Like biases and information in elections*

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Abstract

We model an election among two downsián candidates and a third deterministic politician. There is uncertainty about the state of the world. Candidates receive signals on the state and propose a policy to implement. There are two groups of voters: ideological and non-ideological. For both the cases in which the deterministic candidate is biased towards the policy preferred by a majority or a minority of the electorate, we characterize all the government structures (coalition governments) that allow for information transmission by the two strategic candidates. Contrary to expected, our results show that the presence of a third candidate facilitate equilibria in which the two major parties behave honestly. Additionally, we obtain that this honest behavior is more frequent when the deterministic candidate supports the policy preferred by the majority of the electorate than when he is against it. Loosely put, the more populist this candidate, the better.

Keywords: Electoral competition; coalition governments; information transmission; heterogeneous voters

JEL: D72; D82

1 Introduction

In systems with a representative democracy, the question of whether the electoral process can aggregate the information the politicians have and transmit it to the voters is of primary importance. Relevant contributions that date back to Harrington (1993), Roemer (1994), Schultz (1995, 1996, 2002), and more recently Heidhues and Lagerlöf (2003), Morelli and Weelen (2012), Loertscher (2012) and

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Kartik et al. (2013), agree on the idea that in the presence of asymmetric information between voters and (better informed) political parties, electoral processes may fail to be informative.\textsuperscript{1}

This abundant literature on the policy distortions that arise when politicians have superior information has so far focused on the classical two-party competition model. However, in the light of the recent results of the 2014 European Elections, this focus seems a bit narrow and unrealistic. In fact, if there is a reason for which past 2014 European Elections are to be remembered is the end of majoritarian politics and the rise of third extremist parties.\textsuperscript{2} We contribute to this literature by proposing a model that studies the incentives of two office-motivated politicians to reveal their private information to voters when the electorate is heterogeneous and there is a third deterministic candidate running for office.

We built a simple and tractable model that closely illustrates the political arena of modern democracies and that poses new interesting questions. First, and foremost, does the introduction of third candidates that dogmatically insist on a particular policy erode the capacity of the strategic candidates to credibly communicate their information to the voters? Does the existence of ideological voters persuade the strategic candidates to act in the benefit of these voters? Does the capacity of strategic candidates to credibly communicate their information vary with the state of the world that non-ideological voters consider most likely to occur? Can information transmission be achieved for any possible coalition government or are there only certain cabinets that make it possible? Do these coalitional governments include the third party?

In this paper we argue that the presence of third deterministic candidates, far from eroding the informativeness of electoral processes, might actually help ease information transmission from candidates to voters. Additionally, and contrary to what we might be inclined to think, we show that the candidates’ capacity to credibly communicate their information to the electorate is greater when all the voters are biased in the same direction, than when there are conflicting views in the electorate.

To make our point, we consider an adaptation of the model in Heidhues and Lagerlöf (2003) (hereafter HL (03)), in which candidates receive imperfect and correlated signals on the state of the world, which is unknown to voters.\textsuperscript{3} Following their specifi-

\textsuperscript{1}A different view is that in Martinelli (2001) and Laslier and der Straeten (2004), who also analyze electoral competition in the presence of asymmetries of information. The distinguishing feature of these papers is that, in addition to parties, they also consider voters with private information about the policy-relevant state variable. This assumption proves crucial to their results that transmission of private information is an equilibrium in this case.

\textsuperscript{2}The rise of third extremist parties has been the rule all over Europe, from France (where Front National won 25\% of votes) and UK (where Ukip got the biggest share of votes), to Italy, Spain, Denmark, Austria or Greece.

\textsuperscript{3}Whereas previous models in the literature focused on situations in which information is either exclusive to one candidate (Harrington (1993) and Schultz (2002)), or is equally accessed by the two politicians (Roemer (1995) and Schultz (1995, 1996)), Heidhues and Lagerlöf (2003) propose the first model that considers the effects of the dispersion of information between the candidates.
cations, we consider a binary world, with two states and two possible policies. For expositional purposes, and inspired by the current EU economic crisis, we identify the two policies as an expansionary fiscal policy, that aims to stimulate aggregated demand through public spending; and a policy of austerity, that aims to reduce budget deficits in order to foster the return of sustainable growth. Accordingly, the state of the world will, in our words, be either pro-stimulus or pro-austerity. We assume that a policy consisting of expansionary measures or fiscal stimulus is the one that best fits the economy if the state is pro-stimulus, and that an austerity policy is the appropriate one if the state is pro-austerity. Following HL03, we assume that candidates observe the signals and propose the policies so as to win office.

We extend the HL03 set-up in two directions. First, we consider the existence of a third candidate that runs for office. A simplification here is to assume that the third candidate is deterministic, and so always proposes the same policy (that we will choose to be expansive fiscal policy). This is an assumption that aids considerably in the tractability of the problem and that is grounded on real world observation that third parties are usually more dogmatic than main ones. Second, we consider the existence of heterogeneous voters. Namely, we introduce two groups of voters. A majority consisting of non-ideological voters, who want the policy implemented to correctly match the state of the world; and a minority of ideological voters who have a fixed preference for the policy the non-strategic candidate stands for.

on their incentives to reveal their private information to voters through their choice of policy platforms. This feature, together with the competitive nature of the electoral processes, results in bayesian voters penalizing the candidates that contradict the electorate’s priors. As a result, the authors show that if the voters’ prior is biased in favor of a policy, full revelation by the two candidates cannot occur, and that the most reasonable equilibrium (Pareto superior) is the popular beliefs one.

Despite the introduction of a third candidate, we follow HL03 and consider an economy where the policy decision in binary. Our reason is twofold: First, the common formulation facilitates making comparisons with HL03. Second, the current debate about which is the best strategy to return economic growth to the EU area, is dominated by two main arguments: Fiscal austerity, as emphasized by conservatives; and fiscal stimulus, as stated by progressives and social democrats (See Frankel (2012) and Collignon (2012)).

This is a reasonable presumption based on the results of past 2014 European Elections. In addition to this recent evidence, and as a more general fact, empirical evidence shows that multi-party competition and coalition governments is often the case in countries where legislatures are elected by proportional representation (most European and OECD countries).

Indeed, these are parties that define themselves as supporters of direct democracy (Movimiento Cinque Stelle), protectionism and anti-immigration policies (Front National and Danish People’s party), or Euro-sceptic (Ukip).

According to political discussants and newspapers’ editor, the results of the 2014 European Election make clear there is an electorate that rejects the so-called political class and the neoliberal project of reforms and austerity that Brussels have dictated in the last few years. Collignon (2012) writes: ‘Austerity programs, which have become the policy consensus among the technocrats that guide our politicians, are not what people want. Even the most self-righteous of Europe’s conservative Prime Ministers, the Dutch Mark Rutte, had to resign because his parliamentary majority would no longer let him implement them. Hardest hit are, of course, Greece, Ireland,
Our interest is to analyze how the presence of third deterministic politicians and heterogeneous voters affect the incentives of the two office-motivated candidates to credibly transmit their information to the voters through their choice of policy platforms.

The first result we obtain refers to the composition of the government (single-party governments or coalition governments) that allows for information transmission. Our approach here is as general as possible, as in the case a coalition government must form (because no candidate gets an absolute majority of votes), we do not restrict the analysis to a particular coalition formation protocol, but list all the coalitions that together get a strict majority of votes. We obtain that all coalition governments are minimal and include the deterministic candidate. That is, no coalition government between the two mainstream candidates occurs.

Then, we go backwards and for those government structures that could form, we analyze whether there is an equilibrium in which the strategic candidates transmit their information to the voters. Our results show that the presence of third deterministic candidates, far from eroding the informativeness of the electoral process, might actually help ease the information transmission game. This result contrasts with the negative outcome in HL03, who for a set-up of two (strategic) candidates showed that, if the voters’ prior is biased in favor of one of the policies, there is no equilibrium in pure strategies where candidates can credibly transmit their information to the voters. Additionally, and again contrary to what we might be inclined to think and, also, somehow, to the result of HL03, we show that the candidates’ capacity to credibly communicate their information to the voters is greater when all ideological and non-ideological voters are biased in the same direction, than when there are conflicting views in the electorate. Thus, we conclude that homogeneous electorates facilitate information transmission, as compared to electorates with divergent views about which policy is best.

Last, we relax each of the two main features of the model, three candidates and heterogeneous voters, and obtain results for these new scenarios. The analysis with two candidates extends the work by HL03 and shows that the introduction of different types of voters yields equilibria with information transmission, thus breaking with HL03. These new equilibria require, however, of an electorate with opposing biases and with a specific voting behavior. On the other hand, the case with homogeneous voters analyzes a situation that is similar to that considered by Cummins and Nyman (2005), Felgentrauer (2012) and Andina-Diaz (2013), who for different set-ups analyze the effect of competition on the incentives of experts to truthfully communicate their information to an agent. Common to all these works is the result that competition can restore efficiency. All of these works consider, however, only one type of agent. In this sense, the present analysis extends these works showing, among other things, that as important as the existence of a third

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Footnote:

Portugal and Spain where popular discontent is boiling

Footnote:

In the case of non-ideological voters, the bias refers to the state of the world the prior distribution of the state is in favor of.
candidates it is that he is biased in the right direction.

The remainder of the paper is organized as follows. The next section describes the model. Section 3 analyzes the voting behavior and the resulting government structures, accounting for the possibility of coalitions. Given these government structures, Section 4 analyzes whether there are equilibria where the two downswin candidates credibly transmit their information. Section 5 presents a discussion, where we examine the implications that the main two features of the model have on the results. Finally, Section 6 concludes.

2 The model

An election is to be held. There are three political candidates and a unit mass of votes. There are two stages of the world, $w_E$ and $w_A$. To facilitate the reading and motivate our analysis with the current EU economic downturn, thorough the paper $w_E$ refers to an economic situation where "expansionary or fiscal stimulus policies are required to return economic growth" and $w_A$ to one where "austerity measures are first to be implemented if we want to foster long-run sustainable growth". Let $q$ be the prior probability that the state is $w_E$, i.e., $P(w = w_E) = q \in (0, 1)$.

The candidates: Candidates are labeled 1, 2 and 3. Candidates 1 and 2 are downswin and want to get into office. Candidate 3 is considered to have a preferred policy which he always proposes. There are two policy alternatives $E$ and $A$, where $E$ stands for "expansionary fiscal policies" and $A$ for "austerity measures". We assume $E$ is the correct policy in state $w_E$ and $A$ is the correct one in state $w_A$. Candidates 1 and 2 choose the policies to propose so as to win office. Let $x_i \in \{E, A\}$ be the policy proposed by candidate $i \in \{1, 2, 3\}$. Without loss of generality, we assume $x_3 = E$. Rents from office are $K$.

