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Hiding information in electoral competition

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discussion papers

**Hiding Information in Electoral
Competition**

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Hiding Information in Electoral Competition*

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Abstract

We model a two-candidate electoral competition in which there is uncertainty about a policy-relevant state of the world. The candidates receive private signals about the true state, which are imperfectly correlated. We study whether the candidates are able to credibly communicate their information to voters through their choice of policy platforms. Our results show that the fact that private information is dispersed between the candidates creates a strong incentive for them to bias their messages toward the electorate's prior. Information transmission becomes more difficult, the less correlated are the candidates' signals, the lower is the signals' quality, and the stronger is the electorate's prior. Indeed, for weak priors welfare decreases as the prior becomes stronger, and welfare always decreases as the signals become less correlated.

JEL classification: D72, D78, D82

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1 Introduction

An important and much debated question in political economy is whether democracies produce efficient results. The school of thought often associated with the University of Chicago contends that, because of competition for votes between political parties or candidates, public policy will indeed be efficient (see e.g. Wittman 1989). The “Virginia School” of political economy, in contrast, argues

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that voters typically do not have full information about the effects of different policies and, therefore, politicians are able to select policies that are inefficient. Moreover, although the voters would gain if they knew more about the effects of the different policies and thereby were better able to control the politicians, the voters will remain *rationaly ignorant*; that is, since the probability that an individual voter will affect the outcome of an election is very small, she will not acquire costly information about the political alternatives. While Wittman (1989) agrees that voters may initially not be well informed about political markets, he argues that competition between political candidates also eliminates this problem: “The arguments made for the voter’s being uninformed implicitly assume that the major cost of information falls on the voter. However, there are returns to an informed political entrepreneur from providing the information to the voters, winning office, and gaining the direct and indirect rewards of holding office” (p. 1400).

Wittman’s argument raises the question how a political entrepreneur who tries to transmit information to the electorate can do this without facing a severe credibility problem. How does the entrepreneur convince the voters that he, when making statements and choosing his electoral platform, indeed pursues the electorate’s — rather than his own — goals? Presumably the goals of the entrepreneur include winning office, and succeeding in this should be at least as important for him as implementing some particular policy. In this paper we argue that information transmission from political candidates to voters is indeed very difficult. In particular we argue that candidates — because of the very reason that they are in a competition — will have a strong incentive to follow popular beliefs (i.e., the voters’ prior) instead of their own information.

Why, then, do popular beliefs have such a strong drawing power? Our argument goes as follows. When the political entrepreneur considers what policy suggestion to make to the voters, he should anticipate that his opponents may also have access to private information about which policy is the best one for the voters — and that the voters, too, are aware of this. Hence, the entrepreneur knows that, in order to win the election, he must convince the electorate that *his* policy suggestion — and not the ones of the other candidates — is the one that is most likely to lead to the preferred outcome. This means, in particular,

that the entrepreneur should not be truthful to the electorate when his private information goes against the voters' prior beliefs. For if a competing candidate were to suggest a policy that is more in line with the electorate's prior beliefs, the entrepreneur will have a hard time convincing the voters that his information should have a heavier weight than their prior and the other candidate's information taken together. The dilemma for the voters, however, is that information that differs from the prior is precisely the kind of information that would be useful for them.

Hence, the source of the difficulty in transmitting information to the voters is that information is dispersed among the political candidates: they do not have access to exactly the same pieces of information. The reason for this, we believe, is that candidates do not typically get their information from exactly the same sources. For instance, we should expect the candidates to get at least part of their information through personal experiences. Moreover, when consulting experts, different candidates often consult different experts.¹

In the model that we develop in this paper there are two political candidates who run for office. Both of them have some private information about which policy is the best one for the electorate. We allow for any degree of correlation between the noisy signals that the candidates observe: from independence (conditionally on the true state) to almost perfect correlation. The policy space (as well as the signal space) is for simplicity assumed to be binary: the alternatives between which society must choose are "building a bridge" (B) and "not building a bridge" (N). A key assumption is that the electorate's prior beliefs are such that one of the policies (B) is more likely than the other to be the best one. Prior to the election the candidates, who are office-motivated, simultaneously announce policy platforms. After having observed the announced platforms but not the candidates' private signals, the members of the electorate vote for one of the candidates. Finally the winning candidate takes office and implements his announced platform.

From a welfare point of view, the most desirable behavior on the part of

¹This presumption of ours that politicians as a group are better informed than each politician individually has a parallel in the literature on the so-called Condorcet jury theorem (see Piketty 1999 and the references therein). This literature assumes that policy-relevant information is dispersed among *voters* rather than candidates, and it investigates whether the information can be aggregated in a voting procedure.

the candidates would be if they revealed all their private information by always choosing platform B if having observed a signal in favor of B , and platform N if having observed a signal in favor of N . We show, however, that this behavior cannot be part of a (perfect Bayesian) equilibrium.² Indeed, within the family of equilibria in which the candidates do not randomize in their platform choices, the only equilibria that survive a reasonable equilibrium selection criterion³ are babbling (i.e., no information at all can be inferred from the candidates' behavior): either the candidates always choose platform B (the *popular-beliefs equilibria*) or they always choose platform N . The latter equilibria are Pareto-dominated by the former, however, and we therefore conclude that, within this family of equilibria, the outcome associated with the popular-beliefs equilibria is the more reasonable prediction.

The result that popular beliefs have a strong drawing power also holds qualitatively when we consider equilibria in which the candidates are not constrained to play pure strategies. Again disregarding equilibrium outcomes that are Pareto dominated by other equilibrium outcomes, we get the following unique prediction of our model: when the prior beliefs that B is the best policy are relatively strong, then the candidates follow popular beliefs (with probability one); and when the prior is relatively weak, then a mixed equilibrium is played in which the candidates' behavior is distorted toward popular beliefs. For the subset of the parameter space where the mixed equilibrium is played, we obtain the following comparative statics result. Information transmission becomes more difficult, (i) the less correlated are the candidates' signals, (ii) the lower is the signals' quality, and (iii) the larger is the prior probability that B is the best policy. Moreover, welfare always decreases as the signals become less correlated, even though this increases the amount of information the candidates receive collectively. Finally, for weak priors welfare decreases as more prior information becomes available. The reason for the last result is that more prior information distorts the candidates' incentives to reveal the information in their signals

²Perhaps somewhat surprisingly, it turns out that there always exist another kind of fully revealing equilibria. In these equilibria, however, having access to the candidates' information is not useful for the electorate. The reason for this is the way by which one of the candidates reveals his information: he consistently chooses the policy that his signal indicates he should *not* choose; as a consequence, this candidate always loses the election.

³This criterion requires that the electorate treats the two (ex ante identical) candidates symmetrically.

truthfully.⁴

The remainder of the paper is organized as follows. In the next section we describe a relatively simple model that captures our argument. Section 3 considers some useful benchmarks. In Section 4 our main model is analyzed and the results are presented. In Section 5 we review the related literature. Section 6 concludes and discusses the robustness of our results. Most of the proofs are relegated to three appendices.

2 The Model

Consider the following model of an election with two candidates and one representative voter. There are two policy alternatives, B and N , and two states of the world, ω_B and ω_N . For the sake of concreteness we can think of policy B as “building a bridge” and policy N as “not building a bridge”; the states of the world can be thought of as “the costs of building a bridge will be modest” (ω_B) and as “building a bridge will be very costly” (ω_N). The voter wants the bridge to be built if and only if the costs will be modest. More precisely, given a policy $x \in \{B, N\}$ and a state $\omega \in \{\omega_B, \omega_N\}$, the voter’s payoff function $u(x, \omega)$ is such that $u(B, \omega_B) = u(N, \omega_N) = 1$ and $u(B, \omega_N) = u(N, \omega_B) = 0$. It is also assumed that the prior distribution of the state is in favor of policy B , $\Pr(\omega = \omega_B) \equiv q \in (\frac{1}{2}, 1)$. That is, if the prior is the only information that is available, the best policy from the voter’s point of view is to build the bridge.

The two political candidates are labeled 1 and 2. We adopt the standard Downsian assumption that they are only office-motivated: candidate i ’s (where $i \in \{1, 2\}$) payoff if he wins the election is 1, and 0 otherwise. We also assume, again in keeping with the Downsian framework, that the candidates precommit to electoral platforms. More exactly, the sequence of events is as follows. First each one of the two candidates privately observes a noisy signal $s_i \in \{B, N\}$ about the true state ω . Second, conditional upon his signal s_i , each candidate chooses an electoral platform $x_i \in \{B, N\}$; the candidates do this simultaneously. Finally the voter observes the candidates’ chosen platforms x_1 and x_2 and then chooses for whom to vote. The candidate who gets the vote wins office

⁴This particular reason why access to more information can be detrimental to an economic agent has not, to our knowledge, been recognized previously in the literature. For other reasons why more information can be bad, see Lagerlöf (2001) and references therein.

and implements his previously chosen policy.

The signal technology is described by the following table:⁵

	$\Pr(s_2 = k \mid \omega = \omega_k)$	$\Pr(s_2 = j \mid \omega = \omega_k)$	\sum
$\Pr(s_1 = k \mid \omega = \omega_k)$	$(1 - \varepsilon)^2 + \rho\varepsilon(1 - \varepsilon)$	$(1 - \rho)\varepsilon(1 - \varepsilon)$	$1 - \varepsilon$
$\Pr(s_1 = j \mid \omega = \omega_k)$	$(1 - \rho)\varepsilon(1 - \varepsilon)$	$\varepsilon^2 + \rho\varepsilon(1 - \varepsilon)$	ε
\sum	$1 - \varepsilon$	ε	1

where $j, k \in \{B, N\}$ for $j \neq k$. The parameter $\rho \in [0, 1)$ is a measure of the degree of correlation between the candidates' signals: for ρ close to unity they are almost perfectly correlated whereas for $\rho = 0$ they are, conditionally on the true state, independent. The parameter $\varepsilon \in (0, \frac{1}{2})$ is inversely related to the quality of the signals: $(1 - \varepsilon)$ is the probability that a candidate's signal is "correct." Notice that in this formulation of the signal technology it is implicitly assumed that the quality of the candidates' signals are the same.

Let σ_i^j denote the probability that candidate $i \in \{1, 2\}$ chooses platform B after having observed a signal $j \in \{B, N\}$. Moreover, let σ_3^{jk} denote the probability with which the voter elects candidate 1 when having observed the platform configuration $(x_1, x_2) = (j, k)$ for $(j, k) \in \{B, N\}^2$. Finally, let

$$\sigma = (\sigma_1^B, \sigma_1^N; \sigma_2^B, \sigma_2^N; \sigma_3^{BB}, \sigma_3^{BN}, \sigma_3^{NB}, \sigma_3^{NN})$$

denote a vector of (behavioral) strategies of the three players.

The equilibrium concept that we employ is that of perfect Bayesian equilibrium, where this equilibrium concept is defined in the usual way: all three players must make optimal choices at all information sets given their beliefs, and the beliefs are formed using Bayes' rule when that is defined. For the sake of brevity we will refer to a strategy profile σ as an equilibrium if there exist beliefs of the players such that σ together with these beliefs form a perfect Bayesian equilibrium.

3 Some Observations and Benchmarks

As mentioned in the previous section, we assume that when the voter only knows the prior, her belief is that policy B is the best one ($q > 1/2$). Before solving

⁵We have borrowed this way of modeling the correlation between the signals from Bhaskar and van Damme (2000).

for the equilibria of the model, it will be useful to investigate how the voter would change her beliefs about which policy is the best one if she were able to infer the signal of one of the candidates and if she were able to infer both candidates' signals. First, suppose the voter knew the content of exactly one of the signals. Then, if this signal indicated that B is the best policy, the voter would of course still prefer policy B , since her prior also favors this policy. If the signal indicated that N is the best policy, then the voter would change her mind and prefer policy N only if the probability of a correct signal is larger than the prior probability that B is the best policy: $1 - \varepsilon > q$;⁶ if this inequality were reversed, the voter would still prefer policy B .

