1) + f) + (1 - \sigma(x_1, x_2(s_2))) u(\gamma(s_1, s_2), x_2(s_2))], \tag{11}
\]

where \(\gamma(s_1, s_2) = \Pr[W = G|s_1, s_2]\) is the probability that \(W = G\) when both signals are known.

Consider again the case of truthful revealing symmetric strategies. Assuming that party 2 sticks with the equilibrium strategy (that is, party 2 chooses \(x_2 = x_g\) if \(s_2 = g\) and \(x_2 = x_b\) otherwise), the above expectation becomes for an arbitrary choice of \(x_1\):

\[
\begin{align*}
&\Pr[s_2 = g|s_1] [\sigma(x_1, x_g) (u(\gamma(s_1, g), x_1) + f) + (1 - \sigma(x_1, x_g)) u(\gamma(s_1, g), x_g)] \\
&+ \Pr[s_2 = b|s_1] [\sigma(x_1, x_b) (u(\gamma(s_1, b), x_1) + f) + (1 - \sigma(x_1, x_b)) u(\gamma(s_1, b), x_b)]. \tag{12}
\end{align*}
\]

Note, that given our earlier assumptions it holds that

\[\sigma(x_g, x_g) = \sigma(x_b, x_b) = 1/2,\]

as parties then offer identical platforms. Furthermore, in the special case where the equilibrium platform choices \(x_g\) and \(x_b\) are located symmetrically around the voters’ preferred policy \((D/2)\) when no signal is revealed or when parties offer conflicting platforms \((x_g \in \mathbb{X}_{full} < D/2\) and \(x_b = D - x_g\)), we have

\[\sigma(x_g, x_b) = \sigma(x_b, x_g) = 1/2,\]
since voters do not learn anything from observing contrasting platforms in a symmetric truthful revealing equilibrium. The special case where equilibrium platform choices \( x_g \) and \( x_b \) are located symmetrically around \( D/2 \) will play an important role later on.

For a truthful symmetric revealing equilibrium to exist, party 1 must weakly prefer to choose \( x_1 = x_g \) when it observes \( s_1 = g \) over choosing \( x_1 = x_b \), and it must weakly prefer to choose \( x_1 = x_b \) when it observes \( s_1 = b \) over choosing \( x_1 = x_g \). Furthermore, for each possible realization of its signal, it must also prefer not to deviate to any out-of-equilibrium values \( (x_1 \notin \{x_g, x_b\}) \). Whether such a deviation is profitable will depend, of course, on assumptions about voters’ out-of-equilibrium beliefs.

### 2.4 Equilibrium concept and ‘plausible’ beliefs

Given our earlier assumptions, we can summarize our model as follows. There are three players (party 1, party 2, and the voters acting as one player) plus nature. In the first move, nature picks the state of the world, \( W \in \{G, B\} \) (each with a probability of \( 1/2 \)), and signals \( s_i \in \{g, b\} \) for party \( i \in \{1, 2\} \) with \( Pr[s_i = g|W = G] = Pr[s_i = b|W = B] = p \). In the second move, party 1 chooses action (platform) \( x_1 \in X \), after observing only \( s_1 \) (and not \( s_2 \) or \( W \)). In the third move, party 2 chooses action \( x_2 \in X \), after observing only \( s_2 \) (and not \( s_1, x_1, \) or \( W \)). Finally, voters choose action \( \sigma \in [0, 1] \) (the probability with which they elect party 1), after observing only \( x_1 \) and \( x_2 \) (and not \( s_1, s_2, \) or \( W \)). Assuming that the other party adopts strategy \( x_{-i}(s_{-i}) \), and that voters elect party 1 with a probability of \( \sigma(x_1, x_2) \), party \( i \)'s expected utility \( (i = 1, 2) \) is \( U_i(x_i, s_i, x_{-i}(\cdot), \sigma(\cdot, \cdot)) \), as defined in (11) for party 1 (similarly for party 2).

In the context of this model, a Perfect Bayesian Equilibrium (PBE) is a profile of strategies \( (x_1(\cdot), x_2(\cdot), \sigma(\cdot, \cdot)) \), combined with a belief function \( \mu(\cdot, \cdot) \) for the voters that assigns a probability \( \mu(x_1, x_2) \) to \( W = G \) conditional on observing actions \( x_1, x_2 \in X \), such that

(i) party \( i \)'s strategy is optimal given the strategy of party \( -i \) and voters’ strategy \( \sigma(\cdot, \cdot) \), for \( i = 1, 2 \),

(ii) the belief function \( \mu(x_1, x_2) \) is derived from party 1’s and party 2’s strategies using Bayes’ rule where possible, and

(iii) the strategy of voters is optimal for each \( (x_i, x_{-i}(s_{-i})) \in X^2, i = 1, 2 \), if \( Pr[W = G|s_i, s_{-i}] = \mu(x_i, x_{-i}(s_{-i})) \) for all \( (s_i, s_{-i}) \in \{g, b\}^2 \).

Note, that (iii) only requires voters’ strategy to be optimal given some arbitrary action \( x_1 \in X \) of party 1 when \( x_2 \) is in the set of equilibrium responses (i.e., \( x_2 = x_2(s_2) \) for \( s_2 \in \{g, b\} \)), and similarly for party 2. The reason is that we will only consider deviations by a single party (possibly to some out-of-equilibrium platform choices), but
not simultaneous deviations by both parties. Hence, we do not need to specify voters’ beliefs for the case where both parties simultaneously deviate to some out-of-equilibrium platform choices.

Let us now define what we will refer to as “plausible beliefs” in the context of our model. To this end, we will first introduce the concept of “equilibrium domination” for our model. To this end, we will first introduce the concept of “equilibrium domination” for

$$U^*(s_1) > \max_{\sigma \in R^*(x_1)} U_1(x_1, s_1, x_2^*(\cdot), \sigma)$$

where $$R^*(x_1) \in [0, 1]$$ is the set of possible equilibrium responses $$\sigma$$ of the voters that can arise after actions $$x_1$$ and $$x_2 = x_2^*(\cdot)$$ are observed, for some beliefs $$\mu(x_1, x_2)$$. Let $$X_1^- = \{x_1 \in X \text{ but } x_1 \not\in \{x_1^*(g), x_1^*(b)\}\}$$ be the set of out-of-equilibrium choices of $$x_1$$. Now define for each $$x_1 \in X_1^-$$ the set $$S_1^*(x_1) = \{s_1 : \text{condition (13) does not hold}\}$$. Note, that $$S_1^*(x_1) \in \{\{g, b\}, \{g\}, \{b\}, \emptyset\}$$. Intuitively, if $$S_1^*(x_1) = \{g, b\}$$ then party 1 would deviate to action $$x_1$$ for each possible realization of its signal for some beliefs $$\mu(x_1, x_2)$$. If $$S_1^*(x_1) = \{g\}$$ then party 1 would never deviate to action $$x_1$$ when $$s_1 = b$$, for any beliefs $$\mu(x_1, x_2)$$. If $$S_1^*(x_1) = \emptyset$$ then party 1 would never deviate to $$x_1$$, no matter what voters believe and what signal party 1 obtained. Note that in all these cases, we are assuming that voters always respond optimally to their beliefs when choosing $$\sigma$$.

**Definition 1.** A PBE has “plausible beliefs” if for all actions $$x_1 \in X_1^-$$ and all $$s_2 \in \{g, b\}$$, it holds that

(i) if $$S_1^*(x_1) = \{g\}$$ then $$\mu(x_1, x_2^*(s_2)) = Pr[W = G|s_1 = g, s_2 \in x_2^*-1(s_2)],$$

(ii) if $$S_1^*(x_1) = \{b\}$$ then $$\mu(x_1, x_2^*(s_2)) = Pr[W = G|s_1 = b, s_2 \in x_2^*-1(s_2)],$$ and

(iii) if $$S_1^*(x_1) \in \{\{g, b\}, \emptyset\}$$ then $$\mu(x_1, x_2^*(s_2)) = Pr[W = G|s_2 \in x_2^*-1(s_2)],$$

where $$x_2^*-1(s_2)$$ is the inverse of the function $$x_2^*(\cdot)$$ that describes party 2’s equilibrium strategy if the function can be inverted (i.e., if party 2 adopts a revealing strategy), while $$x_2^*-1(s_2) = \emptyset$$ otherwise, in which case voters neglect party 2’s platform choice in their formation of beliefs.

