Information Revelation and Pandering in Elections*

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Abstract

Does electoral competition promote efficient aggregation of politicians' policy-relevant private information? This paper suggests otherwise when politicians are (primarily) office-motivated. In a two-candidate Hotelling-Downs framework, we establish that the electorate's welfare cannot be higher than what can be obtained by disregarding the information of one politician. Under canonical information structures, politicians have an incentive to overreact to their information relative to the electorate's prior belief, i.e. to "anti-pander" rather than pander. We argue that the information-aggregation inefficiency can be traced to the politicians' office motivation; in a suitable sense, it also applies to alternative game forms when politicians make non-binding policy announcements.

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1. Introduction

A fundamental question for representative democracy is whether citizens are sufficiently informed to select representatives whose policy choices will enhance their welfare. While citizens may themselves be poorly informed on policy issues—as posited by Downs (1957) in his "rational ignorance" hypothesis and since documented by numerous studies starting with Campbell, Converse, Miller and Stokes (1960)—political candidates devote substantial resources and have broad access to policy experts and think tanks. Information garnered by politicians may be conveyed to the electorate through their policy positions and electoral campaigns.[1] This paper examines whether elections provide the appropriate incentives for politicians to efficiently reveal their policy-relevant (private) information. If politicians were benevolent, it is plausible that there would be no strategic impediments. But can efficiency be achieved when politicians are not benevolent? In particular, how well do elections aggregate the information of office-seeking politicians?

One prevalent view is that elections function well because even office-seeking politicians are impelled to choose policies that promote voters' interests. Indeed, in an influential article titled "Why Democracies Produce Efficient Results", Wittman (1989, p. 1400) argued that political competition benefits the electorate because "there are returns to an informed political entrepreneur from providing the information to the voters, winning office, and gaining the [...] rewards of holding office." Concurrently, however, there are also charges—both in popular circles and in some recent academic work that we discuss subsequently—that competitive pressures drive office-motivated politicians to *pander* to voters' opinions. After all, the argument goes, it is hard to win an election by campaigning on policies that voters view as unlikely to be good; a politician is better off just promising to do whatever voters are inclined towards. Pandering is viewed as inefficient because it would lead to policies that are excessively distorted toward the voters' less-informed opinions.

In this paper, we (re-)assess the efficiency of elections when office-seeking politicians possess policy-relevant private information. We begin in Section 2 by proposing a natural extension of the classic model of representative democracy: the two-candidate Downsian model (Downs (1957), building on Hotelling (1929)). We maintain all the usual assumptions, including that politicians

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[1] There is evidence that voters learn, update, or refine their views during elections. See, for example, experiments on deliberative polling by Fishkin (1997); empirical studies on the effects of information on voters' opinions by Zaller (1992), Althaus (1998) and Gilens (2001); studies on framing in polls such as the ones by Schuman and Presser (1981); and experiments on priming by Iyengar and Kinder (1987).

maximize the probability of winning the election and make policy commitments, but introduce one twist: each of the politicians has imperfect private information about policy consequences. In other words, each politician has socially-valuable information about which policy would be best for a representative or median voter. For concreteness, we assume a familiar normal-normal information structure;[2] as we discuss, our results can be generalized to other statistical structures.

We establish in Section 3 that Downsian elections cannot efficiently aggregate both politicians' private information. Theorem 1 identifies a minimum degree of inefficiency: the voter's welfare in any electoral equilibrium is equivalent to policy being implemented based on just one politician's information, while not necessarily using even this information efficiently. Consequently, voter welfare is no higher than what can be obtained by disregarding the presence of one politician entirely. This inefficiency is general—across statistical structures and voter preferences—and we explain how it can be traced to two implications of the politicians' office motivation: (i) as far as they are concerned, the politicians are engaged in a constant-sum game; and (ii) even though each of them has socially valuable information, their information does not directly affect the politicians' payoffs.

Why isn't it an equilibrium for each politician to propose a policy that is best for the voter based on his own information, i.e. to use an "unbiased strategy" (in which case the election would aggregate more than one politician's information)? Proposition 1 shows that, perhaps contrary to intuition, politicians would have an incentive to deviate by "anti-pandering"—*overreacting* to their private information—as the rational voter would elect the more extreme politician under unbiased strategies. The voter would do so because each politician's estimate of the state based on his own signal puts more weight on the prior than the voter's estimate after learning both politicians' signals.[3]

Building on the above logic, we identify in Proposition 2 a symmetric equilibrium that features anti-pandering by both politicians. In this equilibrium, politicians choose different platforms with probability one. The anti-pandering mechanism provides a new perspective on the classic issue of policy divergence. Unlike some other prevalent explanations (e.g., ideologically-motivated candidates as

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[2] More precisely: the best policy for the voter—hereafter, the "state" (of the world)—is drawn from a normal distribution; each candidate's private signal is the true state plus noise that is also normally distributed. The voter's payoff is given by a quadratic loss function of the distance between the chosen policy and the state.

[3] Glaeser and Sunstein (2009) and Roux and Sobel (2013) also identify this implication of Bayesian updating in a non-strategic group decision-making context. The underlying statistical property holds whenever the posterior distribution of the state given a politician's signal is in an exponential family and the prior is conjugate with the posterior; this class includes a variety of familiar information structures as elaborated in Subsection 4.1.

in Wittman (1983) and Calvert (1985)), anti-pandering features office-motivated politicians diverging in order to increase their support from a median voter whose ideology is known.[4] There is some empirical evidence that politicians can secure larger vote shares by adopting extreme platforms; see, for example, Stone and Simas (2010) on U.S. House elections. The anti-pandering mechanism even allows for each politician's platform to be more extreme than the preferred policy of the average voter who votes for him, as we formalize by explicitly considering an electorate with heterogenous ideologies (Corollary 1). In this quite stringent sense, political competition can lead to "over-divergence" or policy polarization despite politicians solely seeking office. Although it would be premature to directly link the mechanism we explore here with empirically observed policy divergence, it is interesting to note that over-divergence in the aforementioned sense has been documented (Bruhn and Greene, 2007; Sørensen, 2012). More fundamentally, anti-pandering qualifies the general notion that office motivation produces a centripetal force toward the electorate's median voter.

As with much of the literature, the bulk of our analysis assumes that candidates make commitments to the policies they would implement if elected.[5] From a positive point of view, it seems reasonable to suppose that some degree of electoral commitment is available; in their meta-study of earlier research, Pétry and Collette (2009) conclude that around 67% of campaign promises have historically been kept. The theoretical literature has proposed multiple rationales for commitment, most prominently that of re-election concerns (Alesina, 1988).[6] Nevertheless, particularly for our normative conclusions, it is important to assess the role of the commitment assumption. Section 4 addresses this and other robustness issues. In a nutshell, we propose that incorporating non-binding or "cheap talk" announcements—be they in lieu of commitment, preceding commitment, or as an additional alternative to commitment—does not fundamentally alter our welfare conclusions. An important caveat, however, is that this is now subject to selecting among multiple equilibria in a manner that we explain and argue in favor of. The intuition for why cheap talk should be ineffective

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[4] Other explanations for divergence include those based on increasing turnout (Glaeser, Ponzetto and Shapiro, 2005), campaign contributions (Alesina and Holden, 2008; Campante, 2011), valence asymmetries (Groseclose, 2001; Aragones and Palfrey, 2002), signaling character, competence, or related mechanisms (Callander and Wilkie, 2007; Kartik and McAfee, 2007; Honryo, 2014), or the presence of more than two parties (Palfrey, 1984).

[5] Exceptions include Besley and Coate (1997), Osborne and Slivinski (1996), and subsequent work using citizen-candidate models.

[6] Another rationale, particularly relevant in our context, is that if there is uncertainty about a candidate's quality of information and candidates have reputation concerns (perhaps because of re-election motives), then "flip flopping" or "vacillating" may be associated with poor quality information, resulting in stickiness akin to commitment; see, for example, Prendergast and Stole (1996) or Majumdar and Mukand (2004).

in our setting is as follows: if one politician discloses policy-relevant information while the other does not, the latter is better informed and hence more attractive to the voter if policies have not already been committed to. Thus, politicians prefer not to reveal any information through cheap talk, which renders equilibria in which they do implausible (cf. Farrell, 1993).

In summary: our analysis suggests that one should neither expect (i) electoral competition between office-motivated politicians to result in policies that efficiently aggregate their private information, nor (ii) policies to be distorted toward the electorate's prior. Rather, while politicians' private information can be revealed through their electoral platforms, it can result in anti-pandering. More broadly, office motivation has stringent welfare consequences in our setting. Arguably, when politicians possess private information of significant social value, a well-functioning representative democracy demands either principled or benevolent politicians or alternative institutional arrangements to majoritarian elections.

Related Literature. This paper ties most closely into the literature on electoral competition when candidates have policy-relevant private information.[7] Heidhues and Lagerlof (2003) illustrate why candidates may have an incentive to pander to the electorate's prior belief; their setting is one with binary policies, binary states, and binary signals. We find that in our richer setting, precisely the opposite is true for a broad class of information structures. Plainly, with binary policies, one cannot see the logic of why and how candidates may wish to overreact to private information. Loertscher (2012) maintains the binary signal and state structure, but introduces a continuum policy space. His results are more nuanced, but at least when signals are sufficiently precise, the conclusions are similar to Heidhues and Lagerlof (2003).[8]

Laslier and Van de Straeten (2004) show that if voters in the Heidhues and Lagerlof (2003) model are endowed with sufficiently precise private information about the policy-relevant state, then there are equilibria in which candidates fully reveal their private information; see also Klumpp (2014) and Gratton (2014). By contrast, we are interested in settings in which any information voters possess that candidates do not is relatively imprecise. While we make the extreme assumption that voters

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[7] There are contexts where candidates have private information that is not policy relevant for voters. For instance, the strategic effects of private information about the location of the median voter are studied by Chan (2001), Ottaviani and Sorensen (2006), and Bernhardt, Duggan and Squintani (2007, 2009).

[8] Appendix E shows how overreaction or anti-pandering arises in a binary-signal example when the policies and the state lie in the unit interval. This example is a special case of the statistical family mentioned in fn. 3 and discussed in Subsection 4.1; it permits a closer comparison with Heidhues and Lagerlof (2003) and Loertscher (2012).

have no private information, our main points are robust to (small) variations on this dimension.

Schultz (1996) studies a model in which two candidates are perfectly informed about the policy-relevant state but are ideologically motivated. He finds that when the candidates' ideological preferences are sufficiently extreme, platforms cannot reveal the true state; however, because of the perfect information assumption, full revelation can be sustained when ideological preferences are not too extreme. Martinelli (2001) and Martinelli and Matsui (2002) derive further results with ideologically motivated candidates who are perfectly informed about a policy-relevant variable.

There are other models of politics in which policy distortions arise because office-motivated politicians wish to influence voters' beliefs; the mechanisms, however, are less related to ours because these models are generally of a single incumbent with "career concerns" to build reputation for either competence or aligned preference.[9] While most of these papers focus on pandering toward the electorate's prior, anti-pandering arises in Prendergast and Stole (1996) and Levy (2004).

The literature on cheap talk in elections is limited. Harrington (1992, 1993b), Panova (2009), Schnakenberg (2014), and Kartik and van Weelden (2015) identify different reasons why informative communication is possible when politicians' ideological preferences are their private information.

2. A Downsian Model with Expert Politicians

In our baseline model, an electorate is represented in reduced-form by a single (median or representative) voter, whose preferences depend upon policy, $y \in \mathbb{R}$, and an unknown state of the world, $\theta \in \mathbb{R}$. Subsequently, we will explicitly discuss heterogeneous voter ideologies. We assume the voter's preferences can be represented by a von Neumann-Morgenstern utility function, $U(y, \theta) = -(y - \theta)^2$. The state θ is drawn from a normal distribution with mean 0 and finite precision $\alpha > 0$ (i.e. variance $1/\alpha$). Each of two candidates, A and B, maximizes the probability of winning the election. Each candidate i privately observes a signal $\theta_i = \theta + \varepsilon_i$, where each ε_i is drawn independently of any other random variable from a normal distribution with mean 0 and finite precision $\beta > 0$.[10]

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[9] Harrington (1993a) and Cukierman and Tommasi (1998) are early contributions; see also Canes-Wrone, Herron and Shotts (2001), Maskin and Tirole (2004), Prat (2005), and more recently, Morelli and van Weelden (2013) and Acemoglu, Egorov and Sonin (2013).

[10] The normal-normal structure is a well-known family of conjugate distributions; Subsection 4.1 discusses other statistical structures. The assumption that both candidates receive equally precise signals is for expositional simplicity; our results also hold when one candidate is known to receive a more precise signal than the other. Such asymmetric "competence" can serve to capture incumbency advantage. Our results can also be extended in other directions,

After privately observing their signals, candidates simultaneously choose platforms, $y_A \in \mathbb{R}$ and $y_B \in \mathbb{R}$ respectively. Upon observing both platforms, the voter updates her belief about the state and then elects one of the two candidates. The elected candidate implements his platform as policy, i.e., platforms are commitments in the Downsian tradition. All aspects of the model except candidates' privately observed signals are common knowledge, and players are expected-utility maximizers.

Equilibrium and welfare. With some abuse of notation, a pure strategy for a candidate i will be denoted as a (measurable) function $y_i(\cdot) : \mathbb{R} \to \mathbb{R}$, so that $y_i(\theta_i)$ is the platform chosen by i when his signal is θ_i.[11] A mixed strategy for the voter is a (measurable) function $p(\cdot) : \mathbb{R}^2 \to [0,1]$, where $p(y_A, y_B)$ represents the probability with which candidate A is elected when the platforms are y_A and y_B. We are interested in (weak) perfect Bayesian equilibria of the electoral game (including those in which candidates play mixed strategies), which implies that the voter elects candidate i if y_i is strictly preferred to y_{-i}, where the subscript $-i$ refers to candidate i's opponent. As is common, we require that the voter randomize with equal probability between the two candidates if she is indifferent between y_A and y_B. This tie-breaking specification is not essential (see, in particular, fn. 17); but it simplifies matters by pinning down voter behavior on any equilibrium path. Furthermore, for technical reasons, we restrict attention to equilibria in which for any given policy of one candidate, say y_A, the voting function $p(y_A, \cdot)$ has at most a countable number of discontinuities, and analogously for $p(\cdot, y_B)$ for any y_B.

The notion of welfare we use is the voter's ex-ante expected utility.

Terminology and preliminaries. A pure strategy $y_i(\cdot)$ is *informative* if it is not constant and it is *fully revealing* if it is a one-to-one function, i.e. if the candidate's signal can be inferred from his platform. As is well known (Degroot, 1970), the normal-normal information structure implies that the expected value of the state θ given a single signal θ_i is

$$\mathbb{E}\left[\theta | \theta_i\right] = \frac{\beta}{\alpha + \beta} \theta_i, \tag{1}$$

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including candidates' signals being correlated conditional on the state and adding uncertainty about the precision of their signals.