Second, suppose the voter knew the content of both signals. Then, if both indicated policy B , the voter would of course still prefer policy B . Similarly, if one signal were in favor of B and the other in favor of N , the voter would again still prefer policy B , since the signals are of the same quality and thus their informational contents would cancel out. If both signals indicated policy N , then the voter would prefer policy N only if the prior probability that B is the best policy is not too large:⁷

$$q < \frac{(1 - \varepsilon) [1 - \varepsilon (1 - \rho)]}{1 - 2\varepsilon (1 - \varepsilon) (1 - \rho)} \equiv \tilde{q}. \quad (1)$$

If this inequality were reversed, the voter would still prefer policy B even after having observed two signals indicating N . Since this would not make for an interesting problem, we assume that $q \in (1/2, \tilde{q})$ throughout the analysis.

Let us now look at a welfare benchmark in which a planner who maximizes the voter's expected utility can dictate to each one of the two candidates which platform to choose as a function of that candidate's signal. The voter then, just as in our main model, updates her beliefs given the observed platforms and elects the candidate who will give her the highest expected utility given her updated beliefs. The best thing the planner can do is to let each candidate choose platform B if having observed a signal B , and platform N if having observed a signal N . This means that the voter will, if the candidates' platforms differ, elect the candidate who has chosen platform B ; if the platforms are identical, then it does not matter who she elects.

⁶One can check this formally by using Bayes' rule.

⁷Again, this expression can be derived by using Bayes' rule.

Let us denote the voter's expected utility in this benchmark by EU_{BM} . We get

$$\begin{aligned}
EU_{BM} &= \Pr(\omega = \omega_B) \Pr(s_1 = B \vee s_2 = B \mid \omega = \omega_B) \\
&\quad + \Pr(\omega = \omega_N) \Pr(s_1 = N \wedge s_2 = N \mid \omega = \omega_N) \\
&= q \left[(1 - \varepsilon)^2 + 2\varepsilon(1 - \varepsilon) - \varepsilon(1 - \varepsilon)\rho \right] + (1 - q) \left[(1 - \varepsilon)^2 + \varepsilon(1 - \varepsilon)\rho \right] \\
&= (1 - \varepsilon) [1 + \varepsilon(2q - 1)(1 - \rho)].
\end{aligned}$$

The expected utility EU_{BM} forms a useful benchmark since it gives us an upper bound on the level of expected utility that may be realized in any equilibrium. Notice that EU_{BM} is decreasing in ρ , as we would expect: welfare is higher if the signals are less correlated because then there is more information available.

Finally in this section we will investigate two positive benchmarks in which the assumptions of our main model are slightly altered. Doing this will help us understand exactly what features of the model drive the results that we will derive later. The first benchmark is the case where $\rho = 1$. That is, here the candidates observe the same signal, and the content of this signal is unobservable to the voter. The second benchmark is a situation where there are no popular beliefs, that is, where $q = 1/2$. We make the following observation.

Observation 1 (Identical Signals or No Popular Beliefs). *Suppose that either (a) $\rho = 1$ or (b) $q = 1/2$. Then $\sigma = (1, 0; 1, 0; \sigma_3, \sigma_3, \sigma_3, \sigma_3)$ for any $\sigma_3 \in [0, 1]$ is an equilibrium.*

Part (a) of Observation 1 says that if the candidates have access to exactly the same information, then there exists an equilibrium with full revelation, that is, an equilibrium in which the candidates' behavior is such that the voter can perfectly infer the contents of their signals. To see that this claim is true, notice that none of the candidates will have an incentive to deviate since they win the election with the same probability for all platform configurations. Similarly, the voter will surely not have an incentive to deviate if the platforms are the same. Moreover, the voter will observe different platforms only off the equilibrium path, and one can easily check that there exist out-of-equilibrium beliefs that make her behavior optimal also at those information sets.⁸ Part (b) of Observation 1 says that if there are no popular beliefs, then again there exists a fully

⁸For $\sigma_3 \in (0, 1)$, the requirement on these beliefs off the equilibrium path is that the voter

revealing equilibrium in which both candidates follow their signals. Here, key to why full revelation is possible is that if the candidates have chosen different platforms — which means that the voter can infer that one of them received a signal in favor of B while the other received a signal in favor of N — then the voter’s updated beliefs will be identical to her prior beliefs; this is because the quality of the signals is the same and hence the informational contents of the two signals cancel out.

4 Equilibrium Behavior

We will now return to the main model described in Section 2. First we solve for equilibria of that model in which both candidates (at both their information sets) choose pure strategies⁹ (Section 4.1). After that we investigate equilibria in which at least one of the candidates (at at least one of his information sets) is randomizing between the platforms (Section 4.2).

4.1 Candidates’ Playing Pure

Let us start with considering the possible existence of an equilibrium with full revelation. Perhaps somewhat surprisingly, it turns that such equilibria do exist.

Proposition 1 (Full Revelation). *A strategy profile σ is a fully revealing equilibrium if and only if $\sigma \in \{(1, 0; 0, 1; 1, 1, 1, 1), (0, 1; 1, 0; 0, 0, 0, 0)\}$.*

In words, there exist exactly two equilibria that are fully revealing; these differ from each other only with respect to the labeling of the candidates. In each one of the equilibria, one of the candidates is winning the election with probability one regardless of which platforms he and the other candidate have chosen. The winning candidate is choosing policy B if observing a signal B , and policy N if observing a signal N . The candidate who is always losing chooses policy N if observing a signal B , and policy B if observing a signal N . That is, equilibria in which the voter can infer both candidates’ information do exist, but having this information is not very useful for the voter; she always votes for

thinks that a candidate who has chosen a platform B is, to some extent, more likely to have deviated than the candidate who has chosen platform N .

⁹When we say that the candidates “choose pure strategies” (or “play pure”) in an equilibrium, we mean that, in this equilibrium, $\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N \in \{0, 1\}$.

one of the candidates anyway, mainly because the losing candidate’s behavior is rather odd: he always does the opposite to what his signal suggests he “should” do.

Denote the voter’s expected utility in a fully revealing equilibrium by EU_{FR} . We know that in this kind of equilibrium one of the candidates always wins the election, and this candidate chooses platform B if and only if he has observed a signal B . Hence, $EU_{FR} = 1 - \varepsilon$. Figure 1 illustrates how EU_{FR} and the expected utility in the welfare benchmark, EU_{BM} , vary with the prior q . Unsurprisingly, we see that EU_{FR} is always strictly lower than EU_{BM} .

[FIGURE 1 ABOUT HERE]

Why is it impossible to sustain an equilibrium in which both candidates announce platforms identical to their signals? The basic reason is that the policy that the voter prefers when only knowing the prior (i.e., policy B) has a too strong drawing power. To see this, suppose that we indeed had an equilibrium in which both candidates followed their signals. Now, if it turns out that the candidates have chosen different platforms, then the voter can infer that one of them has received a signal in favor of B while the other one has received a signal in favor of N . Since the quality of the signals are the same, the informational contents of the two signals will cancel out and B is still the alternative that is most likely to be the best one. Hence, the voter will elect the candidate choosing platform B . Anticipating this, a candidate who has received a signal N will have an incentive, we claim, not to choose platform N but platform B .

To see why this claim is true, suppose for simplicity that when both candidates have chosen the same platform, the voter elects either one with equal probability.¹⁰ Then, if a candidate who has received a signal in favor of policy N follows his equilibrium strategy and chooses platform N , he will lose for sure if his opponent has received a signal B and win with probability $1/2$ if his opponent also has received a signal N . On the other hand, if he deviates and chooses policy B , he will win with probability $1/2$ if the opponent also has

¹⁰Of course, since the voter is indifferent between the candidates when they have chosen the same platform, it would also be optimal for the voter to randomize with some other probability. A proof of Proposition 1 must, therefore, generalize the argument in the text to any probability. We do this in Appendix A.

received a signal B and win for sure if the opponent has received a signal N . Thus, a candidate who has received a signal N will prefer to choose platform B .

The equilibria that are characterized in Proposition 1 are actually quite fragile. Indeed, the reason why we can sustain a fully revealing equilibrium in which one candidate always “does the opposite” is that this candidate is always — even when the candidates have chosen the same platform — losing the election for sure. If there were the slightest amount of uncertainty about which candidate the voter elects when the platforms are the same, then platform B would again have a too strong drawing power and the fully revealing equilibria would cease to exist. Quite apart from that argument, one can also wonder what a candidate who knows that he will lose with probability one is doing in the race in the first place. We now introduce an assumption that indeed implies that, if choosing the same platform as his opponent, a candidate will not be able to predict the outcome of the election perfectly.

Assumption 1 (Symmetric Voting). *The probability with which the voter elects a candidate is independent of the labeling of the candidates: $\sigma_3^{BB} = \sigma_3^{NN} = 1/2$ and $\sigma_3^{BN} = 1 - \sigma_3^{NB}$.*

We find this assumption reasonable since the candidates are ex ante identical. It is also in line with what is assumed in standard formulations of the Hotelling-Downs model, namely that if the two candidates choose the same platform then they share the votes equally; see e.g. Osborne (1995).¹¹

As is evident from Proposition 1, Assumption 1 rules out the possibility of an equilibrium with full revelation. As the following proposition shows (we will ignore the knife-edge case where $q = 1 - \varepsilon$), the only pure-strategy equilibria that survive Assumption 1 are babbling ones, that is, equilibria in which the voter cannot infer any information about the contents of the signals.

Proposition 2 (Surviving Pure Equilibria). *Suppose that $q \neq 1 - \varepsilon$. A strategy profile σ that satisfies Assumption 1 and in which the candidates play pure is an equilibrium if and only if either*

¹¹In a working paper version of the present paper (Heidhues and Lagerlöf, 2000) we use an alternative Assumption 1, which gives us the same results as here. This alternative assumption requires that, if the chosen platform configuration is such that the voter is indifferent between the candidates, both of them win with positive probability. We justify the assumption by arguing that this is in fact the way in which the candidates would perceive the voter’s behavior in a possible extension of our model along the lines of probabilistic voting theory.

- (a) $\sigma = (1, 1; 1, 1; \frac{1}{2}, \alpha, 1 - \alpha, \frac{1}{2})$ for $\alpha \in [\frac{1}{2}, 1]$ and $q \in (\frac{1}{2}, 1 - \varepsilon)$; or
 $\sigma = (1, 1; 1, 1; \frac{1}{2}, 1, 0, \frac{1}{2})$ for $q \in (1 - \varepsilon, \tilde{q})$; or
- (b) $\sigma = (0, 0; 0, 0; \frac{1}{2}, 1 - \alpha, \alpha, \frac{1}{2})$ for $\alpha \in [\frac{1}{2}, 1]$ and $q \in (\frac{1}{2}, 1 - \varepsilon)$.

In the babbling equilibria described in part (a) of Proposition 2 (which we will call the *popular-beliefs equilibria*), policy B is always implemented. Both candidates win with positive probability and, when choosing their platforms, they both follow the voter's prior. In the babbling equilibria described in part (b), policy N is always implemented. This equilibrium outcome is indeed rather odd. It can be sustained only because the voter's out-of-equilibrium beliefs are such that if a candidate is the only one choosing platform B , then the voter believes that this candidate observed a signal in favor of N with a sufficiently high probability.¹²

Let us denote the voter's expected utility in the equilibria described in part (a) of Proposition 2 by EU_{bab}^B , and in (b) by EU_{bab}^N . Because in (a) the winning candidate always chooses platform B , the voter's expected utility is here simply given by the prior: $EU_{bab}^B = q$. Similarly, $EU_{bab}^N = 1 - q$. The graphs of these functions are depicted in Figure 1. Both the babbling equilibrium outcomes are in welfare terms worse than the outcome of the welfare benchmark. This is, of course, particularly true for the equilibrium in which the candidates babble on N . Furthermore, it follows from Figure 1 that, for $q > 1 - \varepsilon$, the fully revealing equilibrium is worse in welfare terms than the equilibrium in which both candidates babble on B .