Intuitively, we assume that when party 1 would only deviate to $$x_1$$ after observing $$s_1 = g$$ for some beliefs (favoring this deviation), but never after observing $$s_1 = b$$, then

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6Our introduction of this concept follows Mas-Colell, Whinston, Green (1995) – see pages 467-471, but is more restrictive than their concept of “reasonable beliefs” or out-of-equilibrium beliefs that satisfy the “Intuitive Criterion”.

7We show definitions here only for party 1; for party 2, corresponding definitions apply but are not shown here for the sake of brevity.
voters infer that party 1 must have received signal $s_1 = g$ after observing platform choice $x_1$. Hence, their belief (probability) that the true state of the world is good after observing a deviation by party 1 to $x_1$ and some equilibrium platform choice $x_2^*(s_2)$ of party 2, must coincide with the belief they would form if they could directly observe the realization of party 1’s signal $s_1$, and draw the same inferences about the realization of party 2’s signal as they would if party 1 had chosen some equilibrium platform choice. The same type of reasoning applies when party 1 would only deviate to $x_1$ after observing $s_1 = b$ (see case (ii) in Definition 1).

By contrast, if party 1 would never find a deviation to $x_1$ profitable, irrespective of what voters would infer about its signal after observing this platform choice and some equilibrium platform choice of party 2 (case iii), then voters cannot “learn” anything from observing this out-of-equilibrium platform choice about the realization of party 1’s signal, so they form their beliefs in the same way as they would if they could only observe party 2’s equilibrium platform choice. Furthermore, we assume in case (iii) that the same holds true also in situations where for both possible realizations of $s_1$, party 1 would deviate to $x_1$ for some beliefs $\mu(x_1, x_2)$. Intuitively, upon observing such a platform choice $x_1$, voters cannot be sure whether the party observed $s_1 = g$ and deviated to this action in the hope that voters would form some beliefs that render this deviation profitable for party 1, or whether the party observed $s_1 = b$ and deviated to this action in the hope that voters would form some (identical or other) beliefs that render this deviation profitable for party 1 in this case.

3 Benchmark: binary action space

Let us now analyze the benchmark case with a binary action space in more detail, and analyze possible equilibrium outcomes of this game. This is particularly simple (as long as we focus on pure strategies), because there are no out-of-equilibrium actions whenever a revealing equilibrium exists. We focus in particular on the question whether a truthful symmetric revealing equilibrium exists. ‘Truthful’ implies that $x_i = x_g = 0$ when $s_i = g$ and $x_i = x_b = 1$ when $s_i = b$.\(^8\) We should expect that such an equilibrium does not exist if parties’ office holding motives are sufficiently strong, because this game is similar to the one analyzed by Heidhues and Lagerlöf (2003) where parties are only office-motivated. These authors find a similar result.\(^9\)

\(^8\)A revealing equilibrium that is not truthful would entail $x_i = 1$ when $s_i = g$ and $x_i = 0$ when $s_i = b$ for at least one party. Party $i$ then offers the platform that is suitable for the inverse of its signal. Heidhues and Lagerlöf (2003) show that such equilibria can exist; however, they cease to exist under the symmetry condition.

\(^9\)Another difference between their approach and our model is that these authors assume that payoffs are symmetric with regards to the two states of the world and voters have a biased prior belief about their probability, while in our model the prior is unbiased but payoffs are asymmetric across the states.
Proposition 1. In the benchmark case with a binary action space, no truthful symmetric revealing equilibrium exists when \( D \neq 1 \) and \( f \) is sufficiently large (a sufficient condition is \( f > 2p - 1 \)).

We, thus, find that if \( f \) is sufficiently large, party 1 has an incentive to deviate from the (assumed) equilibrium strategy when \( D < 1 \) and \( s_1 = b \), or when \( D > 1 \) and \( s_1 = g \). Hence, it has an incentive to follow the voters’ preferred policy given their prior belief, by choosing a policy platform that conforms to this prior, rather than to the party’s private signal. When \( D < 1 \), then under the deviation strategy party 1 always sets \( x_1 = x_g = 0 \), irrespective of the realization of \( s_1 \), and when \( D > 1 \) it always sets \( x_1 = x_b = 1 \) under the deviation strategy. We, thus, find that in the benchmark case with a binary action space, electoral competition may fail to reveal parties’ true information about the necessity for investments in climate stability to the voters, and hence, may lead to an implementation of inefficient policies.

The pessimistic result of Proposition 1 suggests that parties may instead adopt non-revealing (pooling) strategies in equilibrium (i.e., \( x_1^*(s_1) = x_2^*(s_2) = x_{pool} \) for all possible realizations of \( s_1 \) and \( s_2 \)). Note, that in the context of symmetric non-revealing strategies, Definition 1 implies that ‘plausible’ out-of-equilibrium beliefs must conform to the voters’ prior (i.e., \( \mu(x_1, x_{pool}) = 1/2 \)) whenever party 1 would have an incentive to deviate to \( x_1 \neq x_{pool} \) for both possible realizations of \( s_1 \) if voters would interpret this deviation as revealing a ‘good’ or a ‘bad’ realization of the signal \( s_1 \). Note that – since party 2 sticks with its non-revealing equilibrium strategy – voters do not learn anything from observing party 2’s platform choice \( x_2^* \).

Proposition 2. When \( D < 1 \) there is a bias in favor the inactive policy, and there is a symmetric pure strategy equilibrium with plausible beliefs that entails \( x_1^* = x_2^* = 0 \) for any realization of \((s_1, s_2)\) if \( f > 1 - 2(1 - p)D \); when \( D > 1 \) the bias is in favor of the active policy and there is a symmetric pure strategy equilibrium with \( x_1^* = x_2^* = 1 \) for any \((s_1, s_2)\) if \( f > 1 - 2(1 - p)D \).

The result of Proposition 2 is intuitive. Suppose \( D < 1 \) so that – given voters’ prior belief – they favor the inactive policy (\( x = 0 \)). If parties are primarily office-motivated (i.e., if \( f \) is sufficiently large) then even if party 1 observes a ‘good’ signal, it has an incentive to deviate to a pro-active policy if voters’ out-of-equilibrium beliefs, \( \mu(1, 0) \), are such that this deviation would be profitable also when a ‘bad’ signal is observed. But then voters cannot learn anything from observing a deviation, so that their belief remains at

\[ x_g = 0 \text{ when } W = G \text{ yields a utility of zero for the voters, while action } x_b = 1 \text{ when } W = B \text{ delivers a payoff of } -1/2, \text{ which is the effort cost when } x = 1. \text{ When } x = 0 \text{ but } W = B, \text{ voters’ utility is } -D, \text{ while it is } -1/2 \text{ when } x = 1 \text{ but } W = G. \text{ Hence, in our model, a bias in favor of one of the two policy options arises due to the asymmetric payoff structure, while it arises due to the biased prior in Heidhues and Lagerlöf (2003).} \]
the prior. But this implies that voters do not elect the deviating party (i.e., \( \sigma(1, 0) = 0 \)), so that the deviation is not profitable for party 1, irrespective of the realization of its signal. In other words, parties have an incentive to choose policy platforms that conform with voters’ preferred policy given their prior. This undermines parties’ incentives to reveal their true signals under electoral competition.

4 Full model: continuous action space

Let us now proceed to the analysis of the full model, where parties’ actions \( x_i \) are not constrained to be in the binary set \( \{0, 1\} \), but can take on any values in the continuous set \( X_{\text{full}} = [0, 1] \). Our goal is to analyze to what extent parties are able to convey their private knowledge about the probability of an approaching catastrophe to the voters, given that they are engaged in an electoral competition. We are in particular interested in the question whether the pessimistic result of Proposition 1 continues to hold in this more general setting. It is well-known that without any restrictions on the formation of out-of-equilibrium beliefs, a potentially large set of equilibria may be sustainable. Our motivation is to see whether truthful revealing equilibria may exist under some ‘plausible’ assumptions about beliefs. We will first look at symmetric revealing equilibria, and later also consider asymmetric equilibria.