The information structure of the candidates: Each candidate 1 and 2 receives a signal $s_1, s_2 \in \{e, a\}$, on the state of the world.\(^9\) Signals are correlated, with $\rho \in [0, 1)$ being a measure of the degree of correlation between the signals. Hence, the higher $\rho$, the greater the correlation. Additionally, signals are not perfectly informative about the state of the world. With probability $(1 - \varepsilon)$, a candidate’s signal is equal to the state; with probability $\varepsilon$ she receives an incorrect signal. We assume $\varepsilon \in (0, 1/2)$. Table 1 summarizes the signal technology.\(^{10}\)

<table>
<thead>
<tr>
<th>$P(s_1 = j/w = w_j)$</th>
<th>$P(s_2 = k/w = w_j)$</th>
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<tr>
<td>$(1 - \varepsilon)^2 + \rho \varepsilon (1 - \varepsilon)$</td>
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<td>$(1 - \rho) \varepsilon (1 - \varepsilon)$</td>
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\(^9\)This is the same as considering that all the three candidates observe a signal on the state. The reason being that the third candidate always proposes the very same policy, hence, whether he receives a signal or not, and which is the content of the signal, is totally irrelevant.

\(^{10}\)The signal technology is the same as in HL03.
Upon receiving a signal, candidates choose the policy to implement if elected.

The voters: There is a unit mass of voters. Voters can be of two kinds, ideological or non-ideological voters. A non-ideological voter, denoted by 4, wants the policy to be appropriate to the state. Her utility is \( U_4(E, w_E) = U_4(A, w_A) = 1 \) and \( U_4(E, w_E) = U_4(A, w_E) = 0 \). An ideological voter, denoted by 5, always prefers fiscal stimulus policies to cutbacks and other stiff austerity measures. Her utility is \( U_5(E, w_i) = 1 \) and \( U_5(A, w_i) = 0 \), for \( i \in \{E, A\} \).

Let \( \beta \) be the fraction of non-ideological voters. In order for the problem to be interesting, we assume \( \beta \in (\frac{1}{2}, 1) \), i.e., we consider a majority of non-ideological voters. The voters observe the platform profile and choose the candidate/s for whom to vote.

The election and the government formation: A strict majority of votes is required to govern. Given a vector of vote shares \( v = (v_1, v_2, v_3) \), with \( v_1 + v_2 + v_3 = 1 \), candidate \( i \in \{1, 2, 3\} \) receives a strict majority of votes when \( v_i > \sum v_j \), for \( j \neq i \). In this case, he governs alone (there is a single-party government) and gets the entire payoff \( K \) from holding office. The policy implemented in this case is \( x_i \). In case no candidate wins such a majority, a coalition government must form. Here we are as general as possible and consider all coalitions that together obtain a strict majority of votes.\(^{12}\)

We denote a government coalition by \( C \), where \( C \in \{\{1, 2\}, \{1, 3\}, \{2, 3\}, \{1, 2, 3\}\} \). The final policy of the government coalition \( C = \{i, j\} \) is defined as \( \frac{v_i}{v_i + v_j} x_i + \frac{v_j}{v_i + v_j} x_j \).\(^{13}\) The rents \( K \) from holding office are in this case to be distributed between the politicians in the government coalition, according to vote shares.

The players strategies: Note that for the deterministic candidate, \( x_3 = E \). Having this in mind, we restrict notation to exclusively account for the behavior of the two strategic candidates. We define \( \sigma^j_i \) as the probability that candidate \( i \in \{1, 2\} \) proposes policy \( E \) after observing signal \( j \in \{e, a\} \), and \( \sigma_e = (\sigma^1_e, \sigma^2_e; \sigma^3_e, \sigma^4_e) \) as the vector of the equilibrium strategies for the (strategic) candidates. Similarly, from now on we refer to \( (x_1, x_2) = (j, k) \), with \( (j, k) \in \{E, A\}^2 \), as a platform profile.

Regarding voters, let \( \sigma^{j,k}_{4,i} \) and \( \sigma^{j,k}_{5,i} \) be the probability that a non-ideological and ideological voter, respectively, votes for \( i \in \{1, 2, 3\} \), after having observed the policy proposal \( (x_1, x_2) = (j, k) \), for \( (j, k) \in \{E, A\}^2 \). We assume symmetric

\(^{11}\)Following Buti and Carnot (2013) and Collignon (2012), who respectively argue that the debate on the fiscal strategy in the EU has been seen at times like a war of religions or ideologies, and that austerity programs is not what people want, we distinguish between ideological voters (those with a biased in favour of fiscal stimulus) and non-ideological voters (those that may support any type of policy, provided that the policy is the one that best fits the economy).

\(^{12}\)This means we do not restrict the analysis to a particular coalition formation protocol, but instead list all the coalitions that together obtain a strict majority of votes.

\(^{13}\)For the sake of exposition, we stick to this formulation, although the results of the paper are more general and hold for any weights in \((0, 1)\), and not necessarily for those that correspond to the vote shares.
voting among the non-ideological voters. That is, we focus on equilibria in which all the voters of this group use the same voting strategy.\(^{14}\)

**The equilibria:** We are interested in studying whether the two office-motivated candidates can credibly communicate their information to the voters through their choice of policy platforms. Thus, our analysis focuses on equilibria with full revelation. In the following, we say that an equilibrium is *fully revealing* if the two strategic candidates perfectly signal their information at all stages of the nature. Note that if we restrict our attention to this class of equilibria, candidate \(i \in \{1, 2\}\) has two strategies: (i) A faithful strategy, defined by \((\sigma_i^f, \sigma_i^p) = (1, 0)\), and (ii) a reversed strategy, defined by \((\sigma_i^r, \sigma_i^p) = (0, 1)\). Then, in the fully revealing class of equilibrium we focus on, the vector of the candidates’ equilibrium strategies is \(\sigma_i \in \{(1, 0; 1, 0), (1, 0; 0, 1), (0, 1; 1, 0), (0, 1; 0, 1)\}\).

The equilibrium concept that we use is the perfect Bayesian equilibrium. We solve the game by backwards induction. We proceed as follows. First, for a given platform profile that corresponds to a particular class of the fully revealing equilibria, we analyze the equilibrium voting behavior and the resulting electoral outcomes. This allows us to know, for each of these platforms profiles, which is the resulting composition of the government (single-party government or coalition government). Then, we go backwards and for each of the possible composition of the government, we analyze the incentives of the (strategic) candidates to credibly transmit their information to the electorate through their choice of policy platforms.

3 Voting behavior and electoral outcomes

Assuming that a fully revealing equilibrium is played in the first stage of the game, this section is devoted to the study of the government structures (single-party government or coalition government) that can result in equilibrium. Remember that for a politician to win office he must get an absolute majority of votes, and that if this is not the case, a coalition government (together obtaining a strict majority) needs form.

Prior to this analysis, it is useful to analyze how voters would change their belief about which policy is best, if they could learn the content of the two candidates’ signals.\(^{15}\) Note that this is always the case on the fully revealing class of equilibria we focus on. There are two cases to distinguish: The prior distribution of the state is in favor of the expansionary fiscal policy \((q > 1/2)\); and the prior distribution

\(^{14}\)Note that this assumption simplifies the characterization of the voting profiles that sustain a particular electoral outcome and, since there is a majority of non-ideological voters, does not affect the electoral outcome (which candidate/s form government). Hence, it has no consequences for our results.

\(^{15}\)This analysis will focus on the behavior of the non-ideological voters, since ideological voters have a state-independent preferred policy, \(E\), which they always vote for.
of the state is in favor of the austerity policy \((q < 1/2)\).\(^{16}\)

First, suppose \(q > 1/2\). In this case, a non-ideological voter with no other information than her prior thinks that policy \(E\) is the best. Now, let us consider that the voter knew the content of the two signals. If both were in favor of policy \(E\), the voter would be reinforced in her opinion that policy \(E\) is the best.\(^{17}\) If one signal indicated \(e\) and the other \(a\), the content of the two signals would cancel out and the voter would still prefer \(E\), her prior.\(^{18}\) Last, suppose the two signals indicated \(a\). Applying Bayes rule, we obtain that \(P(w = w_A/s_1 = a, s_2 = a) > P(w = w_E/s_1 = a, s_2 = a)\) if and only if \((1-q)[(1-\varepsilon)^2 + \rho \varepsilon (1-\varepsilon)] > q[\varepsilon^2 + \rho \varepsilon (1-\varepsilon)]\), which can be rewritten as \(q < \tilde{q} = \frac{(1-\varepsilon)[1-\varepsilon(1-\rho)]}{1-2(1-\varepsilon)(1-\rho)}\). In order for the problem to be interesting, when analyzing the case \(q > 1/2\), we will assume that after two \(a\) signals, non-ideological voters change their mind and prefer \(A\). This requires the prior probability that \(E\) is the best policy being not too large, i.e., \(q \in \left(\frac{1}{2}, \tilde{q}\right)\).\(^{19}\)

Analogously, if \(q < 1/2\), a non-ideological voter with no other information than her prior would vote for policy \(A\). Now, if the voter knew that at least one signal indicates \(a\), she would prefer \(A\). Otherwise, we assume she changes her mind and prefers \(E\). Similarly to the previous case, this requires the prior probability that \(A\) is the best policy being not too large, i.e., \(q \in \left(1 - \tilde{q}, \frac{1}{2}\right)\).

**Assumption 1. (Not too large prior)** \(q \in \left(1 - \tilde{q}, \tilde{q}\right)\), with \(\tilde{q} = \frac{(1-\varepsilon)[1-\varepsilon(1-\rho)]}{1-2(1-\varepsilon)(1-\rho)}\).

Let \(\tilde{q} = P(w_E/s_1, s_2)\) be the (non-ideological) voters’ posterior belief that the state is \(w_E\), conditioned on candidates 1 and 2 observing signals \(s_1\) and \(s_2\), respectively. Assumption 1 guarantees that, independently of which policy, \(E\) or \(A\), the prior distribution of the state is in favor to, non-ideological voters may change their mind and end up with a belief that differs from their initial one. That is, if \(q \in \left(1 - \tilde{q}, \tilde{q}\right)\), \(\tilde{q}\) has support in all interval \((0, 1)\). Note, additionally, that the voters’ updated beliefs may favor a policy that is not proposed by any of the candidates.\(^{20}\) In this case, we assume non-ideological voters are bound to vote for

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\(^{16}\)There is a third case, that corresponds to the situation of a balanced prior \((q = 1/2)\).

\(^{17}\)Applying Bayes rule we observe that \(P(w = w_E/s_1 = e, s_2 = e) > P(w = w_A/s_1 = e, s_2 = e)\) if and only if \(q[(1-\varepsilon)^2 + \rho \varepsilon (1-\varepsilon)] > (1-q)[\varepsilon^2 + \rho \varepsilon (1-\varepsilon)]\), which always holds as \(\varepsilon < 1/2\) and \(q > 1/2\).

\(^{18}\)By Bayes rule, \(P(w = w_E/s_i = e, s_j = a) > P(w = w_A/s_i = e, s_j = a)\), for \(i \neq j\), if and only if \(q(1-\rho)\varepsilon (1-\varepsilon) > (1-q)(1-\rho)\varepsilon (1-\varepsilon)\), which always holds as \(q > 1/2\).

\(^{19}\)The reader can easily check that \(\tilde{q} > \frac{1}{2}\) if and only if \(\varepsilon < \frac{1}{2}\), which is always the case. Hence, the region \(q \in \left(\frac{1}{2}, \tilde{q}\right)\) does exist.

\(^{20}\)Since \(x_i = E\), this could only be the case if voters observe \((x_1, x_2) = (E, E)\) and the posterior belief is \(\tilde{q} < \frac{1}{2}\), i.e., the posterior advocates austerity measures. This occurs when either \(q > 1/2\) and the two candidates use a reversed strategy, or \(q < 1/2\) and there is at least one candidate using a reversed strategy.
a candidate that supports their non-preferred policy.