From Proposition 2 it follows that for low enough values of the prior, imposing Assumption 1 does not yield a unique equilibrium outcome. One natural criterion for selecting among the remaining equilibria, which is often used in applications of cheap talk games, is to assume that an equilibrium is not played if its associated outcome is Pareto dominated by some other equilibrium outcome. If we use this criterion, then, for all q (such that $q \neq 1 - \varepsilon$), the outcome of the popular-beliefs equilibria is the only one that survives.¹³ This suggests that,

¹²Indeed, equilibria that are "truly" babbling — in the sense that both the voter's equilibrium and out-of-equilibrium beliefs are identical to her prior beliefs — can be found only in part (a) of Proposition 2.

¹³This result follows immediately from the fact that the candidates (by Assumption 1) are equally well off under the popular-beliefs equilibrium outcome as under the equilibrium outcome in which the candidates babble on N , and the voter strictly prefers the popular-beliefs

provided the candidates are required to play pure, the most reasonable prediction of the game is the outcome associated with the popular-beliefs equilibria.

Hence, the lesson that the analysis in this subsection seems to teach us is that, given that the candidates must play pure and that their signals are not perfectly correlated, no information transmission at all is possible in equilibrium. Indeed, this is the conclusion of the authors. A more conservative interpretation of the results, however, would not dismiss the equilibria of Proposition 1, in which the information of one of the candidates is credibly transmitted and made use of. In fact, as the reader easily can verify, for $q < 1 - \varepsilon$ there also exist partially revealing pure-strategy equilibria in which one candidate, who always wins, follows his signal and the other one babbles on either B or N , although these equilibria do not survive Assumption 1. The conservative conclusion would then be that, as long as the candidates' signals are not perfectly correlated, *one signal at the most* can be credibly transmitted and made use of in equilibrium.¹⁴ As we will see in the following subsection, this conclusion is also valid if we allow the candidates to randomize in their platform choices.

4.2 Candidates' Mixing

Let us thus consider the existence and the welfare properties of equilibria in which at least one of the candidates is mixing at at least one of his information sets. By doing so, we will be able to check the robustness of our "follow-popular-beliefs" result from the previous subsection.¹⁵ Throughout the rest of the paper

outcome.

¹⁴One may notice that this result is consistent with our argument in the Introduction that information transmission will be difficult because of the very reason that the candidates are competing with each other. For the only reason why information transmission is possible in these kinds of equilibria is that one candidate always wins so that, in practice, competition does not play a role.

¹⁵Indeed, in our model there is a special reason why restricting attention to equilibria in which the candidates play pure may be overly restrictive: if we allow the candidates to randomize, it is conceivable that they will be able to transmit more information than otherwise, since then (and only then) will they be able to choose the amount of noise in their messages continuously and endogenously. Yet, focusing attention on equilibria in which the candidates randomize between platforms raises the question how to interpret such behavior.

The interpretation that we have in mind relies on Harsanyi's (1973) purification idea. That is, we view the electoral competition as a frequently occurring event in which the candidates' payoffs are subject to small random variations. In particular the candidates could, on top of being office-motivated, have some small ideological leanings toward one of the policies, and the magnitude of this incremental payoff term is private information to the candidate. What is perceived as randomizations would, then, in fact be deterministic choices given some realization of the stochastic term. Moreover, a candidate does not need to make a deliberate choice to use his pure strategies with the required probabilities; instead the variations in the payoffs induce him to, over time, choose each pure strategy with the right frequency. What

we maintain Assumption 1.

Recall that the reason why a fully revealing equilibrium in which the candidates follow their signals cannot exist is that whenever the candidates have chosen different platforms, the voter will elect the candidate with platform B with probability one; as a consequence, no candidate will ever follow a signal in favor of N . In order to find a mixed equilibrium in which the candidates follow their signals at least to some degree, it is thus natural to start looking for circumstances under which the voter will be indifferent between the candidates if having observed two different platforms. Hence, suppose the candidates' behavior is such that (a) $(x_1, x_2) = (B, N)$ and $(x_1, x_2) = (N, B)$ are played along the equilibrium path,¹⁶ and (b) the voter's updated beliefs after having observed one platform B and one platform N put equal weights on the state being ω_B and the state being ω_N :

$$\Pr(\omega = \omega_B \mid x_1 = B, x_2 = N) = \Pr(\omega = \omega_B \mid x_1 = N, x_2 = B) = \frac{1}{2}.$$

By making use of Bayes' rule, which will be well-defined due to (a), we can rewrite the above equalities as follows (see Lemma A4 in Appendix C):

$$\begin{aligned} & \sigma_1^B (1 - \sigma_2^B) (q - \varepsilon) + (\sigma_1^B - \sigma_1^N) (\sigma_2^B - \sigma_2^N) (1 - \rho) \varepsilon (1 - \varepsilon) (2q - 1) \\ & = \sigma_1^N (1 - \sigma_2^N) (1 - \varepsilon - q), \end{aligned} \quad (2)$$

$$(\sigma_1^B - \sigma_2^B) (q - \varepsilon) = (\sigma_1^N - \sigma_2^N) (1 - \varepsilon - q). \quad (3)$$

Eqs. (2) and (3) actually define a whole family of mixed equilibria. Among these, however, we want to find the one that performs best in terms of information transmission and welfare. Since one would expect that it is desirable to receive information from both candidates, let us guess that such an equilibrium is symmetric: $\sigma_1^B = \sigma_2^B = \sigma^B$ and $\sigma_1^N = \sigma_2^N = \sigma^N$. Moreover, given that the prior is in favor of B , making σ^B close to unity should be more important than making σ^N close to zero (doing both those things would not be consistent with

Harsanyi can show — thereby providing a strong justification for this interpretation — is that (somewhat loosely put), in almost any strategic form game, almost any mixed equilibrium is close to a strict pure strategy equilibrium of any perturbation of the game in which the players' payoffs are subject to small random shocks. For a useful discussion of this interpretation of a mixed equilibrium as well as others, see Osborne and Rubinstein (1994, pp. 37-44).

¹⁶That is, for both candidates, we do not have $\sigma_i^B = \sigma_i^N = 0$ nor do we have $\sigma_i^B = \sigma_i^N = 1$.

(2) and (3)); hence, let us set $\sigma^B = 1$. Eqs. (2) and (3) now simplify to one equation having only one unknown variable, σ^N . Solving for σ^N yields

$$\sigma^N = \frac{\varepsilon(1-\varepsilon)(2q-1)(1-\rho)}{1-\varepsilon-q+\varepsilon(1-\varepsilon)(2q-1)(1-\rho)} \equiv f(q, \varepsilon, \rho). \quad (4)$$

One can check that, for $q < 1 - \varepsilon$, the function $f(q, \varepsilon, \rho)$ is indeed a well-defined probability since it takes values strictly between zero and one. This means that for $q < 1 - \varepsilon$ there is an equilibrium in which both candidates choose platform B with probability one when they have observed a signal in favor of B , and they choose platform N with probability $f(q, \varepsilon, \rho)$ when they have observed a signal in favor of N . In this equilibrium, if the voter observes the platform configuration $(x_1, x_2) = (B, N)$, for example, she can infer that candidate 2 observed a signal in favor of N . Candidate 1, however, may or may not have observed a signal in favor of B ; this is because, with a probability $f(q, \varepsilon, \rho) (> 0)$, candidate 1 chooses platform B after having observed a signal in favor of N .

Taking this endogenous noise into account, the voter calculates the probability that candidate 1 indeed observed a signal in favor of B . She then uses this probability and the fact that candidate 2 observed a signal in favor of N to update her beliefs about the true state. The magnitude of the endogenous noise $f(q, \varepsilon, \rho)$ is such that, after this updating, the two states are equally likely. Accordingly, the voter is indifferent between the candidates when she sees the platform configuration $(x_1, x_2) = (B, N)$. By symmetry, the voter is also indifferent between the candidates when she observes the platform configuration $(x_1, x_2) = (N, B)$. This means that it is (weakly) optimal for the voter to choose $\sigma_3^{BN} = \sigma_3^{NB} = 1/2$, which is consistent with Assumption 1. If so, the candidates will win the election with the same probability for all four platform configurations (recall Assumption 1). Hence, it is indeed (weakly) optimal for them to randomize between the platforms when they have observed a signal in favor of N , which in turn confirms that $f(q, \varepsilon, \rho)$ can be part of an equilibrium.

Let us denote the equilibrium that is associated with the function f by $\hat{\sigma}$; that is,

$$\hat{\sigma} \equiv \left(1, f(q, \varepsilon, \rho); 1, f(q, \varepsilon, \rho); \frac{1}{2}, \frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right).$$

As we conjectured above, $\hat{\sigma}$ is indeed the equilibrium that is best from the voter's point of view among the equilibria that are implicitly defined by (2) and (3) (and we therefore, from now on, will refer to $\hat{\sigma}$ as the *good mixed equilibrium*). This is one of the statements of the following proposition.

Proposition 3 (Unique Prediction). *For $q < 1 - \varepsilon$, the strategy profile $\hat{\sigma}$ is an equilibrium, and it satisfies Assumption 1. The outcome of this equilibrium Pareto dominates the outcomes of all other equilibria that satisfy Assumption 1. For $q > 1 - \varepsilon$, the unique equilibrium that satisfies Assumption 1 is the popular-beliefs equilibrium.*

Proposition 3 also says that if more than one signal is needed to persuade the voter that policy N is the best policy (i.e., if $q > 1 - \varepsilon$), then the only equilibrium surviving Assumption 1 is the popular-beliefs equilibrium. In other words, if the voter's prior is so strong that it is essential for her to get access to information from more than one candidate, then *any* credible information transmission is infeasible, even when we allow for mixed strategies on the part of the candidates. For lower values of the voter's prior (i.e., for $q < 1 - \varepsilon$), some information can credibly be transmitted to the voter. Even here, however, there is a tendency for the candidates to follow popular beliefs rather than their own information. This will be confirmed by the comparative statics that we devote the remainder of this section to.

Let us first note that $f(q, \varepsilon, \rho)$ is increasing in q , with $f(1/2, \varepsilon, \rho) = 0$ and $f(1 - \varepsilon, \varepsilon, \rho) = 1$. This means that, as q approaches $1/2$, the endogenous noise vanishes and we approach full revelation (cf. part (b) of Observation 1). As q increases, however, so that the voter's prior beliefs get more biased in favor of policy B , the endogenous noise becomes monotonically larger; in the limit, as q approaches $1 - \varepsilon$, the good mixed equilibrium approaches the popular-beliefs equilibria discussed in the previous subsection (i.e., the equilibria in which both candidates babble on B).

The endogenous noise $f(q, \varepsilon, \rho)$ is increasing also in its second argument. In particular, as the quality of the candidates' signals increases (i.e., as ε decreases), one moves continuously from an equilibrium that is close to the popular-beliefs equilibria (for ε close to $1 - q$) to an equilibrium with close to full revelation (for ε close to 0). Finally, $f(q, \varepsilon, \rho)$ is decreasing in its third argument, with

$f(q, \varepsilon, 0) \in (0, 1)$ and $f(q, \varepsilon, 1) = 0$. That is, information transmission becomes easier as the signals become more correlated. In the limit, as the signals become perfectly correlated, the endogenous noise vanishes and we again approach full revelation (cf. part (a) of Observation 1).