[11] A mixed strategy for candidate i is a mapping $\sigma_i : \mathbb{R} \to \Delta(\mathbb{R})$, where $\Delta(\mathbb{R})$ denotes the set of probability measures on $\mathbb{R}$. All our formal results and proofs cover mixed strategies for candidates; however, since candidates' mixing does not play an essential role, the main text focuses on candidates using pure strategies for simplicity.

whereas conditional on both signals, the expected value is

$$\mathbb{E}\left[\theta | \theta_A, \theta_B\right] = \frac{2\beta}{\alpha + 2\beta} \left(\frac{\theta_A + \theta_B}{2}\right). \tag{2}$$

Because of quadratic-loss utility, the optimal policy for the voter is the conditional expectation of the state given all available information. Since the only information a candidate has when he selects his platform is his own signal, we refer to the strategy $y_i(\theta_i) = \mathbb{E}[\theta|\theta_i] = \frac{\beta}{\alpha+\beta}\theta_i$ as the *unbiased strategy*. Plainly, this strategy is fully revealing. We say that a strategy $y_i(\cdot)$ displays *pandering* to the voter's beliefs if for all $\theta_i \neq 0$, $y_i(\theta_i)$ is in between 0 and $\mathbb{E}[\theta|\theta_i]$, i.e. sign$\{\theta_i\} = $ sign$\{y_i(\theta_i)\} = $ sign$\{\mathbb{E}[\theta|\theta_i] - y_i(\theta_i)\}$. In other words, a candidate panders if his platform is systematically distorted from his unbiased estimate of the best policy toward the voter's prior expectation of the best policy. Analogously, we say that $y_i(\cdot)$ displays *anti-pandering* or *overreaction* to private information if for all $\theta_i \neq 0$, sign$\{\theta_i\} = $ sign$\{y_i(\theta_i)\} = $ sign$\{y_i(\theta_i) - \mathbb{E}[\theta|\theta_i]\}$. We say that a platform y is *more extreme* than platform y' if the former is further from the prior mean, 0, than the latter, i.e. if $|y| > |y'|$.

An equilibrium is informative if at least one candidate plays an informative strategy. Observe that for any uninformative pure strategy, there is an equilibrium in which both candidates use that pure strategy due to the latitude in specifying off-path beliefs. Our interest will be in informative equilibria. An equilibrium is fully revealing if both candidates' strategies are fully revealing. An equilibrium is *symmetric* if both candidates use the same strategy. An equilibrium is *competitive* if both candidates have an ex-ante positive probability of winning; it is *non-competitive* if one candidate wins with ex-ante probability one.[12]

3. Main Results

3.1. Anti-Pandering and Polarization

Given that the voter desires policies as close as possible to the true state, and that a candidate's only information when choosing his policy is his private signal, one might conjecture that a candidate can do no better than playing an unbiased strategy, particularly if the opponent is also using an unbiased strategy. However:

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[12] A technical note is that because of the continuum of candidates' signals and policies, various statements in the analysis and proofs should be understood to hold subject to "almost all" qualifiers (indeed, even the definition of equilibrium should be understood as imposing optimality of each candidate's behavior for almost all signals); we supress such caveats unless essential.

Proposition 1. *The profile of unbiased strategies is not an equilibrium: candidates would deviate by overreacting to their information.*

(Proofs of this and all other formal results are in Appendix B.)

The incentive to overreact arises because if both candidates were to play unbiased strategies, the voter would optimally select the candidate with a more extreme platform, i.e. the candidate whose platform is larger in absolute value. Why? Since unbiased strategies are fully revealing, the voter would infer both candidates' signals from their platforms. Equations (1) and (2) imply that she would form a posterior expectation that has the same sign as the average of the two candidates' individual posterior expectations but that is more extreme.[13] Since the candidate whose platform is closer to the voter's posterior expectation is elected, it follows that the voter would elect i if and only if $|y_i| > |y_{-i}|$. Hence, each candidate would like to raise his probability of playing the more extreme platform, which can be achieved by placing more weight on his private signal than what is prescribed by the unbiased strategy. Consequently, overreacting to private information constitutes a profitable deviation, whereas pandering does not.[14]

Despite the incentive to overreact, can information be revealed in equilibrium? Perhaps surprisingly, we find that an appropriate degree of overreaction can support full revelation of information.

Proposition 2. *There is a symmetric and fully-revealing equilibrium with overreaction where both candidates play*

$$y(\theta_i) = \mathbb{E}[\theta | \theta_i, \theta_{-i} = \theta_i] = \frac{2\beta}{\alpha + 2\beta} \theta_i. \tag{3}$$

In this equilibrium, each candidate is elected with probability $1/2$ regardless of the signal realizations θ_A and θ_B. Furthermore, this is the unique symmetric pure-strategy equilibrium in which candidates use fully-revealing and continuous strategies.

Not only does Proposition 2 establish existence of a fully revealing equilibrium, but it also provides

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[13] Indeed, the voter's posterior mean can be larger in magnitude than both candidates' platforms (rather than just their average); this is always the case when θ_A and θ_B are sufficiently close, since the posterior mean is continuous in signals, and for any $\hat{\theta}$, $|\mathbb{E}[\theta | \theta_A = \theta_B = \hat{\theta}]| = \frac{2\beta}{\alpha + 2\beta}|\hat{\theta}| > |\mathbb{E}[\theta | \theta_A = \hat{\theta}]| = \frac{\beta}{\alpha + \beta}|\hat{\theta}|$.

[14] Another way to understand the point is to note that when the voter conjectures unbiased strategies by the candidates, equation (2) implies that for any platform of candidate $-i$, an increase in candidate i's platform by $\varepsilon > 0$ would raise the voter's posterior by $\frac{2\beta}{\alpha + 2\beta}\left(\frac{\alpha + \beta}{\beta}\frac{\varepsilon}{2}\right) > \frac{\varepsilon}{2}$. Thus, increasing (resp., decreasing) his platform would benefit candidate i when he is located to the right (resp., the left) of $-i$. Since under unbiased strategies a candidate's expectation of his opponent's platform is in between zero and his own unbiased platform, pandering would reduce the probability of winning while overreacting would increase it.

a sense in which uniqueness obtains. Indeed, Proposition 4 in Appendix B establishes a stronger uniqueness result based only on "local" analogs of the properties required in Proposition 2.

The strategy given by (3) requires each candidate i to choose his platform to be the Bayesian estimate of the state assuming his opponent has received the same signal. This is an overreaction because he anticipates that, in expectation, his opponent's signal will be more moderate than his own, as the expectation of the opponent's signal equals his unbiased estimate of the state, $\frac{\beta}{\alpha+\beta}\theta_i$. When the voter believes that both candidates overreact according to (3), platforms do not affect winning probabilities because whenever candidate i increases his platform by $\delta > 0$, the Bayesian updating formula (2) implies that the voter's posterior increases by $\frac{2\beta}{\alpha+2\beta}\left(\frac{\alpha+2\beta}{2\beta}\frac{\delta}{2}\right) = \delta/2$, and thus she remains indifferent between the two platforms.

Although the coefficient in (3), $\frac{2\beta}{\alpha+2\beta}$, is increasing in the precision of candidates' signals, β, and decreasing in the precision of the prior, α, the same is true for the unbiased strategy's coefficient, $\frac{\beta}{\alpha+\beta}$. The degree of overreaction in the equilibrium of Proposition 2, as measured by $\frac{2\beta}{\alpha+2\beta} - \frac{\beta}{\alpha+\beta}$, is non-monotonic in the parameters: it is increasing in β (resp., decreasing in α) when $\beta\sqrt{2} < \alpha$ and decreasing in β (resp., increasing in α) when $\beta\sqrt{2} > \alpha$. The degree of overreaction vanishes as either α or β tend to 0 or ∞. Thus, Proposition 2 predicts non-trivial overreaction when candidates are somewhat better informed than the electorate but not overly so.

To further understand the degree of overreaction in Proposition 2, it is useful to briefly consider heterogeneous voters. Suppose there is a continuum of voters; each voter k has utility function $U_k(y,\theta) = -(y - \theta - b_k)^2$, where $b_k \in \mathbb{R}$ parameterizes the voter's ideology. The aggregate distribution of b_k is independent of all other random variables and given by a cumulative distribution function $F(\cdot)$ that is continuous and symmetric around zero: for any b, $F(b) = 1 - F(-b)$. Thus, the median ideology is zero and any voter k's ex-ante preferred policy is her ideology b_k. We say that a voter k's *interim preferred policy* is her ideal policy when she casts her ballot, $\mathbb{E}[\theta|y_A, y_B] + b_k$. To focus on the central issues, we assume that voters vote sincerely, i.e. for the candidate whose platform is closest to their interim preferred policy. Plainly, the ordering of voters by their ideology agrees with their ordering by either their ex-ante preferred policies or their interim preferred policies no matter what strategies the candidates use. Whenever candidates adopt distinct platforms, say $y_i > y_{-i}$, we say their platforms are *polarized* if y_i is to the right of the interim preferred policy of the average voter who votes for i, and y_{-i} is to the left of the interim preferred policy of the average

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voter who votes for $-i$.

Corollary 1. *With a heterogenous electorate as just described, it remains an equilibrium for both candidates to play* (3)*; regardless of their platforms, both obtain a vote share of one half. Platforms are polarized if and only if*

$$\frac{2\beta}{\alpha + 2\beta}\frac{|\theta_i - \theta_{-i}|}{2} = \frac{|y_i - y_{-i}|}{2} > \mathbb{E}[b_k | b_k > 0]. \tag{4}$$

Since the anti-pandering strategies of Proposition 2 make the median voter indifferent between the two candidates no matter their platforms, the equilibrium is preserved with a heterogeneous electorate: now, all right-leaning voters (those with positive ideologies) will vote for the candidate whose policy is further to the right, and conversely for all left-leaning voters. It bears emphasis that anti-pandering is not driven by a desire to cater to the ideological distribution of voters; to the contrary, the candidates' equilibrium strategies are invariant to various properties of the ideological distribution (subject to symmetry around 0).

Condition (4) identifies when candidates' policies are polarized in the precise sense defined above. The inequality says that the policies must be further apart than the ideology of the average right-leaning voter.[15] Such policies occur with positive ex-ante probability; whether the inequality is satisfied or not depends on how disparate the candidates' realized signals are. Ex ante, condition (4) is more likely to hold when candidates are better informed relative to the electorate (higher β or lower α) or when there is less ideological dispersion in the electorate.[16] Overall, Corollary 1 establishes that in the current model, the policies of the political elite can be quite polarized even when the electorate's ideological distribution is "nicely shaped", e.g. single-peaked or otherwise concentrated around the median.

3.2. Equilibrium Welfare

Return now to the baseline setting with a single (median) voter. Even though the equilibrium of Proposition 2 fully reveals all available information to the voter, it does not use either politician's in-

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[15] More generally, if F is not symmetric around its median, 0, then condition (4) can be written as $\frac{1}{2}|y_i - y_{-i}| > \max\{\mathbb{E}[b_k | b_k > 0], -\mathbb{E}[b_k | b_k < 0]\}$.

[16] For example, if ideologies are normally distributed with mean zero, then $\mathbb{E}[b_k | b_k > 0]$ is increasing in the variance. More generally, note that $\mathbb{E}[b_k | b_k > 0] = 2\mathbb{E}[\max\{b_k, 0\}]$ because $F(0) = 1/2$. As $\max\{b_k, 0\}$ is a convex function, it has higher expectation when F undergoes a second-order stochastically dominated shift, in particular when there is a mean-preserving spread of F.

formation efficiently because of their overreaction. This prompts the question of what other equilibria exist and whether there are any with higher voter welfare.

Fix an arbitrary equilibrium. Given the candidates' (possibly mixed) strategies, denote by v_i the voter's welfare (i.e. ex-ante expected utility) from electing candidate i no matter which policy pair is actually proposed. Plainly, since this is a feasible strategy for the voter, the voter's equilibrium welfare cannot be smaller than $\max\{v_A, v_B\}$. Our key result, Theorem 1 below, proves that this is in fact *exactly* the voter's equilibrium welfare—even though, in equilibrium, the voter may be selecting both candidates with ex-ante positive probability (as in the equilibrium of Proposition 2). Since a candidate's policy can only depend on his own information, it follows that it is as if the voter's welfare in any equilibrium is influenced by just one candidate's signal and not by the other's. Therefore, electoral competition between office-motivated candidates leads to an inescapable inefficiency.

Theorem 1. *In any equilibrium, there is some candidate $i \in \{A, B\}$ such that the voter's equilibrium welfare is equal to the welfare obtained by electing candidate i no matter the proposed policies.*

As the proof is somewhat involved but the result is central, we will sketch the main steps of the argument. The key insight is Lemma 4 in Appendix B: any equilibrium must have the property that for any on-path platform of a candidate i, say y_i, the probability with which i would win when playing y_i cannot depend on what signal i has received. To establish this point, we first note that given any strategy for the voter, $p(y_A, y_B)$, the two candidates are engaged in a constant-sum Bayesian game in which their payoffs depend only on the pair policy platforms and not (directly) on the signals. We provide in Appendix A a general result about any two-player constant-sum Bayesian-game whose payoffs depend only on the players' actions and not on their types: every equilibrium has the property that the distribution of actions played by some type of a player would also be a best response for any other type of that player, even though the two types will generally hold different beliefs about the opponent's distribution of actions when types are correlated. A version of this result for finite games has also been obtained by Viossat (2006).

Building on Lemma 4, we show in Lemma 5 that if an equilibrium is *informative*, it must be an *ex-post* equilibrium in the sense that the voter's strategy, $p(y_A, y_B)$ must be constant across all on-path platform pairs. Hence, a candidate would have no incentive to deviate even if he observed his opponent's platform before making his choice. Note, in particular, that this property is satisfied by the equilibrium of Proposition 2. An intuition for this step is as follows. Consider any informative

equilibrium. Since at least one candidate's platform is correlated with his signal, and since each candidate's signal provides him with information about his opponent's signal, it follows that at least one candidate's signal is informative about his opponent's platform. But then, the interim probability of winning for a candidate can be independent of his signal (as required by Lemma 4) only if the winning probability is independent of which platforms are played on the equilibrium path.[17]

This ex-post property for informative equilibria implies that in *any* equilibrium, informative or uninformative, one of two cases holds: (a) the equilibrium is non-competitive and there is a candidate i who is always elected regardless of the signal profile; or (b) the equilibrium is competitive and the voter is indifferent between both candidates for all pairs of on-path platforms. In the latter case, the voter's expected utility given any on-path platform pair is, of course, the same regardless of whom she elects. It follows that in either case, the voter's ex-ante expected utility can be evaluated by assuming that she always elects one of the two candidates, which is what Theorem 1 states.

Theorem 1 determines an upper bound on the voter's welfare in any equilibrium of the Downsian election because despite there being two informed candidates, the voter's welfare might as well be determined by only one of their signals and the corresponding policy platform. It follows that there cannot be any equilibrium which delivers a higher welfare to the voter than she would obtain by always electing one candidate who plays the unbiased strategy, i.e. who choses policy optimally based on his signal. Our next result confirms that this outcome can be supported as a non-competitive equilibrium, and furthermore, that any competitive equilibrium yields strictly lower welfare.

Theorem 2. *There is a non-competitive equilibrium where the candidate who wins with probability one plays the unbiased strategy. There is no equilibrium that yields the voter a higher ex-ante expected utility, and any competitive equilibrium yields the voter strictly lower ex-ante expected utility.*

There are multiple constructions to verify the first statement of Theorem 2. The simplest one is such that the winning candidate, i, plays the unbiased strategy, the opponent plays an uninformative strategy, say $y_{-i}(\theta_{-i}) = 0$, and the voter believes that any deviation by candidate $-i$ is also uninfor-

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[17] It is worth clarifying that this argument for informative equilibria does not use the assumption that the voter must randomize with equal probability when indifferent between candidates' platforms. The ex-post property also applies to uninformative equilibria, but only under the randomization assumption. If the voter were not required to randomize uniformly when indifferent, there are uninformative equilibria with the flavor of "matching pennies": for example, both candidates randomize uniformly over $\{-x, x\}$ for some $x > 0$, and the voter elects candidate A if $y_A = y_B$ while she elects candidate B if $y_A = -y_B$ (and randomizes with equal probability off the equilibrium path). Nevertheless, the conclusion of Theorem 1 applies to uninformative equilibria as well even without the randomization assumption.

mative. Interestingly, the same outcome can be supported also with $-i$ playing the fully-revealing strategy $y_{-i}(\theta_{-i}) = \theta_{-i}$. Candidate $-i$ is overreacting to his information here to such an extent, choosing what would be an unbiased estimate only under a Laplacian or improper prior, that the voter never finds it optimal to elect him despite correctly inferring his information.