4.1 Symmetric truthful revealing equilibria

As in the benchmark model, a symmetric truthful revealing equilibrium consists of two choices, \( x_g \) and \( x_b \), such that party \( i \) chooses \( x_i = x_g \) if \( s_i = g \) and \( x_i = x_b \) if \( s_i = b \). However, \( x_g \) and \( x_b \) can take on arbitrary values in \( X_{\text{full}} \), as long as \( x_b > x_g \) holds (if \( x_b < x_g \), the equilibrium would not be ‘truthful’, and if \( x_b = x_g \) it would not be revealing).

As a working hypothesis, suppose that any values of \( x_g \) and \( x_b \) in \( X_{\text{full}} \), with \( x_b > x_g \), can be sustained as equilibrium ‘strategies’ in some symmetric truthful revealing equilibrium.\(^{10}\) Then the question arises how \( x_g \) and \( x_b \) should be chosen optimally in order to maximize the expected utility of the voters. Hence, we are looking for the social welfare optimum under the constraint that only two policies can be implemented, and they have to be fixed before the signals are revealed. Let us impose yet another restriction, namely that the two policies (\( x_g \) and \( x_b \)) have to be located symmetrically around the ‘neutral policy’ \( D/2 \). This case will be of particular interest later on when we characterize symmetric truthful revealing equilibria.

Lemma 1. If only two different policies can be implemented (\( x_g \) and \( x_b \)), with the additional constraint that \( x_b = D - x_g \), and these policies are fixed before the signals are

\(^{10}\)In the analysis of symmetric truthful revealing equilibria we sometimes refer to \( x_g \) and \( x_b \) as ‘strategies’, when each party \( i \) (\( i \in \{1, 2\} \)) chooses \( x_i = x_g \) if \( s_i = g \), and \( x_i = x_b \) if \( s_i = b \).
revealed, then the policies \( x_g = x_g^* = (1 - p)D \) and \( x_b = x_b^* = pD \) deliver the highest expected utility to the voters.

The restriction \( x_b = D - x_g \) implies that both policies are located symmetrically around the “neutral policy” \( x_g^* = D/2 \), which is voters’ most preferred policy given their prior (\( \mu = 1/2 \)). Voters are indifferent between such policies \( x_g \) and \( x_b \) when \( \mu = 1/2 \). Such outcomes will be of particular interest in the subsequent analysis, because voters then randomize between the two parties when they observe conflicting policy platforms. This makes equilibria sustainable, which would otherwise be vulnerable to deviations. Observe, that the ‘strategies’ \( x_g^* = (1 - p)D \) and \( x_b^* = pD \) coincide with the voters’ most preferred policies when only one signal is revealed: \( x_g^* = (1 - p)D \) is the optimal policy when the signal is ‘good’, while \( x_b^* = pD \) is optimal when there is only one signal and it is ‘bad’.

The intuition behind Lemma 1 is straight-forward. Given the restriction that at most two different policies can be implemented, the (unconstrained) social welfare optimum cannot be implemented since there are three different realizations of voters’ most preferred policy, given the underlying information structure: \( x_{gg}^* = \frac{(1-p)^2}{p^2 + (1-p)^2} D \) when \( s_1 = s_2 = g \), \( x_{bb}^* = \frac{p^2}{p^2 + (1-p)^2} D \) when \( s_1 = s_2 = b \), and \( x_{gb}^* = D/2 \) when signals differ. The policy \( x_b^* = pD \) can be seen as a compromise between the “neutral policy” \( D/2 \) which is optimal when voters do not learn anything about the true state of nature, and the pro-active strategy \( \frac{p^2}{p^2 + (1-p)^2} D \) which is optimal when both signals are ‘bad’ (similarly for \( x_g^* \)).

It is worth noting, however, that when the restriction \( x_b = D - x_g \) is relaxed, a (slightly) higher welfare can be achieved when only two policies can be implemented. In this case, voters would select policy \( x_g \) (resp. policy \( x_b \)) with probability 1 when they are offered conflicting platforms. The optimal values for \( x_g \) and \( x_b \) are then skewed (relative to the reference point \( D/2 \)).

We are now ready to present the first result of this subsection:

**Proposition 3.** If voters ignore out-of-equilibrium platform choices in their formation of beliefs, there exists a unique symmetric truthful revealing equilibrium. In this equilibrium, parties adopt the ‘strategies’ \( x_g^* = (1 - p)D \) and \( x_b^* = pD \).

Interestingly, the result of Proposition 3 holds for any value of \( f \). Even when parties’ office-holding motives are very strong, they can truthfully convey their realized signals to the voters via their policy platform choices. However, the result comes with the caveat that voters ignore out-of-equilibrium platform choices in their formation of beliefs.

\( ^{11} \)E.g., for \( p = 3/4 \) and \( D = 1 \), the expected welfare is maximized when \( x_g \approx 0.1 \) and \( x_b \approx 0.681 \), if the pro-active policy (\( x_b \)) is implemented with probability 1 when signals differ. The same expected welfare is obtained when \( x_g \approx 0.318 \) and \( x_b = 0.9 \), if the less active policy (\( x_g \)) is implemented with probability 1 when signals differ. However, the additional welfare (relative to the symmetric case where \( x_g = x_g^* \) and \( x_b = x_b^* \)) is in the order of magnitude of only 1 percent, and for most parameter constellations that we have checked far below that.
This can be seen as a benchmark case, and the assumption has also been adopted by other authors (e.g.,...) in the literature. However, it turns out that in our model, this assumption is quite restrictive.

**Lemma 2.** Voters’ out-of-equilibrium beliefs that are underlying the PBE characterized in Proposition 3 are not ‘plausible’.

Intuitively, if party 1 receives signal $s_1 = g$ then a deviation to $x_1^{dev} = x_g^*$ is profitable when voters infer that party 1 must have received signal $s_1 = g$. Then if $s_2 = g$, party 1 is elected for sure (rather than with a probability of $1/2$ – as in equilibrium), and in addition, it implements a policy that is (in expectation) superior to the policy that would be implemented in equilibrium. When $s_2 = b$ then the probability that party 1 is elected under the deviation drops to zero. However, from the perspective of party 1 this case is less likely because given $s_1 = g$, the conditional probability that $s_2 = b$ is below $1/2$. Furthermore, the policy that is implemented in this case is as good (in expectation) as the policy that party 1 would implement under its equilibrium strategy. Overall, the deviation, thus, leads to an increase in party 1’s expected payoff. Conversely, if $s_1 = b$ then party 1 has no incentive to deviate to $x_1^{dev} = x_g^*$, irrespective of voters’ beliefs. To see this, note that both for $s_2 = g$ and $s_2 = b$, party 1 prefers the policy of party 2 to $x_1^{dev}$. Furthermore, there is a gain in the probability of being elected (from $1/2$ to $1$) only when $s_2 = g$, while there is a loss (from $1/2$ to $0$) when $s_2 = b$, but the latter case is more likely (given $s_1 = b$) since the conditional probability that $s_2 = b$ is greater than $1/2$ when party 1 observes signal $s_1 = b$. 

Figure 2 illustrates the ranges of $x_1$-values to which party 1 would be willing to deviate under some beliefs of the voters when it received a ‘good’ signal (green line), and when it received a ‘bad’ signal (red line). The lowest value of $x_1$ to which party 1 would be willing to deviate when $s_1 = g$ is given by the condition that voters are indifferent between this policy platform and the platform $x_2 = x_g^*$ that party 2 chooses when $s_2 = g$. Party 1 would never deviate to even lower values of $x_1$ because it is, then, never elected, irrespective of what voters infer about the realization of its signal when they observe the deviation. A deviation to values of $x_1$ in the interval $(D/2, x_g^*)$ is profitable to party 1 if $f$ is sufficiently large, and voters believe that this party received a bad signal when
they observe the deviation, because the conditional probability that \( s_2 = g \) when party 1 observes \( s_1 = g \) is greater than \( 1/2 \). Note, that this deviation induces wrong beliefs about party 1’s true signal. Since voters infer that \( s_1 \neq s_2 \) they prefer party 1’s platform to that of party 2 because it is closer to the “neutral policy” \( D/2 \). Also a deviation to values of \( x_1 \) in the interval \((x^*_g, D/2)\) is profitable to party 1 if \( f \) is sufficiently large, if voters believe that this party received a bad signal when they observe the deviation. Again, such a deviation induces wrong beliefs about party 1’s true signal, and since voters infer that \( s_1 \neq s_2 \) when \( s_2 = g \) they prefer party 1’s platform to that of party 2 because it is closer to the “neutral policy” \( D/2 \).