[FIGURE 2 ABOUT HERE]

Let us further notice that a decrease in ε has an unambiguously positive effect on the voter's expected utility: a lower ε means that (i) there is more information available to the candidates, and (ii) the amount of endogenous noise becomes smaller. For an increase in the prior q or a decrease in the degree of correlation ρ , however, the corresponding two effects will go in different directions: a larger q or a smaller ρ means that (i) there is *more* information available, and (ii) the amount of endogenous noise becomes larger. To see which of these two effects dominates for changes in q respectively in ρ , let us calculate the voter's expected utility in the good mixed equilibrium, denoted by EU_{mix} :¹⁷

$$EU_{mix} = 1 - \varepsilon - f(q, \varepsilon, \rho)(1 - \varepsilon - q). \quad (5)$$

In Figure 2, the graph of EU_{mix} is depicted as a function of q .¹⁸ This graph tells us that for low enough values of q , the negative effect of a larger amount of endogenous noise has a heavier weight than the direct and positive effect of having access to more prior information. The level of q that yields the lowest expected utility is given by

$$q^\circ(\varepsilon, \rho) = \frac{(1 - \varepsilon)\sqrt{2} + \sqrt{\varepsilon(1 - \varepsilon)(1 - \rho)}}{\sqrt{2} + 2\sqrt{\varepsilon(1 - \varepsilon)(1 - \rho)}}.$$

One can show that the function q° is strictly decreasing in ε with $q^\circ(0, \rho) = 1$ and $q^\circ(1/2, \rho) = 1/2$. This means that if the candidates' signals are very accurate, then the voter's expected utility is, for almost all q 's, decreasing in her prior. Intuitively, when politicians are very competent they are likely to learn the true state through their signal; hence it does not matter much what the value of q is, and the positive effect of more prior information is therefore insignificant. When the error term ε gets close to $1/2$, however, so that the

¹⁷Eq. (5) is implied by Lemma A6, which is stated and proven in Appendix C.

¹⁸A proof that EU_{mix} is convex in q (as indicated by the figure) is available from the authors on request. One can also easily verify that $\lim_{q \rightarrow 1/2} EU_{mix} = \lim_{q \rightarrow 1 - \varepsilon} EU_{mix} = 1 - \varepsilon$.

candidates' signals are almost uninformative, the voter is better off from an increase in the prior q for almost all values of this parameter.

Finally notice that since f is decreasing in ρ and EU_{mix} depends on ρ only through f (see (5)), EU_{mix} is *always* increasing in the degree of correlation between the candidates' signals. Hence, even though a larger ρ means that less information is available to the candidates collectively, this effect is always dominated by the fact that the endogenous noise is smaller for larger ρ .

The following proposition summarizes the comparative statics results discussed above.

Proposition 4 (Comparative Statics). *In the good mixed equilibrium, information transmission becomes more difficult: (i) the less correlated are the candidates' signals, (ii) the lower is the signals' quality, and (iii) the stronger are popular beliefs. Moreover, for $q \in (\frac{1}{2}, q^o(\varepsilon, \rho))$ welfare decreases as popular beliefs become stronger, and welfare always decreases as the signals become less correlated.*

5 Related Literature

The question whether information can be credibly transmitted from politicians to voters has been addressed in some other papers, too.¹⁹ These papers have also identified reasons why we should, under particular circumstances, expect such information transmission to be difficult. This related literature, however, has focused on mechanisms that are different from the one investigated in the present paper — that is, the go-for-the-prior incentive of the candidates that arises whenever the two candidates do not have exactly the same information. The reason why this obstacle to credible information transmission does not appear in the previous papers is that these assume that either only one of the candidates has private information or that both candidates have exactly the same private information.²⁰

¹⁹See, for example, Cukierman and Tommasi (1998), Harrington (1992, 1993), Letterie and Swank (1998), Martinelli (2001), Roemer (1994), Schultz (1995, 1996, 1999), and Wärneryd (1994).

²⁰After having finished the first version of this paper we became aware of a paper by Chan (2001). His analysis is related to ours in that he makes the point that the degree of correlation between two candidates' private signals will affect their platform choices. In Chan's model, however, the uncertainty concerns the electorate's preferences, and it is only the candidates who face this uncertainty. This means that, in Chan's framework, one cannot address the

The paper that is perhaps most closely related to ours is Schultz (1996). He shows that whenever two political parties are sufficiently much polarized — in the sense that their policy preferences are sufficiently much different from the median voter’s — the parties will have an incentive to misrepresent their information in order to increase their chances of winning office and thereby being able to implement their own favorite policy. A similar effect is present in Cukierman and Tommasi (1998). They show that, because of the credibility problem, a typical left-wing policy may be easier to implement by a right-wing politician (and vice versa), and it therefore “takes a Nixon to go to China.” Harrington (1993) develops an innovative and non-standard electoral-competition model in which an incumbent president has an incentive to bias his policy toward popular beliefs. Key to his model is that voters and candidates (exogenously) have different beliefs as to what is the best policy.

The logic that is at work in our model is also closely related to that in Brandenburger and Polak (1996). They show how a corporate manager who maximizes the stock market’s assessment of the value of the firm will follow the market’s prior beliefs instead of his own superior information when choosing between investment alternatives. An important and distinguishing feature of our model compared to theirs is that our candidates care about how they are perceived *relative* to their opponent. As a consequence, the degree of correlation between the candidates’ signals, which does not have any counterpart in Brandenburger and Polak, plays a central role in our analysis, and we also obtain equilibria that are qualitatively different from theirs (see for example our Proposition 1).²¹

The phenomenon in our model that political candidates behave opportunistically and follow the electorate’s prior instead of their own information also makes it similar to papers by Prendergast (1993) on “yes men” and by Morris (1999) on political correctness. The yes men in Prendergast’s principal-agent model distort their messages toward the principal’s prior because their performance is evaluated using the principal’s opinion as a benchmark. This kind of

question how the amount of information transmission from candidates to voters is affected by the correlation.

²¹For an early model that is very similar to Brandenburger and Polak’s and which concerns an election, see Wärneryd (1994). There, however, there is only one politician, who is to be approved or not by the electorate. This feature makes Wärneryd’s model closer to Brandenburger and Polak’s than to ours, and the above remarks also apply to his model.

incentive contract can be optimal for the principal since she wants to induce the agent to make an effort and she cannot make the contract contingent on the true state. In Morris’s model of political correctness, a decision maker is consulting an advisor who may be either “good” (i.e., with identical preferences to the decision maker) or “bad” (i.e., biased in favor of a particular decision). Since an advisor wants to be consulted also in later periods in order to influence future policy, he is anxious not to be perceived as a bad advisor. Because of these instrumental reputational concerns, he may have an incentive to initially bias his advice away from the bad advisor’s preferred policy.

Our model is also related, more generally, to other work on strategic information transmission. As in Crawford and Sobel’s (1982) model of cheap talk, sending messages in our model (i.e., choosing platforms) has no cost to the candidates other than that inherent in the electorate’s choice of action, since our candidates are solely office-motivated. In their model of expert advice, Krishna and Morgan (2001) extend the Crawford and Sobel setting by assuming that there are *two* senders who act sequentially and who both know the true state. They show that having two senders instead of only one can actually decrease the amount of information transmitted — a result which is in the spirit of ours although driven by other assumptions. The Krishna and Morgan paper and several other recent models of expert advice²² differ from our setting in at least two important regards. First, our “experts” (i.e., candidates) care intrinsically about whether their “advice” is followed or not (i.e., whether they get elected). In the cited literature, in contrast, experts care either about the policy they advise on or about the decision maker’s perception of their competence. Second, the advice provided by the experts in our model has a real effect in that it determines the action set available to the decision maker. In our application, which concerns an electoral competition, we believe our setup to be very natural.

6 Concluding Discussion

The results of the present paper were derived in a simple framework. In this concluding section we will discuss which of the assumptions of the model are needed for our results to hold qualitatively, and which ones merely served the

²²See, for example, Ottaviani and Sørensen (2000, 2001).

purpose of simplifying the analysis. At the end of the section we will also briefly mention what our results may imply for two related questions that were not studied here.

One assumption that is crucial for our results is that the candidates can only make their platform choices contingent on their own information and not on what their opponent says. That is, we do not allow platforms that take the form “I promise to lower taxes if I *and my opponent* say that this is good for the economy.” If we allowed the candidates to make such commitments, then they would be able to transmit all their information to the electorate. We believe it is natural, however, to rule out such commitments in a model of electoral competition, since it seems implausible that they would be used in the real world.²³

Another reason why our particular commitment assumption is important is that if the candidates were not able to commit to *any* platform, then they may — once they are in office — simply do what is in the electorate’s interest. Our assumption that the candidates can commit could, in principle, be justified by thinking of it as a reduced form of a repeated game (similar to Alesina, 1988). For the repeated-game argument to be valid, however, there must be some benefit associated with the candidates’ having access to a commitment technology. This would potentially be the case if the candidates, besides being office-motivated, had ideological (or other) leanings toward one of the policies. An important question is therefore whether our results are robust to such an extension.

Hence, consider a variation of our original model in which both candidates, on top of their payoff from holding office, receive some incremental payoff $\gamma \neq 0$ (where $|\gamma|$ is not too large) if policy N is implemented, but which otherwise is identical to the model described in Section 2. Two things will change in this setting. First, even without imposing Assumption 1, the fully revealing equilibria in Proposition 1 will no longer exist.²⁴ The reason for this is that,

²³One possible theoretical justification for not allowing such commitments is that in a natural extension of the model in which the candidates have private information about their own competence, they would not have an incentive to commit in this fashion. For a candidate who makes his own policy choice a function of his opponent’s opinion may signal that he does not trust his own judgement — i.e., that the candidate knows that he is of low competence.

²⁴As long as we do not impose Assumption 1, however, an equilibrium in which one signal is transmitted will still exist. In this equilibrium one candidate babbles on his preferred policy

in order to sustain those equilibria, one candidate must win with probability one regardless of his platform choice. But if so, this candidate will always choose his preferred policy instead of following his signal. Second, given these policy preferences of the candidates, some equilibria will not be Pareto rankable. All other essential parts of our analysis we would expect to be qualitatively unaffected by such an extension. In particular, we have verified that the good mixed equilibrium still exists and that it gives the voter higher expected utility than all other equilibria satisfying Assumption 1. Furthermore, we strongly believe that Propositions 2 and 4 would remain valid.

Another assumption of the model, which is obviously important, is that the candidates somehow have access to policy-relevant information. One plausible justification for this is that, often in the real world, interest groups, think tanks, and bureaucrats freely provide politicians with such information. Another possibility would be that the politicians themselves acquired the information. Given our assumption that the candidates do not care about the true state, however, it is not clear whether they would have an incentive to do that if information acquisition is costly (and unobservable). One may therefore wonder whether our results are also robust to an extension in which the candidates care about the true state. In particular, suppose both candidates, on top of their payoff from holding office, receive some incremental payoff $\delta > 0$ if the implemented policy is identical to the true state. This extension is quite complex, since here the candidates' incentive constraints will depend on their beliefs about the true state. We have verified, however, that the good mixed equilibrium exists if δ is sufficiently small,²⁵ and it is also fairly straightforward to see that the equilibria in which the candidates play pure still exist (including the fully revealing ones listed in Proposition 1). In general, we would expect all essential results of our model to be robust to this extension.

Finally, we assumed the existence of a single voter. Clearly, we could have assumed the existence of multiple identical voters without changing our results. Alternatively, one could have assumed an (odd) number of voters who differ in their preferences with regard to policy B and N . In such a generalization, we

and the other candidate follows his signal. To induce the latter candidate to reveal his signal truthfully, he is elected with a lower probability whenever he chooses his preferred policy.

²⁵For simplicity, we restricted attention to the case in which $\rho = 0$.

can think of our voter as being the median voter.²⁶

Let us conclude by pointing at a couple of possible implications of our results that go beyond the questions that we have been immediately concerned with in this paper. First, the result that the candidates' behavior is very much guided by their beliefs about popular opinion suggests that they should have an incentive to acquire information about the electorate's beliefs rather than about the policy-relevant state of the world: a candidate who wants to win an election should use his campaign funds to buy public opinion polls rather than hiring an expert on the policy issue itself. Indeed, in the real world we often observe that political parties commission public opinion polls. Second, the result that policy platforms typically reflect popular opinion rather than the candidates' information about the true state suggests that interest groups may well prefer to address the electorate directly (e.g. through TV commercials) rather than providing the candidates with the same information.