The second statement of Theorem 2 says that any "real" competition between candidates necessarily reduces the voter's welfare relative to a non-competitive equilibrium in which one candidate plays the unbiased strategy.[18] Clearly, the latter outcome can also be achieved if there were only one candidate contesting the election in the first place. This is a novel rationale, based on information aggregation of politicians' policy-relevant information, for why non-contested elections may be beneficial to citizens.

3.3. Pandering and Welfare

A common view is that voter welfare is harmed when politicians pander to the voter's prior (e.g. Heidhues and Lagerlof, 2003). While we have established in Proposition 1 and Proposition 2 that politicians may in fact be driven to anti-pander rather than pander, it is nevertheless of interest to understand how pandering would affect voter welfare.

We find that an appropriate degree of (dis-equilibrium) pandering would actually benefit the voter. To get some intuition for why, consider again the benchmark where both politicians play the unbiased strategy, $y_i(\theta) = \mathbb{E}[\theta|\theta_i] = \frac{\beta}{\alpha+\beta}\theta_i$. As established in Proposition 1, the voter would then select the politician with the more extreme platform. This implies a "winner's curse": the electoral winner, say i, would have received the more extreme signal, and so voter welfare would be improved if i were elected with a slightly more moderate platform. Such moderation can be achieved by under-reacting to private information, i.e. pandering.

Building on this intuition, the following result shows that, subject to a qualifier, voter welfare in the Downsian game form would be actually be maximized by a suitable degree of pandering.

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[18] For example, one can explicitly compute the voter's welfare difference between a non-competitive election in which the winner plays the unbiased strategy and the competitive equilibrium of Proposition 2. The voter's ex-ante expected utility in the former is $-\frac{1}{\alpha+\beta}$, while it is $-\frac{4\beta^2+\alpha^2+5\beta\alpha}{(\alpha+2\beta)^2(\alpha+\beta)}$ in the latter. Both expressions converge to 0 as either $\beta \to \infty$ or $\alpha \to 0$; hence, both equilibria are welfare equivalent in these limiting cases. However, the welfare difference between the two equilibria is not monotonic in the parameters.

Proposition 3. *The strategy profile where both candidates play*

$$y(\theta_i) = \mathbb{E}[\theta | \theta_i, |\theta_{-i}| < |\theta_i|], \tag{5}$$

maximizes voter welfare among all candidates' strategy profiles in which the voter's optimal response would lead to candidate i winning whenever $|\theta_i| > |\theta_{-i}|$. This strategy displays pandering. Hence, an appropriate degree of pandering is beneficial to voter's welfare.

The intuition for (5) is follows: for any candidate i, the platform that maximizes voter welfare given any information Ω_i is $\mathbb{E}[\theta | \Omega_i]$; when the voter is (optimally) selecting the candidate with the more extreme signal, the relevant information in Ω_i consists of i's own signal, θ_i, and what i can infer from being selected by the voter, viz. that $|\theta_i| > |\theta_{-i}|$. It is then straightforward why (5) displays pandering: in addition to his own signal, a candidate conditions on the opponent having a more moderate signal. Since the voter would optimally elect the candidate with a more extreme signal if both candidates used unbiased strategies (recall Proposition 1 and its discussion), an implication of Proposition 3 is that both candidates playing according to (5) dominates—in terms of voter welfare—both candidates playing unbiased strategies, and hence, by Theorem 1, any equilibrium of the office-motivated game.[19]

4. Discussion

In this section, we discuss three issues: more general voter preferences and information structures, candidates who are not entirely office motivated, and alternative game forms.

4.1. Preferences and Information Structures

Our fundamental result on how electoral competition limits welfare, Theorem 1, holds rather generally across voter preferences and information structures. An inspection of the theorem's proof shows that

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[19] We conjecture that Proposition 3 also holds without the qualification that a candidate must win when he has the more extreme signal. To see some intuition, consider any symmetric strategy profile where both candidates play $y(\cdot)$ that is symmetric around 0. For the unbiased strategy, $y(\theta_i) = \mathbb{E}[\theta | \theta_i]$, we have $y'(\cdot) = \frac{\beta}{\beta + \alpha}$; for the overreaction strategy identified in Proposition 2, $y(\theta_i) = \mathbb{E}[\theta | \theta_i, \theta_{-i} = \theta_i]$, we have $y'(\cdot) = \frac{2\beta}{\alpha + 2\beta}$. Presuming differentiability, one can verify that whenever $y'(\cdot) \in [0, \frac{2\beta}{\alpha + 2\beta}]$, it would be optimal for the voter to elect the candidate with the more extreme platform and hence the more extreme signal. Thus, roughly speaking, the requirement that a candidate wins when he has the more extreme signal is satisfied so long as neither candidate overreacts by more than he would when conditioning on the opponent having received the same signal as he did. It appears unlikely that such a degree of overreaction could be socially desirable.

the only juncture at which the information structure plays any role is to ensure that when a candidate i's strategy is informative, the distribution of i's platforms from the point of view of his opponent, $-i$, is not linear in θ_{-i}. Plainly, this is a property that will typically hold in any statistical structure in which θ_A and θ_B are correlated with each other through the true state θ. As long as this property is satisfied, Theorem 1 holds regardless of what the statistical structure is, whether and how candidates wish to deviate from the unbiased strategy profile, what the voter's utility function $U(y, \theta)$ is, how the voter randomizes if indifferent (cf. fn. 17), and what the policy space is. For example, the result applies to the models of Heidhues and Lagerlof (2003) and Loertscher (2012), thereby generalizing some of those authors' observations in their models.

The results on anti-pandering do require more structure. However, they extend directly to a well-known class of statistical structures in which the distribution of the candidates' signals is in an exponential family and the prior is a conjugate prior. This class includes a variety of widely-used discrete and continuous distributions with bounded and unbounded supports, such as normal, exponential, gamma, beta, chi-squared, binomial, Dirichlet, and Poisson. Appendix E works out a Beta-Bernoulli example that delivers the same qualitative insights as our normal-normal structure.

The important property within the exponential family is that the posterior expectation $\mathbb{E}[\theta|\theta_1, \ldots, \theta_n]$ of the state θ given a prior mean parameter, say θ_0, and any number of signal realizations, $\theta_1, \ldots, \theta_n$, is linear in $(\theta_0, \theta_1, \ldots, \theta_n)$ (Jewel, 1974; Kass, Dannenburg and Goovaerts, 1997). When the distribution of each $\theta_i|\theta$ is identical for $i = 1, \ldots, n$,[20] there are constants w_0 and w_1 such that $\mathbb{E}[\theta|\theta_1, \ldots, \theta_n] = \frac{w_0}{w_0 + nw_1}\theta_0 + \frac{nw_1}{w_0 + nw_1}\frac{\sum_{i=1}^n \theta_i}{n}$, and therefore,

$$\mathbb{E}[\theta|\theta_1, \ldots, \theta_n] - \theta_0 = \frac{nw_1}{w_0 + nw_1}\left(\frac{\sum_{i=1}^n \theta_i}{n} - \theta_0\right), \tag{6}$$

while

$$\frac{\sum_{i=1}^n \mathbb{E}[\theta|\theta_i]}{n} - \theta_0 = \frac{\sum_{i=1}^n \left(\frac{w_0}{w_0+w_1}\theta_0 + \frac{w_1}{w_0+w_1}\theta_i\right)}{n} - \theta_0 = \frac{w_1}{w_0 + w_1}\left(\frac{\sum_{i=1}^n \theta_i}{n} - \theta_0\right). \tag{7}$$

It is immediate from (6) and (7) that for any $n > 1$ and any vector of signal realizations, the average of the individual posterior expectations and the posterior expectation given the average signal both shift in the same direction relative to the prior mean, but the latter does so by a larger

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[20] The points made below hold even when this is not the case, but this simplification makes the argument transparent.

magnitude. It is this property that underlies the incentive to overreact in an unbiased strategy profile (Proposition 1); the logic of anti-pandering thus applies here.[21,22] The following generalization of Proposition 2 can be verified: there is an equilibrium with overreaction in which both candidates play $y(\theta_i) = \frac{2w_1}{w_0+2w_1}\theta_i + \frac{w_0}{w_0+2w_1}\theta_0$, with the voter being indifferent between them after observing any pair of on-path platforms. While there may be off-path platforms in this setting (as in the Beta-Bernoulli example in Appendix E), the equilibrium can be supported with reasonable off-path beliefs.

4.2. Ideological Motivation

Political candidates surely care about securing office. Yet, one may argue that it is extreme to assume they are solely office motivated. Our welfare results are robust to small departures from this assumption. Specifically, suppose that each candidate i's payoff is

$$u_i(y,\theta,W) = -\rho_i(y - \theta - b_i)^2 + (1-\rho_i)\mathbb{1}_{\{W=i\}}, \tag{8}$$

where y is the implemented policy, θ is the state, and $W \in \{A, B\}$ is the winner of the election. In this specification, $\rho_i \in [0,1]$ measures how policy-motivated candidate i is while $b_i \in \mathbb{R}$ measures his preference conflict with the voter over policies, i.e. his ideological bias. Assume these parameters are common knowledge. A candidate i is office-motivated if $\rho_i = b_i = 0$, he is benevolent if $\rho_i = 1$ and $b_i = 0$, and he is purely policy-motivated but ideologically biased if $\rho_i = 1$ and $b_i \neq 0$. We say that candidates whose preferences are given by (8) have *mixed motivations*.

An election with mixed motivations is not generally a constant-sum game for the candidates. Thus, the analytical tools we have used earlier to characterize bounds on voter welfare cannot be directly applied. Furthermore, because our policy space is not compact—hence standard results like the Theorem of the Maximum cannot be invoked—it is not obvious that our welfare conclusions remain essentially intact when candidates have even the slightest degree of policy motivation. We formally show in the Appendix C that when b_i and ρ_i are sufficiently close to zero for each candidate i, any equilibrium that maximizes the voter's welfare must have one candidate winning with ex-ante

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[21] Note that because the prior density need not be symmetric any longer around the mean (unlike with a normal prior) and signals may be bounded (unlike with normally distributed signals), the appropriate definitions of overreaction and pandering have to be broadened from earlier. We now say that a strategy $y_i(\cdot)$ displays pandering if for all θ_i, $|y_i(\theta_i) - \mathbb{E}[\theta]| \leq |\mathbb{E}[\theta|\theta_i] - \mathbb{E}[\theta]|$ with strict inequality for some θ_i. Analogously, $y_i(\cdot)$ has overreaction if for all θ_i, $|y_i(\theta_i) - \mathbb{E}[\theta]| \geq |\mathbb{E}[\theta|\theta_i] - \mathbb{E}[\theta]|$ with strict inequality for some θ_i.

[22] The focus on posterior expectations of the state is justified when the voter has a quadratic loss function. See the discussion in Roux and Sobel (2013) to get a sense of how asymmetric loss functions would affect the conclusions.

probability close to one, i.e. be almost non-competitive. Consequently, the maximum equilibrium voter welfare must be close to that obtained by efficiently aggregating one candidate's signal, despite there being two sources of information. Thus, the message of Theorem 2 carries over when candidates are largely, but not entirely, office motivated.[23]

4.3. Non-Binding Announcements

As discussed in the introduction, some degree of policy commitment is empirically plausible. Notwithstanding, one may worry that our normative results, Theorem 1 and Theorem 2, rely critically on not endowing candidates any ability to communicate their information without committing to policies. After all, if one holds fixed the information revealed through platforms (in the fully-revealing equilibrium of Proposition 2, for example), allowing candidates to implement an arbitrary policy once elected would yield higher welfare for the median voter.

We should note two qualifications to such reasoning. First, when the electorate consists of heterogeneous ideologies (e.g. as formalized after Proposition 2), there will be conflict among voters about their preferred policy, and hence it would not necessarily be straightforward for a candidate to implement a policy different from his platform. Second, even focussing on a single (median) voter, the voter need not be better off when the elected candidate is free to implement any policy if candidates have their own policy preferences.[24]

Even setting these qualifications aside, however, and focussing on our baseline model with a single voter and purely office-motivated candidates, we believe that relaxing the commitment assumption would not improve voter welfare precisely because it is then implausible that office-motivated can-

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[23] We should emphasize that our notion of a candidate i being largely office motivated involves not only $\rho_i \approx 0$ but also $b_i \approx 0$; this plays an important role in the arguments provided in Appendix C. We cannot rule out that in a game in which ρ_A and ρ_B are both approximately zero but neither b_A nor b_B are, the maximum equilibrium welfare for the voter may be "much" larger than when $\rho_A = \rho_B = 0$. The intuition is that competition can have a beneficial "disciplining effect" in the presence of large ideological biases, as is well understood since the work of Wittman (1977) and Calvert (1985). Nevertheless, the ideological biases would have to be large enough for this effect to outweigh the welfare loss we identify from information distortion when candidates care significantly about winning.

[24] Here is an example. For simplicity, take the policy space to be compact, say $[-1, 1]$. Let candidate A's preferences be represented by $u_A(y, \theta, W) = \mathbb{1}_{\{W=A\}} + y$ and B's preferences be represented by $u_B(y, \theta, W) = \mathbb{1}_{\{W=B\}} - y$, where W is the winner of the election and y is the implemented policy. Plainly, given any strategy for the voter, the candidates are engaged in a constant-sum game. Since the constant-sum property is what underlies Theorem 1, it can be verified that Theorem 1 also applies to this setting. Note that one equilibrium of this Downsian game has both candidates committing to the ex-ante optimal policy, 0, independent of their information. Now consider the game with non-binding platforms. The lack of commitment implies that the elected candidate will always implement an extreme policy (policy 1 by A and policy -1 by B); it readily follows that the voter's welfare in any equilibrium of this game may be lower than in (the voter-welfare-maximizing equilibrium of) the Downsian game.

didates reveal their private information through non-binding platforms. There are various ways in which one can alter our model to include non-binding communication, or "cheap talk". For concreteness, consider the following variation: platforms are simply non-binding, so that the elected candidate is free to implement any policy regardless of the platform he announced. As one would expect, this *pure communication game* has multiple equilibria. There are uninformative equilibria in which the elected politician implements the best policy given (only) his information; these equilibria provide the same welfare as the best equilibrium of our baseline model.

But there are also equilibria that fully aggregate information: each candidate can "truthfully" reveal his information through his non-binding announcement; the voter randomizes equally between candidates no matter their platforms; and the elected candidate implements the efficient policy given the information revealed by both candidates' announcements. We claim such equilibria are not plausible, however. Intuitively, suppose that candidate i could deviate and "refuse" to reveal his information through his non-binding announcement (or simply misrepresent his information and then claim to have done so). Given that the opponent has revealed his information (as, by hypothesis, he is playing his equilibrium strategy), i is strictly better informed than his opponent and is the only candidate capable of implementing the efficient policy; the voter should thus elect i. Consequently, either candidate would find such a deviation profitable. In fact, it is straightforward that this logic applies not just to fully-revealing equilibria, but to any equilibrium in which either candidate makes informative announcements. In other words, the only plausible equilibria are uninformative.

Formalizing this argument requires two ingredients: (i) ensuring it is feasible for a candidate to deviate in the prescribed manner; and (ii) ensuring that after such a deviation, the voter will elect the candidate who she believes to better informed. Our baseline equilibrium concept (perfect Bayesian equilibrium) is compatible with precluding both (i) and (ii); the former because there may be no off-path announcements, and the latter because the voter may perversely believe that the better-informed candidate will implement a less efficient policy after the election. In Appendix D we formalize a refinement criterion that builds on the ideas of Myerson (1989) and Farrell (1993) to eliminate such equilibria. Indeed, in a simpler sender-receiver context, Farrell (1993, Example 2) observed that informative equilibria are not compelling when an informed party would be better off by not revealing any information.