Figure 2 illustrates why the equilibrium characterized in Proposition 3 is based on implausible beliefs. Namely, there is a range of values for \( x_1 \) to which party 1 would only deviate under some beliefs if it received a ‘good’ signal, but to which it would never deviate if it received a ‘bad’ signal (see the green line at the left-hand-side of the figure). So voters must infer that \( s_1 = g \) when they observe such “extreme” (small) values of \( x_1 \), while they must infer that \( s_1 = b \) when they observe very large values of \( x_1 \) (see the red line at the right-hand side of the figure). Hence, the assumption that voters ignore out-of-equilibrium platform choices in these ranges in their formation of beliefs is implausible.

The above observations suggest that there may exist another type of PBE where voters do not ignore out-of-equilibrium platform choices in their formation of beliefs, and infer that \( s_1 = g \) if \( x_1 \) is (sufficiently) small, and that \( s_1 = b \) if \( x_1 \) is (sufficiently) large. This is confirmed by our next result:

**Proposition 4.** If voters infer that party \( i \) \((i = 1, 2)\) has received a ‘good’ signal if \( x^*_g \leq x_i < D/2 \), and a ‘bad’ signal if \( D/2 < x_i \leq x^*_b \), then there exists a unique symmetric truthful revealing equilibrium where parties adopt the ‘strategies’ \( x^*_g \) and \( x^*_b \), if \( f \) is in an intermediate range. The underlying beliefs are ‘plausible’ (see Definition 1).

The intuition why \( f \) must not be “too small” for this equilibrium to exist is that when winning office is not (sufficiently) attractive for a party, then one of the two parties would deviate to a policy platform arbitrarily close to the neutral policy, while still conveying its signal to the voters. This way, the party would get elected when the two signals are conflicting, in which case the implemented policy is then (almost) optimal, in contrast to the policy that would be implemented if both parties play their equilibrium strategies. However, after party \( i \) has observed its own signal, the probability that the signal of the other party is conflicting with its own signal is below \( 1/2 \). Therefore, to stabilize the above equilibrium, some office-holding motives must be present. If these motives are sufficiently strong, they prevent parties from deviating to a platform that is socially optimal under conflicting signals.
4.2 Asymmetric truthful revealing equilibria

We have seen above that a symmetric truthful revealing equilibrium with the ‘strategies’ $x^g_*$ and $x^b_*$ does not exist for plausible beliefs, because each party would have an incentive to deviate either to the policy platform $x^g_g$, or to $x^b_b$. Recall, that these actions are socially optimal when two conforming signals are revealed. However, also the symmetric truthful revealing equilibrium where parties play these strategies (see Proposition 4) is not optimal from a social welfare perspective, because the implemented policies differ from the voters’ preferred policy in case the two signals are conflicting. The social optimum requires that in this case, the ‘neutral policy’ ($x = D/2$) is implemented. In the following, we will analyze whether asymmetric equilibria exist that lead to outcomes which are closer to the welfare optimum. Note, that since there are only two parties, with any symmetric equilibrium at most two different policies can be implemented, while four different policies can be implemented in an asymmetric equilibrium. Such asymmetric equilibria, therefore, could potentially lead to the social welfare optimum, because in the latter there are only three different policies that need to be implemented ($x^{**}_g$, $x^{**}_b$, and $x = D/2$), depending on the realization of the two signals.

Consider the following (candidate) equilibrium. Suppose, party 1 offers policy platforms near the extremes of the policy space, that is, $x_1 = x^{**}_g$ if $s_1 = g$ and $x_1 = x^{**}_b$ if $s_1 = b$. By contrast, party 2 offers platforms in the center of the policy space. For a social optimum, it is necessary that both parties are able to convey their private information truthfully and credibly to the voters. Hence, the case where party 2 always offers the platform $x = D/2$, irrespective of its signal, cannot lead to the social optimum. However, that platform choice is optimal whenever the two signals are conflicting. One way to resolve this problem would be to add a “cheap talk” stage to the game where party 2 can announce whether it received a good or a bad signal, independently of its actual platform choice. In order to avoid such a change in the structure of the game itself, we may assume instead that party 2 announces a platform choice of $D/2 - \epsilon$ when it receives a good, and $D/2 + \epsilon$ when it receives a bad signal, where $\epsilon$ is an infinitesimally small positive number. This way, party 2’s platform choice is still ‘revealing’, although the implemented policy effectively leads to the same welfare as the policy $x = D/2$ whenever this party is elected.

**Proposition 5.** There exists an asymmetric truthful revealing equilibrium with plausible beliefs where party 1 plays the strategy $x_1 = x^{**}_g$ if $s_1 = g$ and $x_1 = x^{**}_b$ if $s_1 = b$, while party 2 plays $x_2 = D/2 - \alpha$ if $s_2 = g$ and $x_2 = D/2 + \alpha$ if $s_2 = b$, if $f$ is sufficiently small. If $f \leq f_{\text{crit},1}$ then the equilibrium entails $\alpha = \epsilon$ (where $\epsilon$ is infinitesimally small), whereas if $f_{\text{crit},1} < f < f_{\text{crit},2}$ then $\alpha$ is strictly positive.
5 Conclusion

In a complex world, even interested voters cannot be well-informed about every conceivable policy dimension. Hence, they have to rely on representatives and their experts who collect information for them. Parties can then try to signal their private information to the voters via their platform choices, and voters elect the party that offers a more attractive platform choice, given their updated beliefs.

The observation that political parties often disagree even about fundamental issues such as climate change suggests that pandering is not the main issue here. If parties would pander to the public opinion, their announcements and platform choices should converge towards the dominant position. In the context of anthropogenic climate change, the observed disagreement is particularly puzzling, given the large amount of consensus among experts on this issue.

This paper showed that when parties care both about holding office and about the efficiency of the implemented policy, they may well be able to convey their private information to the voters. In a symmetric equilibrium, the outcome then exhibits anti-pandering, that is, platform choices are more extreme than would be socially desirable. Relaxing the symmetry assumption leads to a richer set of outcomes that can be implemented. In particular, there exist asymmetric equilibria in which parties truthfully reveal their private information, and the implemented outcomes are efficient. This is, e.g., the case when one party adopts more extreme policy positions (it follows its true signal but behaves as if it had received two signals with identical contents), whereas the other party adopts a moderate position (close to the “neutral policy”, i.e., voters’ preferred policy when signals are conflicting). This way, the moderate party can still reveal its information by deviating only marginally from the neutral policy, while still offering an (almost) ideal platform in case the two parties’ signals differ.
Appendix: Proofs

A.1 Proofs for Section 3

Proof of Proposition 1. Suppose to the contrary of the claim that a truthful symmetric revealing equilibrium exists. Then party 1’s expected utility when observing $s_1 = g$ and choosing $x_1$ according to the equilibrium strategy ($x_1 = 0$) is (using (2), (3), and (4) in (12)):

$$z \left[ u(p^2, 0) + \frac{1}{2} f \right] + (1 - z) \left[ \sigma(0, 1) \left( u(\frac{1}{2}, 0) + f \right) + (1 - \sigma(0, 1)) u(\frac{1}{2}, 1) \right],$$

where $z \equiv p^2 + (1 - p)^2$ is defined for notational convenience.