We can now go into the analysis of the voting process and the formation of the government. Remember that a majority of votes is required to govern.

Given \((x_1, x_2) = (j, k)\), with \((j, k) \in \{E, A\}^2\), we define \(G^{x_1x_2} \subset \{\{1\}, \{2\}, \{3\}, \{1, 2\}, \{1, 3\}, \{2, 3\}, \{1, 2, 3\}\}\) as the set of all government compositions (single-party governments and coalition governments), that can result in equilibrium. Let \(g^{x_1x_2}\) be an element of this set.

Assuming that a fully revealing equilibrium is played in the first stage of the game, the next result lists all the compositions of the government that, for a particular platform profile, can result in equilibrium.\(^{21}\) We obtain that when no candidate gets an absolute majority of votes, only minimal politically-akin coalitions can form, i.e., coalitions between candidates that propose the same policy. Note that this is the case even though we consider office-seeking candidates. The reason being the assumption of a majority of non-ideological voters, whose vote determines the election outcome, which means they can always vote as to prevent the formation of a non-akin coalition.\(^{22}\)

**Lemma 1.** Given a platform profile \((x_1, x_2) = (j, k)\), for \((j, k) \in \{E, A\}^2\), the set of all government structures \(G^{x_1x_2}\) that can be sustained in equilibrium are:

(i) For any \(\hat{q} \in (0, 1)\), \(G^{EE} = \{\{1\}, \{2\}, \{3\}, \{1, 2\}, \{1, 3\}, \{2, 3\}\}\).

(ii) If \(\hat{q} < 1/2\), \(G^{EA} = \{\{2\}\}\), and if \(\hat{q} > 1/2\), \(G^{EA} = \{\{1\}, \{3\}, \{1, 3\}\}\).

(iii) If \(\hat{q} < 1/2\), \(G^{AE} = \{\{1\}\}\), and if \(\hat{q} > 1/2\), \(G^{AE} = \{\{2\}, \{3\}, \{2, 3\}\}\).

(iv) If \(\hat{q} < 1/2\), \(G^{AA} = \{\{1\}, \{2\}\}\), and if \(\hat{q} > 1/2\), \(G^{AA} = \{\{3\}\}\).

**Proof.** In the Appendix.

\(^{21}\)The analysis assumes \(q \neq 1/2\). As for the case \(q = 1/2\), the posterior on the state is either \(\hat{q} > 1/2\), \(\hat{q} < 1/2\) or \(\hat{q} = 1/2\). Regarding the last case, an analogous argument to the one used in the text shows that for any platform profile \((x_1, x_2) = (j, k)\), for \((j, k) \in \{E, A\}^2\), \(G^{AA} = \{\{1\}, \{2\}, \{3\}, \{1, 2\}, \{1, 3\}, \{2, 3\}\}\). Hence, under this assumption, in equilibrium, any coalition can form.

\(^{22}\)The literature on coalition formation includes papers that consider ideological political parties, which suffer a disutility when the policy implemented by the coalition they belong to differs from their own preferred electoral position. See Austen-Smith and Banks (1988). This assumption is usually intended to reduce the number of coalitions that can form in equilibrium. The reader can note that this assumption will not play any role in this paper (in terms of reducing the number of coalitions) since, in equilibrium, only ideologically-akin coalitions get enough votes as to form a government. Hence, in this work we abstract from this type of consideration.
no coalition between the two strategic candidates can form. The reason to this appears straightforward in the case where the two politicians propose different policies, but turns to be not so clear in the case where they both support the austerity policy. To see this point, note that in this case candidate 3 always gets the support of the ideological voters, which means that for policy $A$ to be implemented, the non-ideological voters must assure that one of the strategic candidates gets an absolute majority of votes. Hence the result.

4 Information transmission

We now return to the main question of whether the two major candidates can credibly communicate their information to the voters through their choice of policy platforms. To this aim, we go backwards and analyze whether the resulting government composition allows for information transmission. We focus on fully revealing equilibria.$^{23}$

Like biases

Let us start considering the case in which politicians know that expansionary fiscal policies are more popular within the electorate than cutbacks and other stiff austerity measures. In terms of our analysis, this means $P(w_E) = q > 1/2$. That is, the prior distribution of the state is in favor of fiscal stimulus policies. In this case, a non-ideological voter with no other information than her prior prefers $E$. Note that in this case both ideological and non-ideological voters have the same like biases.

Perhaps somewhat surprising, our results show that candidates can, in this case, credibly communicate their information to the voters. More interestingly, we obtain that the number of government structures that allows for full revelation is here greater than in the case of opposing biases, which is analyzed next.

How can it be that the number of equilibria in which the two major parties behave honestly is higher when the electorate is homogeneous than when voters have different points of view? To see the intuition for this result, note that in both scenarios, the strategic candidates have an incentive to bias their message towards the electorate’s preferred policy, as in HL03.$^{24}$ However, the presence of third candidates who dogmatically support fiscal stimulus policies introduces a second effect, that reduces the attractiveness of proposing $E$. In the case of like

\[\text{E} \quad \frac{1}{2} \quad \text{E} \]

$^{23}$The analysis of this section is done for the cases in which the electorates’ prior is biased in favor of one of the states. As for the case $q = 1/2$, after two contradicting signals, the posterior will be $\hat{q} = 1/2$, which does not impose any restriction on the government composition. That is, if $q = 1/2$, information transmission is easily attainable.

$^{24}$Given that signals are of the same quality, any voter observing two contradicting signals would cancel out the content of the two signals and so, would vote for the candidate that proposes the policy the prior is in favor to.

$^{25}$Any strategic candidate proposing $E$ has to take into account that some of the votes of those who prefer $E$ may go for the deterministic candidate.
biases, this second effect counterbalances and offsets the first one, hence facilitating equilibria in which the two major parties behave honestly. In contrast, in the case of opposing biases, the first and the second effect go in the same direction, making therefore information transmission more difficult to hold.

Next, we introduce an assumption that only applies in the case of like biases and that will allow us to simplify the analysis of this scenario.

Assumption 2. (Equal treatment of equals) If \( g_{EA}^E = \{1\} \), then \( g_{AE}^E = \{2\} \); if \( g_{EA}^E = \{3\} \), then \( g_{AE}^E = \{3\} \); and if \( g_{EA}^E = \{1, 3\} \), then \( g_{AE}^E = \{2, 3\} \).

Note that this assumption only restricts the voting behavior, therefore the electoral outcome, when the two strategic candidates support different policies (in which case, the voters’ preferred policy is \( E \)). That is, when the non-ideological voters’ choice is between the deterministic candidate and the only strategic candidate that proposes \( E \). To these situations, Assumption 2 states that the identity of the downian politician (whether he is 1 or 2) does not affect the voting behavior. Last, for \( i, j \in \{e, a\} \), let us define \( P_{ij} = P(s_2 = i/s_1 = j) \).

Proposition 1. (Like biases) Under Assumption 1 and 2, a configuration \( \{\sigma_c; \{g_{x_1x_2}\}_{x_1x_2 \in (E,A)^2}\} \) constitutes a fully revealing equilibrium if and only if:

(i) \( \sigma_c = (1, 0; 1, 0) \) and either:

\[
\begin{align*}
(a) \quad & g_{EA}^E = g_{AE}^E = \{3\}, \; g_{AA}^E = g_{EE}^E = \{1\}; \text{ or} \\
(b) \quad & g_{EA}^E = g_{AE}^E = \{3\}, \; g_{AA}^E = \{1\}, \; g_{EE}^E = \{1, 3\}, \text{ with } P_{e/e} \geq 2P_{a/e}; \text{ or} \\
(c) \quad & g_{EA}^E = g_{AE}^E = \{3\}, \; g_{AA}^E = g_{EE}^E = \{2\}; \text{ or} \\
(d) \quad & g_{EA}^E = g_{AE}^E = \{3\}, \; g_{AA}^E = \{2\}, \; g_{EE}^E = \{2, 3\}, \text{ with } P_{e/e} \geq 2P_{a/e}; \text{ or}
\end{align*}
\]

(ii) \( \sigma_c = (1, 0; 0, 1) \), \( g_{AE}^E = \{1\} \), \( g_{AA}^E = \{3\} \) and either:

\[
\begin{align*}
(a) \quad & g_{EE}^E = \{1\}, \; g_{EA}^E = \{3\}; \text{ or} \\
(b) \quad & g_{EE}^E = \{3\}, \; g_{EA}^E = \{1\}; \text{ or} \\
(c) \quad & g_{EE}^E = \{3\}, \; g_{EA}^E = \{1, 3\}, \; P_{e/e} > 2P_{a/e}; \text{ or} \\
(d) \quad & g_{EE}^E = \{1, 3\}, \; g_{EA}^E = \{1, 3\}; \text{ or} \\
(e) \quad & g_{EE}^E = \{1, 3\}, \; g_{EA}^E = \{1\}, \; P_{a/a} > 2P_{e/a}; \text{ or}
\end{align*}
\]

(iii) \( \sigma_c = (0, 1; 1, 0) \), \( g_{EA}^E = \{2\} \), \( g_{AA}^E = \{3\} \) and either:

\[
\begin{align*}
(a) \quad & g_{EE}^E = \{2\}, \; g_{AE}^E = \{3\}; \text{ or} \\
(b) \quad & g_{EE}^E = \{3\}, \; g_{AE}^E = \{2\}; \text{ or} \\
(c) \quad & g_{EE}^E = \{3\}, \; g_{AE}^E = \{2, 3\}, \; P_{e/e} > 2P_{a/e}; \text{ or} \\
(d) \quad & g_{EE}^E = \{2, 3\}, \; g_{AE}^E = \{2, 3\}; \text{ or} \\
(e) \quad & g_{EE}^E = \{2, 3\}, \; g_{AE}^E = \{2\}, \; P_{a/a} > 2P_{e/a}; \text{ or}
\end{align*}
\]
\[(iv) \sigma_c = (0, 1; 0, 1) \text{ and } g^{AA} = g^{EA} = g^{AE} = g^{EE} = 3.\]

Proof. In the Appendix. \qed

Proposition 1 yields a number of remarkable comments. First and foremost, that the most robust equilibrium is the one in which candidates use a faithful strategy (case (i)). Nonetheless, this is the only equilibrium in which the two main candidates have chances of winning office (although not together in a coalition, as discussed next). Apart from this case, one of the strategic candidates (the one using the reversed strategy) never gets elected, which is the reason that explains why we can sustain these equilibria. In this sense, equilibria in (ii) – (iv) are more fragile than that in (i).

The second important remark is that none of the previous equilibria comprise a coalition between the two mainstream candidates. A result that is grounded in the fact that, after observing \((x_1, x_2) = (A, A)\), if \(\bar{q} < \frac{1}{2}\), non-ideological voters need vote for one of the strategic candidates with probability one.\(^{25}\) This apparently minor feature obliges the non-ideological voters to vote again with probability one for the same main candidate when the platform observed is \((x_1, x_2) = (E, E)\). Otherwise, the candidate who previously received no votes could find it profitable to deviate to \(E\).