Thus, we suggest, perhaps paradoxically, that it is policy commitment which allows office-

motivated candidates' platforms to reveal information about their signals. The logic that a candidate does not want to reveal information through cheap talk because it makes his opponent better informed—or, that by concealing his information, he can gain an informational advantage to subsequently exploit—has similar ramifications for other game forms besides the pure communication game. Consider a game where candidates can first make cheap-talk announcements followed by binding platforms. Again, we would suggest that the only plausible equilibria are those in which no information is revealed in the cheap-talk stage, in which case electoral outcomes coincide with those of our Downsian model. A similar point applies if candidates are given a choice between non-binding and binding platforms, whether or not this choice is preceded by a round (or indeed, multiple rounds) of cheap-talk announcements.

5. Conclusion

Motivated by the debate on whether political competition promotes information aggregation and allows an electorate to make informed choices when exercising its voting rights, this paper has studied Downsian electoral competition between two office-motivated candidates who have private information about policy consequences.

Contrary to a prevalent intuition that politicians are driven to policies favored by the electorate's prior beliefs, we find that familiar information structures impel politicians to anti-pander, i.e. to overreact to their information. An anti-pandering equilibrium can even result in polarized policies wherein each politician's platform is more extreme than the preferred policy of the average voter who votes for him. Despite revealing information, the welfare distortions associated with such platforms can be severe.

Our main normative result is a sharp bound on voter welfare, which holds generally across information structures: welfare in any equilibrium is effectively determined by just one candidate's policy function. Consequently, Downsian elections cannot efficiently aggregate more than one candidate's information, despite the availability of two informational sources. We also find that voter welfare is maximized by non-competitive equilibria in which one candidate wins the election with probability one while choosing a policy that is socially optimal based on his information alone. Any equilibrium in which both candidates win with positive ex-ante probability—including the anti-pandering equilibrium—yields strictly lower voter welfare. Indeed, an appropriate degree of (dis-equilibrium)

pandering candidates would actually benefit voters.

We have argued that the fundamental source of inefficiency in aggregating both candidates' information is their office motivation. Even if candidates are able to make non-binding or cheap-talk announcements, we suggest that no information can be revealed through this channel in plausible equilibria, and hence the maximum voter's welfare is no larger than that of a Downsian election.

As in most formal models of spatial electoral competition, we have restricted attention to two candidates and assumed that their information is exogenously given. Relaxing both these assumptions are interesting topics for future research.

Furthermore, while we have focused exclusively here on electoral competition, we suspect the logic underlying anti-pandering and welfare limits are relevant more broadly. For example, consider two consultants (or other experts) proposing changes that an organization should undertake; the optimal course of action is uncertain and only one of their proposals can be accepted. One may also consider product choice or standards submissions by firms who are vying for a consumer's purchase or a standards-setting body's approval. Depending on the application, it may of interest to extend our model to incorporate additional features such as prices.

Appendices

A. Two-Player Constant-Sum Games

This Appendix states a key auxiliary result, Theorem 3 below, which we apply in the proof of Theorem 1. For finite games, the result has been obtained by Viossat (2006, Proposition 3.8); we require a version of infinite games and provide a direct proof.

A two-player complete-information constant-sum game is given by (S, u_1, u_2) where $S := S_1 \times S_2$ with each S_i a topological action (i.e. pure strategy) space for player i, and each $u_i : S \to \mathbb{R}$ is a bounded utility function for player i such that for $s \in S$, $u_1(s) = -u_2(s)$. We write $\Delta(S_i)$ and $\Delta(S)$ as the spaces of mixed strategies and mixed strategy profiles respectively,[25] and payoffs are extended to mixed strategies using expected utility as usual. For any $\mu \in \Delta(S)$, we write $\mu(\cdot|s_i) \in \Delta(S_{-i})$ as the conditional distribution of μ over S_{-i} given s_i.

$\mu \in \Delta(S)$ is a **correlated equilibrium** (or, more precisely, an objective correlated equilibrium) of this game if for any i and $s_i \in supp[\mu]$,

$$u_i(s_i, \mu(\cdot|s_i)) = \sup_{s_i' \in S_i} u_i(s_i', \mu(\cdot|s_i)).$$

The game has a **value** if there exists

$$v_1^* := \max_{\sigma_1} \min_{\sigma_2} u_1(\sigma_1, \sigma_2) = \min_{\sigma_2} \max_{\sigma_1} u_1(\sigma_1, \sigma_2).$$

We say that v_1^* is player 1's value and that any solution to the above minimax/maximin problem is an **optimal strategy** for player 1. Analogously, $v_2^* = -v_1^*$ is player 2's value and her optimal strategies are defined in the analogous way.

Fix an arbitrary two-player complete-information constant-sum game as just defined.

Theorem 3. *If μ is a correlated equilibrium, then for μ-a.e. s_i and s_i', $u_i(s_i', \mu(\cdot|s_i)) = v_i^*$ (and hence s_i' is a best response to $\mu(\cdot|s_i)$).*

(A proof is provided below.)

Observe that while Theorem 3 is stated for correlated equilibria of complete-information games, it has an obvious implication for Bayesian equilibria for a class of Bayesian games. Specifically, take any two-player constant-sum Bayesian game $G \equiv (S, u_1, u_2, T, p)$ where S, u_1, u_2 are as introduced before, $T := T_1 \times T_2$ is the space of type profiles (each T_i is a measurable type space for player i), and $p \in \Delta(T)$ is a common-prior probability measure, so that any type's t_i's beliefs about the opponent's type is given by $p(t_{-i}|t_i)$. Note that the players' types may be correlated. The important restriction in G is that each player's payoff depends only on the action profile and not on the type profile (and that the available actions are type-independent). A mixed-strategy for player i in this

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[25] More precisely: each S_i is viewed as a measurable space with its Borel sigma-field and $\Delta(S_i)$ is the space of Borel probability measures on S_i. The product space S is endowed with the product topology.

Bayesian game is $\sigma_i : T \to \Delta(S)$, and a Bayesian equilibrium is (σ_1, σ_2) that satisfies the usual conditions. It is straightforward that any Bayesian equilibrium of G is a correlated equilibrium of the complete-information game $\hat{G} \equiv (S, u_1, u_2)$. It follows from Theorem 3 that if (σ_1, σ_2) is a Bayesian equilibrium of G, then for any i and for p-almost-all t_i and t_i', $\sigma_i(t_i)$ must be a best response for type t_i' given the distribution $p(\cdot|t_i')$ over his opponent's type and $\sigma_{-i}(\cdot)$.

A.1. Proof of Theorem 3

The proof of Theorem 3 requires three lemmas. Throughout, we hold fixed an arbitrary two-player complete-information constant-sum game as defined above.

Lemma 1. *If μ is a correlated equilibrium, then the game has a value, and each player's payoff from μ is his value. Moreover, the marginal induced by μ for each player is an optimal strategy for that player.*

Proof. Let $v_i = u_i(\mu)$ be player i's payoff in the correlated equilibrium; clearly $v_1 = -v_2$. Let $\sigma_i \in \Delta(S_i)$ be the marginal distribution over player i's actions induced by μ. Since μ is a correlated equilibrium, it must be that for any $s_1 \in S_1$, $u_1(s_1, \sigma_2) \leq v_1$ (otherwise, for some recommendation, s_1 would be a profitable deviation), and hence $u_2(s_1, \sigma_2) \geq -v_1 = v_2$. So player 2 has a strategy that guarantees him at least v_2. By a symmetric argument, player 1 has a strategy that guarantees him at least $v_1 = -v_2$. It follows that (v_1, v_2) is the value of the game; furthermore, each σ_i is an optimal strategy. $\square$

Lemma 2. *If μ is a correlated equilibrium, then for μ-a.e. s_i, $u_i(s_i, \mu(\cdot|s_i)) = v_i^*$.*

Proof. By Lemma 1, the game has a value and each player has an optimal strategy. Since any $s_i \in supp[s_i]$ must be a best response against $\mu(\cdot|s_i)$, it follows that

$$\text{for any } s_i \in supp[\mu], \ u_i(s_i, \mu(\cdot|s_i)) \geq v_i^*. \tag{9}$$

But this implies that under μ, neither player can have a positive-probability set of actions that all yield him an expected payoff strictly larger than v_i^*, because then by (9) his expected payoff from μ would be strictly larger than v_i^*, implying that the opponent's payoff from μ is strictly lower than v_{-i}^*, a contradiction. $\square$

For finite games, the following result was noted by Forges (1990).

Lemma 3. *If μ is a correlated equilibrium, then for μ-a.e. s_i, $\mu(\cdot|s_i)$ is an optimal strategy for player $-i$.*

Proof. Without loss of generality, assume $i = 1$. By Lemma 2, $u_1(s_1, \mu(\cdot|s_1)) = v_1^*$ for μ-a.e. s_1. Hence, by best responses in a correlated equilibrium, it follows that for μ-a.e. s_1,

$$v_1^* = \max_{s_1'} u_1\left(s_1', \mu\left(\cdot|s_1\right)\right) = -\min_{s_1'}\left(-u_1\left(s_1', \mu\left(\cdot|s_1\right)\right)\right) = -\min_{s_1'} u_2\left(s_1', \mu\left(\cdot|s_1\right)\right).$$

Since $v_1^* = -v_2^*$, we conclude that for μ-a.e. s_1, $v_2^* = \min_{s_1'} u_2\left(s_1', \mu\left(\cdot|s_1\right)\right)$, i.e. $\mu(\cdot|s_1)$ guarantees player 2 a payoff of v_2^*, hence $\mu(\cdot|s_1)$ is an optimal strategy for player 2. $\qquad\square$

Proof of Theorem 3. Without loss of generality, let $i = 1$. Fix any s_1 that is generic with respect to the measure μ. From Lemma 3, we have that for any s_1', $u_1(s_1', \mu(\cdot|s_1)) \leq v_1^*$. So suppose that there is a set, S_1', such that $\mu(S_1') > 0$ and for each $s_1' \in S_1'$, $u_1(s_1', \mu(\cdot|s_1)) < v_1^*$, or equivalently that $u_2\left(s_1', \mu(\cdot|s_1)\right) > v_2^*$. Then, there must be some set S_2' such that $\mu(S_2') > 0$ and $\mu(S_1'|S_2') > 0$. By playing $\mu(\cdot|s_1)$ whenever μ recommends any $s_2 \in S_2'$, player 2 has an expected payoff strictly larger than v_2^* for a positive-probability set of recommendations, a contradiction with Lemma 2. $\qquad\square$

B. Proofs

Proof of Proposition 1. Assume both candidates use the unbiased strategy, i.e. $y_i(\theta_i) = \frac{\beta}{\alpha+\beta}\theta_i$. Since this strategy is fully revealing, the voter correctly infers θ_A, θ_B for all signal realizations. The voter's expected utility from a platform y given signal realizations θ_A and θ_B has the standard mean-variance decomposition:

$$
\begin{aligned}
\mathbb{E}[U\left(y,\theta\right)|\theta_A,\theta_B] &= -\mathbb{E}\left[(y-\theta)^2|\theta_A,\theta_B\right] \\
&= -\left[y^2 + \mathbb{E}(\theta^2|\theta_A,\theta_B) - 2y\mathbb{E}(\theta|\theta_A,\theta_B)\right] \\
&= -\left[y^2 + \mathbb{E}(\theta|\theta_A,\theta_B)^2 - 2y\mathbb{E}(\theta|\theta_A,\theta_B)\right] - \mathbb{E}(\theta^2|\theta_A,\theta_B) + \mathbb{E}(\theta|\theta_A,\theta_B)^2 \\
&= -\left[y - \mathbb{E}(\theta|\theta_A,\theta_B)\right]^2 - Var\left(\theta|\theta_A,\theta_B\right).
\end{aligned}
$$

This pins down the voter's strategy; in particular, the voter must elect candidate i rather than j if y_i is closer to $\mathbb{E}[\theta|\theta_A,\theta_B]$ than is y_j.

We now argue that for any θ_A, candidate A can profitably deviate from the unbiased strategy prescription. To show this, note that against any realization of θ_B, A wins if

$$
(y_B\left(\theta_B\right) - \mathbb{E}\left[\theta|\theta_B,\theta_A\right])^2 > (y_A\left(\theta_A\right) - \mathbb{E}\left[\theta|\theta_B,\theta_A\right])^2.
$$

Substituting from the formula for the unbiased strategy and from (2), this is equivalent to

$$
\left(\frac{\beta}{\alpha+\beta}\theta_B - \frac{\beta}{\alpha+2\beta}(\theta_A+\theta_B)\right)^2 > \left(\frac{\beta}{\alpha+\beta}\theta_A - \frac{\beta}{\alpha+2\beta}(\theta_A+\theta_B)\right)^2,
$$

or after algebraic simplification, $(\theta_A)^2 > (\theta_B)^2$. Hence, A wins when his type is more extreme (i.e. larger in magnitude) than B's, which implies that no matter his true type, candidate A strictly increases his win probability by mimicking a more extreme type. $\qquad\square$

We require two lemmas to prove our main results. Lemma 4 below shows that a candidate's probability of winning with any on-path platform cannot depend on his signal. Some notation is helpful to state the result precisely. Given any equilibrium (which may have mixing by candidates), let $\Pi_i(y_i;\theta_i)$ denote the expected utility (i.e. win probability) for candidate i when his type is θ_i and he plays platform y_i, and let Y_i denote the set of platforms that i plays with strictly positive ex-ante

probability. Given any equilibrium, when we refer to "for almost all on-path platforms", we mean for all but a set of platforms that have ex-ante probability zero with respect to the prior over types and the equilibrium strategies. Similarly for statements about generic platforms.

Lemma 4. *Given any equilibrium and any i, for almost all on-path platforms, y_i, y_i', and almost all types θ_i, θ_i', $\Pi_i\left(y_i; \theta_i\right) = \Pi_i\left(y_i'; \theta_i'\right)$.*

Proof. Fix any equilibrium. Given the voter's strategy, $p(y_A, y_B)$, the induced game between the two candidates is a constant-sum Bayesian game. Any equilibrium of this two-player Bayesian game is a correlated equilibrium of a complete-information constant-sum game between the two candidates where each chooses an action $y_i \in \mathbb{R}$ and for any profile (y_A, y_B), the payoff to candidate A is $p(y_A, y_B)$ while the payoff to candidate B is $1 - p(y_A, y_B)$. The Lemma follows from a general fact about constant-sum games that is stated and proved as Theorem 3 in Appendix A. $\square$

We can now show that any informative equilibrium is an *ex-post* equilibrium in the sense that neither candidate can affect his probability of winning by changing his platform, no matter which of his opponent's platforms is realized.

Lemma 5. *In any informative equilibrium, the voter's strategy is constant over almost all on-path platforms.*

Proof. Fix any equilibrium where, without loss of generality, candidate B is playing an informative strategy. We will show that for a generic platform of candidate A, A's winning probability is almost-everywhere constant over B's platforms. Pick an arbitrary *finite* partition of the range of player B's on-path platforms, $\{Y_B^1, \ldots, Y_B^m\}$, where each Y_B^j is a convex set. Without loss, we may take $m > 1$ since B's strategy is informative.