When party 1 adopts a deviation strategy, in which it selects policy platform $x_1 = x_b = 1$ when $s_1 = g$, it obtains the following expected payoff when observing $s_1 = g$:

$$z \left[ \sigma(1, 0) \left( u(p^2, 1) + f \right) + (1 - \sigma(1, 0)) u(\frac{p^2}{z}, 0) \right] + (1 - z) \left[ u(\frac{1}{2}, 1) + \frac{1}{2} f \right].$$

Consider the case where $D < 1$. Then $\sigma(0, 1) = 1$ and $\sigma(1, 0) = 0$, because voters prefer the inactive policy when they are offered non-identical policies (see Section 2.1). Then party 1’s expected payoff when it sticks with the equilibrium strategy simplifies to:

$$zu(p^2, 0) + \frac{1}{2} f + (1 - z)u(\frac{1}{2}, 0) + (1 - z)f,$$

whereas the deviation profit becomes:

$$zu(p^2, 0) + (1 - z)u(\frac{1}{2}, 1) + \frac{1 - z}{2} f.$$

Hence, the equilibrium strategy is more profitable than the deviation strategy if

$$(1 - z) \left[ u(\frac{1}{2}, 0) - u(\frac{1}{2}, 1) \right] + f/2 > 0,$$

which simplifies to (using (1))

$$(1 - z)(1 - D) + f > 0.$$ 

This condition is fulfilled since $D < 1$ and $z = p^2 + (1 - p)^2 = 1 - 2p + 2p^2 < 1$.

Now consider the case where $D > 1$. Then $\sigma(0, 1) = 0$ and $\sigma(1, 0) = 1$, because voters prefer the active policy when their belief remains at the prior. Then party 1’s expected payoff when it sticks with the equilibrium strategy becomes:

$$zu(p^2, 0) + \frac{1}{2} f + (1 - z)u(\frac{1}{2}, 1),$$
whereas the deviation profit simplifies to:

\[ zu\left(\frac{1}{2}, 1\right) + zf + (1 - z)u\left(\frac{1}{2}, 1\right) + \frac{1 - z}{2}f. \]

Hence, the deviation strategy is strictly more profitable than the (assumed) equilibrium strategy if

\[ z\left[u\left(\frac{1}{2}, 1\right) - u\left(\frac{1}{2}, 0\right)\right] + f/2 > 0, \]

which simplifies to (using (1))

\[ f + 2(1 - p)^2D > p^2 + (1 - p)^2. \]

Since \( D > 1 \), a sufficient condition for this to hold is \( f > 2p - 1 \).

We repeat the above analysis for the case where party 1 observes a bad signal: \( s_1 = b \). Then party 1’s expected utility when choosing \( x_1 \) according to the equilibrium strategy \((x_1 = 1)\) is:

\[(1 - z)\left[\sigma(1, 0)\left(u\left(\frac{1}{2}, 1\right) + f\right) + (1 - \sigma(1, 0))u\left(\frac{1}{2}, 0\right)\right] + z u\left(\frac{1 - p)^2}{z}, 1\right) + \frac{zf}{2}. \]

When party 1 adopts a deviation strategy, in which it selects policy platform \( x_1 = x_g = 0 \) when \( s_1 = b \), it obtains the following expected payoff when observing \( s_1 = b \):

\[(1 - z)u\left(\frac{1}{2}, 0\right) + \frac{1 - z}{2}f + z \left[\sigma(0, 1)\left(u\left(\frac{1 - p)^2}{z}, 0\right) + f\right) + (1 - \sigma(0, 1))u\left(\frac{1 - p)^2}{z}, 1\right)\]. \]

Consider the case where \( D < 1 \). Then using \( \sigma(0, 1) = 1 \) and \( \sigma(1, 0) = 0 \) the above expected payoffs simplify to:

\[(1 - z)u\left(\frac{1}{2}, 0\right) + zu\left(\frac{1 - p)^2}{z}, 1\right) + \frac{zf}{2}. \]

\[(1 - z)u\left(\frac{1}{2}, 0\right) + \frac{1 - z}{2}f + z u\left(\frac{1 - p)^2}{z}, 0\right) + zf. \]

Hence, the deviation strategy is more profitable if

\[ z\left[u\left(\frac{1 - p)^2}{z}, 0\right) - u\left(\frac{1 - p)^2}{z}, 1\right)\right] + f/2 > 0, \]

which simplifies to

\[ f + p^2 + (1 - p)^2 > 2p^2D. \]

Since \( D < 1 \), a sufficient condition for this to hold is again \( f > 2p - 1 \).

Now consider the case where \( D < 1 \). Then using \( \sigma(0, 1) = 0 \) and \( \sigma(1, 0) = 1 \) the above
expected payoffs simplify to:

\[(1 - z)u(\frac{1}{2}, 1) + (1 - z)f + z\left(\frac{(1-p)^2}{z}, 1\right) + \frac{z}{2}f,\]

\[(1 - z)u(\frac{1}{2}, 0) + \frac{1-z}{2}f + z\left(\frac{(1-p)^2}{z}, 1\right).\]

Hence, the equilibrium strategy is more profitable than the deviation strategy if

\[(1 - z)[u(\frac{1}{2}, 1) - u(\frac{1}{2}, 0)] + f/2 > 0,\]

which simplifies to

\[(1 - z)(D - 1) + f > 0.\]

This condition is fulfilled since \(D > 1\).

\[\Box\]

Proof of Proposition 2. We first show that there exists a symmetric non-revealing equilibrium where both parties set \(x_1^* = x_2^* = 0\) for any realization of \((s_1, s_2)\) when \(D < 1\). If \(pD \leq 1/2\) this is trivial because – given that party 2 sticks with its non-revealing equilibrium strategy – this implies that voters will always vote for party 2 is party 1 deviates to \(x_1 = 1\). Even if this deviation leads voters to believe that party 1 observed a ‘bad’ signal, they still prefer the inactive policy because the damages are too low to warrant an investment in climate stability. In the following we, thus, focus on the case where \(pD > 1/2\).

Suppose first that party 1 obtains signal \(s_1 = g\). In this case, party 1’s expected payoff when it sticks with the equilibrium strategy is:\[\text{12}\]

\[f/2 + u(\gamma(s_1 = g), 0) = f/2 - (1 - p)D,\]

where \(\gamma(s_1 = g) = Pr[W = G|s_1 = g] = p\) reflects party 1’s belief about the probability that \(W = G\) after observing the own signal (party 2’s signal is not revealed in equilibrium).

If party 1 adopts a deviation strategy, which is to set \(x_1 = 1\) when \(s_1 = g\), it obtains the following expected payoff:

\[z\left[\sigma\left(u(\frac{\bar{w}^2}{z}, 1) + f\right) + (1 - \sigma)u(\frac{\bar{w}^2}{z}, 0)\right] + (1 - z)\left[\sigma\left(u(\frac{1}{2}, 1) + f\right) + (1 - \sigma)u(\frac{1}{2}, 0)\right],\]

where \(\sigma = \sigma(1, 0)\) is used as a short-hand. Using (1), this simplifies to

\[\sigma f - \sigma/2 - (1 - \sigma)(1 - p)D.\]

Hence, when observing the signal \(s_1 = g\), the deviation strategy is more profitable for

\[\text{12}\text{It is straight-forward to verify that the same expression is obtained when applying (11), using } x_2(s_2) = 0\text{ for all } s_2 \in \{g, b\}.\]
party 1 than following the equilibrium strategy if:

\[ f(2\sigma - 1) - \sigma + 2(1 - p)\sigma D > 0. \]

This is most likely to be fulfilled if \( p \) is small (i.e., close to 1/2) and \( D \) close to 1; for \( p = 1/2 \) and \( D = 1 \) the condition becomes:

\[ f(2\sigma - 1) > 0, \]

which is violated for any \( f > 0 \) when \( \sigma \leq 1/2 \). Hence, \( \sigma > 1/2 \) is a necessary condition for this deviation to be profitable. The value of \( \sigma = \sigma(1, 0) \) will depend on out-of-equilibrium beliefs (see below).