Last, we observe that a necessary condition for some of the government structures to sustain information transmission is \(P_{i/i} \geq 2P_{i/j}\). Since \(P_{i/i}\) is increasing in \(\rho\) and decreasing in \(\varepsilon\), and \(P_{i/j}\) is decreasing in \(\rho\) and increasing in \(\varepsilon\), we obtain that the higher the correlation between the candidates’ signals (\(\rho\)) and the lower the signal’s error (\(\varepsilon\)), the higher the number of the government structures that sustain information transmission. Next Corollary formalizes this idea.

**Corollary 1.** The number of the government structures that allow for information transmission increases in:

(i) the correlation between the candidates’ signals,
(ii) the quality of the signals.

Proof. From the signal technology described in Table 1, we obtain \(P_{i/i} = (1 - \varepsilon)^2 + \varepsilon^2 + 2\rho\varepsilon(1 - \varepsilon)\) and \(P_{i/j} = 2(1 - \rho)(1 - \varepsilon)\). Since \(\partial P_{i/i}/\partial \rho > 0\), \(\partial P_{i/i}/\partial \varepsilon = 2(2\varepsilon - 1)(1 - \rho) < 0\), \(\partial P_{i/j}/\partial \rho < 0\) and \(\partial P_{i/j}/\partial \varepsilon = 2(1 - \rho)(1 - 2\varepsilon) > 0\), the proof follows. \(\Box\)

### Opposing biases

Let us now consider the case of non-ideological voters ex ante thinking that austerity measures are more appropriate than expansionary fiscal policies to return sustainable economic growth. In terms of our analysis, this means \(P(w_E) = q < 1/2\). That is, the prior distribution of the state is in favor of austerity policies. In this case, we say that ideological and non-ideological voters have opposing biases.

\(^{25}\)So as to prevent an eventual coalition between the deterministic (proposing \(E\)) and a strategic candidate (proposing \(A\)), in which case the implemented policy would differ from the non-ideological voters’ preferred policy, which in this case is \(A\).
As already pointed out, our result here shows that while we might be inclined to think that candidates have more incentives to behave honestly when the electorate is heterogeneous than when all voters are (ex-ante) biased in favor of a policy, the presence of opposing views does not facilitate but makes information transmission harder. We base this conclusion on two arguments: First, the number of equilibria in which candidates can credibly communicate their information to voters is here smaller than in the case of like biases. The reason being that with opposing biases, the incentive to go for the electorate’s prior (now $A$) is no longer counterbalanced, but even reinforced by the existence of a deterministic candidate that dogmatically supports policy $E$. Second, the equilibria in the present case are quite fragile, in the sense that these equilibria always embed one candidate, the one using a reversed strategy, that loses the election for sure.\footnote{Similarly to cases (ii) – (iv) in Proposition 1.}

**Proposition 2.** (Opposing biases) Consider \( q \in (1 - \tilde{q}, \frac{1}{2}) \). A configuration \( (\sigma_c; \{g^{x_1,x_2}\}_{(x_1,x_2) \in (E,A)^2}) \) constitutes a fully revealing equilibrium if and only if:

(i) \( \sigma_c = (1,0;0,1) \) and \( g^{AA} = g^{AE} = g^{EA} = g^{EE} = \{1\} \); or

(ii) \( \sigma_c = (0,1;1,0) \) and \( g^{AA} = g^{AE} = g^{EA} = g^{EE} = \{2\} \).

**Proof.** In the Appendix. \( \Box \)

The comparison between the results in Propositions 1 and 2 draws an important conclusion: It is neither the fact that voters are homogeneous, nor even the existence of a deterministic politician, that facilitates credible transmission of information by office-motivated candidates. The crucial feature is what policy does the deterministic candidate support. Our result is that populist third candidates, i.e., those dogmatically supporting the policy (ex-ante) preferred by the majority of the electorate, are those that do indeed facilitate equilibria in which the two major candidates behave honestly.

It is also important to realize that the informativeness of electoral processes comes at a price. Namely, that for some platform profile, third candidates may form government. Note that this does not mean that the policy implemented in this case might be the inappropriate one. To see it, note that in any fully revealing equilibrium, non-ideological voters are able to extract all the information contained in the candidates’ signals. This, together with the fact that they want the policy implemented to be congruent with the state of the world, yields the result that the implemented policy will always be the one that, in expected terms, best fits the state. Hence, the cost we refer to has to be with the more subtle aspect of being governed by a politician who is known will never react to changes in the economic state. That is, a politician that will dogmatically insist on the very same class of policies, independently of their effectiveness.
5 Discussion

We now discuss how the main two assumptions in the model affect our results.

5.1 Two-candidate competition

We first relax the assumption of three candidates competing for office and analyze an scenario with, exclusively, two office-motivated candidates. Note that in this case, there is no room for coalitions, as winning office is only a matter of getting more votes than your opponent. In this sense, we here consider candidates that maximize their number of votes.\textsuperscript{26}

Remember we denote by $\sigma_{i,k}^1$ and $\sigma_{i,k}^2$ the probability that a non-ideological and ideological voter, respectively, votes for $i \in \{1, 2\}$, after observing the policy proposal $(x_1, x_2) = (j, k)$, with $(j, k) \in \{E, A\}^2$.

As in the main body of the paper, we posit two scenarios, like biases and opposing biases. Interestingly, our result now shows that there is no information transmission in the case of like biases, but it does in the case of opposing biases.\textsuperscript{20} Paradoxically, this is in contrast to the results in the previous section, where the presence of an electorate with a like bias facilitated equilibria in which the two main candidates behaved honestly. This means that the result in the present set-up goes much in line with the stark intuition that heterogeneity of views within the voters reduces the incentives to go for the electorate’s prior. In fact, this is the reason that explains the next result.

Proposition 3. (Two-candidate system) Suppose $q \neq 1/2$. A configuration $(\sigma_c; \{\sigma_{i,x_2}^1, \sigma_{i,x_2}^2\}_{(x_1,x_2) \in \{E,A\}^2})$ constitutes a fully revealing equilibrium if and only if $q < 1/2$, $\beta = 1/2$ and either:

(i) $\sigma_c = (1, 0; 0, 0)$, $\sigma_{i,1}^{AE} = 1$, $\sigma_{i,1}^{EA} = 0$ and $\sigma_{i,1}^{AA} = \sigma_{i,1}^{EE} = 1/2 \forall i \in \{4, 5\}$; or

(ii) $\sigma_c = (0, 1; 0, 1)$, $\sigma_{i,1}^{AE} = 1$, $\sigma_{i,1}^{EA} = 0$ and $\sigma_{i,1}^{AA} = \sigma_{i,1}^{EE} = 1/2 \forall i \in \{4, 5\}$.

Proof. In the Appendix. $\square$

Proposition 3 shows that if there are only two candidates competing for office, the electoral process can only be informative if voters have opposing views. Otherwise, the incentive to go for the popular belief prevents any information flow. Note that this is much a reflect of the result in HL03, who for a set-up with one

\textsuperscript{26} The simpler set-up with only two politicians allowing us to consider candidates that maximize their number of votes. Note that this is in contrast to the main body of the paper, where analytical results could only be obtained under the assumption that candidates maximize their probability of winning. Note, additionally, that under the new scenario, there is no longer a need to know which candidate wins for each platform profile. This allows us to relax the assumption that $\beta > 1/2$, and consider instead the more general case of $\beta \in (0, 1)$.

\textsuperscript{20} As for the case $q = 1/2$, it can be shown that there is an equilibrium in which the two candidates use a truthful strategy, i.e., $\sigma_c = (1, 0; 1, 0)$. A necessary condition is required for this equilibrium to hold: $\sigma_{i,1}^{AE} + \sigma_{i,2}^{EA} = 1$, hence $\sigma_{i,2}^{AA} + \sigma_{i,1}^{EE} = 2\beta - 1$, which further requires $\beta \geq 1/2$. 

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(non-ideological) voter, showed that because of the too powerful drawing power of the electorate’s prior, office-motivated candidates could not credible communicate their information to the voters.

Going back to our analysis, note that the equilibria in Proposition 3 are fragile, in the sense that they require a very particular group configuration and a very specific voting profile. Namely, that ideological and non-ideological voters are equal in size, and that when the two candidates choose the same platform, they share the votes equally. Despite this limitation, the relevance of this result is that it puts forth the role of voters heterogeneity in a context that, if not for this diversity, would be identical to that in HL03. In this sense, our paper presents an extension to their work, not only for considering heterogeneity of voters, but for the introduction of a third candidate.

5.2 One type of voter

Let us now consider that voters are only of one type: non-ideological. That is, there is an unanimous consensus in the electorate that the best policy is that fitting the state of the world.

To be consistent with the main body of the paper, we consider that the third candidate is biased in favor of a policy of fiscal stimulus. Additionally, we assume $q > 1/2$, i.e., with no other information, voters think that expansionary fiscal policies are the most appropriate ones to return economic growth.

Our first result refers to the voting behavior and the resulting electoral outcomes.

**Lemma 2.** Given a platform profile $(x_1, x_2) = (j, k)$, for $(j, k) \in \{E, A\}^2$, the government structures $G^{x_1x_2}$ that can be sustained in equilibrium are:

(i) For any $\hat{q} \in (0, 1)$, $G^{EE} = \{\{1\}, \{2\}, \{3\}, \{1, 2\}, \{1, 3\}, \{2, 3\}\}$.

(ii) If $\hat{q} < 1/2$, $G^{EA} = \{\{2\}\}$, and if $\hat{q} > 1/2$, $G^{EA} = \{\{1\}, \{3\}, \{1, 3\}\}$.

(iii) If $\hat{q} < 1/2$, $G^{AE} = \{\{1\}\}$, and if $\hat{q} > 1/2$, $G^{AE} = \{\{2\}, \{3\}, \{2, 3\}\}$.

(iv) If $\hat{q} < 1/2$, $G^{AA} = \{\{1\}, \{2\}, \{1, 2\}\}$, and if $\hat{q} > 1/2$, $G^{AA} = \{\{3\}\}$.

A comparison between Lemmas 1 and 2 shows that for those platform configuration for which $\hat{q} > 1/2$, nothing changes when moving from a scenario with two groups of voters to one with one group. The reason being that in this case, and in both scenarios, all voters have a preference for the expansionary fiscal policy, so the number of groups is irrelevant to the result. In contrast, the case with $\hat{q} < 1/2$

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30In the case $q < 1/2$, we predict no equilibrium with full revelation. The reason is that in this case, the incentive to go for the electorate's' prior (now A) is not counterbalanced by the existence of a third candidate dogmatically proposing that policy, but even reinforced by the fact that this candidate always proposes $E$. 

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illustrates a situation where opinions differ. Note, however, that despite the opposing views, if only one candidate proposes the austerity policy, the equilibrium strategy of the majority group is, in both cases, unique. Namely, to vote for that candidate with probability one. This means that, also in this case, there is no difference between the two scenarios. The difference is thus to be found in the case that is left: The posterior favors the austerity policy, which happens to be the policy proposed by the two office-motivated candidates. In this case, we now obtain that a coalition between the two mainstream candidates can form. This is in contrast to the case with two groups of voters, where no government coalition between the strategic candidates were possible. The fact that there are no ideological voters in the present case is key to the result.