For a generic on-path platform of player A, $\overline{y}_A$, Lemma 4 implies there is some v_A^* such that

$$v_A^* = \Pi_A\left(\overline{y}_A; \theta_A\right) = \Pi_A\left(\overline{y}_A; \theta_A'\right) \quad \text{for almost all } \theta_A, \theta_A'.$$

Let $q(Y_B^j | \theta_A)$ be the probability that B plays a platform in the set Y_B^j given his possibly-mixed strategy $\sigma_B(\cdot)$ and that his type is distributed according to the conditional distribution given θ_A, i.e. $\theta_B | \theta_A \sim \mathcal{N}\left(\frac{\beta}{\alpha+\beta}\theta_A, \frac{\beta}{\alpha+\beta} + \frac{1}{\beta}\right)$. Let $p(\overline{y}_A | Y_B^j; \theta_A)$ be the probability with which A of type θ_A expects to win when he chooses platform y_A given that the opponent's platform falls in the set Y_B; notice that because $p(\cdot, \cdot)$ is locally constant (as our restriction is to equilibria where $p(\overline{y}_A, \cdot)$ has only at most a countable number of discontinuities), the dependence on θ_A can be dropped if each Y_B^j has been chosen as a sufficiently small interval, because then the distribution of B's platforms within Y_B^j is irrelevant. Therefore, with the understanding that each Y_B^j is a small enough interval, we write $p(\overline{y}_A | Y_B^j)$.

Therefore, for any generic m types of player A, $(\theta_A^1, \ldots, \theta_A^m)$, we have

$$
\begin{pmatrix}
q\left(Y_B^1 | \theta_A^1\right) & \cdots & q\left(Y_B^m | \theta_A^1\right) \\
\vdots & & \vdots \\
q\left(Y_B^1 | \theta_A^m\right) & \cdots & q\left(Y_B^m | \theta_A^m\right)
\end{pmatrix}
\begin{pmatrix}
p\left(\overline{y}_A | Y_B^1\right) \\
\vdots \\
p\left(\overline{y}_A | Y_B^m\right)
\end{pmatrix}
=
\begin{pmatrix}
v_A^* \\
\vdots \\
v_A^*
\end{pmatrix}.
$$

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The unknowns above are $p(\bar{y}_A|Y_B^j)$; clearly one solution is for each $p(\bar{y}_A|Y_B^j) = v_A^*$. If we prove that this is the unique solution for some generic choice of $(\theta_A^1, \ldots, \theta_A^m)$, we are done, because $\bar{y}_A$ was a generic platform for A and the partition $\{Y_B^1, \ldots, Y_B^m\}$ was arbitrary (subject to each Y_B^j being a small enough interval). The Rouché-Capelli Theorem implies that it suffices to show that for some choice of $(\theta_A^1, \ldots, \theta_A^m)$, the coefficient matrix of $q(\cdot|\cdot)$ above has non-zero determinant. Suppose that for some selection of distinct types $(\theta_A^1, \ldots, \theta_A^m)$, the coefficient matrix has zero determinant. Since $q(\cdot|\theta_A^j)$ changes non-linearly in θ_A^j (because B's strategy is informative and $\theta_B|\theta_A^j$ is normally distributed), it follows that the determinant cannot remain zero for all perturbations of $(\theta_A^1, \ldots, \theta_A^m)$. $\qquad\square$

We next prove a result that will deliver Proposition 2 as a corollary. To state the result, we need some terminology. Say that a (possibly mixed) strategy for candidate i, $\sigma_i : \mathbb{R} \to \Delta(\mathbb{R})$, is *locally pure* at θ_i if types in a neighborhood of θ_i do not mix, and hence it is meaningful to write $y_i(\cdot)$ in a neighborhood of θ_i. A strategy that is locally pure at θ_i is *locally continuous* at θ_i if $y_i(\cdot)$ is continuous in some neighborhood of θ_i. A strategy that is locally pure at θ_i is also *locally revealing* at θ_i if there there is a neighborhood of θ_i, say $N(\theta_i)$, such that for each $\theta_i' \in N(\theta_i)$, $\{\tilde{\theta}_i \in \mathbb{R} : y_i(\theta_i') \in supp[\sigma_i(\tilde{\theta}_i)]\} = \{\theta_i'\}$. In words, local revelation requires that the voter be able to infer a candidate's signal from his platform for some interval of signals; it is then well-defined to write the inverse function $y_i^{-1}(y_i(\theta_i))$ in the relevant region.

Proposition 4. *Any competitive equilibrium in which for each candidate $i \in \{A, B\}$ there is some θ_i such that i's strategy is locally pure, revealing, and continuous at θ_i must be such that for some $i \in \{A, B\}$ and $c \in \mathbb{R}$:*

$$y_i(\theta_i) = \frac{2\beta}{\alpha + 2\beta}\theta_i + c \quad and \quad y_{-i}(\theta_{-i}) = \frac{2\beta}{\alpha + 2\beta}\theta_{-i} - c. \tag{10}$$

Conversely, for any $i \in \{A, B\}$ and $c \in \mathbb{R}$, the above strategy profile defines an equilibrium where the voter elects each candidate with probability $1/2$ after observing any platform pair $(y_A, y_B) \in \mathbb{R}^2$.

Proof. We prove the second statement first. Given the voter's behavior, a candidate's platform does not affect his election probability. It suffices therefore to verify that the voter is indifferent between the two candidates for any pair of platforms. Since the candidates' strategies are fully revealing, the voter correctly infers the candidates' signals from the platform pair. Furthermore, since the candidates' pure strategies each have range $\mathbb{R}$, there are no off-path platform pairs. Therefore, it suffices to show that for any θ_i and θ_{-i}, $-\mathbb{E}[(y_i(\theta_i) - \theta)^2|\theta_i, \theta_{-i}] = -\mathbb{E}[(y_{-i}(\theta_{-i}) - \theta)^2|\theta_i, \theta_{-i}]$, or equivalently that $(y_i(\theta_i) - \mathbb{E}[\theta|\theta_i, \theta_{-i}])^2 = (y_{-i}(\theta_{-i}) - \mathbb{E}[\theta|\theta_i, \theta_{-i}])^2$.[26] Using (10) and (2), this latter equality can be rewritten as

$$\left(\frac{2\beta}{\alpha + 2\beta}\theta_i + c - \frac{2\beta}{\alpha + 2\beta}\left(\frac{\theta_i + \theta_{-i}}{2}\right)\right)^2 = \left(\frac{2\beta}{\alpha + 2\beta}\theta_{-i} - c - \frac{2\beta}{\alpha + 2\beta}\left(\frac{\theta_i + \theta_{-i}}{2}\right)\right)^2,$$

which holds for any θ_i, θ_{-i}.

---

[26] That this latter equality is equivalent to the former follows from a standard mean-variance decomposition under quadratic loss utility as in the proof of Proposition 1.

To prove the first part of the result, fix a competitive equilibrium such that each candidate i's strategy is locally continuous, revealing, and pure in some neighborhood of some point, θ_i; it is then well-defined to write $y_i(\cdot)$ in the neighborhood. It also follows that for each i there is a non-empty, open, and convex set $Y_i \subseteq range[y_i(\cdot)]$ such that the set of platforms in Y_i has positive probability under $y_i(\cdot)$ and $y_i(\cdot)$ is invertible over Y_i. Hence, for any $y_i \in Y_i$, $\theta_i(y_i) := y_i^{-1}(y_i)$ is well defined. Since the equilibrium is informative (by local revelation) and competitive, Lemma 5 implies that the voter randomizes equally between both candidates for all on-path platform pairs. This implies that for any $y_A' \in Y_A$ and $y_B' \in Y_B$, we must have $\mathbb{E}[\theta|y_A', y_B'] = \frac{y_A' + y_B'}{2}$, which implies $\frac{\beta}{\alpha + 2\beta}(\theta_A(y_A') + \theta_B(y_B')) = \frac{y_A' + y_B'}{2}$, or equivalently

$$\theta_B(y_B') = \frac{\alpha + 2\beta}{2\beta}\left(y_A' + y_B'\right) - \theta_A(y_A'). \tag{11}$$

Now observe that since each Y_i is an open set, given any $y_A \in Y_A$ and $y_B \in Y_B$, the same argument can also be made for platforms $y_A + \varepsilon$ and $y_B - \varepsilon$ for all ε that are small enough in absolute value. Hence,

$$\theta_B(y_B - \varepsilon) = \frac{\alpha + 2\beta}{2\beta}\left(y_A + y_B\right) - \theta_A(y_A + \varepsilon). \tag{12}$$

Substituting into (12) from (11) with $y_B' = y_B - \varepsilon$ and $y_A' = y_A$ yields

$$\frac{\alpha + 2\beta}{2\beta}\left(y_A + y_B - \varepsilon\right) - \theta_A(y_A) = \frac{\alpha + 2\beta}{2\beta}\left(y_A + y_B\right) - \theta_A(y_A + \varepsilon),$$

or equivalently,

$$\theta_A(y_A + \varepsilon) = \frac{\alpha + 2\beta}{2\beta}\varepsilon + \theta_A(y_A). \tag{13}$$

Since y_A and ε were arbitrary (so long as $y_A \in Y_A$ and $|\varepsilon|$ is small), the equality in (13) requires that for some constant $c_A \in \mathbb{R}$, $\theta_A(y_A) = \frac{\alpha + 2\beta}{2\beta}y_A + c_A$ for all $y_A \in Y_A$, or equivalently $y_A(\theta_A) = \frac{2\beta}{\alpha + 2\beta}\theta_A + c_A$. A symmetric argument establishes the analog for $y_B(\theta_B)$ with some constant c_B. But now (11) requires $c_B = -c_A$. Finally, the two strategies must be pure and linear on the entire domain, because otherwise, given the linearity on a subset of the domain, there will be a positive-probability set of on-path platform pairs, say (y_A, y_B), for which $\mathbb{E}[\theta|y_A, y_B] \neq \frac{y_A + y_B}{2}$, contradicting the voter randomizing between candidates for such platform pairs. $\square$

Proof of Proposition 2. Observe that each candidate wins with ex-ante probability $1/2$ in any symmetric equilibrium, hence a symmetric equilibrium is competitive. Both the existence and uniqueness claims now follow as a corollary of Proposition 4. $\square$

Proof of Corollary 1. The first statement follows from the observations that the candidates' strategies make the median voter (with ideology zero) indifferent between the two platforms no matter their realization (Proposition 2) and that the ordering of voters' by their interim preferred policies is the same as by their ideologies.

For the second statement, consider any pair of realized policies, y_A and y_B. Given the candidates' strategies, $\mathbb{E}[\theta|y_A, y_B] = \frac{y_A + y_B}{2}$. Thus, the interim preferred policy for voter k is $y_k = \mathbb{E}[\theta|y_A, y_B] + b_k = \frac{y_A + y_B}{2} + b_k$. Suppose first that i is the candidate who is further to the right: $y_i > y_{-i}$. The

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interim preferred policy of the average voter who votes for i is $\mathbb{E}\left[y_k | b_k > 0\right] = \frac{y_i + y_{-i}}{2} + \mathbb{E}\left[b_k | b_k > 0\right]$. The difference between candidate i's platform and his average voter's interim preferred policy is $y_i - \mathbb{E}\left[y_k | b_k > 0\right] = \frac{y_i - y_{-i}}{2} - \mathbb{E}\left[b_k | b_k > 0\right]$. Thus, i's policy is to the right of his average voter's interim preferred policy if and only if

$$\frac{y_i - y_{-i}}{2} > \mathbb{E}\left[b_k | b_k > 0\right]. \tag{14}$$

Following an analogous reasoning, if $y_i < y_{-i}$ then i's platform is to the left of his average voter's interim preferred policy if and only if

$$\frac{y_i - y_{-i}}{2} < \mathbb{E}\left[b_k | b_k < 0\right]. \tag{15}$$

Due to the symmetry of F around 0, inequalities (14) and (15) can be jointly expressed as $\frac{|y_i - y_{-i}|}{2} > \mathbb{E}[b_k | b_k > 0]$. $\qquad \square$

Proof of Theorem 1. Fix any equilibrium. The result obviously holds if the voter is electing one candidate with probability one on the equilibrium path, so assume this is not the case. There are two cases to consider:

(i) First suppose the equilibrium is informative. Then Lemma 5 implies that the voter is indifferent between the two candidates for almost all on-path platform pairs. Hence, voter welfare would not change if, holding fixed the candidates' strategies, either of the candidates were elected with probability one.

(ii) Now suppose the equilibrium is uninformative. Then the voter chooses between platforms based on the prior. Let $V(y)$ denote the expected utility for the voter from policy y based on the prior. Since the equilibrium is competitive, there exists some V^* such that for almost all policies y that are proposed in equilibrium by either candidate, $V(y) = V^*$; otherwise, one of the candidates is not playing a best response to the other. This implies that the voter's welfare would not change if, holding fixed the candidates' strategies, either candidate were elected with probability one. $\qquad \square$

Proof of Theorem 2. Suppose candidate i plays the unbiased strategy, $y_i(\theta_i) = \frac{\beta}{\alpha + \beta} \theta_i$, while candidate $-i$ plays $y_{-i}(\theta_i) = \theta_i$. Given these strategies, it is straightforward to verify that it is optimal for the voter to elect candidate i no matter which pair of platforms is observed. In fact, letting $i = A$ without loss of generality,

$$\left(y_A - \mathbb{E}\left[\theta | y_A, y_B\right]\right)^2 - \left(y_B - \mathbb{E}\left[\theta | y_A, y_B\right]\right)^2$$
$$= \left(\frac{\beta}{\alpha + \beta}\theta_A - \frac{\beta\left(\theta_A + \theta_B\right)}{\alpha + 2\beta}\right)^2 - \left(\theta_B - \frac{\beta\left(\theta_A + \theta_B\right)}{\alpha + 2\beta}\right)^2 \leq 0.$$

In turn, given this voter strategy, each candidate is obviously indifferent over all platforms, and hence this constitutes a fully-revealing non-competitive equilibrium in which the winning candidate i plays the unbiased strategy.

Theorem 1 implies that no equilibrium can provide the voter a strictly higher welfare than that

obtained in the above equilibrium; clearly any uninformative equilibrium provides strictly lower welfare. Now consider any informative and competitive equilibrium. By Lemma 5, the voter must be indifferent between almost-all on-path platforms, and hence the voter's welfare can be evaluated by assuming that the voter elects either of the two candidates with probability one (while holding their strategies fixed). But then, since both candidates cannot be playing the unbiased strategy (Proposition 1), it follows that the voter's welfare is strictly lower than in the above equilibrium. □

Proof of Proposition 3. By the law of iterated expectations, the voter's ex-ante utility can be expressed as

$$\mathbb{E}[U] = -\mathbb{E}\left[(y-\theta)^2\right] = -\mathbb{E}\left[\mathbb{E}\left[(y-\theta)^2 \,|\theta_A,\theta_B\right]\right] = -\mathbb{E}\left[\left(y - \frac{\beta\left(\theta_A+\theta_B\right)}{\alpha+2\beta}\right)^2\right] - \frac{1}{\alpha+2\beta}$$

$$= -\Pr\left(A \; wins\right)\mathbb{E}\left[\left(y_A - \frac{\beta\left(\theta_A+\theta_B\right)}{\alpha+2\beta}\right)^2 \,\middle|\, A \; wins\right]$$

$$- \Pr\left(B \; wins\right)\mathbb{E}\left[\left(y_B - \frac{\beta\left(\theta_A+\theta_B\right)}{\alpha+2\beta}\right)^2 \,\middle|\, B \; wins\right] - \frac{1}{\alpha+2\beta}. \quad (16)$$

It is convenient to define $h_i\left(\theta_i\right) := \mathbb{E}\left[\theta_{-i}|\theta_i, i \; wins\right]$. Using iterated expectations again and a mean-variance decomposition as in the proof of Proposition 1, it also holds that for any $i \in \{A, B\}$,

$$\mathbb{E}\left[\left(y_i - \frac{\beta\left(\theta_A+\theta_B\right)}{\alpha+2\beta}\right)^2 \,\middle|\, i \; wins\right]$$

$$= \mathbb{E}\left[\mathbb{E}\left[\left(y_i - \frac{\beta\left(\theta_A+\theta_B\right)}{\alpha+2\beta}\right)^2 \,\middle|\, \theta_i, i \; wins\right] \,\middle|\, i \; wins\right]$$

$$= \mathbb{E}\left[\left(y_i - \frac{\beta\left(\theta_i + \mathbb{E}\left[\theta_{-i}|\theta_i, i \; wins\right]\right)}{\alpha+2\beta}\right)^2 + \left(\frac{\beta}{\alpha+2\beta}\right)^2 Var\left[\theta_{-i}|\theta_i, i \; wins\right] \,\middle|\, i \; wins\right]$$

$$= \mathbb{E}\left[\left(y_i - \frac{\beta\left(\theta_i + h(\theta_i)\right)}{\alpha+2\beta}\right)^2 \,\middle|\, i \; wins\right] + \left(\frac{\beta}{\alpha+2\beta}\right)^2 \mathbb{E}\left[Var\left[\theta_{-i}|\theta_i, i \; wins\right] \,\middle|\, i \; wins\right]. \quad (17)$$

(16) and (17) imply

$$\mathbb{E}[U] = -\left(\frac{\beta}{\alpha+2\beta}\right)^2 L_V - L_E - \frac{1}{\alpha+2\beta}, \quad (18)$$

where

$$L_V := \sum_{i=A,B} \Pr\left(i \; wins\right)\mathbb{E}\left[Var\left[\theta_{-i}|\theta_i, i \; wins\right] \,\middle|\, i \; wins\right], \quad (19)$$

$$L_E := \sum_{i=A,B} \Pr\left(i \; wins\right)\mathbb{E}\left[\left(y_i(\theta_i) - \frac{\beta\left(\theta_i + h(\theta_i)\right)}{\alpha+2\beta}\right)^2 \,\middle|\, i \; wins\right]. \quad (20)$$

Our problem is to maximize (18) subject to i winning when $|\theta_i| > |\theta_{-i}|$. Since (19) does not

depend on platforms while (20) is bounded below by 0, a solution must satisfy for each i:

$$y_i(\theta_i) = \frac{\beta(\theta_i + h(\theta_i))}{\alpha + 2\beta} = \mathbb{E}[\theta|\theta_i, i \ wins].$$

Since the constraint is that i wins when $|\theta_i| > |\theta_{-i}|$, it follows immediately that the solution is for each candidate to use the strategy (5).