Appendix A: Proof of Proposition 1

Proof of Proposition 1. For an equilibrium to be fully revealing we must have $\sigma_i^B \in \{0, 1\}$ and $\sigma_i^N = 1 - \sigma_i^B$ for all $i \in \{1, 2\}$. Thus, there are four cases to consider: (i) $\sigma_1^B = \sigma_2^B = 1$ and $\sigma_1^N = \sigma_2^N = 0$; (ii) $\sigma_1^B = \sigma_2^B = 0$ and $\sigma_1^N = \sigma_2^N = 1$; (iii) $\sigma_1^B = \sigma_2^N = 1$ and $\sigma_1^N = \sigma_2^B = 0$; and (iv) $\sigma_1^N = \sigma_2^B = 1$ and $\sigma_1^B = \sigma_2^N = 0$. We must show that: (i) and (ii) cannot be part of an equilibrium; (iii) is part of an equilibrium if and only if $\sigma_3^{BB} = \sigma_3^{BN} = \sigma_3^{NB} = \sigma_3^{NN} = 1$; and (iv) is part of an equilibrium if and only if $\sigma_3^{BB} = \sigma_3^{BN} = \sigma_3^{NB} = \sigma_3^{NN} = 0$.

Suppose (i) is part of an equilibrium. By definition, in any fully revealing equilibrium the voter can infer both candidates' signals. Because in (i) a candidate's chosen policy platform is always identical to the signal he has received, the candidate who has chosen platform B wins whenever the chosen platforms differ: $\sigma_3^{BN} = 1$ and $\sigma_3^{NB} = 0$. In equilibrium, choosing policy N when having observed a signal N (i.e., $\sigma_i^N = 0$) must be a best response for both candidates; i.e.:

$$\sigma_3^{NN} P_{N|N} \geq \sigma_3^{BB} P_{B|N} + P_{N|N}, \quad (6)$$

²⁶One caveat, however, is that if the electorate is sufficiently heterogenous, equilibria with different amounts of information transmission may not be Pareto rankable.

$$(1 - \sigma_3^{NN}) P_{N|N} \geq (1 - \sigma_3^{BB}) P_{B|N} + P_{N|N}, \quad (7)$$

where we used the simplifying notation

$$P_{j|k} \equiv \Pr(s_2 = j \mid s_1 = k) \equiv \Pr(s_1 = j \mid s_2 = k)$$

for $j, k \in \{B, N\}$ (the latter identity holds because the quality of the two signals are the same). Adding inequalities (6) and (7) yields $P_{N|N} \geq P_{B|N} + 2P_{N|N}$, which is impossible since $P_{B|N} = 1 - P_{N|N}$.

Now, suppose (ii) is part of an equilibrium. Again, the voter can infer both candidates' signals. Because in (ii) a candidate's chosen policy platform is always opposite to the signal he has received, the candidate who has chosen platform B , again, wins whenever the chosen platforms differ: $\sigma_3^{BN} = 1$ and $\sigma_3^{NB} = 0$. In equilibrium, choosing policy N when having observed a signal B (i.e., $\sigma_i^B = 0$) must be a best response for both candidates; i.e.:

$$\sigma_3^{NN} P_{B|B} \geq \sigma_3^{BB} P_{N|B} + P_{B|B}, \quad (8)$$

$$(1 - \sigma_3^{NN}) P_{B|B} \geq (1 - \sigma_3^{BB}) P_{N|B} + P_{B|B}. \quad (9)$$

Adding inequalities (8) and (9) yields $P_{B|B} \geq P_{N|B} + 2P_{B|B}$, which is impossible.

Next, consider case (iii). Again, the voter can infer both candidates' signals. Because candidate 1's chosen signal is always identical to the signal he has received and candidate 2's chosen signal is always opposite to the signal he has received, candidate 1 wins whenever the chosen platforms differ: $\sigma_3^{BN} = 1$ and $\sigma_3^{NB} = 1$. In equilibrium, candidate 2's choosing policy N when having observed a signal B (i.e., $\sigma_2^B = 0$) must be a best response:

$$(1 - \sigma_3^{NN}) P_{N|B} \geq (1 - \sigma_3^{BB}) P_{B|B}. \quad (10)$$

Moreover, candidate 2's choosing policy B when having observed a signal N (i.e., $\sigma_2^N = 1$) must be a best response:

$$(1 - \sigma_3^{BB}) P_{B|N} \geq (1 - \sigma_3^{NN}) P_{N|N}. \quad (11)$$

Adding inequalities (10) and (11), using $P_{N|N} = 1 - P_{B|N}$ and $P_{B|B} = 1 - P_{N|B}$, and rewriting yield

$$(\sigma_3^{BB} + \sigma_3^{NN} - 2) (P_{B|B} - P_{B|N}) \geq 0. \quad (12)$$

Since $P_{B|B} > P_{N|B}$, inequality (12) can only be met if $\sigma_3^{BB} = \sigma_3^{NN} = 1$. Conversely, if we do have $\sigma_3^{BB} = \sigma_3^{BN} = \sigma_3^{NB} = \sigma_3^{NN} = 1$, then clearly none of the candidates has an incentive to deviate. This establishes the claim for case (iii). Case (iv) is analogous to case (iii) and is therefore omitted. ■

Appendix B: Proof of Proposition 2

In order to prove Proposition 2, we will use Lemmas A1-A3 stated and proven below.

Lemma A1. *In any babbling equilibrium in which $(x_1, x_2) = (B, N)$ (respectively, $(x_1, x_2) = (N, B)$) along the equilibrium path, one has $\sigma_3^{BN} = 1$ (respectively, $\sigma_3^{NB} = 0$).*

Proof. By definition, in a babbling equilibrium no information is revealed. Thus, the voter's posterior is equal to her prior. Hence the voter strictly prefers a candidate who has chosen platform B to a candidate who has chosen platform N . ■

Lemma A2. *Suppose $q > 1 - \varepsilon$. Then, in any babbling equilibrium in which either $x_1 = B$ or $x_2 = N$ (respectively, either $x_1 = N$ or $x_2 = B$) along the equilibrium path, one has $\sigma_3^{BN} = 1$ (respectively, $\sigma_3^{NB} = 0$).*

Proof. In case no candidate deviated the claim follows from Lemma A1. Thus, suppose one candidate deviated. For $q > 1 - \varepsilon$, the voter strictly prefers policy B if she knows at most one signal. Thus, independently of what beliefs the voter holds about the deviator's signal, she strictly prefers a candidate who has chosen platform B to a candidate who has chosen platform N . ■

Lemma A3. *Suppose $q < 1 - \varepsilon$ and that σ_3^{jk} , for $j, k \in \{B, N\}$, is part of a babbling equilibrium in which $(x_1, x_2) = (j, k)$ only off the equilibrium path. Then there exist beliefs on the part of the voter that support any $\sigma_3^{jk} \in [0, 1]$.*

Proof. Since $(x_1, x_2) = (j, k)$ is off the equilibrium path at least one candidate deviated, so the voter's beliefs about that candidate's signal are not

determined by Bayes' rule. Moreover, for $q < 1 - \varepsilon$, believing that one candidate's signal is in favor of N and that the other candidate is babbling suffices to make the voter prefer N . Hence, one can always find some out-of-equilibrium beliefs on the part of the voter about the deviator's signal (or the deviators' signals) that make any $\sigma_3^{jk} \in [0, 1]$ optimal. ■

Proof of Proposition 2. We will prove the proposition by first considering all possible babbling equilibria in pure strategies and showing that only the ones listed in the proposition exist and satisfy Assumption 1. Thereafter we will show that no other equilibrium in which both candidates play pure survives Assumption 1.

In any babbling equilibrium in which the candidates play pure, one has $\sigma_i^B = \sigma_i^N = \sigma_i$ and $\sigma_i \in \{0, 1\}$ for all $i \in \{1, 2\}$. Thus there are four cases to investigate: (i) $\sigma_1 = \sigma_2 = 1$; (ii) $\sigma_1 = 1, \sigma_2 = 0$; (iii) $\sigma_1 = \sigma_2 = 0$; (iv) $\sigma_1 = 0, \sigma_2 = 1$.

Consider case (i). From Lemma A3 we know that, for $q < 1 - \varepsilon$, any $\sigma_3^{NB}, \sigma_3^{BN} \in [0, 1]$ are consistent with the voter's incentive constraints being satisfied. By Assumption 1, $\sigma_3^{BB} = \sigma_3^{NN} = 1/2$. In equilibrium, each candidate's choosing policy B must be a best response. This requires that $\sigma_3^{BB} \geq \sigma_3^{NB}$ and $1 - \sigma_3^{BB} \geq 1 - \sigma_3^{BN}$ or, equivalently, $\sigma_3^{NB} \square \sigma_3^{BB} = 1/2 \square \sigma_3^{BN}$. By Assumption 1, $\sigma_3^{BN} = 1 - \sigma_3^{NB}$. Thus, for $q < 1 - \varepsilon$, case (i) is part of a babbling equilibrium if and only if $\sigma_3^{NB} \in [0, 1/2]$ and $\sigma_3^{BN} = 1 - \sigma_3^{NB}$. Moreover, for $q > 1 - \varepsilon$ it follows from Lemma A2 that case (i) is part of a babbling equilibrium if and only if $\sigma_3^{NB} = 0$ and $\sigma_3^{BN} = 1$. Case (i) corresponds to part (a) of Proposition 2.

Consider case (ii). By Lemma A1, $\sigma_3^{BN} = 1$. In equilibrium, candidate 2's choosing policy N must be a best response. That is, $1 - \sigma_3^{BN} \geq 1 - \sigma_3^{BB}$. This inequality in conjunction with $\sigma_3^{BN} = 1$, however, imply $\sigma_3^{BB} = 1$, which is inconsistent with Assumption 1. Hence, case (ii) cannot be part of a babbling equilibrium.

Consider case (iii). By Lemma A2, for $q > 1 - \varepsilon$, $\sigma_3^{BN} = 1$ and $\sigma_3^{NB} = 0$. From Lemma A3 we know that, for $q < 1 - \varepsilon$, any $\sigma_3^{NB}, \sigma_3^{BN} \in [0, 1]$ are consistent with the voter's incentive constraints being satisfied. Moreover, by Assumption 1, $\sigma_3^{BB} = \sigma_3^{NN} = 1/2$. In equilibrium, choosing policy N (i.e.,

$\sigma_1 = 0$ and $\sigma_2 = 0$) must be a best response for both candidates. That is, $\sigma_3^{NN} \geq \sigma_3^{BN}$ and $1 - \sigma_3^{NN} \geq 1 - \sigma_3^{NB}$. Hence, $\sigma_3^{BN} \square \sigma_3^{NN} = 1/2 \square \sigma_3^{NB}$. These inequalities, however, are inconsistent with $\sigma_3^{BN} = 1$ and $\sigma_3^{NB} = 0$. Thus, for $q > 1 - \varepsilon$, case (iii) cannot be part of a babbling equilibrium. For $q < 1 - \varepsilon$, case (iii) is part of a babbling equilibrium if and only if $\sigma_3^{BN} \in [0, 1/2]$ and $\sigma_3^{NB} = 1 - \sigma_3^{BN}$. Case (iii) corresponds to part (b) of Proposition 2. Case (iv) is analogous to case (ii) and therefore omitted.