Taking into account that if \( \hat{q} < 1/2 \), \( G^{AA} = \{1, 2, 1, 2\} \) in the present scenario, we now go into the analysis of the corresponding information transmission game. We obtain that, in addition to the equilibria characterized in Proposition 1, there are two new government structures that facilitate equilibria in which the two major candidates behave honestly. Additionally, we obtain that these new equilibria embed the two strategic politicians faithfully revealing their information to the electorate, and forming the government coalition \( C = \{1, 2\} \) when their signals coincide.

**Proposition 4.** (One type of voter) A configuration \( (\sigma_c; \{g^{x_1,x_2}\}_{(x_1,x_2) \in (E,A)^2}) \) constitutes a fully revealing equilibrium if and only if it satisfies one of the conditions (i)-(iv) of Proposition 1, or condition

(v) \( \sigma_c = (1,0,1,0) \) and either:

(a) \( g^{EA} = \{1,3\}, g^{AE} = \{2,3\}, g^{AA} = \{1,2\}, g^{EE} = \{3\}; \) or

(b) \( g^{EA} = g^{AE} = \{3\}, g^{AA} = \{1,2\}, g^{EE} = \{1,2\}. \)

**Proof.** In the Appendix.

Our analysis with only one type of voter is a generalization of Felgenhauer (2012), who proposes an interesting model that shares with the present paper the idea of considering a third candidate and studying how the incentives to transmit information are shaped when a third dogmatic politician enters the game. Despite the common inspiration, the analysis and the results in our paper differ substantially from those in Felgenhauer (2012). First and foremost, his analysis is done for a setup with only one voter.\(^3\) Additionally, we consider a more sophisticated signal technology, which allows us to study the importance of the signals’ correlation

\(^3\) The implications of the presence of two groups of voters are clear at this point. First one is that it enriches the analysis, introducing strategic considerations within these groups. Namely, non-ideological voters that, in case of indifference between two candidates that propose austerity policies, need to vote in block for one of them, so that no room for a coalition with the third candidate is left. Second, the presence of two groups of voters reveals that the electoral process is more likely to be informative when the third candidates favor the policy preferred by the majority of the electorate, than when they cater to a minority group.
and/or the signals’ quality in the results. Last, we explicitly model the government formation process, which later on allows us to characterize all the government structures that embed information transmission.\textsuperscript{32}

6 Conclusion

It is little wonder that past 2014 European Elections will be remembered as the rejection election. Indeed, poll results all over Europe showed the end of the seemingly settled two-party political system of the mid-20th century. From Britain to Denmark, France, Italy or Spain, "the center-left and center-right groups that form the core of national and European Union politics have seen their power eroded by the rise of extremist parties very different from one another, united only by their rejection of the way things are, both at home and at the European Union" (As goes Greece, so goes Europe?, \textit{The New York Times}, 28th May 2014).

The rise of third parties presents an unprecedented challenge to mainstream political parties and to the society as a whole. What consequences will this threat have for the economic model that will govern us in the near future is something that we will learn in due course. As for the consequences that this threat can have for the informativeness of electoral processes, this paper already presents results in this direction.

In this work we argue that, contrary to expected, the presence of third deterministic candidates, far from eroding the informativeness of electoral processes, might actually help ease the information transmission game. Additionally, and again contrary to what we might be inclined to think, we show that the candidates’ capacity to credibly communicate their information to the voters is greater when all the voters are biased in the same direction, than when there are conflicting views in the electorate. Last, we obtain that only politically-akin coalitions embed information transmission, and that a governing coalition will never be formed between the two mainstream parties.

7 Appendix

Proof of Proposition 1:

\textit{Proof.} Prior to the analysis, note that the rents from office $K$ are to be shared between the politicians in the government. This means that if for candidate $i$, $v_i > 1/2$, in equilibrium, he is going to govern alone, i.e., $G = \{i\}$. Analogously, if $\max\{v_1, v_2, v_3\} < 1/2$, in equilibrium, only minimal winning coalitions form, i.e., $C = \{\{1, 2\}, \{1, 3\}, \{2, 3\}\}$. Next, we analyze the four cases considered in the statement:

\textsuperscript{32}This analysis yields interesting insights, as it is that there is no fully revealing equilibrium in which for the same, or even for different platforms profiles, the two strategic candidates have chances of winning office; and that there is neither an equilibrium in which the two mainstream candidates are coalition partners.
(i) Consider \((x_1, x_2) = (EE)\). In this case only expansionary fiscal policies are being proposed, therefore only stimulus policies can be implemented. Thus, if the posterior belief says that policy \(E\) is best, the payoff to the non-ideological voter is 1, independently of her vote; whereas it is 0, independently of her vote, if the posterior indicates \(A\). Hence, any strategy \((\sigma_{A, EE}^*, \sigma_{EA, EE}^*, \sigma_{AE, EE}^*) \in [0, 1]^3\), such that \(\sum_{i=(1,2,3)} \sigma_{i, EE}^* = 1\) is an equilibrium strategy profile for the non-ideological voter. As for the ideological voter, \((\sigma_{A, EE}^*, \sigma_{A, EE}^*, \sigma_{AE, EE}^*) \in [0, 1]^3\), such that \(\sum_{i=(1,2,3)} \sigma_{i, EE}^* = 1\). Then, in equilibrium, one of the following voting profiles result:

- \(v_i > 1/2\), for some \(i \in \{1, 2, 3\}\). In this case, candidate \(i\) gets an absolute majority of votes and wins office with probability one. Formally, \(G_{EE} = \{\{i\}\}\).

- \(\max\{v_1, v_2, v_3\} < 1/2\). In this case, for all \(i, j, k \in \{1, 2, 3\}\), \(v_i + v_j = v_i + (1 - v_i - v_k) = 1 - v_k > 1/2\). Hence, any coalition of any two candidates is a winning coalition and can therefore form a government. Formally, \(G_{EE} = \{\{1, 2\}, \{1, 3\}, \{2, 3\}\}\).

- \(v_i = 1/2, v_j, v_k > 0\), for \(i, j, k \in \{1, 2, 3\}\). In this case, \(v_i + v_j > 1/2, v_i + v_k > 1/2\) and \(v_j + v_k = 1/2\). Hence, only coalitions including candidate \(i\) are winning coalitions. Formally, \(G_{EE} = \{\{i, j\}, \{i, k\}\}\).

- \(v_i = v_j = 1/2, v_k = 0\), for \(i, j, k \in \{1, 2, 3\}\). In this case, only \(v_i + v_j > 1/2\). Then, \(G_{EE} = \{\{i, j\}\}\).

(ii) Consider \((x_1, x_2) = (EA)\). In this case \((\sigma_{A, EA}^*, \sigma_{A, EA}^*, \sigma_{A, EA}^*) = (\varepsilon, 0, 1 - \varepsilon)\), with \(\varepsilon \in [0, 1]\).

First, consider \(\hat{q} < 1/2\), i.e., the voter’s updated belief says that policy \(A\) is best. In this case, the payoff to a non-ideological voter is \(U_4(A, w_A) = 1\) when the elected government consists of candidate 2 alone, whereas it is smaller otherwise.\(^{35}\) Then, \((\sigma_{1, EA}^*, \sigma_{4, EA}^*, \sigma_{4, EA}^*)\) is an equilibrium strategy profile for the non-ideological voter if and only if \(\beta \sigma_{1, EA}^* > \beta (\sigma_{4, EA}^* + \sigma_{4, EA}^*) + (1 - \beta)\), i.e., \(v_2 > v_1 + v_3\). Hence, \(G_{EA} = \{\{2\}\}\).

Now, consider \(\hat{q} > 1/2\). Here, if \(G \in \{\{1\}, \{3\}, \{1, 3\}\}\), the payoff to a non-ideological voter is \(U_4(E, w_E) = 1\), whereas it is smaller otherwise. Hence, the non-ideological voter must prevent candidate 2 from getting into office.

\(^{33}\)Note that if having half of the votes were sufficient to govern, we would have another possible electoral outcome, in which either candidate \(i\) would govern alone or a coalition between candidates \(j\) and \(k\) would do. Then, \(G_{EE} = \{\{i, j\}, \{i, k\}, \{i \lor j\}\}\).

\(^{34}\)Again, if having half of the votes were sufficient to govern, the set of electoral outcomes would be \(G_{EE} = \{\{i, j\}, \{i \lor j\}\}\).

\(^{35}\)The payoff to a non-ideological voter would be either 0, if the resulting government implements policy \(E\), or \(\alpha \in (0, 1)\), if the policy implemented by the resulting government is a convex combination of stimulus and austerity measures. Here, \(\alpha\) corresponds to the probability that policy \(A\) is implemented.
This means that her equilibrium strategy profile \((\sigma_{4,1}^{*EA}, \sigma_{4,2}^{*EA}, \sigma_{4,3}^{*EA})\) must satisfy that if neither candidate 1 nor 3 gets an absolute majority of votes, candidate 2 cannot form government. Mathematically, \(v_2 + v_i < 1/2\), for \(i \in \{1, 3\}\), where, in our case \(v_2 = \beta \sigma_{4,2}^{EA}\) and \(v_i = \beta \sigma_{4,i}^{EA} + (1 - \beta) \sigma_{5,i}^{EA}\). But for this to be true, \(\sigma_{4,2}^{*EA} = 0\), as otherwise \(v_2 + v_i = (1 - v_i - v_i) + v_i > 1/2\), given no candidate wins an absolute majority of votes. Thus, in equilibrium, \(v_2 = 0\), and either candidate 1 or 3 gains a strict majority of votes and governs alone, or both candidates obtain half of the votes, in which case a coalition between these candidates must form.\(^{36}\) Hence, \(G^{EA} = \{\{1\}, \{3\}, \{1, 3\}\}\).

(iii) Consider \((x_1, x_2) = (AE)\). Analogously to the previous case, we obtain that if the voter’s updated belief says that policy \(A\) is best, \(G^{AE} = \{\{1\}\}\); whereas if it says that policy \(E\) is best, \(G^{AE} = \{\{2\}, \{3\}, \{2, 3\}\}\).

(iv) Last, consider \((x_1, x_2) = (AA)\). In this case \((\sigma_{5,1}^{*AA}, \sigma_{5,2}^{*AA}, \sigma_{5,3}^{*AA}) = (0, 0, 1)\).

First, consider \(q < 1/2\). Here, if the resulting government is \(G \in \{\{1\}, \{2\}, \{1, 2\}\}\), the payoff to a non-ideological voter is \(U_4(A, w_A) = 1\), whereas it is smaller otherwise. This means that the non-ideological voter must prevent candidate 3 from entering the government. Using an analogous argument to that used in case (ii) of the proof, it means that her equilibrium strategy profile \((\sigma_{4,1}^{*AA}, \sigma_{4,2}^{*AA}, \sigma_{4,3}^{*AA})\) must satisfy that if neither candidate 1 nor 2 gets an absolute majority of votes, candidate 3 cannot be pivotal. As shown before, it requires \(\sigma_{4,3}^{*AA} = 0\). Note, however, that even if this holds, \(v_3 = 1 - \beta > 0\), as candidate 3 gets in this case the votes of the ideological voters. Hence, if no candidate gets an absolute majority of votes, candidate 3 could happen to enter the government. Then, the equilibrium strategy profile for the non-ideological voter \((\sigma_{4,1}^{*AA}, \sigma_{4,2}^{*AA}, \sigma_{4,3}^{*AA})\) must satisfy either \(\beta \sigma_{4,1}^{*AA} > 1/2\) or \(\beta \sigma_{4,2}^{*AA} > 1/2\). Note that \(\beta \sigma_{4,1}^{*AA} = 1/2\) (analogously, \(\beta \sigma_{4,2}^{*AA} = 1/2\) is not possible in equilibrium. To see it, let us consider \(\beta \sigma_{4,1}^{*AA} = 1/2\). In this case \(v_1 + v_3 > 1/2\), which means that candidate 3 could eventually enter the government, in which case the payoff to the non-ideological voter would be smaller. Hence, \(\beta \sigma_{4,1}^{*AA} > 1/2\) and therefore, \(G^{AA} = \{\{1\}, \{2\}\}\).