Using the closed-form expression for truncated normal distributions, equation (5) can be expressed as

$$y(\theta_i) = \frac{\beta}{\alpha + \beta}\theta_i - \sigma\frac{\beta}{\alpha + 2\beta}\frac{\phi\left(\frac{1}{\sigma}\frac{\alpha}{\alpha+\beta}\theta_i\right) - \phi\left(-\frac{1}{\sigma}\frac{\alpha+2\beta}{\alpha+\beta}\theta_i\right)}{\Phi\left(\frac{1}{\sigma}\frac{\alpha}{\alpha+\beta}\theta_i\right) - \Phi\left(-\frac{1}{\sigma}\frac{\alpha+2\beta}{\alpha+\beta}\theta_i\right)},$$

where $\sigma = \sqrt{\frac{\alpha+2\beta}{(\alpha+\beta)\beta}}$, and $\phi(\cdot)$ and $\Phi(\cdot)$ are respectively the density and cumulative distributions of the standard normal distribution, $\mathcal{N}(0,1)$. To see that this strategy has pandering, consider any $\theta_i > 0$ (with a symmetric argument for $\theta_i < 0$). Then $0 < y(\theta_i) < \frac{\beta}{\alpha+\beta}\theta_i$ because $\phi\left(\frac{1}{\sigma}\frac{\alpha}{\alpha+\beta}\theta_i\right) > \phi\left(\frac{1}{\sigma}\frac{\alpha+2\beta}{\alpha+\beta}\theta_i\right) > 0$ and $\Phi\left(\frac{1}{\sigma}\frac{\alpha}{\alpha+\beta}\theta_i\right) > \Phi\left(-\frac{1}{\sigma}\frac{\alpha+2\beta}{\alpha+\beta}\theta_i\right) > 0.$ $\square$

C. Mixed Motives

The goal of this section is to substantiate the discussion in Subsection 4.2 of the main text by formally generalizing our main welfare conclusions to a setting where candidates are largely but not entirely office motivated. The main result, Theorem 4 below, will be that when b_i and ρ_i (as defined in Subsection 4.2) are sufficiently close to zero for each $i = A, B$, any equilibrium that maximizes the voter's welfare must have one candidate winning with ex-ante probability close to one, i.e. be almost non-competitive. Consequently, the maximum equilibrium voter welfare must be close to that obtained by efficiently aggregating only one candidate's signal.

In the context of mixed-motivation games, as defined in Subsection 4.2 of the main text, we say that candidate's i strategy is *unbiased* if

$$y_i(\theta_i) = \frac{\beta}{\alpha + \beta}\theta_i + b_i. \tag{21}$$

Note that this refers to candidate i choosing a policy that maximizes *his* preference over policy given his signal, as opposed to the voter's.

Proposition 5. *Assume candidates have mixed motivations. There is a fully revealing non-competitive equilibrium in which one candidate i plays the unbiased strategy (21), the other candidate $-i$ plays*

$$y_{-i}(\theta_{-i}) = \theta_{-i} - \frac{\alpha + \beta}{\beta}b_i, \tag{22}$$

and the voter elects candidate i no matter the pair of platforms. Furthermore, this is the unique fully revealing and non-competitive equilibrium in which the winning candidate plays the unbiased strategy.

(The proof is in the Supplementary Appendix.)

As the equilibrium constructed above is invariant to ρ_A and ρ_B, it has a number of interesting implications. First, the equilibrium exists when candidates are purely policy-motivated. Second, for $\rho_A = \rho_B = b_A = b_B = 0$, this equilibrium reduces to one that verifies the first statement of Theorem 2.[27] Moreover, by taking $b_A = b_B = 0$ and $\rho_A = \rho_B = 1$, we see that there is also a non-competitive equilibrium where the winner plays the unbiased strategy when both candidates are benevolent.[28] Hence, the equilibrium of Proposition 5 continuously spans all three polar cases of candidate motivation.

We are now ready to establish the robustness of Theorem 2 when b_i and ρ_i are sufficiently close to zero for both $i = A, B$. Let an arbitrary Downsian game with mixed-motivated candidates be parameterized by $(\boldsymbol{\rho}, \boldsymbol{b})$, where $\boldsymbol{\rho} = (\rho_A, \rho_B)$ and $\boldsymbol{b} = (b_A, b_B)$. Given any equilibrium, σ, of a mixed-motivations game (including equilibria where candidates play mixed strategies), let $U_V(\sigma)$ be the voter's welfare, i.e. ex-ante expected utility, in this equilibrium. Note that the voter's welfare depends only on the strategies used and not directly on the candidates' motivations. For any $\varepsilon \in [0, 1/2]$, let $\Sigma^\varepsilon(\boldsymbol{\rho}, \boldsymbol{b})$ be the set of equilibria in a mixed-motivations game where each candidate wins with ex-ante probability at least ε. Let $U_V^\varepsilon(\boldsymbol{\rho}, \boldsymbol{b}) := \sup_{\sigma \in \Sigma^\varepsilon(\boldsymbol{\rho}, \boldsymbol{b})} U_V(\sigma)$ be the highest welfare for the voter across all equilibria in which each candidate wins with probability at least $\varepsilon \in [0, 1/2]$, given candidates' motivations $(\boldsymbol{\rho}, \boldsymbol{b})$; in particular, $U_V^0(\boldsymbol{\rho}, \boldsymbol{b})$ is the highest welfare across all equilibria.

Theorem 4. *Assume candidates have mixed motivations. Then,*

1. *As $(\boldsymbol{\rho}, \boldsymbol{b}) \to (\boldsymbol{0}, \boldsymbol{0})$, $U_V^0(\boldsymbol{\rho}, \boldsymbol{b}) \to U_V^0(\boldsymbol{0}, \boldsymbol{0})$.*

2. *For any $\varepsilon > 0$, there exists $\delta > 0$ such that for all $(\boldsymbol{\rho}, \boldsymbol{b})$ close enough to $(\boldsymbol{0}, \boldsymbol{0})$,[29] it holds that $U_V^\varepsilon(\boldsymbol{\rho}, \boldsymbol{b}) < U_V^0(\boldsymbol{\rho}, \boldsymbol{b}) - \delta$.*

(The proof is in the Supplementary Appendix.)

To interpret this result, let $\sigma^B(\boldsymbol{\rho}, \boldsymbol{b})$ be the equilibrium identified in Proposition 5 where, without loss, A is winning candidate who plays (21). We know from Theorem 2 that $U_V^0(\boldsymbol{0}, \boldsymbol{0}) = U_V(\sigma^B(\boldsymbol{0}, \boldsymbol{0}))$. Since Proposition 5 assures that $\sigma^B(\boldsymbol{\rho}, \boldsymbol{b}) \in \Sigma^0(\boldsymbol{\rho}, \boldsymbol{b})$, the first part of Theorem 4 implies that when candidates are close to purely office-motivated, the equilibrium of Proposition 5 provides close to the highest possible equilibrium welfare to the voter. In this sense, the conclusion of Theorem 2 that the voter's welfare cannot be higher than in a non-competitive equilibrium in which one candidate plays the unbiased strategy is robust to candidates having mixed motivations. It is worth remarking that one cannot just invoke the Theorem of the Maximum here; in fact, because the policy space is not compact, the equilibrium correspondence is not upper semi-continuous.[30] However, the proof shows

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[27] Proposition 5 shows that there are in fact a continuum of fully revealing non-competitive equilibria with purely office-motivated candidates, because when $\rho_A = \rho_B = 0$, one may substitute any constant in place of b_i in (21) and (22) and produce a non-competitive equilibrium. However, among these, only the equilibrium in which the constant is zero has the winning candidate playing an unbiased strategy when $b_A = b_B = 0$.

[28] Of course, by Proposition 3, this is Pareto-dominated when the candidates are benevolent.

[29] I.e. if for each i, $\rho_i \in [0, 1]$ and $b_i \in \mathbb{R}$ are both close enough to zero.

[30] To see this, note that given any candidates' motivations with $b_A > 0$, there is an equilibrium where both candidates use the constant strategy $y(\cdot) = 1/b_A$; this is supported by suitable off-path beliefs such that any candidate whose platform differs from b_A loses for sure. As $b_A \downarrow 0$, this sequence of equilibria does not converge to a limit equilibrium.

that any sequence of voter-welfare-maximizing equilibria must converge in welfare.

The second part of Theorem 4 shows that the second part of Theorem 2 is also robust. It says that given any $\varepsilon > 0$, there is a bound $\delta > 0$ such that any equilibrium in which both candidates win with ex-ante probability greater than ε when they are largely office-motivated will provide a level of voter welfare that is bounded away from $U_V^0(\mathbf{0}, \mathbf{0})$ by δ. Combined with the first part of Theorem 4, it follows that once candidates are primarily office-motivated, *any* equilibrium that maximizes the voter's welfare must have one candidate winning with ex-ante probability close to one and hence be almost non-competitive.

D. A Refinement for the Communication Game

This Appendix formalizes the claim made in Subsection 4.3 that one can build on the ideas of Myerson (1989) and Farrell (1993) to provide a formal equilibrium refinement eliminating informative equilibria when candidates' announcements are non-binding or cheap talk. We develop the formalization for the main variation discussed in Subsection 4.3, in which candidates make (one round of) non-binding announcements, and the elected candidate is free to choose any policy. However, it bears emphasis that related formalizations are also available from the authors on request for other variations of the game form, for example when candidates first make observable non-binding announcements followed by commitments before the voter chooses whom to elect.

The *communication game* form we study is as follows: after privately observing their signals θ_i and θ_{-i} as in the baseline model, both candidates simultaneously choose non-binding platforms, which we refer to hereafter as *announcements*, $y_i \in \mathbb{R}$ and $y_{-i} \in \mathbb{R}$. (Considering other spaces of announcements would not affect our results.) Upon observing the pair of announcements, the voter updates her belief about θ and then elects one of the two candidates. As in the baseline model, the voter elects each candidate with equal probability when she is indifferent. The elected candidate i can choose any policy in $\mathbb{R}$ to implement.

Consider the equilibrium that fully aggregates information, as described in Subsection 4.3. Each candidate i adopts the "truthful" announcement strategy, $y_i(\theta_i) = \theta_i$; the voter elects each candidate with equal probability no matter what announcements are made; and, for all (θ_i, θ_{-i}), the elected candidate i implements policy using the function $s_i(\theta_i, y_i, y_{-i}) = \mathbb{E}[\theta|\theta_i, \theta_{-i} = y_{-i}]$. Notice that this profile of strategies forms an equilibrium because neither candidate i can affect his probability of being elected by changing his announcement.

However, we believe this equilibrium is not plausible because each candidate i would profitably deviate by "refusing" to reveal his information, if he only somehow could, and by then implementing the efficient policy $\mathbb{E}[\theta|\theta_i, \theta_{-i} = y_{-i}]$ if elected. If the voter knows that candidate i has deviated in this fashion, the voter would find it uniquely optimal to elect i. Note that it is credible for i to implement policy $\mathbb{E}[\theta|\theta_i, \theta_{-i} = y_{-i}]$ when elected because i is indifferent over policies once in office. Furthermore, given that $-i$'s announcement has revealed θ_{-i} but θ_i remains private information to i (owing to his "refusal" to reveal his information), only candidate i can implement the efficient policy.

As discussed in the main text, there are two issues in formalizing this reasoning. To address

them, we appeal to the notion of *neologism proofness* by Farrell (1993); sea also Myerson's (1989) *coherent plans* and Matthews, Okuno-Fujiwara and Postlewaite's (1991) *announcement-proofness*. Farrell (1993) refinement is defined for cheap-talk games with one sender and one receiver. But it can be be adapted to the current two-sender context by enriching it with Myerson's (1989) notion of *reliable promises*, as follows.

Definition of neologism-proof equilibrium.   For each player i and (measurable) set of types $\Theta_i \subseteq \mathbb{R}$, a *neologism* is a message, denoted as $n_i(\Theta_i)$, while a *promise* is a policy strategy $q_i(\cdot)$ mapping each type $\theta_i \in \Theta_i$ and each pair of announcements (y_i, y_{-i}) into a policy in $\mathbb{R}$. A *statement* is a neologism-promise pair. Fix any equilibrium of the communication game. Assume that for each candidate i and any set Θ_i, there is an out-of-equilibrium message $n_i(\Theta_i)$. Also assume that if such a neologism were sent by i, together with a promise $q_i(\cdot)$, the voter would believe them in the following sense. First, she would update her beliefs about the state θ based solely on the event $\theta_i \in \Theta_i$ and y_{-i} (using the equilibrium strategy of $-i$); furthermore, the voter would posit that candidate $-i$ updates analogously. Second, she would believe that player i plays according to the promise $q_i(\cdot)$ if elected.

The promise $q_i(\cdot)$ is *reliable* if it is optimal for candidate i to follow when elected. In our setting, it is trivially true that any promise $q_i(\cdot)$ is reliable, simply because candidates do not have policy preferences. The statement $(n_i(\Theta_i), q_i(\cdot))$ is *credible for candidate i* (relative to the equilibrium), if two conditions are met: (i) the promise $q_i(\cdot)$ is reliable; and (ii) when the voter believes the statement in the sense defined above, the set of signals θ_i for which candidate i strictly prefers to send the statement $(n_i(\Theta_i), q_i)$ over his equilibrium announcement $y_i(\theta_i)$ is precisely Θ_i. To be clear: we mean "strictly prefer" in terms of candidate i's interim expected utility given his signal, taking expectations over candidate $-i$'s behavior.[31] An equilibrium is *neologism proof* if neither candidate has a credible statement.