Let us now show that there exists no other equilibrium in which both candidates play pure and which survives Assumption 1 than the babbling ones. As can be seen from Proposition 1, Assumption 1 rules out the possibility of an equilibrium with full revelation. We are left to consider the possibility of equilibria in which one candidate babbles and the other fully reveals his signal. Suppose such an equilibrium exists. Along the equilibrium path of any such equilibrium, the voter will face two situations: one in which the candidates announced the same platform and another in which they announced different platforms. Since the voter learns exactly one signal in the kind of equilibrium under consideration, she strictly prefers one of the candidates to the other whenever their platforms differ (recall that we ignore the knife-edge case in which $q = 1 - \varepsilon$). Hence, whenever $x_1 \neq x_2$, she either votes for (a) the fully revealing candidate or (b) the babbling candidate with probability one. In case (a), however, the revealing candidate has a strict incentive to always announce the platform that the babbling candidate has *not* chosen; this is because if he chose the same platform as the babbling candidate, then, by Assumption 1, he would get elected with probability $1/2$. Similarly, in case (b), the revealing candidate always has an incentive to choose the same platform as the babbling candidate; this is because here, again by Assumption 1, he gets elected with positive probability $1/2$ if his platform is identical to the babbling candidate's platform. ■

Appendix C: Proof of Proposition 3

In order to prove Proposition 3, we will use Lemmas A4-A10 stated and proven below. Lemmas A4-A6 and A8-A9 concern strategy profiles that satisfy a requirement we call Condition 1. This is the requirement on the candidates' behavior that we made in subsection 4.2 and which gave us (2) and (3) and

eventually the good mixed equilibrium. Formally, we say that *Condition 1a* respectively *Condition 1b* is satisfied if: (a) for all $i \in \{1, 2\}$, we do not have $\sigma_i^B = \sigma_i^N = 0$ nor do we have $\sigma_i^B = \sigma_i^N = 1$; and (b) we do have

$$\Pr(\omega = \omega_B \mid x_1 = B, x_2 = N) = \Pr(\omega = \omega_B \mid x_1 = N, x_2 = B) = \frac{1}{2}.$$

And we say that *Condition 1* is satisfied if Condition 1a and Condition 1b are satisfied. Notice that, under Assumption 1, if Condition 1b is violated so is Condition 1a. To see this, suppose, for example, that $\Pr(\omega = \omega_B \mid x_1 = B, x_2 = N) < 1/2$. Then $\sigma_3^{BN} = 0$. Moreover, by Assumption 1, $\sigma_3^{NB} = 1$ and $\sigma_3^{BB} = \sigma_3^{NN} = 1/2$. Hence, candidate 1 will choose B with positive probability only if candidate 2 chooses N with zero probability; i.e., either $\sigma_1^B = \sigma_1^N = 0$ or $\sigma_2^B = \sigma_2^N = 1$, which violates Condition 1a.

Lemma A4. *Condition 1 implies (2) and (3). Furthermore, if Condition 1a is satisfied then (2) and (3) imply Condition 1b.*

Proof. First, we show that Condition 1 implies (2) and (3). Given that Condition 1a holds, Condition 1b and Bayes' rule (which is well defined if Condition 1a holds) imply that

$$\begin{aligned} & \Pr(\omega = \omega_B \mid x_1 = B, x_2 = N) \\ &= \frac{\Pr(x_1 = B, x_2 = N \mid \omega = \omega_B) \Pr(\omega = \omega_B)}{\sum_{j=B,N} \Pr(x_1 = B, x_2 = N \mid \omega = \omega_j) \Pr(\omega = \omega_j)} = \frac{1}{2}. \end{aligned} \quad (13)$$

Rewriting (13) we have

$$q \Pr(x_1 = B, x_2 = N \mid \omega = \omega_B) = (1 - q) \Pr(x_1 = B, x_2 = N \mid \omega = \omega_N). \quad (14)$$

We can also write

$$\begin{aligned} & \Pr(x_1 = B, x_2 = N \mid \omega = \omega_j) \\ &= \Pr(x_1 = B, x_2 = N \mid s_1 = B, s_2 = B) \Pr(s_1 = B, s_2 = B \mid \omega = \omega_j) \\ &+ \Pr(x_1 = B, x_2 = N \mid s_1 = B, s_2 = N) \Pr(s_1 = B, s_2 = N \mid \omega = \omega_j) \\ &+ \Pr(x_1 = B, x_2 = N \mid s_1 = N, s_2 = B) \Pr(s_1 = N, s_2 = B \mid \omega = \omega_j) \\ &+ \Pr(x_1 = B, x_2 = N \mid s_1 = N, s_2 = N) \Pr(s_1 = N, s_2 = N \mid \omega = \omega_j) \end{aligned}$$

for $j \in \{B, N\}$. Hence,

$$\begin{aligned} & \Pr(x_1 = B, x_2 = N \mid \omega = \omega_B) \\ &= \sigma_1^B (1 - \sigma_2^B) \left[(1 - \varepsilon)^2 + \rho\varepsilon(1 - \varepsilon) \right] + \sigma_1^B (1 - \sigma_2^N) (1 - \rho)\varepsilon(1 - \varepsilon) + \\ & \sigma_1^N (1 - \sigma_2^B) (1 - \rho)\varepsilon(1 - \varepsilon) + \sigma_1^N (1 - \sigma_2^N) \left[\varepsilon^2 + \rho\varepsilon(1 - \varepsilon) \right] \end{aligned} \quad (15)$$

and

$$\begin{aligned} & \Pr(x_1 = B, x_2 = N \mid \omega = \omega_N) \\ &= \sigma_1^B (1 - \sigma_2^B) \left[\varepsilon^2 + \rho\varepsilon(1 - \varepsilon) \right] + \sigma_1^B (1 - \sigma_2^N) (1 - \rho)\varepsilon(1 - \varepsilon) + \\ & \sigma_1^N (1 - \sigma_2^B) (1 - \rho)\varepsilon(1 - \varepsilon) + \sigma_1^N (1 - \sigma_2^N) \left[(1 - \varepsilon)^2 + \rho\varepsilon(1 - \varepsilon) \right]. \end{aligned} \quad (16)$$

Substituting (15) and (16) into (14) and then rewriting one has (2).²⁷ Similarly, Condition 1b also requires that $\Pr(\omega = \omega_B \mid x_1 = N, x_2 = B) = 1/2$, which (using Bayes' rule) can be rewritten as

$$q \Pr(x_1 = N, x_2 = B \mid \omega = \omega_B) = (1 - q) \Pr(x_1 = N, x_2 = B \mid \omega = \omega_N). \quad (17)$$

By symmetry (cf. (2)), (17) can be rewritten as

$$\begin{aligned} & \sigma_2^B (1 - \sigma_1^B) (q - \varepsilon) + (\sigma_1^B - \sigma_1^N) (\sigma_2^B - \sigma_2^N) (1 - \rho)\varepsilon(1 - \varepsilon) (2q - 1) \\ &= \sigma_2^N (1 - \sigma_1^N) (1 - \varepsilon - q). \end{aligned} \quad (18)$$

Subtracting (18) from (2) yields (3). Hence, in an equilibrium that satisfies Condition 1, (2) and (3) must hold. It remains to show that if Condition 1a is satisfied then (2) and (3) imply that Condition 1b is met. First, subtracting (3) from (2) yields (18). Moreover, (2) and (18) are just rewritten forms of (14) and (17), respectively. Hence, provided that Bayes' rule is well-defined (which it is if Condition 1a is satisfied), (2) and (3) imply Condition 1b. ■

Lemma A5. *In any equilibrium satisfying Condition 1, $(\sigma_1^B - \sigma_1^N) (\sigma_2^B - \sigma_2^N) > 0$.*

Proof. From the proof of Lemma A4 we know that, in any equilibrium satisfying Condition 1, (14) must hold. Hence, since $q > 1/2$, we must have

$$\Pr(x_1 = B, x_2 = N \mid \omega = \omega_B) < \Pr(x_1 = B, x_2 = N \mid \omega = \omega_N). \quad (19)$$

²⁷In order to derive (2), it is useful to note that

$$\sigma_1^B (1 - \sigma_2^N) + \sigma_1^N (1 - \sigma_2^B) \equiv \sigma_1^B (1 - \sigma_2^B) + \sigma_1^N (1 - \sigma_2^N) + (\sigma_1^B - \sigma_1^N) (\sigma_2^B - \sigma_2^N).$$

By using (15) and (16) in inequality (19) and then rewriting, we obtain

$$\sigma_1^B (1 - \sigma_2^B) < \sigma_1^N (1 - \sigma_2^N). \quad (20)$$

Similarly, (17) and the fact that $q > 1/2$ imply that

$$\sigma_2^B (1 - \sigma_1^B) < \sigma_2^N (1 - \sigma_1^N). \quad (21)$$

Inequality (20) implies that if $\sigma_2^B < \sigma_2^N$, then $\sigma_1^B < \sigma_1^N$; and inequality (21) implies that if $\sigma_1^B < \sigma_1^N$, then $\sigma_2^B < \sigma_2^N$. Hence, we must have $(\sigma_1^B - \sigma_1^N)(\sigma_2^B - \sigma_2^N) \geq 0$. It remains to show that we cannot have $(\sigma_1^B - \sigma_1^N)(\sigma_2^B - \sigma_2^N) = 0$. To see this, notice that if we use $\sigma_1^B = \sigma_1^N$ in (20) we get $\sigma_2^B > \sigma_2^N$ whereas $\sigma_1^B = \sigma_1^N$ in (21) gives us $\sigma_2^B < \sigma_2^N$; hence, $\sigma_1^B \neq \sigma_1^N$. A similar exercise for σ_2^B and σ_2^N gives us $\sigma_2^B \neq \sigma_2^N$. ■

Lemma A6. *If an equilibrium satisfies Condition 1, the voter's expected utility can be written as*

$$EU_{cond1} = \sigma_i^B (q - \varepsilon) - \sigma_i^N (1 - \varepsilon - q) + 1 - q, \quad \text{for } i \in \{1, 2\}.$$

Proof. Conditioning on the true state ω , one can write

$$\begin{aligned} EU_{cond1} &= q \left[\Pr(x_1 = B, x_2 = B \mid \omega = \omega_B) + \sigma_3^{BN} \Pr(x_1 = B, x_2 = N \mid \omega = \omega_B) \right] + \\ & \quad + (1 - \sigma_3^{NB}) \Pr(x_1 = N, x_2 = B \mid \omega = \omega_B) \\ (1 - q) & \left[(1 - \sigma_3^{BN}) \Pr(x_1 = B, x_2 = N \mid \omega = \omega_N) + \right. \\ & \quad \left. \sigma_3^{NB} \Pr(x_1 = N, x_2 = B \mid \omega = \omega_N) + \Pr(x_1 = N, x_2 = N \mid \omega = \omega_N) \right]. \end{aligned}$$

It follows from the proof of Lemma A4 that Condition 1 requires that (14) and (17) hold. Using (14) and (17) to rewrite the above equation one obtains

$$\begin{aligned} EU_{cond1} &= q [\Pr(x_1 = B, x_2 = B \mid \omega = \omega_B) + \Pr(x_1 = N, x_2 = B \mid \omega = \omega_B)] + \\ & \quad (1 - q) [\Pr(x_1 = B, x_2 = N \mid \omega = \omega_N) + \Pr(x_1 = N, x_2 = N \mid \omega = \omega_N)]. \end{aligned}$$

This equation simplifies to

$$\begin{aligned} EU_{cond1} &= q \Pr(x_2 = B \mid \omega = \omega_B) + (1 - q) \Pr(x_2 = N \mid \omega = \omega_N) \\ &= q [\sigma_2^B (1 - \varepsilon) + \sigma_2^N \varepsilon] + (1 - q) [(1 - \sigma_2^B) \varepsilon + (1 - \sigma_2^N) (1 - \varepsilon)] \\ &= \sigma_2^B (q - \varepsilon) - \sigma_2^N (1 - \varepsilon - q) + 1 - q, \end{aligned}$$

which means that the lemma is true for $i = 2$. Since Condition 1 is met, Lemma A4 implies that (3) is satisfied. It follows from (3) that if the lemma is true for $i = 2$, then it is also true for $i = 1$. ■

Lemma A7. *Suppose Assumption 1 is satisfied. Then, in any equilibrium in which at least one of the candidates is randomizing, $\sigma_3^{BN} = \sigma_3^{NB} = 1/2$.*