Last, consider \(q > 1/2\). In this case, the payoff to a non-ideological voter is \(U_4(E, w_E) = 1\) when the elected government consists of candidate 3 alone, and it is smaller otherwise. Then, \((\sigma_{4,1}^{*AA}, \sigma_{4,2}^{*AA}, \sigma_{4,3}^{*AA})\) is an equilibrium strategy profile for the non-ideological voter if and only if \(\beta \sigma_{4,3}^{*AA} + 1 - \beta > \beta (\sigma_{4,1}^{*AA} + \sigma_{4,2}^{*AA})\). Hence, \(G^{AA} = \{\{3\}\}\). This completes the proof.

Proof of Proposition 1:

\(^{36}\)Given the assumption that a strict majority of votes is required to govern. If we were to relax this assumption and allow for a coin toss to decide who wins in this case, the set of electoral outcomes would be \(G^{EE} = \{\{1\}, \{3\}, \{1, 3\}, \{1 \lor 3\}\}\).
Proof. We have to analyze four cases:

(i) Let us conjecture an equilibrium in which \( \sigma_c = (1, 0; 1, 0) \).

In equilibrium, choosing \( E \) when having observed \( e \) must be a best response for candidates 1 and 2, respectively:

\[
P_{e/e} \begin{cases} 
K & \text{if } g^{EE} = \{1\} \\
K/2 & \text{if } g^{EE} \in \{(1,2), (1,3)\} \\
0 & \text{if } g^{EE} \in \{(2,2), (2,3)\}
\end{cases} + 
P_{a/e} \begin{cases} 
K & \text{if } g^{EA} = \{1\} \\
K/2 & \text{if } g^{EA} = \{1,3\} \\
0 & \text{if } g^{EA} = \{3\}
\end{cases}
\]

\[
P_{a/e} \begin{cases} 
K & \text{if } g^{EA} = \{1\} \\
K/2 & \text{if } g^{EA} = \{1,3\} \\
0 & \text{if } g^{EA} = \{3\}
\end{cases} \leq P_{a/a} \begin{cases} 
K & \text{if } g^{AA} = \{1\} \\
K/2 & \text{if } g^{AA} = \{1,3\} \\
0 & \text{if } g^{AA} = \{3\}
\end{cases}
\]

Analogously, choosing \( A \) when having observed \( a \) must be a best response for candidates 1 and 2, respectively:

\[
P_{a/a} \begin{cases} 
K & \text{if } g^{AA} = \{1\} \\
K/2 & \text{if } g^{AA} = \{1,3\} \\
0 & \text{if } g^{AA} = \{3\}
\end{cases} + 
P_{a/e} \begin{cases} 
K & \text{if } g^{EE} = \{1\} \\
K/2 & \text{if } g^{EE} \in \{(1,2), (1,3)\} \\
0 & \text{if } g^{EE} \in \{(2,2), (2,3)\}
\end{cases}
\]

\[
P_{a/e} \begin{cases} 
K & \text{if } g^{EE} = \{1\} \\
K/2 & \text{if } g^{EE} \in \{(1,2), (1,3)\} \\
0 & \text{if } g^{EE} \in \{(2,2), (2,3)\}
\end{cases} \geq P_{a/a} \begin{cases} 
K & \text{if } g^{AA} = \{2\} \\
K/2 & \text{if } g^{AA} = \{2,3\} \\
0 & \text{if } g^{AA} = \{3\}
\end{cases}
\]

Now, let us first suppose \( g^{EA} = \{1\} \). By Assumption 2, \( g^{AE} = \{2\} \). In this case, a necessary condition for (3) to hold is \( g^{AA} = \{1\} \), but then (4) cannot hold. Similarly, let us suppose \( g^{EA} = \{1,3\} \). By Assumption 2, \( g^{AE} = \{2,3\} \). Again, \( g^{AA} = \{1\} \) is necessary for (3) to hold, but then (4) cannot hold. Hence, there is not an equilibrium of the types conjectured.

Last, let us suppose \( g^{EA} = \{3\} \). By Assumption 2, \( g^{AE} = \{3\} \). Here we have two cases: (a) Consider \( g^{AA} = \{1\} \). A necessary condition for (4) to hold is \( g^{EE} \in \{(1,3), (1,3)\} \), and a necessary condition for (1) to hold is either \( g^{EE} \in \{(1,2), (1,3)\} \) and \( P_{e/e} \geq 2P_{a/e}, \) or \( g^{EE} = \{1\} \). Note that if \( g^{EE} \in \{(1,1), (1,3)\} \), conditions (2) and (3) hold. Hence, if either
\( g^{EE} = \{13\} \) and \( P_{e/e} \geq 2P_{a/e} \), or \( g^{EE} = \{1\} \), there is an equilibrium of the type conjectured. (b) Analogously to the previous case, there is an equilibrium in which \( g^{AA} = \{2\} \) and either \( g^{EE} = \{2, 3\} \) and \( P_{e/e} \geq 2P_{a/e} \), or \( g^{EE} = \{2\} \).

(ii) Let us conjecture an equilibrium in which \( \sigma_e = (1, 0; 0, 1) \).

In equilibrium, choosing \( E (A) \) when having observed \( e \) must be a best response for candidate 1 (2), respectively:

\[
P_{e/e} \begin{cases} 
K & \text{if } g^{EA} = \{1\} \\
K/2 & \text{if } g^{EA} = \{1, 3\} \\
0 & \text{if } g^{EA} = \{3\}
\end{cases} + P_{a/e} \begin{cases} 
K & \text{if } g^{EE} = \{1\} \\
K/2 & \text{if } g^{EE} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{EE} \in \{(2), (3), (2, 3)\}
\end{cases} \geq P_{a/e} K \quad (5)
\]

\[
0 \geq P_{e/e} \begin{cases} 
K & \text{if } g^{EE} = \{2\} \\
K/2 & \text{if } g^{EE} \in \{(1, 2), (2, 3)\} \\
0 & \text{if } g^{EE} \in \{(1), (3), (1, 3)\}
\end{cases} \quad (6)
\]

Analogously, choosing \( A (E) \) when having observed \( a \) must be a best response for candidate 1 (2), respectively:

\[
P_{a/a} K \geq P_{a/a} \begin{cases} 
K & \text{if } g^{EA} = \{1\} \\
K/2 & \text{if } g^{EA} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{EA} \in \{(2), (3), (2, 3)\}
\end{cases} + P_{e/a} \begin{cases} 
K & \text{if } g^{EA} = \{1\} \\
K/2 & \text{if } g^{EA} = \{1, 3\} \\
0 & \text{if } g^{EA} = \{3\}
\end{cases} \geq 0 \quad (7)
\]

First, note that condition (8) always hold, and that a necessary condition for (6) to hold is \( g^{EE} \in \{(1), (3), (1, 3)\} \).

Then, let us first consider \( g^{EE} = \{1\} \). In this case, a necessary condition for (7) to hold is \( g^{EA} = \{3\} \), in which case (5) holds. Hence, there is an equilibrium of the type conjectured.

Second, let us consider \( g^{EE} = \{3\} \). A necessary condition for (5) to hold is either \( g^{EA} = \{1, 3\} \) and \( P_{e/e} > 2P_{a/e} \), or \( g^{EA} = \{1\} \). Note that in both cases condition (7) holds. Hence, there is an equilibrium of the type conjectured.

Last, let us consider \( g^{EE} = \{1, 3\} \). Again, a necessary condition for (5) to hold is either \( g^{EA} = \{1, 3\} \) or \( g^{EA} = \{1\} \). (a) If \( g^{EA} = \{1\} \), a necessary condition for (7) to hold is \( P_{a/a} > 2P_{e/a} \). Hence, there is an equilibrium of the type conjectured. (b) If \( g^{EA} = \{1, 3\} \), (7) always hold. Hence, there is an equilibrium of the type conjectured.

(iii) The case \( \sigma_e = (0, 1; 1, 0) \) is analogous to the previous one.
Last, let us conjecture an equilibrium in which \( \sigma_c = (0, 1; 0, 1) \).

In equilibrium, choosing \( A \) when having observed \( e \) must be a best response for candidates 1 and 2, respectively:

\[
0 \geq P_{e/A} \begin{cases} K & \text{if } g^{AA} = (1) \\ K/2 & \text{if } g^{AA} = \{1, 3\} \\ 0 & \text{if } g^{AA} = \{3\} \end{cases} + P_{e/E} \begin{cases} K & \text{if } g^{EE} = \{1\} \\ K/2 & \text{if } g^{EE} \in \{\{1, 2\}, \{1, 3\}\} \\ 0 & \text{if } g^{EE} \in \{\{2\}, \{3\}, \{2, 3\}\} \end{cases} \tag{9}
\]

\[
0 \geq P_{e/E} \begin{cases} K & \text{if } g^{AE} = (2) \\ K/2 & \text{if } g^{AE} = \{2, 3\} \\ 0 & \text{if } g^{AE} = \{3\} \end{cases} + P_{e/A} \begin{cases} K & \text{if } g^{AA} = (2) \\ K/2 & \text{if } g^{AA} \in \{\{1, 2\}, \{2, 3\}\} \\ 0 & \text{if } g^{AA} \in \{\{1\}, \{3\}, \{1, 3\}\} \end{cases} \tag{10}
\]

For (9) and (10) to hold, a necessary condition is \( g^{EA} = g^{AE} = g^{EE} = \{3\} \). Additionally, note that if \((x_1, x_2) = (AA)\), the non-ideological voter thinks policy \( E \) is the best one, then \( g^{AA} = \{3\} \). Hence, candidates 1 and 2 never gets votes, therefore the configuration considered is an equilibrium. This completes the proof.

\[\square\]

**Proof of Proposition 2:**

*Proof.* We have to analyze four cases:

(i) Let us conjecture an equilibrium in which \( \sigma_c = (1, 0; 1, 0) \).