Implications.   We claim the "truthful" equilibrium described earlier is not neologism proof. Suppose that either candidate i sends the statement composed of the neologism $n_i(\mathbb{R})$ and the promise $\bar{q}_i(\cdot)$ such that $\bar{q}_i(\theta_i, y_i, y_{-i}) = \mathbb{E}[\theta|\theta_i, \theta_{-i} = y_{-i}]$, for all θ_i, y_i, y_{-i}. The neologism $n_i(\mathbb{R})$ can be interpreted as "silence": candidate i refuses to reveal any information by saying only that his signal lies in $\mathbb{R}$. With the promise $\bar{q}_i(\cdot)$, the candidate i conveys to the voter that, if he is elected, he will use his information θ_i and the opponent's information θ_{-i} (inferred from the announcement y_{-i}) optimally for voter welfare.

Plainly, the uniquely optimal action for the voter when this statement is received, and believed in the sense defined above, is to elect candidate i for any candidate $-i$'s equilibrium announcement y_{-i}: candidate i's post-electoral policy will be the policy that efficiently aggregates all information, $\mathbb{E}[\theta|\theta_i, \theta_{-i}]$; while $-i$'s policy will at best reflect only his own information, $\mathbb{E}[\theta|\theta_{-i}]$. Consequently, no matter his signal θ_i, candidate i strictly prefers sending the statement $(n(\mathbb{R}), \bar{q}_i(\cdot))$ to his equilibrium announcement. It follows that the statement $(n(\mathbb{R}), \bar{q}_i)$ is credible, which implies the equilibrium is

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[31] But, in fact, our conclusions would not change if one instead uses the following more demanding notion: given his signal θ_i, candidate i strictly prefers sending the neologism/promise pair if (i) his payoff is weakly higher no matter which equilibrium announcement is sent by candidate $-i$, and (ii) strictly higher for a set of announcements that have positive probability given θ_i.

not neologism proof.

The same logic extends to all fully- and partially-informative equilibria, as summarized below. Note that the voter's welfare in any uninformative equilibrium can be no higher than efficiently aggregating one candidate's signal.

Theorem 5. *No informative equilibrium of the communication game is neologism proof. There exist neologism-proof uninformative equilibria in which voter welfare is that of efficiently aggregating one candidate's signal.*

__Proof of Theorem 5__. Step 1: We first show that no informative equilibrium is neologism proof. Lemma 5 applied to the communication game implies that in any informative equilibrium, each candidate wins with either probability one half, zero or one, no matter the candidates' signals and (on-path) announcements. Consider any such informative equilibrium. At least one of the two candidates, say i, wins the game with probability at most one half regardless of his signal.

Consider first the case in which $-i$ plays an informative strategy. Suppose i adopts the statement composed of the neologism $n(\mathbb{R})$ and the promise $\bar{q}_i(\cdot)$ such that $\bar{q}_i(\theta_i, y_i, y_{-i}) = \mathbb{E}[\theta|\theta_i, y_{-i}]$, for all θ_i, y_i, y_{-i}. The voter then believes that if $-i$ is elected, he will at best implement policy $\mathbb{E}[\theta|\theta_{-i}]$; whereas if i is elected, he will implement $\mathbb{E}[\theta|\theta_i, y_{-i}]$. Following a similar decomposition to that used in the proof of Proposition 3, the voter's expected payoff from electing i is therefore

$$-\mathbb{E}\left[(\mathbb{E}[\theta|\theta_i, y_{-i}] - \theta)^2 \,|y_{-i}\right] = -\frac{1}{\alpha + 2\beta} - \left(\frac{\beta}{\alpha + \beta}\right)^2 \mathbb{E}\left[\mathrm{Var}\left[\theta_{-i}|\theta_i, y_{-i}\right]\Big|y_{-i}\right], \qquad (23)$$

Similarly, the expected payoff from electing $-i$ is

$$-\mathbb{E}\left[(\mathbb{E}[\theta|\theta_{-i}] - \theta)^2 \,|y_{-i}\right] = -\mathbb{E}\left[(\mathbb{E}[\theta|\theta_{-i}] - \theta)^2\right] = -\frac{1}{\alpha + 2\beta} - \left(\frac{\beta}{\alpha + \beta}\right)^2 \mathbb{E}\left[\mathrm{Var}\left[\theta_i|\theta_{-i}\right]\right]$$

$$= -\frac{1}{\alpha + 2\beta} - \left(\frac{\beta}{\alpha + \beta}\right)^2 \mathbb{E}\left[\mathrm{Var}\left[\theta_{-i}|\theta_i\right]\right], \qquad (24)$$

where the first equality is because y_{-i} does not affect either expectation on the left hand side, and the third equality just changes variables. It is clear that (23) must be weakly larger than (24) no matter the value of y_{-i} since the voter's payoff can never be reduced by observing an additional signal about θ. We now argue that because candidate $-i$'s strategy is informative, (23) must be strictly larger than (24) for some on-path y_{-i}.

Suppose this is not the case. Then, considering only on-path y_{-i}'s,

$$\mathbb{E}_{\theta_i}\left[\mathrm{Var}\left[\theta_{-i}|\theta_i, y_{-i}\right]\Big|y_{-i}\right] = \mathbb{E}_{\theta_i}\left[\mathrm{Var}\left[\theta_{-i}|\theta_i\right]\right] \text{ for all } y_{-i}$$

$$\implies \mathbb{E}_{y_{-i}}\mathbb{E}_{\theta_i}\left[\mathrm{Var}\left[\theta_{-i}|\theta_i, y_{-i}\right]\Big|y_{-i}\right] = \mathbb{E}_{\theta_i}\left[\mathrm{Var}\left[\theta_{-i}|\theta_i\right]\right]$$

$$\iff \mathbb{E}_{\theta_i}\mathbb{E}_{y_{-i}}\left[\mathrm{Var}\left[\theta_{-i}|\theta_i, y_{-i}\right]\Big|y_{-i}\right] = \mathbb{E}_{\theta_i}\left[\mathrm{Var}\left[\theta_{-i}|\theta_i\right]\right] \text{ by changing order of integration}$$

$$\implies \mathrm{Var}\left[\mathbb{E}\left[\theta_{-i}|\theta_i, y_{-i}\right]\right] = 0 \text{ for all } \theta_i \text{ by law of total variance}$$

$$\iff \mathbb{E}[\theta_{-i}|\theta_i, y_{-i}] = \mathbb{E}[\theta_{-i}|\theta_i] \text{ for all } y_{-i} \text{ and } \theta_i \text{ by iterated expectation,}$$

which cannot hold since y_{-i} is the realization of an informative signal about θ_{-i}. Specifically, consider the case where candidate $-i$ plays a pure strategy, $y_{-i}(\cdot)$. Then, since $y_{-i}(\cdot)$ is not constant (because it is informative),

$$\mathbb{E}[\theta_{-i}|\theta_i, y_{-i}] = \int_{y_{-i}^{-1}(y_{-i})} \theta_{-i} \frac{f(\theta_{-i}|\theta_i)}{\Pr(y_{-i})} d\theta_{-i} \neq \int_{-\infty}^{\infty} \theta_{-i} f(\theta_{-i}|\theta_i) d\theta_{-i} = \mathbb{E}[\theta_{-i}|\theta_i],$$

for a set of y_{-i} that occur with positive probability.

Therefore, we conclude that following the statement $(n(\mathbb{R}), \bar{q}_i(\cdot))$ from candidate i, electing i is at least as good for the voter as electing $-i$ for any y_{-i}, and strictly so for a set of y_{-i} with positive probability. Since candidate i wins with probability at most one half no matter y_{-i} on the equilibrium path, it follows that sending the statement $(n(\mathbb{R}), \bar{q}_i(\cdot))$ improves i's payoff regardless of his signal θ_i. Hence, the statement $(n(\mathbb{R}), \bar{q}_i(\cdot))$ is credible for i, which implies the equilibrium is not neologism proof.

Consider now the case in which $-i$ plays an uninformative announcement strategy. Then i's announcement must be informative (since the equilibrium is informative). If $-i$ wins with probability one, then it is easily verified that it is credible for i to make the same statement as above, $(n(\Theta_i), \bar{q}_i(\cdot))$. If $-i$ wins with probability one half or zero, the same argument as above can be applied—reversing the role of $-i$ and i—to conclude that $-i$ has a credible statement.

Step 2: Now we prove the theorem's second statement. Consider the uninformative competitive equilibrium in which both candidates i adopt the platform $\mathbb{E}[\theta|\theta_i]$ if elected, no matter the announcements. It can be verified using the same logic as above that if either candidate i were to send any neologism $n_i(\Theta_i)$, together with any promise $q_i(\cdot)$, the voter would weakly prefer to elect candidate $-i$ no matter which announcement y_{-i} is observed. As each candidate wins with probability one half no matter their announcements on the equilibrium path, there is no credible statement, and so the equilibrium is neologism proof. Plainly, the voter's welfare in this equilibrium is that of efficiently aggregating one candidate's signal. $\qquad\square$

E. A Beta-Bernoulli Example

We provide here an example when the state follows a Beta distribution and each candidate gets a binary signal drawn from a Bernoulli distribution; the feasible set of policies is $[0,1]$ (or any superset thereof). This statistical structure is a member of the exponential family with conjugate priors discussed in the main text. Aside from illustrating how the incentives to overreact exist even when the state distribution may not be unimodal and may be skewed, signals are discrete, etc., it also provides a closer comparison with the setting of Heidhues and Lagerlof (2003) and Loertscher (2012) than does our baseline normal-normal model.

Assume the prior distribution of θ is $Be(\alpha, \beta)$, which is the Beta distribution with parameters $\alpha, \beta > 0$ whose density is given by $f(\theta) = \frac{\theta^{\alpha-1}(1-\theta)^{\beta-1}}{B(\alpha,\beta)}$, where $B(\cdot, \cdot)$ is the Beta function.[32] Thus θ has support $[0,1]$ and $\mathbb{E}[\theta] = \frac{\alpha}{\alpha+\beta}$. For reasons explained at the end of the section, we assume

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[32] If α and β are positive integers then $B(\alpha, \beta) = \frac{(\alpha-1)!(\beta-1)!}{(\alpha+\beta-1)!}$.

$\alpha \neq \beta$. (This rules out a uniform prior, which corresponds to $\alpha = \beta = 1$.) Each candidate $i \in \{A, B\}$ observes a private signal $\theta_i \in \{0, 1\}$; conditional on θ, signals are drawn independently from the same Bernoulli distribution with $\Pr(\theta_i = 1 | \theta) = \theta$. The policy space is any subset of $\mathbb{R}$ containing $[0, 1]$.

It is well-known that the posterior distribution of the state given signal 1 is now $Be(\alpha + 1, \beta)$ (i.e. has density $f(\theta | \theta_i = 1) = \frac{\theta^{\alpha}(1-\theta)^{\beta-1}}{B(\alpha+1, \beta)}$); similarly the posterior given signal 0 is $Be(\alpha, \beta + 1)$. It is also straightforward to check that the posterior distribution of the state given two signals is as follows: if both $\theta_i = \theta_{-i} = 1$, it is $Be(\alpha + 2, \beta)$; if $\theta_i = 0$ and $\theta_{-i} = 1$, it is $Be(\alpha + 1, \beta + 1)$; and if $\theta_i = \theta_{-i} = 0$, it is $Be(\alpha, \beta + 2)$.

It follows that

$$\mathbb{E}[\theta | \theta_i] = \frac{\alpha + \theta_i}{\alpha + \beta + 1} \text{ and } \mathbb{E}[\theta | \theta_i, \theta_{-i}] = \frac{\alpha + \theta_i + \theta_{-i}}{\alpha + \beta + 2}.$$

The above formulae imply that for any realization (θ_A, θ_B),

$$\text{sign}(\mathbb{E}[\theta | \theta_A, \theta_B] - \mathbb{E}[\theta]) = \text{sign}\left(\frac{\mathbb{E}[\theta | \theta_A] + \mathbb{E}[\theta | \theta_B]}{2} - \mathbb{E}[\theta]\right),$$

$$|\mathbb{E}[\theta | \theta_A, \theta_B] - \mathbb{E}[\theta]| > \left|\frac{\mathbb{E}[\theta | \theta_A] + \mathbb{E}[\theta | \theta_B]}{2} - \mathbb{E}[\theta]\right|. \tag{25}$$

In other words, both the posterior mean given two signals and the average of the individual posterior means shift in the same direction from the prior mean, but the former does so by a larger amount.

Consequently, if candidates were to play unbiased strategies and the voter best responds, then whenever $\theta_A \neq \theta_B$ there is one candidate who wins with probability one: the candidate i with $\theta_i = 1$ (resp., $\theta_i = 0$) when $\beta > \alpha$ (resp., $\beta < \alpha$). Of course, when $\theta_A = \theta_B$, both candidates would choose the same platform and win with equal probability. It is worth highlighting that when $\theta_A \neq \theta_B$, it is the candidate with the ex-ante *less* likely signal who wins, because ex-ante $\Pr(\theta_i = 1) = \mathbb{E}[\theta] = \alpha/(\alpha + \beta)$. This implies that unbiased strategies cannot form an equilibrium, but not because candidates would deviate when drawing the ex-ante less likely signal; rather, they would deviate when drawing the ex-ante *more* likely signal to the platform corresponding to the ex-ante less likely signal.[33] Notice that this profitable deviation given signal θ_i is to an (on-path) platform y_i such that $|y_i - \mathbb{E}[\theta]| > |\mathbb{E}[\theta | \theta_i] - \mathbb{E}[\theta]|$; hence, it is a profitable deviation through overreaction rather than pandering.

Finally, we observe there is symmetric fully revealing equilibrium with overreaction in which both candidates play

$$y(1) = \frac{\alpha + 2}{\alpha + \beta + 2} \text{ and } y(0) = \frac{\alpha}{\alpha + \beta + 2}.$$

This strategy displays overreaction because

$$y(0) < \mathbb{E}[\theta | \theta_i = 0] < \mathbb{E}[\theta] < \mathbb{E}[\theta | \theta_i = 1] < y(1).$$

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[33] See Che, Dessein and Kartik (2013) for an analog where options that are "unconditionally better-looking" need not be "conditionally better-looking".

It is readily verified that when both candidates use this strategy, $\mathbb{E}\left[\theta|\theta_A,\theta_B\right] = \frac{y(\theta_A)+y(\theta_B)}{2}$ for all (θ_A,θ_B), and hence each candidate would win with probability $1/2$ for all on-path platform pairs; a variety of off-path beliefs can be used to support the equilibrium.

Note that this overreaction equilibrium would exist even when $\alpha = \beta$. However, were $\alpha = \beta$, unbiased strategies would also constitute an equilibrium: the reason is that in this case, both sides of (25) would be equal to each other (in fact, equal to zero) when $\theta_A \neq \theta_B$, and hence the voter would elect both candidates with equal probability no matters their platforms under unbiased strategies.

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Supplementary Appendix (For Online Publication Only)

F. Proofs for Mixed Motives

Here we provide proofs for [Proposition 5](#) and [Theorem 4](#) from [Appendix C](#). The following Lemma will be used in the proof of [Proposition 5](#).