Now suppose party 1 instead obtains signal \( s_1 = b \). In this case, party 1’s expected payoff when it sticks with the equilibrium strategy (i.e., \( x_1^* = 0 \)) is

\[ f/2 + u(\gamma(s_1 = b), 0) = f/2 - pD. \]

If party 1 adopts a deviation strategy, which is to set \( x_1 = 1 \) when \( s_1 = b \), it obtains the following expected payoff:

\[
(1 - z)[\sigma\left(u(\frac{1}{2}, 1) + f\right) + (1 - \sigma)u(\frac{1}{2}, 0)] + z[\sigma\left(u(\frac{(1-p)^2}{z}, 1) + f\right) + (1 - \sigma)u(\frac{(1-p)^2}{z}, 0)],
\]

where \( \sigma = \sigma(1, 0) \) is again used as a short-hand. Using (1), we find that this deviation strategy is profitable if

\[ f(2\sigma - 1) + \sigma(2pD - 1) > 0. \]

It is easy to verify that this condition is weaker than the condition for a profitable deviation under \( s_1 = g \), which is intuitive, since (under the deviation) party 1 now offers a platform that conforms to its true signal. Hence, we observe that \( \sigma > 1/2 \) is a necessary condition for both deviations to be profitable at the same time. However, whenever this is the case, voters cannot learn anything from observing the deviation, so their belief \( \mu \) must stay at the prior (1/2), and in this case we have \( \sigma(x_1 = 1, x_2^* = 0) = 0 \) because voters favor the inactive policy given their prior. Hence, a profitable deviation can only arise in the case where only the type that observes \( s_1 = b \) is interested in deviating. In this case, voters can infer this type’s true signal by observing the deviation, so that \( \sigma = 1 \) is assured by our assumption that \( pD > 1/2 \), which implies that active climate policy is optimal from the voters’ perspective if they observe only one signal and this signal is ‘bad’. The deviation is then profitable if (setting \( \sigma = 1 \))

\[ f > 1 - 2pD, \]
which is always fulfilled since \( pD > 1/2 \). However, given \( \sigma = 1 \), the deviation by the type with \( s_1 = g \) also becomes profitable when

\[
f > 1 - 2(1 - p)D.
\]

Hence, if this condition is met, voters cannot learn anything from observing the deviation because party 1 would have an incentive to deviate irrespective of the signal it observed. But this implies that out-of-equilibrium beliefs coincide with voters’ prior, which implies that \( \sigma = 0 \) so that the deviation is not profitable for either type. Hence, under the above condition there exists no profitable deviation for any ‘plausible’ specification of out-of-equilibrium beliefs and for any realization of party 1’s signal.

\[\square\]

### A.2 Proofs for Section 4

**Proof of Lemma 1.** Given the parties’ strategies \( x_i = x_g \) if \( s_i = g \) and \( x_i = x_b \) if \( s_i = b \) with \( x_b = D - x_g \) and \( x_g < D/2 \), voters’ expected utility is given by

\[
-\frac{x_g^2}{4} - \frac{x_b^2}{4} - \frac{D}{2} \left[ (1 - p)^2(1 - x_g) + p^2(1 - x_b) + p(1 - p)((1 - x_g) + (1 - x_b)) \right],
\]

where we have used the assumption that voters choose \( x_g \) resp. \( x_b \) with a probability of 1/2 when platforms differ, and the probabilities: \( \Pr[W = B] = 1/2 \), \( \Pr[s_1 = s_2 = g|W = B] = (1 - p)^2 \), \( \Pr[s_1 = s_2 = b|W = B] = p^2 \), as well as \( \Pr[s_1 = g, s_2 = b \text{ or } s_1 = b, s_2 = g|W = B] = 2p(1 - p) \). The maximization over \( x_g \) and \( x_b \) then yields

\[
x_g^* = (1 - p)D \quad \text{and} \quad x_b^* = pD.
\]

**Proof of Proposition 3.** If voters ignore out-of-equilibrium platform choices in their formation of beliefs, they only take into consideration the information revealed by party 2’s platform choice when party 1 deviates to some \( x_1 \neq x_g^* \). That is, \( \mu(x_1, x_2 = x_g^*) = p \) and \( \mu(x_1, x_2 = x_b^*) = 1 - p \).

Suppose, party 1 observes signal \( s_1 = g \). If party 2 obtains a ‘good’ signal, too, then under the equilibrium strategies, each party is elected with probability 1/2, and a deviation by party 1 to any other \( x_1 \neq x_g^* \) does not pay. If party 1 chooses some \( x_1 \neq x_b^* \), voters observe an out-of-equilibrium platform choice and disregard this ‘signal’. Hence, they trust only party 2’s ‘signal’, and given that they then, effectively, only observe one signal, their most preferred policy is \( x_g^* = (1 - p)D \), which is also the platform offered by party 2. So party 2 is elected with probability 1, and the same policy is implemented as under party 1’s equilibrium strategy. Party 1’s expected payoff is, thus, strictly reduced if \( f > 0 \), because under the equilibrium strategies it is elected with probability 1/2. If party 1 deviates to \( x_1 = x_b^* \), voters do not observe an out-of-equilibrium platform choice. Their
belief, thus, remains at the prior as they now observe conflicting platform choices. Given this belief, they elect party 1 with probability 1/2 (as under the equilibrium strategies), because they are indifferent between the two platforms, given their belief. The deviation, however, strictly reduces party 1’s payoff, because if it is elected, it implements a policy that is inferior to the policy that is implemented in equilibrium (it is ‘further away’ from the optimal policy when both signals are revealed, which is $(1-p)^2 D < x_g^* = (1-p)D$).

If party 1 observes signal $s_1 = g$ but party 2 obtains a ‘bad’ signal, then in equilibrium both parties are elected with probability 1/2. If party 1 deviates to some $x_1 \neq x_b^*$, voters observe an out-of-equilibrium platform choice and disregard this ‘signal’. Hence, they trust only party 2’s ‘signal’, and given that signal, their most preferred policy is $x_b^* = pD = x_2$, so party 2 is elected with probability 1. Given the two parties’ signals, party 1 is indifferent between the two policies $x_g^* = (1-p)D$ and $x_b^* = pD$, so the deviation strictly lowers its expected payoff as it now loses the election with probability 1. If party 1 deviates to $x_1 = x_g^*$, it is elected with probability 1/2 as in equilibrium, but the deviation is not (strictly) profitable because it is indifferent between $x_g^* = (1-p)D$ and $x_b^* = pD$. The same line of reasoning applies also when party 1 observes signal $s_1 = b$.

Uniqueness follows from observing that for any other symmetric truthful revealing “strategies”, there always exists some profitable deviation. E.g., suppose in equilibrium a party that observes a good signal chooses policy platform $x_g < x_g^* = (1-p)D$, while the “strategy” adopted when a bad signal is observed is to choose $x_b^* = pD$. Then if both parties observe a ‘good’ signal ($s_1 = s_2 = g$), a unilateral deviation by party 1 to $x_1 = x_g^* = (1-p)D$ is profitable. Voters then only take into consideration the ‘signal’ conveyed by party 2’s platform choice, and given this information, the policy $x_g^* = (1-p)D$ is optimal from the voters’ perspective, so they vote for party 1 with probability 1 (rather than with probability 1/2 as is the case when both parties stick with their equilibrium strategies). Similarly, if party 2 has the signal $s_2 = b$ while $s_1 = g$, the same deviation by party 1 induces again the voters to neglect the ‘signal’ conveyed by party 1’s platform choice, and only take into consideration the information embedded in party 2’s platform choice. Given this information, they prefer party 2’s platform, and this party is elected with probability 1. Party 1 is indifferent between this policy and its own policy under the deviation, given the conflicting signals of the two parties. However, given that party 1 has received the signal $s_1 = g$, from its perspective the (ex-ante) probability ($z$) that party 2 will also receive a good signal is greater than 1/2. Hence, the increase in party 1’s expected payoff due to the office-holding motive ($f > 0$) that follows from the higher probability of being elected when $s_2 = g$ outweighs (in expectation) the reduced probability of being elected when $s_2 = b$. In addition, party 1’s payoff from the implemented policy is increased under the deviation when $s_2 = g$, while it stays the same when $s_2 = b$. The deviation is, thus, strictly profitable. Similar arguments apply also
when \( x_g > (1 - p)D \), or when \( x_b \gtrless pD \).