Proof. Suppose not. Then there exist an equilibrium in which one candidate chooses both platforms with positive probability and in which $\sigma_3^{NB} > 1/2$ or $\sigma_3^{NB} < 1/2$. First, suppose that in equilibrium $\sigma_3^{NB} > 1/2$. Then, by Assumption 1, $\sigma_3^{BN} = 1 - \sigma_3^{NB} < 1/2$. Hence, independently of whether candidate 2 chooses platform B or N (or randomizes with any probability between them), candidate 1's unique best response is to choose platform N ; this is because $\sigma_3^{NB} > \sigma_3^{BB}$ and $\sigma_3^{NN} > \sigma_3^{BN}$. Symmetrically, independently of whether candidate 1 chooses platform B or N , candidate 2's unique best response is to choose platform N . Hence, if $\sigma_3^{NB} > 1/2$, both candidates choose platform N in equilibrium, contradicting the assumption of the proof that one candidate chooses both platforms with positive probability. The proof that both candidates choose platform B if $\sigma_3^{NB} < 1/2$ is analogous and therefore omitted. ■

Lemma A8. *For $q < 1 - \varepsilon$, the outcome of $\hat{\sigma}$ Pareto dominates the outcomes of all other equilibria that satisfy Assumption 1 and Condition 1.*

Proof. Condition 1a together with the fact that an equilibrium that satisfies Assumption 1 cannot be fully revealing imply that at least one candidate is randomizing. Hence, from Lemma A7 and Assumption 1 it follows that the candidates are indifferent between all equilibria that satisfy Assumption 1 and Condition 1. This means that, in order to prove the claim in the lemma, it suffices to show that the outcome of $\hat{\sigma}$ gives the voter higher expected utility than the outcomes of all other equilibria that satisfy Assumption 1 and Condition 1. Lemmas A4 and A6 imply that showing this is identical to showing that $(\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N) = (1, f(q, \varepsilon, \rho), 1, f(q, \varepsilon, \rho))$ solves the following problem:

$$\max_{\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N} \frac{\sigma_1^B + \sigma_2^B}{2} (q - \varepsilon) - \frac{\sigma_1^N + \sigma_2^N}{2} (1 - \varepsilon - q)$$

subject to (2), (3), and $\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N \in [0, 1]$.

In solving this problem, it will be useful to note that the value of the objective function at the point $(\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N) = (1, f(q, \varepsilon, \rho), 1, f(q, \varepsilon, \rho))$ is

$$q - \varepsilon - f(q, \varepsilon, \rho)(1 - \varepsilon - q) > 0,$$

since $q - \varepsilon > 1 - \varepsilon - q$. Hence, since $(\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N) = (1, f(q, \varepsilon, \rho), 1, f(q, \varepsilon, \rho))$ satisfies the constraints (2) and (3), the value of the objective function evaluated at the solution of the maximization problem is positive. In particular, since Lemma A6 implies that the objective function can be rewritten as $\sigma_i^B(q - \varepsilon) - \sigma_i^N(1 - \varepsilon - q)$, this rules out that $\sigma_i^B = 0$ for $i = \{1, 2\}$. Furthermore, one may rule out that $\sigma_i^N = 1$ since

$$q - \varepsilon - f(q, \varepsilon, \rho)(1 - \varepsilon - q) > \sigma_i^B(q - \varepsilon) - (1 - \varepsilon - q).$$

Next, we set up the Lagrangian for the above maximization problem and show that no other candidate solution for a maximum exists besides $(\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N) = (1, f(q, \varepsilon, \rho), 1, f(q, \varepsilon, \rho))$, thereby proving that this indeed is the maximum.

$$\begin{aligned} \mathcal{L} = & \frac{\sigma_1^B + \sigma_2^B}{2}(q - \varepsilon) - \frac{\sigma_1^N + \sigma_2^N}{2}(1 - \varepsilon - q) \\ & - \lambda \left[\sigma_1^B(1 - \sigma_2^B)(q - \varepsilon) + (\sigma_1^B - \sigma_1^N)(\sigma_2^B - \sigma_2^N)K \right. \\ & \quad \left. - \sigma_1^N(1 - \sigma_2^N)(1 - \varepsilon - q) \right] \\ & - \mu [(\sigma_1^B - \sigma_2^B)(q - \varepsilon) - (\sigma_1^N - \sigma_2^N)(1 - \varepsilon - q)] \\ & + \theta_1^B(1 - \sigma_1^B) + \theta_2^B(1 - \sigma_2^B) + \theta_1^N\sigma_1^N + \theta_2^N\sigma_2^N, \end{aligned}$$

where $K \equiv (1 - \rho)\varepsilon(1 - \varepsilon)(2q - 1)$. A maximum must satisfy the following first-order conditions:

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial \sigma_2^B} = 0 = & \frac{q - \varepsilon}{2} - \lambda \{ -\sigma_1^B(q - \varepsilon) + (\sigma_1^B - \sigma_1^N)K \} \\ & + \mu(q - \varepsilon) - \theta_2^B, \end{aligned} \quad (22)$$

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial \sigma_2^N} = 0 = & -\frac{(1 - \varepsilon - q)}{2} - \lambda \{ -(\sigma_1^B - \sigma_1^N)K + \sigma_1^N(1 - \varepsilon - q) \} \\ & - \mu(1 - \varepsilon - q) + \theta_2^N. \end{aligned} \quad (23)$$

Since we have ruled out that either $\sigma_i^B = 0$ or $\sigma_i^N = 1$ for $i \in \{1, 2\}$, we are left to check the cases in which either $\sigma_i^B = 1$ or $\sigma_i^B \in (0, 1)$ and in which either $\sigma_i^N = 0$ or $\sigma_i^N \in (0, 1)$ for $i \in \{1, 2\}$. Thus, we have to consider $2^4 = 16$ cases. By Proposition 1, $\sigma_1^B = \sigma_2^B = 1$ and $\sigma_1^N = \sigma_2^N = 0$ is not an equilibrium,

and hence we are left to consider the following 15 cases for candidate solutions:

(1) $\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N \in (0, 1)$; (2) $\sigma_1^B = 1$ and $\sigma_1^N, \sigma_2^B, \sigma_2^N \in (0, 1)$; (2') $\sigma_2^B = 1$ and $\sigma_1^B, \sigma_1^N, \sigma_2^N \in (0, 1)$; (3) $\sigma_1^N = 0$ and $\sigma_1^B, \sigma_2^B, \sigma_2^N \in (0, 1)$; (3') $\sigma_2^N = 0$ and $\sigma_1^B, \sigma_1^N, \sigma_2^B \in (0, 1)$; (4) $\sigma_1^B = 1, \sigma_1^N = 0$, and $\sigma_2^B, \sigma_2^N \in (0, 1)$; (4') $\sigma_2^B = 1, \sigma_2^N = 0$, and $\sigma_1^B, \sigma_1^N \in (0, 1)$; (5) $\sigma_1^N = 0, \sigma_2^B = 1$, and $\sigma_1^B, \sigma_2^N \in (0, 1)$; (5') $\sigma_1^B = 1, \sigma_2^N = 0$, and $\sigma_1^N, \sigma_2^B \in (0, 1)$; (6) $\sigma_1^B = \sigma_2^B = 1$ and $\sigma_1^N, \sigma_2^N \in (0, 1)$; (7) $\sigma_1^N = \sigma_2^N = 0$ and $\sigma_1^B, \sigma_2^B \in (0, 1)$; (8) $\sigma_1^B = \sigma_2^B = 1, \sigma_1^N = 0$ and $\sigma_2^N \in (0, 1)$; (8') $\sigma_1^B = \sigma_2^B = 1, \sigma_2^N = 0$ and $\sigma_1^N \in (0, 1)$; (9) $\sigma_1^N = \sigma_2^N = 0, \sigma_1^B = 1$ and $\sigma_2^B \in (0, 1)$; (9') $\sigma_1^N = \sigma_2^N = 0, \sigma_2^B = 1$ and $\sigma_1^B \in (0, 1)$. It is easy to see that cases (2')-(5'), (8'), and (9') are symmetric to the corresponding cases (2)-(5), (8), and (9) and therefore we will omit them below.

In the following, we show that the only candidate solution belongs to case (6), and that this solution is $(\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N) = (1, f(q, \varepsilon, \rho), 1, f(q, \varepsilon, \rho))$. Below we use the fact that if $\sigma_i^j \in (0, 1)$ then $\theta_i^j = 0$.

Cases 1-4: Here one has $\theta_2^B = \theta_2^N = 0$. Rewriting (22) and (23) in matrix form, using the fact that $\theta_2^B = \theta_2^N = 0$, gives us

$$\begin{pmatrix} -(q - \varepsilon) + K & -K \\ -K & 1 - \varepsilon - q + K \end{pmatrix} \begin{pmatrix} \sigma_1^B \\ \sigma_1^N \end{pmatrix} = \begin{pmatrix} \frac{1+2\mu}{2\lambda}(q - \varepsilon) \\ -\frac{1+2\mu}{2\lambda}(1 - \varepsilon - q) \end{pmatrix}.$$

Applying Cramer's rule, one has that $\sigma_1^B = \sigma_1^N$ if

$$\begin{aligned} & \frac{1+2\mu}{2\lambda}(q - \varepsilon)[1 - \varepsilon - q + K] - \frac{1+2\mu}{2\lambda}(1 - \varepsilon - q)K \\ &= \frac{1+2\mu}{2\lambda}(1 - \varepsilon - q)[(q - \varepsilon) - K] + \frac{1+2\mu}{2\lambda}(q - \varepsilon)K. \end{aligned}$$

This equation holds if

$$(q - \varepsilon)[1 - \varepsilon - q + K] - (1 - \varepsilon - q)K = (1 - \varepsilon - q)[(q - \varepsilon) - K] + (q - \varepsilon)K,$$

which simplifies to $(q - \varepsilon)(1 - \varepsilon - q) = (1 - \varepsilon - q)(q - \varepsilon)$. Hence, if $\theta_2^B = \theta_2^N = 0$, then $\sigma_1^B = \sigma_1^N$, which contradicts Lemma A5.

Case 5: Using $\sigma_2^B = 1$ and $\sigma_1^N = 0$, constraint (2) simplifies to $\sigma_1^B(1 - \sigma_2^N)K = 0$. This equality, however, contradicts $\sigma_1^B, \sigma_2^N \in (0, 1)$ since $K > 0$.

Case 6: Using $\sigma_1^B = \sigma_2^B = 1$ in constraint (3), one has $\sigma_1^N = \sigma_2^N = \sigma^N$. Next, by using $\sigma_1^B = \sigma_2^B = 1$ and $\sigma_1^N = \sigma_2^N = \sigma^N$ in constraint (2), we can solve for $\sigma^N = f(q, \varepsilon, \rho)$. Hence, the point $(\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N) = (1, f(q, \varepsilon, \rho), 1, f(q, \varepsilon, \rho))$ is one candidate for the maximum.

Case 7: Substituting $\sigma_1^N = \sigma_2^N = 0$ into constraint (2) yields $\sigma_1^B (1 - \sigma_2^B) (q - \varepsilon) + \sigma_1^B \sigma_2^B K = 0$. This equality, however, contradicts $\sigma_1^B \in (0, 1)$.

Case 8: Using $\sigma_1^B = \sigma_2^B = 1$ and $\sigma_1^N = 0$, constraint (3) simplifies to $-\sigma_2^N (1 - \varepsilon - q) = 0$, which contradicts $\sigma_2^N \in (0, 1)$.

Case 9: Using $\sigma_1^B = 1$ and $\sigma_1^N = \sigma_2^N = 0$, constraint (3) simplifies to $(1 - \sigma_2^B) (q - \varepsilon) = 0$, which contradicts $\sigma_2^B \in (0, 1)$.