Lemma 6. *Fix any equilibrium in which candidate i is always elected, plays a pure strategy $y_i(\cdot)$ that is a continuous function and fully revealing. Then, for any on-path platform of candidate $-i$, $y \in range[y_i(\cdot)]$, it holds that $\mathbb{E}[\theta|y_i = y_{-i} = y] = y$.*

Proof. Suppose, to contradiction, that $\mathbb{E}[\theta|y_i = y_{-i} = y] > y$ for some on-path platform of $-i$, $y \in$ range $[y_i(\cdot)]$; the case of reverse inequality is analogous. Since $y_i(\theta_i)$ is continuous and fully revealing, $\mathbb{E}[\theta|y_i = y - \varepsilon, y_{-i} = y]$ is continuous in ε. Thus, for small enough $\varepsilon > 0$, $\mathbb{E}[\theta|y_i = y - \varepsilon, y_{-i} = y] > y$. It follows that for small enough $\varepsilon > 0$, the voter must elect candidate $-i$ upon seeing $y_i = y - \varepsilon$ and $y_{-i} = y$. This contradicts the hypothesis that i is always elected. $\qquad\square$

Proof of [Proposition 5](#). Without loss of generality, let $i = A$. Given the strategies [(21)](#) and [(22)](#), it follows that

$$\mathbb{E}[\theta|y_A, y_B] = \frac{\beta(y_A - b_A)\frac{\alpha+\beta}{\beta} + \beta\left(y_B + \frac{\alpha+\beta}{\beta}b_A\right)}{\alpha + 2\beta} = \frac{\alpha y_A + \beta(y_A + y_B)}{\alpha + 2\beta}.$$

Straightforward algebra then verifies that for any y_A and y_B,

$$(y_A - \mathbb{E}[\theta|y_A, y_B])^2 < (y_B - \mathbb{E}[\theta|y_A, y_B])^2 \iff \beta < \alpha + \beta.$$

Hence it is optimal for the voter to always elect candidate A; clearly the candidates are playing optimally given this strategy for the voter.

To prove the uniqueness claim, fix any fully revealing equilibrium in which i always wins and plays [(21)](#). For any on-path platform of candidate $-i$, say y, let $\theta_{-i}(y)$ denote the unique type that uses platform y. Since [Lemma 6](#) holds continues to apply when candidates have mixed motivations, it follows that for any on-path platform y of candidate $-i$,

$$\mathbb{E}[\theta|y_i = y_{-i} = y] = \frac{\beta}{\alpha + 2\beta}\left(\frac{\alpha + \beta}{\beta}(y - b_i) + \theta_{-i}(y)\right) = y.$$

Rearranging and simplifying yields $\theta_{-i}(y) = y + \frac{\alpha+\beta}{\beta}b_i$. Since this is true for any on-path platform of $-i$, candidate $-i$ must be using the pure strategy $y_{-i}(\theta_{-i}) = \theta_{-i} - \frac{\alpha+\beta}{\beta}b_i$. $\qquad\square$

We next derive a sequence of lemmas that are needed to prove [Theorem 4](#). We begin with some notation. Recall that $\Sigma^\varepsilon(\boldsymbol{\rho}, \boldsymbol{b})$ is the set of equilibria where each candidate wins with ex-ante probability at least ε. Define

$$\Sigma^*(\boldsymbol{\rho}, \boldsymbol{b}) := \{\sigma \in \Sigma^0(\boldsymbol{\rho}, \boldsymbol{b}) : U_V(\sigma) = U_V^0(\boldsymbol{\rho}, \boldsymbol{b})\}$$

as the set of voter-welfare-maximizing equilibria given $(\boldsymbol{\rho}, \boldsymbol{b})$.[34] Say that a sequence of strategy profiles $\sigma^n \to \sigma$ if: (1) for each i and θ_i, $y_i^n(\theta_i) \to y_i(\theta_i)$; and (2) for each pair $(y_A, y_B) \in \mathbb{R}^2$, $v^n(y_A, y_B) \to v(y_A, y_B)$.[35] In other words, convergence of strategies is point-wise. Despite using point-wise convergence, observe that because the ex-ante probability of $\{\theta_i : \theta_i \notin [-k, k]\}$ can be made arbitrarily small by choosing $k > 0$ arbitrarily large, it follows that if $\sigma^n \to \sigma$ then $U_V(\sigma^n) \to U_V(\sigma)$.

Lemma 7. *For any $(\boldsymbol{\rho}, \boldsymbol{b})$, there is an equilibrium where both candidates play $y_i(\cdot) = 0$.*

Proof. Immediate. $\qquad\square$

Given a strategy profile σ, let $W^\sigma(\theta_A, \theta_B)$ denote the set of candidates who win positive probability when the signal realizations are θ_A, θ_B; note that given σ, this is independent of $(\boldsymbol{\rho}, \boldsymbol{b})$.

Lemma 8. *For any (θ_A, θ_B), there exists $k > 0$ such that for any $(\boldsymbol{\rho}, \boldsymbol{b})$, if $\sigma \in \Sigma^*(\boldsymbol{\rho}, \boldsymbol{b})$ and $i \in W^\sigma(\theta_A, \theta_B)$, then $|y_i(\theta_i)| < k$.[36]*

Proof. Lemma 7 implies that for any $(\boldsymbol{\rho}, \boldsymbol{b})$, $U_V^0(\boldsymbol{\rho}, \boldsymbol{b}) > -Var(\theta) = -1/\alpha$. Now fix any (θ_A, θ_B) and note that $\mathbb{E}[\theta|\theta_A, \theta_B]$ does not depend on $(\boldsymbol{\rho}, \boldsymbol{b})$. Hence, for any $x > 0$, there exists $k > 0$ such that for any σ, if $i \in W^\sigma(\theta_A, \theta_B)$ and $|y_i(\theta_i)| > k$, then the voter's utility from σ conditional on the realization of (θ_A, θ_B) is less than $-x$ (using the fact that the range of $v(\cdot)$ is $\{0, 1/2, 1\}$). Since the voter's utility conditional on any signal profile is bounded above by zero, it follows that there is some $x > 0$ such that the voter's utility from σ conditional on (σ_A, σ_B) being realized cannot be less than $-x$ if $\sigma \in \Sigma^*(\rho)$, no matter what $(\boldsymbol{\rho}, \boldsymbol{b})$ is. The desired conclusion now follows. $\qquad\square$

Lemma 9. *Fix any sequence of voter-welfare-maximizing equilibria as $(\boldsymbol{\rho}, \boldsymbol{b}) \to (\mathbf{0}, \mathbf{0})$, $\sigma^{\boldsymbol{\rho}, \boldsymbol{b}} \in \Sigma^*(\boldsymbol{\rho}, \boldsymbol{b})$. Then either:*

(1) for some i, $\Pr(i$ wins in $\sigma^{\boldsymbol{\rho}, \boldsymbol{b}}) \to 0$ as $(\boldsymbol{\rho}, \boldsymbol{b}) \to 0$; or

(2) for any i and θ_i, there exists $k > 0$ such that $|y_i^{\boldsymbol{\rho}, \boldsymbol{b}}(\theta_i)| < k$.

Proof. Suppose the lemma is false. Then, without loss, there is a type $\overline{\theta}_A$, a number $\delta > 0$, and a (sub)sequence of $(\boldsymbol{\rho}, \boldsymbol{b}) \to (\mathbf{0}, \mathbf{0})$ with equilibria $\sigma^{\boldsymbol{\rho}, \boldsymbol{b}} \in \Sigma^*(\boldsymbol{\rho}, \boldsymbol{b})$ such that: (i) for all $(\boldsymbol{\rho}, \boldsymbol{b})$ and $i \in \{A, B\}$, $\Pr(i$ wins in $\sigma^{\boldsymbol{\rho}, \boldsymbol{b}}) > \delta$; and (ii) either $y_A^{\boldsymbol{\rho}, \boldsymbol{b}}(\overline{\theta}_A) \to +\infty$ or $y_A^{\boldsymbol{\rho}, \boldsymbol{b}}(\overline{\theta}_A) \to -\infty$. Lemma 8 implies for any $k > 0$, there exists $(\hat{\boldsymbol{\rho}}, \hat{\boldsymbol{b}}) > 0$ such for any $(\boldsymbol{\rho}, \boldsymbol{b}) < (\hat{\boldsymbol{\rho}}, \hat{\boldsymbol{b}})$ if $|\theta_B| < k$ then $A \notin W^{\sigma^{\boldsymbol{\rho}, \boldsymbol{b}}}(\overline{\theta}_A, \theta_B)$. (Intuitively, as $(\boldsymbol{\rho}, \boldsymbol{b}) \to 0$, since $y_A^{\boldsymbol{\rho}, \boldsymbol{b}}(\overline{\theta}_A)$ explodes, it must be that type $\overline{\theta}_A$ wins only against at most a set of θ_B's that have vanishing prior probability.) Since the distribution of $\theta_B|\overline{\theta}_A$ does not change with $(\boldsymbol{\rho}, \boldsymbol{b})$, it follows that

$$\text{for any } \varepsilon > 0, \text{ if } (\boldsymbol{\rho}, \boldsymbol{b}) \text{ is small enough then } U_A(\overline{\theta}_A; \sigma^\rho, \boldsymbol{\rho}, \boldsymbol{b}) < \varepsilon, \tag{26}$$

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[34] In what follows, we will proceed as if $\Sigma^*(\boldsymbol{\rho}, \boldsymbol{b})$ is non-empty for all $(\boldsymbol{\rho}, \boldsymbol{b})$. If this is not the case, one can proceed almost identically, just by defining for any $\varepsilon > 0$, $\Sigma_\varepsilon^*(\boldsymbol{\rho}, \boldsymbol{b}) := \{\sigma \in \Sigma^0(\boldsymbol{\rho}, \boldsymbol{b}) : U_V(\sigma) \geq U_V^*(\boldsymbol{\rho}, \boldsymbol{b}) - \varepsilon\}$, and then applying the subsequent arguments for a sequence of $\varepsilon \to 0$.

[35] Here, y_i^n and v^n are the components of σ^n and similarly for the limit; a similar convention is used subsequently. Note that this supposes that candidates are playing pure strategies in equilibrium; this is for notational simplicity only, as it can be verified that the arguments go through for equilibria in which candidates may mix, with the notion of convergence being that of the weak topology.

[36] Recall that we suppress "almost all" qualifiers.

where $U_A(\theta_A; \sigma, m)$ is the expected utility for candidate A when his type is θ_A in an equilibrium σ given candidate motivations $(\boldsymbol{\rho}, \boldsymbol{b})$. However, notice that by point (i) above, it must be that there is a bounded set, say $\Theta_A \subset \mathbb{R}$, such that for any $(\boldsymbol{\rho}, \boldsymbol{b})$, $\Pr(i \text{ wins in } \sigma^{\boldsymbol{\rho},\boldsymbol{b}} | \theta_A \in \Theta_A)$ is bounded below by some positive number.[37] But then, type $\overline{\theta}_A$ can mimic the play of types in Θ_A (e.g. mix uniformly over their strategies) to get a strictly positive probability of winning for all $(\boldsymbol{\rho}, \boldsymbol{b})$, which given (26) would be a profitable deviation for small enough $(\boldsymbol{\rho}, \boldsymbol{b})$. $\qquad\square$

Proof of Theorem 4. Recall that $\sigma^B(\boldsymbol{\rho}, \boldsymbol{b})$ is the equilibrium identified in Proposition 5 where, without loss, A is the candidate who wins with probability one. We prove each part of Theorem 4 in turn.

<u>Part 1.</u> Let $\sigma^{\boldsymbol{\rho},\boldsymbol{b}} \in \Sigma^*(\boldsymbol{\rho}, \boldsymbol{b})$ be an arbitrary sequence of voter-welfare-maximizing equilibria as $(\boldsymbol{\rho}, \boldsymbol{b}) \to (\mathbf{0}, \mathbf{0})$.[38] Applying Lemma 9 to this sequence, there are two exhaustive cases:

(a) If Case 1 of Lemma 9 holds, then it is straightforward to verify that $U_V(\sigma^{\boldsymbol{\rho},\boldsymbol{b}}) \to U_V^0(\mathbf{0}, \mathbf{0})$. Intuitively, if i is winning with ex-ante probability approximately zero, then the voter's welfare cannot be much higher than if $-i$ wins with ex-ante probability one using the unbiased strategy.

(b) If Case 2 of Lemma 9 holds, pick any subsequence of $\sigma^{\boldsymbol{\rho},\boldsymbol{b}}$ that converges (at least one exists) and denote the limit by $\sigma^{\mathbf{0},\mathbf{0}}$. Since payoffs are continuous, it can be verified using standard arguments that $\sigma^{\mathbf{0},\mathbf{0}}$ is an equilibrium of the limit pure-office-motivation game (intuitively, if any type of a candidate or the voter has a profitable deviation, there would also have been a profitable deviation from $\sigma^{\boldsymbol{\rho},\boldsymbol{b}}$ for small enough $(\boldsymbol{\rho}, \boldsymbol{b}) > (\mathbf{0}, \mathbf{0})$; just as one argues in the proof of the Theorem of the Maximum). This implies that

$$\lim_{(\boldsymbol{\rho},\boldsymbol{b})\to(\mathbf{0},\mathbf{0})} U_V(\sigma^{\boldsymbol{\rho},\boldsymbol{b}}) = U_V(\sigma^{\mathbf{0},\mathbf{0}}) \le U_V^0(\mathbf{0}, \mathbf{0}).$$

Since $U_V(\sigma^{\boldsymbol{\rho},\boldsymbol{b}}) \ge U_V(\sigma^B(\boldsymbol{\rho}, \boldsymbol{b}))$ for all $(\boldsymbol{\rho}, \boldsymbol{b})$, it follows from Proposition 5 that in fact

$$\lim_{(\boldsymbol{\rho},\boldsymbol{b})\to(\mathbf{0},\mathbf{0})} U_V(\sigma^{\boldsymbol{\rho},\boldsymbol{b}}) = U_V(\sigma^{\mathbf{0},\mathbf{0}}) = U_V^0(\mathbf{0}, \mathbf{0}).$$

<u>Part 2.</u> Suppose the statement is false. Then, in light of the first part proved above, there is a sequence of equilibria $\sigma^{\boldsymbol{\rho},\boldsymbol{b}}$ as $(\boldsymbol{\rho}, \boldsymbol{b}) \to (\mathbf{0}, \mathbf{0})$ such that $U_V(\sigma^{\boldsymbol{\rho},\boldsymbol{b}}) \to U_V^0(\mathbf{0}, \mathbf{0})$ and

$$\text{for all } \varepsilon > 0, \text{ a subsequence } (\boldsymbol{\rho}, \boldsymbol{b})_\varepsilon \to (\mathbf{0}, \mathbf{0}) \text{ where } \sigma^{(\boldsymbol{\rho},\boldsymbol{b})_\varepsilon} \in \Sigma^\varepsilon(\boldsymbol{\rho}, \boldsymbol{b}).[39] \qquad (27)$$

Applying Lemma 9, it follows that for any $\varepsilon > 0$, i, and θ_i, there exists $k > 0$ such that $|y_i^{(\boldsymbol{\rho},\boldsymbol{b})_\varepsilon}(\theta_i)| < k$. But then, as in the first part above, $\sigma^{\boldsymbol{\rho},\boldsymbol{b}}$ must converge (in subsequence) to some $\sigma^{\mathbf{0},\mathbf{0}}$. Since $U_V(\sigma^{\boldsymbol{\rho},\boldsymbol{b}}) \to U_V^0(\mathbf{0}, \mathbf{0})$, it follows that $\sigma^{\mathbf{0},\mathbf{0}}$ must be non-competitive. But this implies that that for any $\varepsilon > 0$, there exists $\delta > 0$ such that if $(\boldsymbol{\rho}, \boldsymbol{b})$ is in a δ-neighborhood of $(\mathbf{0}, \mathbf{0})$, then $\sigma^{\boldsymbol{\rho},\boldsymbol{b}} \notin \Sigma^\varepsilon(\boldsymbol{\rho}, \boldsymbol{b})$, which contradicts (27). $\qquad\square$

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[37] The reason Θ_A must be a bounded set is because types in the tails have vanishing prior probability.

[38] The same caveat as in fn. 34 applies.

[39] Recall that $\Sigma^\varepsilon(\boldsymbol{\rho}, \boldsymbol{b})$ is the set of equilibria where each candidate wins with ex-ante probability at least ε.