Proof of Lemma 2. Suppose party 1 receives signal \( s_1 = g \). In order to show that voters’ out-of-equilibrium beliefs are not plausible, we will show that (i) there exists a profitable deviation, to \( x_{1\text{dev}} = x_{1g}^* = \frac{(1-p)^2}{2}D \), where \( z = p^2 + (1 - p)^2 \), if voters infer that party 1 must have received the signal \( s_1 = g \) when they observe the platform choice \( x_1 = x_{1\text{dev}} \), and (ii) that the same deviation is never profitable for party 1 when it received signal \( s_1 = b \), irrespective of the beliefs that voters form when they observe this deviation. Hence, under any plausible beliefs, voters should infer that party 1 received a ‘good’ signal when they observe the platform choice \( x_1 = x_{1\text{dev}} \).

In equilibrium, each party is elected with a probability of 1/2 under any realization of the parties’ signals. If party 1 chooses \( x_1 = x_{1\text{dev}} \), it is elected with probability \( \sigma(x_{1\text{dev}}, x_2^*) = 1 \) if party 2 receives signal \( s_2 = g \) because \( x_{1\text{dev}} = x_{1g}^* \) is the most preferred platform choice if voters infer that \( s_1 = g \) holds when observing this deviation. However, if party 1 chooses \( x_1 = x_{1\text{dev}} \), it is elected with probability \( \sigma(x_{1\text{dev}}, x_2^*) = 0 \) if party 2 receives signal \( s_2 = b \), because \( x_2 = x_2^b \) is closer to the voters’ most preferred policy \( D/2 \) under conflicting signals. Parties’ beliefs when both platform choices are revealed are given by \( \gamma(g, g) = \frac{p^2}{z} \), \( \gamma(g, b) = \gamma(b, g) = 1/2 \), and \( \gamma(b, b) = \frac{(1-p)^2}{z} \). Using these expressions in (12), we can compute party 1’s expected payoff under the equilibrium and under the deviation strategy when it received signal \( s_1 = g \). The difference between these expressions is given by

\[
\frac{(1 - 2p)^2(2D^2(1-p)^2p^2 + f(1 - 2p + 2p^2))}{2 - 4p + 4p^2}.
\]

This is strictly positive for any \( p \in (1/2, 1) \), so that the deviation is profitable when party 1 receives signal \( s_1 = g \).

Similarly, we can compute the difference between party 1’s expected payoff under the equilibrium and under a deviation to \( x_{1\text{dev}} = x_{1g}^* \) when it received signal \( s_1 = b \). If voters infer that party 1 must have received signal \( s_1 = g \) when observing this deviation, then this difference is given by

\[
\frac{(1 - 2p)^2(2D^2(1-p)^2p^2(1 - p + p^2) + f(1 - 2p + 2p^2)^2)}{2(1 - 2p + 2p^2)^2}.
\]

This is clearly negative for any \( p \in (1/2, 1) \), so that a deviation to \( x_{1\text{dev}} = x_{1g}^* \) is not profitable when party 1 receives signal \( s_1 = b \). If voters instead infer that party 1 must have received a ‘bad’ signal when they observe this deviation, then party 1 is only elected if \( s_2 = g \), but this implies that party 1 is elected with a lower probability than in equilibrium because – condition on the signal \( s_1 = b \) – the probability that \( s_2 = g \) is \( 1 - z < 1/2 \).

Furthermore, the implemented policy is, then, (in expectation) inferior to either of the
two equilibrium policies, $x_g^*$ and $x_b^*$, from party 1’s perspective. If party 2 receives $s_2 = b$ then party 1 is elected with a probability of zero, and the implemented policy is (in expectation) not worse than in equilibrium. Hence, the deviation to $x_1^{dev} = x_g$ is never profitable when party 1 receives signal $s_1 = b$.

Proof of Proposition 4. Suppose, party 1 received a ‘good’ signal. Then its expected equilibrium payoff is given by

$$z\left[u(p^2/z, x_g^*) + f/2\right] + (1-z)\left[u(1/2, x_g^*) + f/2\right].$$

Consider a deviation to some platform in the range $x_1 \in (x_g^*, D/2)$. Given voters’ beliefs, this implies that when $s_2 = g$ this party is not elected because voters still infer that $s_1 = s_2 = g$, and party 2’s equilibrium platform ($x_2 = x_g^*$) is their preferred action (given their beliefs). If $s_2 = b$ then party 1 is elected with probability 1 (given the deviation) because voters then infer that $s_1 \neq s_2$ so party 1’s platform is closer to their most preferred platform, $D/2$, given their beliefs. But this implies that party 1’s best possible deviation within the range $x_1 \in (x_g^*, D/2)$ is the platform $x_1 = D/2 - \epsilon$. This way, party 1 can still convey its true signal to the voters, and in case the party is elected, the policy platform that is closest to its own preferred action ($D/2$) is, then, implemented. Given this deviation and $s_1 = g$, party 1’s expected payoff is (approximately)

$$zu(p^2/z, x_g^*) + (1-z)\left[u(1/2, D/2) + f\right].$$

The deviation yields a lower expected payoff than the equilibrium strategy (given $s_1 = g$) if

$$f > \frac{D^2p(1-p)}{2(1-2p+2p^2)^2} \equiv f_1^{crit}.$$ 

Now consider a deviation to some platform in the range $x_1 \in (D/2, x_b^*)$. Given voters’ beliefs, party 1, thus, conveys “wrong information” about its true signal to the voters. This implies that when $s_2 = g$ party 1 is elected with probability 1 because voters infer that $s_1 \neq s_2$, so party 1’s platform is closer to their preferred action ($D/2$) than party 2’s equilibrium platform choice (given their beliefs). Under the deviation, party 1 is, however, not elected if $s_2 = b$. Therefore, within the range $x_1 \in (D/2, x_b^*)$, party 1’s best deviation is to $x_1 = D/2 + \epsilon$. This way, this party implements its own preferred policy when it is elected (given the deviation). This leads to an expected payoff to party 1 of

$$z\left[u(p^2/z, D/2) + f\right] + (1-z)u(1/2, x_b^*).$$

This deviation payoff is smaller than party 1’s (expected) equilibrium payoff (given $s_1 = g$).
if
\[ f < \frac{D^2}{4 - 8p + 8p^2} \equiv f_2^{\text{crit}}. \]
The difference \( f_2^{\text{crit}} - f_1^{\text{crit}} = \frac{D^2(1 - 2p)^2}{4(1 - 2p + 2p^2)^2} \) is positive for all \( p \in (0.5, 1) \). Hence, there exists no profitable deviation (given voters’ beliefs) to some \( x_1 \in (x_{gg}^*, D/2) \) or \( x_1 \in (D/2, x_{bb}^*) \) if \( f \) is in an intermediate range, that is, \( f_1^{\text{crit}} \leq f \leq f_2^{\text{crit}} \).

Next, we show that no other deviations are profitable, given voters’ beliefs. Consider a deviation to \( D/2 \). This deviation “hides” party 1’s signal, so that voters form their beliefs only on the basis of what they infer about party 2’s signal. In this case, they always elect party 2, because the condition
\[ u(p, x_{gg}^*) > u(p, D/2) \]
yields
\[ \frac{D^2(1 - 2p)^4}{8(1 - 2p + 2p^2)^2} > 0, \]
which is always fulfilled. Hence, although party 2’s equilibrium policy (with \( s_2 = g \) or \( s_2 = b \)) is not optimal given the voters’ beliefs, with only one signal they still prefer these rather extreme policies to the “neutral policy” (\( D/2 \)). Therefore, a deviation to \( x_1 = D/2 \) is never profitable for party 1.

Now consider a deviation to some \( x_1 < x_{gg}^* \) when party 1 observed \( s_1 = g \). This deviation is never profitable. To see this, not that when \( s_2 = b \) then party 2’s policy platform is closer to the voters’ preferred action (\( D/2 \)). Similarly, also when \( s_2 = g \), party 2 is elected with probability 1, because given their beliefs, the platform \( x_2 = x_{gg}^* \) is the voters’ most preferred action.