In equilibrium, choosing \( E \) when having observed \( e \) must be a best response for candidates 1 and 2, respectively:

\[
P_{e/E} \begin{cases} K & \text{if } g^{EE} = \{1\} \\ K/2 & \text{if } g^{EE} \in \{\{1, 2\}, \{1, 3\}\} \\ 0 & \text{if } g^{EE} \in \{\{2\}, \{3\}, \{2, 3\}\} \end{cases} \geq P_{e/E} K + P_{e/E} \begin{cases} K & \text{if } g^{AA} = \{1\} \\ K/2 & \text{if } g^{AA} \in \{\{1, 2\}, \{2, 3\}\} \\ 0 & \text{if } g^{AA} \in \{\{3\}, \{1, 3\}\} \end{cases} \tag{11}
\]

\[
P_{e/A} \begin{cases} K & \text{if } g^{AE} = \{2\} \\ K/2 & \text{if } g^{AE} \in \{\{1, 2\}, \{2, 3\}\} \\ 0 & \text{if } g^{AE} \in \{\{1\}, \{3\}, \{1, 3\}\} \end{cases} \geq P_{e/A} K + P_{e/A} \begin{cases} K & \text{if } g^{AA} = \{2\} \\ K/2 & \text{if } g^{AA} \in \{\{1, 2\}, \{2, 3\}\} \\ 0 & \text{if } g^{AA} \in \{\{3\}, \{1, 3\}\} \end{cases} \tag{12}
\]

A necessary condition for (11) to hold is \( g^{EE} = \{1\} \). But then (12) cannot hold. Hence, there is not an equilibrium of the type conjectured.

(ii) Let us conjecture an equilibrium in which \( \sigma_c = (1, 0; 0, 1) \).

In equilibrium, choosing \( E \) (\( A \)) when having observed \( e \) must be a best response for candidate 1 (2), respectively:

\[
P_{e/E} \begin{cases} K & \text{if } g^{EA} = \{1\} \\ K/2 & \text{if } g^{EA} \in \{\{1, 3\}\} \\ 0 & \text{if } g^{EA} = \{3\} \end{cases} + P_{e/E} \begin{cases} K & \text{if } g^{EE} = \{1\} \\ K/2 & \text{if } g^{EE} \in \{\{1, 2\}, \{1, 3\}\} \\ 0 & \text{if } g^{EE} \in \{\{2\}, \{3\}, \{2, 3\}\} \end{cases} \geq P_{e/E} K + P_{e/E} \begin{cases} K & \text{if } g^{AA} = \{1\} \\ K/2 & \text{if } g^{AA} \in \{\{1, 2\}, \{2, 3\}\} \\ 0 & \text{if } g^{AA} \in \{\{3\}, \{1, 3\}\} \end{cases} \tag{13}
\]
\[
P_{a/e} \left\{ \begin{array}{ll}
K & \text{if } g^{AA} = \{2\} \\
K/2 & \text{if } g^{EE} = \{1\} \\
0 & \text{if } g^{EE} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{EE} \in \{(1, 3), (2, 3)\}
\end{array} \right.
\text{ if } g^{EE} = \{2\}
\geq P_{a/e} \left\{ \begin{array}{ll}
K & \text{if } g^{EE} = \{1\} \\
K/2 & \text{if } g^{EE} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{EE} \in \{(2, 3), (2, 3)\}
\end{array} \right.
\text{ if } g^{EE} \in \{(1, 2), (1, 3)\}
\]  
\text{(14)}

Analogously, choosing A (E) when having observed a must be a best response for candidate 1 (2), respectively:

\[
P_{a/a}K + P_{e/a} \left\{ \begin{array}{ll}
K & \text{if } g^{AA} = \{1\} \\
K/2 & \text{if } g^{EE} = \{1\} \\
0 & \text{if } g^{EE} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{EE} \in \{(2, 3), (2, 3)\}
\end{array} \right.
\geq P_{a/a} \left\{ \begin{array}{ll}
K & \text{if } g^{AA} = \{1\} \\
K/2 & \text{if } g^{EE} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{AA} \in \{(2, 3), (2, 3)\}
\end{array} \right.
\text{ if } g^{EE} = \{1\}
\]  
\text{(15)}

\[
P_{e/a} \left\{ \begin{array}{ll}
K & \text{if } g^{EE} = \{2\} \\
K/2 & \text{if } g^{EE} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{EE} \in \{(1, 3), (2, 3)\}
\end{array} \right.
\geq P_{a/a} \left\{ \begin{array}{ll}
K & \text{if } g^{AA} = \{1\} \\
K/2 & \text{if } g^{EE} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{AA} \in \{(2, 3), (2, 3)\}
\end{array} \right.
\]  
\text{(16)}

First, note that if \( g^{AA} = \{2\} \), condition (16) cannot hold. Hence, there is not an equilibrium in this case.

Now, consider \( g^{AA} = \{1\} \). A necessary condition for (14) to hold is \( g^{EE} \in \{(1, 2), (1, 3)\} \), and the necessary conditions for (13) to hold are \( g^{EA} = g^{EE} = \{1\} \). Note that in this case, both (15) and (16) hold. Hence, there is an equilibrium of the type conjectured.

(iii) The case \( \sigma_c = (0, 1; 1, 0) \) is analogous to the previous one.

(iv) Last, let us conjecture an equilibrium in which \( \sigma_c = (0, 1; 0, 1) \).

In equilibrium, choosing E when having observed a must be a best response for candidates 1 and 2, respectively:

\[
P_{a/a} \left\{ \begin{array}{ll}
K & \text{if } g^{EE} = \{1\} \\
K/2 & \text{if } g^{EE} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{EE} \in \{(1, 3), (2, 3)\}
\end{array} \right.
\geq P_{a/a}K
\]  
\text{(17)}

\[
P_{a/a} \left\{ \begin{array}{ll}
K & \text{if } g^{EE} = \{2\} \\
K/2 & \text{if } g^{EE} \in \{(1, 2), (1, 3)\} \\
0 & \text{if } g^{EE} \in \{(1, 3), (2, 3)\}
\end{array} \right.
\geq P_{a/a}K
\]  
\text{(18)}

For (17) to hold, a necessary condition is \( g^{EE} = \{1\} \). But then (18) cannot hold. Hence, there is not an equilibrium of the type conjectured. This completes the proof.

\[
\square
\]

**Proof of Proposition 3:**
Proof. We prove it in two steps: Like biases and opposing biases.

1. Let us first consider the case of like biases, i.e. \( q > \frac{1}{2} \). We have to analyze four cases:

1.1) Let us conjecture an equilibrium in which \( \sigma_c = (1, 0; 1, 0) \).
In equilibrium, choosing \( A \) when having observed \( a \) must be a best response for candidates 1 and 2:

\[
P_{a/a}[\beta \sigma_{i,1}^{AA} + (1 - \beta)\sigma_{5,1}^{AA}] \geq P_{a/a} + P_{e/a}[\beta \sigma_{4,1}^{EE} + (1 - \beta)\sigma_{5,1}^{EE}]
\]

\[
P_{a/a}[\beta \sigma_{i,2}^{AA} + (1 - \beta)\sigma_{5,2}^{AA}] \geq P_{a/a} + P_{e/a}[\beta \sigma_{4,2}^{EE} + (1 - \beta)\sigma_{5,2}^{EE}]
\]

Adding inequalities we obtain \( 0 \geq P_{a/a} + P_{e/a} = 1 \), which is impossible. Hence, there is no equilibrium of the type conjectured.

1.2) Let us conjecture an equilibrium in which \( \sigma_c = (1, 0; 0, 1) \).
In equilibrium, choosing \( A \) when having observed \( a \) must be a best response for candidate 1:

\[
P_{a/a}[\beta \sigma_{i,1}^{AA} + (1 - \beta)\sigma_{5,1}^{AA}] \geq P_{a/a} + P_{e/a}[\beta \sigma_{4,1}^{EE} + (1 - \beta)\sigma_{5,1}^{EE}] + P_{e/a}
\]

Analogously, choosing \( A \) when having observed \( e \) must be a best response for candidate 2:

\[
P_{a/e}[\beta \sigma_{i,2}^{AA} + (1 - \beta)\sigma_{5,2}^{AA}] \geq P_{a/e} + P_{e/e}[\beta \sigma_{4,2}^{EE} + (1 - \beta)\sigma_{5,2}^{EE}] + P_{e/e}(1 - \beta)
\]

Since, for \( i, j \in \{E, A\} \) and \( k \in \{4, 5\} \), \( P_{i/j} = P_{j/i} \) and \( \sigma_{i,1}^{ii} + \sigma_{k,2}^{ii} = 1 \), adding inequalities and rearranging, we obtain \( 0 \geq P_{a/a}(1 - \beta) + P_{e/a}(1 - \beta) \). Since for \( i, j \in \{E, A\} \), \( P_{j/i} + P_{i/j} = 1 \), there is no equilibrium of the type conjectured.

1.3) The case \( \sigma_c = (0, 1; 1, 0) \) is analogous to the previous one.

1.4) Last, let us conjecture an equilibrium in which \( \sigma_c = (0, 1; 0, 1) \).
In equilibrium, choosing \( A \) when having observed \( e \) must be a best response for any of the two strategic candidates, let us say, candidate 1. That is to say:

\[
P_{e/e}[\beta \sigma_{i,1}^{AA} + (1 - \beta)\sigma_{5,1}^{AA}] \geq P_{e/e} + P_{a/e}[\beta \sigma_{4,1}^{EE} + (1 - \beta)\sigma_{5,1}^{EE}]
\]

Since \( \beta \sigma_{4,1}^{AA} + (1 - \beta)\sigma_{5,1}^{AA} \leq 1 \), there is no equilibrium of the type conjectured.

2. Let us now consider the case of opposing biases, i.e., \( q < \frac{1}{2} \). Again, there are four cases to analyze:
2.i) Let us conjecture an equilibrium in which $\sigma_c = (1,0;1,0)$. In equilibrium, choosing $E$ when having observed $e$ must be a best response for candidates 1 and 2:

\[
P_{e/e}[\beta \sigma_{4,1}^{EE} + (1-\beta)\sigma_{5,1}^{EE}] + P_{a/e}(1-\beta) \geq P_{e/e}\beta + P_{a/e}[\beta \sigma_{4,1}^{AA} + (1-\beta)\sigma_{5,1}^{AA}]
\]

\[
P_{e/e}[\beta \sigma_{4,2}^{EE} + (1-\beta)\sigma_{5,2}^{EE}] + P_{a/e}(1-\beta) \geq P_{e/e}\beta + P_{a/e}[\beta \sigma_{4,2}^{AA} + (1-\beta)\sigma_{5,2}^{AA}]
\]

(19)

Adding inequalities we obtain $P_{e/e}(1-2\beta) + P_{a/e}(1-2\beta) \geq 0 \iff \beta \leq 1/2$.

Similarly, in equilibrium, choosing $A$ when having observed $a$ must be a best response for candidates 1 and 2:

\[
P_{a/a}[\beta \sigma_{5,1}^{AA} + (1-\beta)\sigma_{4,1}^{AA}] + P_{e/a}\beta \geq P_{a/a}(1-\beta) + P_{e/a}[\beta \sigma_{4,1}^{EE} + (1-\beta)\sigma_{5,1}^{EE}]
\]

\[
P_{a/a}[\beta \sigma_{5,2}^{AA} + (1-\beta)\sigma_{4,2}^{AA}] + P_{e/a}\beta \geq P_{a/a}(1-\beta) + P_{e/a}[\beta \sigma_{4,2}^{EE} + (1-\beta)\sigma_{5,2}^{EE}]
\]

(21)

Adding inequalities we obtain $0 \geq P_{a/a}(1-2\beta) + P_{e/a}(1-2\beta) \iff \beta \geq 1/2$.