Hence, $(\sigma_1^B, \sigma_1^N, \sigma_2^B, \sigma_2^N) = (1, f(q, \varepsilon, \rho), 1, f(q, \varepsilon, \rho))$ must be the maximum since it is the only candidate and we know (from standard arguments) that there exists a solution to the maximization problem. ■

Lemma A9. *Suppose Assumption 1 is satisfied. Then, in any equilibrium that violates Condition 1a and in which at least one of the candidates is randomizing, the voter's expected utility is equal to her expected utility in one of the babbling equilibria.*

Proof. Since, by Lemma A7, the voter elects each candidate with probability 1/2 independently of their platform choices, she is always indifferent between the candidates. Hence, her expected utility is independent of which candidate she elects. Since Condition 1a is violated, at least one candidate plays a pure babbling strategy. Thus, the voter's expected utility must be equal to her utility in one of the babbling equilibria. ■

Lemma A10. *Suppose Assumption 1 is satisfied and that $q > 1 - \varepsilon$. Then the unique equilibrium is the popular-beliefs equilibrium.*

Proof. Consider the following three categories of equilibria (all of which are assumed to satisfy Assumption 1): (i) pure-strategy equilibria, (ii) equilibria that are not pure and which satisfy Condition 1, and (iii) equilibria that are not pure and which violate Condition 1a. (Recall from above that if Condition 1b is violated then Condition 1a must be violated.) First consider category (i). Here the claim follows from Proposition 2, which says that for $q > 1 - \varepsilon$ there exists no other pure-strategy equilibrium. Next consider category (ii). Equilibria belonging to this category do not exist for $q > 1 - \varepsilon$. To see this, notice that for $q > 1 - \varepsilon$ the right-hand side of (2) is less than or equal to zero whereas the left-hand side is, by Lemma A5, strictly positive. Hence, equality (2) does not

hold, which means (by Lemma A4) that there exists no equilibrium satisfying Condition 1. Finally consider category (iii). Since Condition 1a is violated, at least one candidate is babbling. Hence, the voter can infer information about at most one candidate's signal. Thus, since $q > 1 - \varepsilon$, she always prefers policy B , and she will therefore never vote for a candidate who announces policy N . As a consequence, both candidates have a strict incentive to announce policy B and, for $q > 1 - \varepsilon$, the only equilibrium that satisfies Assumption 1 is thus the popular-beliefs equilibrium. ■

Proof of Proposition 3. The two claims made in the first sentence of the proposition follows from the arguments in the main body of the paper. The claim made in the third sentence is proven by Lemma A10. The remaining claim is that for $q < 1 - \varepsilon$ the outcome of the good mixed equilibrium, $\hat{\sigma}$, Pareto dominates the outcomes of all other equilibria that satisfy Assumption 1. We will prove this claim by considering in turn the following three categories of equilibria (all of which are assumed to satisfy Assumption 1): (i) pure-strategy equilibria, (ii) equilibria that are not pure and which satisfy Condition 1, and (iii) equilibria that are not pure and which violate Condition 1a. (Recall from above that if Condition 1b is violated then Condition 1a must be violated.) First consider category (i). Here, by Proposition 2, the only equilibria are the two kinds of babbling equilibria and in these both candidates win with probability $1/2$ along the equilibrium path. The candidates are thus indifferent between the two kinds of babbling equilibria whereas the voter prefers the popular-beliefs equilibria. Hence, the popular-beliefs equilibria Pareto dominate the equilibria in which the candidates babble on N . Moreover, the candidates also win with probability $1/2$ in the good mixed equilibrium, $\hat{\sigma}$, whereas the voter prefers $\hat{\sigma}$ to the popular-beliefs equilibria. To see the latter, notice that $EU_{mix} > EU_{bab}^B$ can equivalently be written as $1 - \varepsilon - f(q, \varepsilon, \rho)(1 - \varepsilon - q) > q$. This inequality, in turn, is equivalent to $1 > f(q, \varepsilon, \rho)$, which always holds for $q < 1 - \varepsilon$. Hence, the good mixed equilibrium Pareto dominates the popular-beliefs equilibria. Next consider category (ii). Here the claim follows from Lemma A8. Finally consider category (iii). By Lemma A7, the candidates will be indifferent between all equilibria in this category. By Lemma A9, the voter's expected utility in any such equilibrium is equal to her expected utility in either one of the babbling

equilibria, both of which are dominated by the good mixed equilibrium. ■

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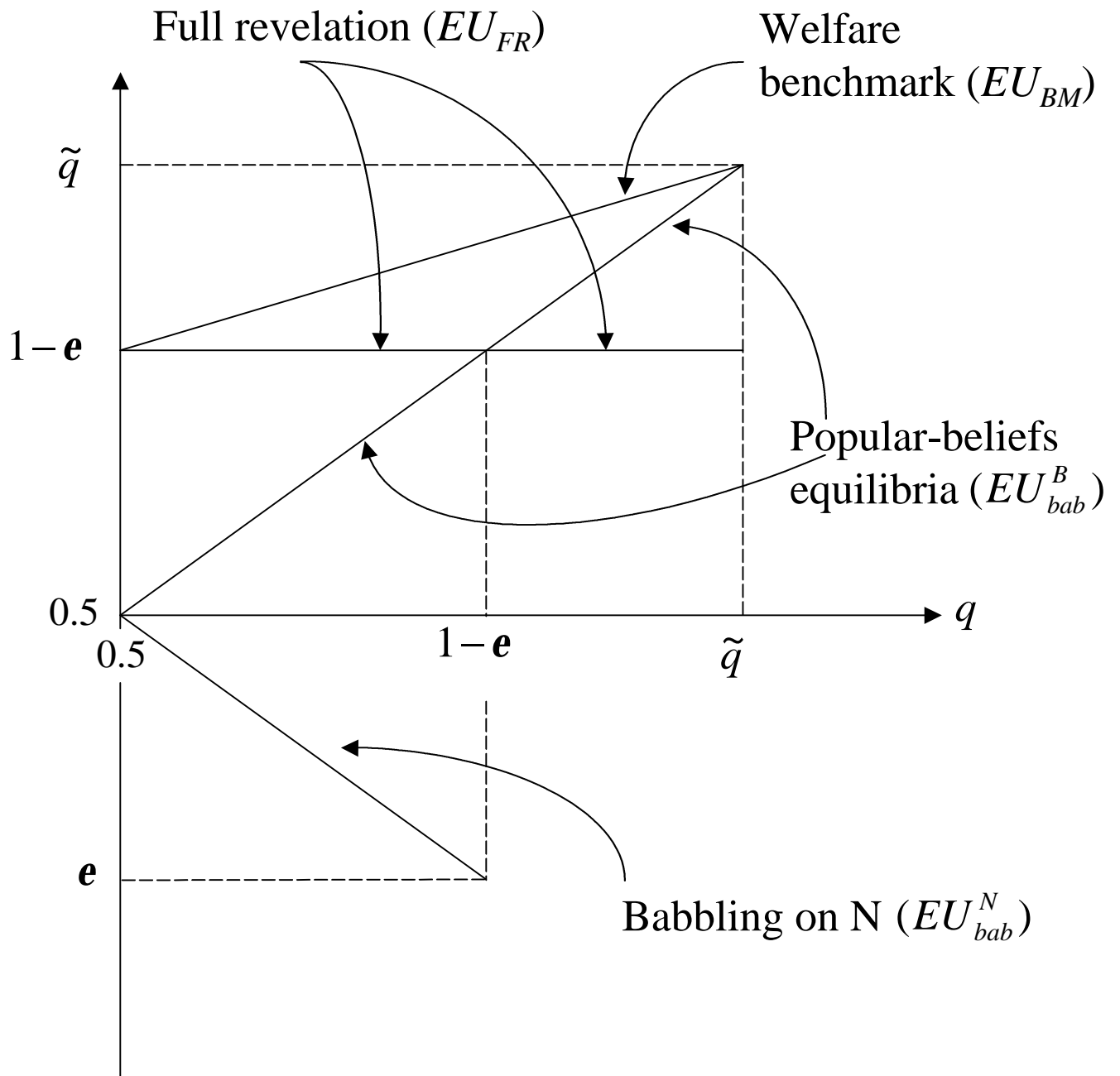


Figure 1: Voter's expected utility in equilibria in which candidates play pure.

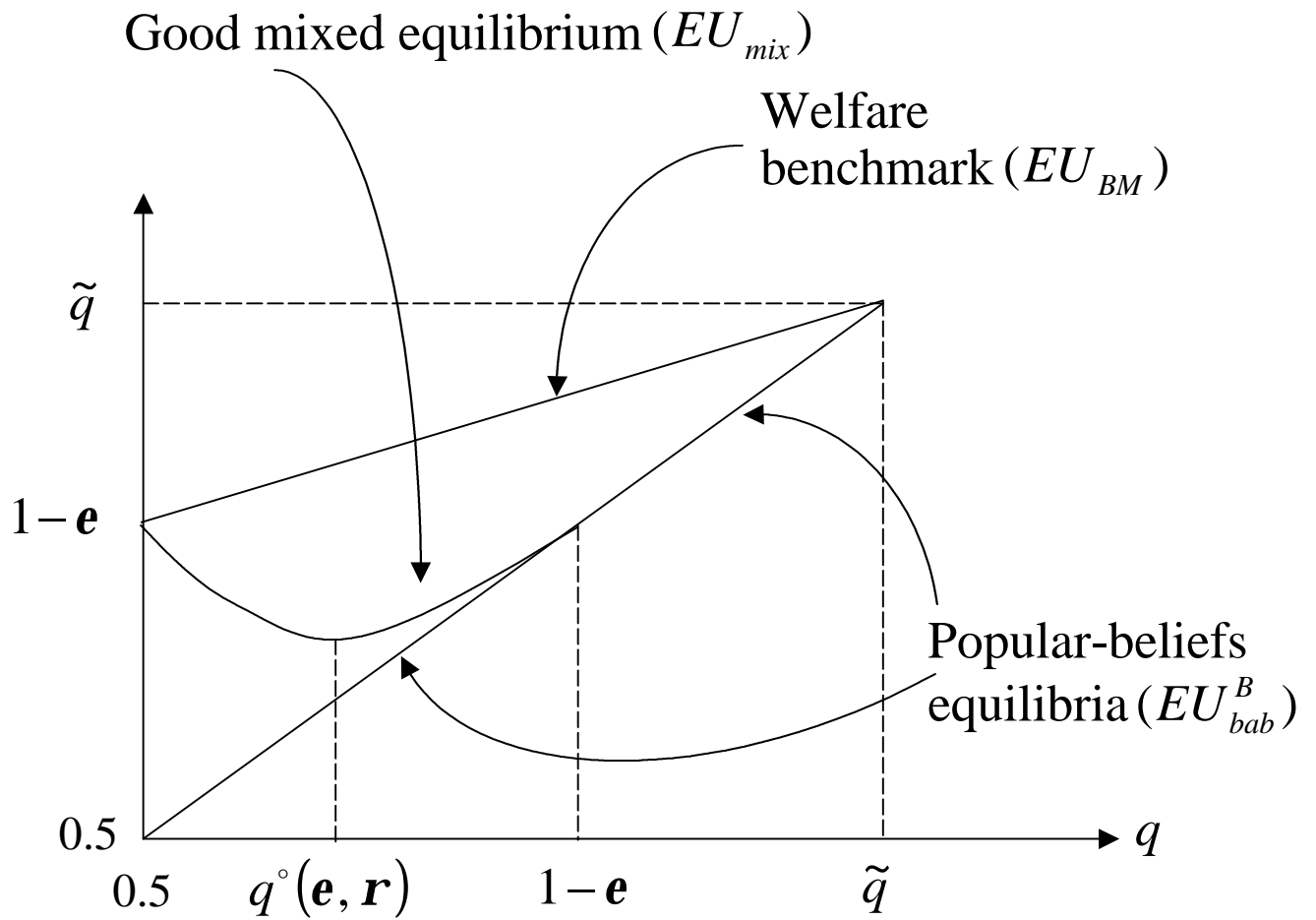


Figure 2: Voter's expected utility in equilibria in which candidates may randomize.