We finally show that the equilibrium beliefs are ‘plausible’. To this end, note that we have already identified party 1’s best deviations in the ranges \( (x_{gg}^*, D/2) \) resp. \( (D/2, x_{bb}^*) \), and specified voters’ beliefs in such a way that they are most favorable for the respective deviation. Hence, if \( f_1^{\text{crit}} \leq f \leq f_2^{\text{crit}} \) then party 1 would not be willing to deviate to any \( x_1 \) in these ranges, irrespective of what voters believe when they observe the deviation. Similarly, there are no profitable deviations to some \( x_1 < x_{gg}^* \), \( x_1 > x_{bb}^* \), or \( x_1 = D/2 \), irrespective of voters’ beliefs. Therefore, if we assume that voters neglect out-of-equilibrium platform choices in these (extreme) ranges in their formation of beliefs, the beliefs are ‘plausible’ according to our Definition 1.

Proof of Proposition 5. Suppose, voters ignore out-of-equilibrium platform choices by party \( i \) (\( i = 1, 2 \)) in their formation of beliefs if \( D/2 - \alpha < x_i < D/2 + \alpha \), while they infer that party \( i \) must have received a good (bad) signal if \( x_{gg}^* \leq x_i \leq D/2 - \alpha \) \( (D/2 + \alpha \leq x_i \leq x_{bb}^*) \). “Extreme” platform choices \((x_i < x_{gg}^* \) or \( x_i > x_{bb}^*)\) are also ignored by voters in their formation of beliefs. Given parties’ equilibrium strategies, when
$s_1 = s_2 = g$ or when $s_1 = s_2 = b$ then party 1 wins the election with probability 1, whereas when signals are conflicting then party 2 wins with probability 1. If party 1 receives a good signal, its expected payoff in equilibrium is

$$z \left[ u(p^2/z, x_{gg}^*) + f \right] + (1 - z)u(1/2, D/2 - \alpha).$$

If party 2 receives a good signal, its expected payoff in equilibrium is

$$zu(p^2/z, x_{gg}^*) + (1 - z)\left[u(1/2, D/2 - \alpha) + f\right].$$

Now consider possible deviations.

Suppose, party 1 receives signal $s_1 = g$. Then a deviation to any $x_1 < D/2 - \alpha$ is not profitable. If $s_1 = g$ then the probability of being elected remains the same (=1) if $x_1 > x_{gg}^*$ or drops to zero if $x_1 < x_{gg}^*$, and in both cases the implemented policy is inferior to the equilibrium policy. If $s_2 = b$ then the probability of being elected remains the same (=0), and also the implemented policy. A deviation to $x_1 = D/2 - \alpha$ is also not profitable.

In that case, party 1’s probability of being elected only rises (from 0 to 1/2) if $s_2 = g$, but this case is less likely to arise (given that party 1 received a good signal) than $s_2 = g$, and even when it arises, the implemented policy under the deviation is (in expectation) not superior to the equilibrium outcome. A deviation to some $x_1 \in (D/2 - \alpha, D/2 + \alpha)$ is not profitable. This “hides” party 1’s signal, so that voters always prefer party 2’s policy that is closer to their preferred policy ($x_g^*$ resp. $x_b^*$) when only the signal of party 2 is “revealed” to the voters if it holds that $D/2 - \alpha > x_g^*$ (see below). Similarly, a deviation to some $x_1 \geq D/2 + \alpha$ is not profitable. If $s_2 = g$ then party 1 is elected with a lower probability than under the equilibrium policy and the implemented policy is not superior to the equilibrium outcome. If $s_2 = b$ then party 1 is elected with a higher probability than under its equilibrium policy, but this case is less likely to arise (given $s_1 = g$) and the implemented policy is in expectation inferior to the equilibrium policy.

Now consider a deviation by party 2, after receiving $s_2 = g$. A deviation to some $x_2$ in the range $(D/2 - \alpha, D/2 + \alpha)$ induces voters to ignore party 2’s platform choice in their formation of beliefs. Under the condition that $u(p, x_{gg}^*) > u(p, D/2 - \alpha)$, i.e., voters prefer party 1’s more extreme platform to the more moderate platform $D/2 - \alpha$ when observing only one signal (and the signal is good), a deviation to some $x_2$ in that range is never profitable, because party 2 then gets elected with a probability of zero. And whenever the implemented policy under the deviation differs from the one under the equilibrium strategy, the policy under the deviation is inferior.

The condition $u(p, x_{gg}^*) > u(p, D/2 - \alpha)$ yields:

$$f < \frac{D^2(1 - 4p + 12p^2 - 16p^3 + 8p^4)}{2 - 4p + 4p^2} \equiv f_b^{crit}.$$
If $f$ is above this critical value, it is generally profitable for firm 2 to deviate to $x_2 = D/2 - \alpha + \epsilon$, because this then raises its probability of being elected from below 1/2 to 1. Hence, $f_b^{\text{crit}}$ serves us as an upper bound for $f$ in the construction of the asymmetric truthful revealing equilibrium. If $f < f_b^{\text{crit}}$ then a deviation to any $x_2$ in the range $(D/2 - \alpha, D/2 + \alpha)$ is never profitable.

Next consider a deviation to $x_2 = D/2 + \alpha$. This deviation induces voters to draw an incorrect inference about party 2’s signal. Although the true signal is good, party 2 chooses a policy platform that conforms to its equilibrium strategy under a bad signal. The deviation can be profitable because – given party 2’s signal – the probability that party 1 has obtained an identical signal is greater than 1/2. However, in that case the implemented policy is worse than under party 2’s equilibrium strategy, which can prevent this type of deviation. The latter effect is stronger, the more distorted the deviation strategy is, compared to the implemented policy under the equilibrium strategy. Comparing party 2’s expected welfare under the equilibrium strategy (see above) with its welfare under the deviation:

$$z\left[u(p^2/z, D/2 + \alpha) + f\right] + (1 - z)u(1/2, x_{bb}^*),$$

we thus obtain a lower bound for the value $\alpha$, which assures that this type of deviation is not profitable. The expression is rather lengthy (not shown). However, when $f$ is sufficiently small, the constraint is not binding so that the lower bound for $\alpha$ is negative. Hence, we can identify a critical value for $f$, above which $\alpha$ is strictly positive. It is given by:

$$f_a^{\text{crit}} = \frac{D^2}{8(1 - 2p + 2p^2)^2}.$$  

If $f < f_a^{\text{crit}}$ we set $\alpha$ equal to $\epsilon$ (infinitesimally small) so that party 2 can still convey its signal to the voters, while implementing an (almost) efficient policy (in case this party is elected). Next consider a deviation to some value $x_2 \in (x_{gg}^*, D/2 - \alpha)$. This deviation is not profitable. The deviation does not raise the probability that party 2 is elected, and leads to the implementation of a worse policy when it is elected. Also a deviation to some $x_2 \in (D/2 + \alpha, x_{bb}^*)$ is not profitable, because it leads to a lower payoff to party 2 than a deviation to $x_2 = D/2 + \alpha$, that has already been ruled out (see above).

Finally consider a deviation to $x_2 = x_{gg}^*$. Under this type of deviation, the moderate party mimics the behavior of the more extreme party. This deviation is potentially profitable, because the probability of being elected raises to 1/2 (after party 2 observed its signal), whereas party 2 is elected with a probability below 1/2 when it sticks with its equilibrium strategy. However, because parties (in equilibrium) do not pursue symmetric strategies, the identity of the party that chooses a certain policy platform may well affect voters’ election decision. Therefore, in order to rule out this type of deviation, we may
assume that – although voters do not neglect party 2’s platform choice in their formation of beliefs – they vote for party 1 when this party chooses an equilibrium policy platform, whereas party 2 is obviously a deviator.

Profitable deviations to more extreme platform choices (outside the range $[x_{g2}^*, x_{b2}^*]$) can be ruled out in the same manner as shown in the proof of Proposition 4.

\[ \square \]

References


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sity of Melbourne.