Hence, both requirements can only meet if $\beta = 1/2$. Now, if $\beta = 1/2$, and taking into account that for $k \in \{4,5\}$ and $i \in \{E,A\}$, $\sigma_{k,1}^{ii} + \sigma_{k,2}^{ii} = 1$, inequalities (19)-(22) can be rewritten as:

\[
P_{a/e}(1-\sigma_{4,1}^{AA} - \sigma_{5,1}^{AA}) = P_{e/e}(1-\sigma_{4,1}^{EE} - \sigma_{5,1}^{EE})
\]

\[
P_{a/a}(1-\sigma_{5,1}^{AA} - \sigma_{4,1}^{AA}) = P_{e/a}(1-\sigma_{4,1}^{EE} - \sigma_{5,1}^{EE})
\]

Now, since $P_{a/i} > P_{j/i}$, there is a unique solution for the system above, which is $\sigma_{4,1}^{AA} = \sigma_{5,1}^{AA} = \sigma_{4,1}^{EE} = \sigma_{5,1}^{EE} = 1/2$. Hence, in this case, there is an equilibrium of the type conjectured.

2.ii) Let us conjecture an equilibrium in which $\sigma_c = (1,0;0,1)$. In this case, the payoffs coincide with those in case 1.i). Hence, there is not an equilibrium in this case.

2.iii) Analogously, there is neither an equilibrium in the case $\sigma_c = (0,1;1,0)$.

2.iv) Last, let us conjecture an equilibrium in which $\sigma_c = (0,1;0,1)$. In equilibrium, choosing $A$ when having observed $e$ must be a best response for candidates 1 and 2. That is to say:

\[
P_{e/e}[\beta \sigma_{4,1}^{AA} + (1-\beta)\sigma_{5,1}^{AA}] + P_{a/e}\beta \geq P_{e/e}(1-\beta) + P_{a/e}[\beta \sigma_{4,1}^{EE} + (1-\beta)\sigma_{5,1}^{EE}]
\]

\[
P_{e/e}[\beta \sigma_{4,2}^{AA} + (1-\beta)\sigma_{5,2}^{AA}] + P_{a/e}\beta \geq P_{e/e}(1-\beta) + P_{a/e}[\beta \sigma_{4,2}^{EE} + (1-\beta)\sigma_{5,2}^{EE}]
\]

(23)

Adding inequalities we obtain $0 \geq P_{e/e}(1-2\beta) + P_{a/e}(1-2\beta) \iff \beta \geq 1/2$.
Similarly, in equilibrium, choosing \( E \) when having observed \( a \) must be a best response for candidates 1 and 2. That is to say:

\[
P_{a/a}[(1-\beta)\sigma_{5,1}^E] + P_{e/a}(1-\beta) \geq P_{a/a}\beta + P_{e/a}[(1-\beta)\sigma_{5,1}^{AA}] \\
P_{a/a}[(1-\beta)\sigma_{5,2}^E] + P_{e/a}(1-\beta) \geq P_{a/a}\beta + P_{e/a}[(1-\beta)\sigma_{5,2}^{AA}]
\]

Adding inequalities we obtain \( P_{a/a}(1-2\beta) + P_{e/a}(1-2\beta) \geq 0 \iff \beta \leq 1/2 \).

Hence, both requirements can only meet if \( \beta = 1/2 \). Now, if \( \beta = 1/2 \), and taking into account that for \( k \in \{4,5\} \) and \( i \in \{E,A\} \), \( \sigma_{k,1}^i + \sigma_{k,2}^i = 1 \), inequalities (23)-(26) can be rewritten as:

\[
P_{a/e}(1-\sigma_{4,1}^E - \sigma_{5,1}^E) = P_{e/e}(1-\sigma_{4,1}^{AA} - \sigma_{5,1}^{AA}) \\
P_{a/a}(1-\sigma_{4,1}^E - \sigma_{5,1}^E) = P_{e/a}(1-\sigma_{4,1}^{AA} - \sigma_{5,1}^{AA})
\]

Now, since \( P_{j/i} > P_{j/i} \), there is a unique solution for the system above, which is \( \sigma_{4,1}^E = \sigma_{4,1}^{AA} = \sigma_{5,1}^E = \sigma_{5,1}^{AA} = 1/2 \). Hence, in this case, there is an equilibrium of the type conjectured.

Proof of Proposition 4:

Proof. First, let us conjecture an equilibrium in which either \( \sigma_c = (1,0;0,1) \), \( \sigma_c = (1,0;0,1) \) or \( \sigma_c = (0,1;1,0) \). In these cases, note that when the platforms’ profile observed is \( (x_1,x_2) = (AA) \), applying Bayes’ rule we obtain \( \hat{q} > 1/2 \). Hence, \( g^{AA} = \{3\} \), as it was the case in the analogous situations of Proposition 1. The analyses of these cases are therefore identical to those in Proposition 1, therefore omitted.

Let us now conjecture an equilibrium in which \( \sigma_c = (1,0;1,0) \).

In equilibrium, choosing \( E \) when having observed \( e \) must be a best response for candidates 1 and 2, respectively:

\[
P_{a/e} \left\{ \begin{array}{ll} K & \text{if } g^{EE} = \{1\} \\ K/2 & \text{if } g^{EE} \in \{1,2\}, \{1,3\} \\ 0 & \text{if } g^{EE} \in \{2\}, \{3\}, \{2,3\} \end{array} \right. \\
+ P_{e/a} \left\{ \begin{array}{ll} K & \text{if } g^{EE} = \{1\} \\ K/2 & \text{if } g^{EE} = \{1,3\} \\ 0 & \text{if } g^{EE} = \{3\} \end{array} \right.
\]

\[
P_{a/e} \left\{ \begin{array}{ll} K & \text{if } g^{EE} = \{2\} \\ K/2 & \text{if } g^{EE} \in \{1,2\}, \{2,3\} \\ 0 & \text{if } g^{EE} \in \{1\}, \{3\}, \{1,3\} \end{array} \right. \\
+ P_{e/a} \left\{ \begin{array}{ll} K & \text{if } g^{EE} = \{2\} \\ K/2 & \text{if } g^{EE} = \{2,3\} \\ 0 & \text{if } g^{EE} = \{3\} \end{array} \right.
\]

\[
P_{a/e} \left\{ \begin{array}{ll} K & \text{if } g^{AE} = \{2\} \\ K/2 & \text{if } g^{AE} \in \{1,2\}, \{2,3\} \\ 0 & \text{if } g^{AE} \in \{1\}, \{3\}, \{1,3\} \end{array} \right. \\
+ P_{e/a} \left\{ \begin{array}{ll} K & \text{if } g^{AE} = \{2\} \\ K/2 & \text{if } g^{AE} = \{2,3\} \\ 0 & \text{if } g^{AE} = \{3\} \end{array} \right.
\]

\[
P_{a/e} \left\{ \begin{array}{ll} K & \text{if } g^{AE} = \{2\} \\ K/2 & \text{if } g^{AE} \in \{1,2\} \\ 0 & \text{if } g^{AE} = \{1\} \end{array} \right.
\]
Analogously, choosing \( A \) when having observed \( a \) must be a best response for candidates 1 and 2, respectively:

\[
\begin{align*}
P_{a/n} \begin{cases} 
K & \text{if } g^{AA} = \{1\} \\
K/2 & \text{if } g^{AA} = \{1,2\} \\
0 & \text{if } g^{AA} = \{2\}
\end{cases} & \geq P_{a/n} \begin{cases} 
K & \text{if } g^{EA} = \{1\} \\
K/2 & \text{if } g^{EA} = \{1,3\} \\
0 & \text{if } g^{EA} = \{3\}
\end{cases} \\

P_{e/a} \begin{cases} 
K & \text{if } g^{EE} = \{1\} \\
K/2 & \text{if } g^{EE} \in \{\{1,2\}, \{1,3\}\} \\
0 & \text{if } g^{EE} \in \{\{2\}, \{3\}, \{2,3\}\} \quad (29)
\end{cases}
\end{align*}
\]

\[
\begin{align*}
P_{a/n} \begin{cases} 
K & \text{if } g^{AA} = \{2\} \\
K/2 & \text{if } g^{AA} = \{1,2\} \\
0 & \text{if } g^{AA} = \{1\}
\end{cases} & \geq P_{a/n} \begin{cases} 
K & \text{if } g^{AE} = \{2\} \\
K/2 & \text{if } g^{AE} = \{2,3\} \\
0 & \text{if } g^{AE} = \{3\}
\end{cases} \\

P_{e/a} \begin{cases} 
K & \text{if } g^{EE} = \{2\} \\
K/2 & \text{if } g^{EE} \in \{\{1,2\}, \{2,3\}\} \\
0 & \text{if } g^{EE} \in \{\{1\}, \{3\}, \{1,3\}\} \quad (30)
\end{cases}
\end{align*}
\]

Now, let us first suppose \( g^{EA} = \{1\} \). By Assumption 2, \( g^{AE} = \{2\} \). In this case, a necessary condition for (29) to hold is \( G^{A AF} = \{1\} \), but then (30) cannot hold.

Similarly, let us suppose \( g^{EA} = \{1,3\} \). By Assumption 2, \( g^{AE} = \{2,3\} \). Now, \( g^{AA} \in \{\{1\}, \{1,2\}\} \) is necessary for (29) to hold. If \( g^{AA} = \{1\} \) we are in the previous situation, therefore no equilibrium exists. Let us consider \( g^{AA} = \{1,2\} \).

Then, a necessary condition for (29) to hold is \( g^{EE} \in \{\{2\}, \{3\}, \{2,3\}\} \), and a necessary condition for (30) to hold is \( g^{EE} \in \{\{1\}, \{3\}, \{1,3\}\} \). Note that if \( g^{EE} = \{3\} \), conditions (27) and (28) hold. Hence, there is an equilibrium of the type conjectured.

Last, let us suppose \( g^{EA} = \{3\} \). By Assumption 2, \( g^{AE} = \{3\} \). Here we have three cases: (a) Consider \( g^{AA} = \{1\} \). A necessary condition for (30) to hold is \( g^{EE} \in \{\{1\}, \{3\}, \{1,3\}\} \), and a necessary condition for (27) to hold is either \( g^{EE} \in \{\{1,2\}, \{1,3\}\} \) and \( P_{e/e} \geq 2P_{a/e} \) or \( g^{EE} = \{1\} \). Note that if \( g^{EE} \in \{\{1\}, \{1,3\}\} \), conditions (28) and (29) hold. Hence, if either \( g^{EE} = \{1,3\} \) and \( P_{e/e} \geq 2P_{a/e} \) or \( g^{EE} = \{1\} \), there is an equilibrium of the type conjectured.

(b) Analogously to the previous case, there is an equilibrium in which \( g^{AA} = \{2\} \) and either \( g^{EE} \in \{\{1,2\}, \{1,3\}\} \) and \( P_{e/e} \geq 2P_{a/e} \), or \( g^{EE} = \{2\} \). (c) Last, consider \( g^{AA} = \{1,2\} \). A necessary condition for (27) to hold is \( g^{EE} \in \{\{1\}, \{1,2\}, \{1,3\}\} \), and a necessary condition for (28) to hold \( g^{EE} \in \{\{2\}, \{1,2\}, \{2,3\}\} \). Note that if \( g^{EE} = \{1,2\} \), conditions (29) and (30) hold. Hence, there is an equilibrium of the type conjectured. This completes the proof.

\[ \square \]

References


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