Information and Extremism in Elections

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Abstract

We show that informative political campaigns can increase political extremism and decrease voter welfare. We present a model of elections in which candidate ideology is strategically selected prior to a campaign which reveals information about candidate quality. Documented means by which campaigns can harm voters are not present in our model; special interest groups, fundraising, and biased or private information are not part of the analysis. Even under these optimistic assumptions, informative campaigns have negative consequences. Our results have implications regarding media coverage, the number of debates, and campaign finance reform.

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Democracy demands an educated and informed electorate.
– Thomas Jefferson

The purpose of a campaign is to send an intelligent and informed voter to the ballot box.
– Calvin Coolidge[1]

1 INTRODUCTION

Information about political candidates emerges during election campaigns through debates, media coverage, informative advertising, and observed performance on the campaign trail. To the extent that it enables voters to make better-informed election day decisions, this information is generally considered good for democracy. Our analysis calls into question this widely-held view. We illustrate how more-informative campaigns provide incentives for candidates to run on less-moderate policy platforms (i.e., ideology). In equilibrium, anticipated voter exposure to better information leads to elected politicians being both higher expected quality and more extreme. When the distribution of voter ideology is sufficiently moderate, the welfare costs from more-extreme policy dominate the benefits from a better-informed electorate. Voters may be made worse off as campaigns become more-informative.

Past results about the detrimental effects of campaigns tend to focus on the need for candidates to fundraise or seek endorsements from special interest groups, considerations that are absent from our analysis. In our framework, we show how campaigns may be detrimental even when there are no special interest groups, fundraising, biased or private information, incumbent advantage, or turnout concerns. Campaigns serve only to produce costless, unbiased information about candidate quality. We are aware of no other paper illustrating that such neutral information revelation during a campaign drives policy divergence and can decrease voter welfare.

Our analysis considers a three stage election game. In the first stage, two political candidates announce policy platforms. In the second stage (the campaign stage), information emerges about candidate quality, a valence trait independent of policy. Finally, in the third stage, voters elect a candidate. The analysis focuses on how the informativeness of the campaign in the second stage leads to election day differentiation between the candidates, and interacts with the selection of policy platform in the first stage. In an extreme case where campaigns reveal nothing about candidate quality, voter beliefs about the candidates are the same on election day as they were on the day candidates announce their policy platforms. Candidates recognize that no new information about them will emerge, and that they need to announce a more-moderate policy than their opponent to win. In this case, competition between candidates when selecting platforms is most fierce, with the platforms of both candidates converging to the one preferred by the median voter. Informative campaigns, on the other hand, weaken the platform competition between the candidates. Even

[1]The quote is from Coolidge's "Radio Address from the White House on the Duties of Citizenship," November 3, 1924. It is made available online by Gerhard Peters and John T. Woolley's "The American Presidency Project," http://www.presidency.ucsb.edu/ws/?pid=24179.

ex ante identical candidates expect an informative campaign to lead to ex post differentiation in expected candidate quality. The more informative the campaigns, the greater the uncertainty about election-day differentiation between the candidates, the greater the expected differentiation, and the weaker is platform competition in the first stage. The more informative the campaigns, the farther both candidates' platforms are from the median voter's ideal.

The analysis identifies a trade off between how informed voters are on election day, and policy divergence away from the median voter. If enough of the electorate prefers more-moderate policies than the equilibrium policies proposed by the candidates, then increasing campaign informativeness decreases aggregate voter welfare. When the distribution of voter preferences is sufficiently concentrated around the median voter, the socially optimal level of campaign informativeness is neither fully uninformative nor fully informative.[2] Rather, an intermediate level of campaign informativeness optimizes the tradeoff between policy divergence and information; for higher levels of informativeness, voters would be better off if they were exposed to less information during the campaign.

The model, which we introduce in Section 2 and analyze in Sections 3 and 4, is stylized, designed to build intuition about the impact of campaign informativeness. It abstracts from factors which are already recognized to contribute to adverse outcomes for voters, and focuses on the roll of campaigns to produce information about candidate quality. The initial analysis also abstracts from some interesting considerations in order to present the main point as clearly as possible. In Section 5 we consider a number of extensions including non-linear preferences, ex ante asymmetries between candidates, and allowing candidates to strategically select the informativeness of their campaigns, important considerations that are absent from the initial analysis. None of these extensions change the main qualitative results.

Our primary contribution comes from showing how information that emerges during campaigns drives uncertainty about voter preferences and thus leads to policy divergence. Although the link between uncertainty about voter preferences and platform divergence is well known (e.g., Calvert 1985), the literature treats the uncertainty about voter preferences as exogenous. Ours is the first to show how campaigns that reveal information about candidate quality to voters can drive such ex ante uncertainty about voter preferences, and thus can incentivize candidates to adopt more divergent policy positions. The relationship between campaign informativeness and these factors is novel to our paper. The most similar result to our main finding is not found in the political economy literature, but rather in the industrial organization literature where Moscarini and Ottaviani (2001) establish that consumer access to product information can weaken price competition between firms. We discuss our analysis in the context of these literatures and others in Section 6.

Our results suggest that anything that leads voters to become more informed about candidate quality will also lead to the nomination of more-extreme politicians. This means that altering the number or format of debates or interviews, increasing media coverage, extending the duration of

[2] Although fully-uninformative campaigns are never socially optimal, they may be preferred to fully informative campaigns, which perfectly inform the voters about candidate quality.

campaigns, or imposing campaign finance reform that reduces (informative) campaign spending may all lead to greater extremism and a decrease in constituent wellbeing.[3] Conversely, imposing or strengthening limits on these factors may result in moderation and improve voter welfare. We discuss these implications further in Section 7.

2 PRELIMINARIES

An election takes place in three stages. First, two political parties simultaneously choose the ideology (e.g., policy platform) of their candidates. Second, the candidates campaign, a process which may reveal information about their quality, a characteristic independent of ideology. Third, voters elect a candidate.

A candidate's ideology determines his or her policy choice if elected. Although candidate ideology is perfectly observable by both parties and voters, uncertainty exists about candidate quality.[4] Quality represents an attribute equally valued by all voters; for example, a high-quality candidate engages in less private rent-seeking while in office, manages resources more efficiently, is better able to understand complex situations and react rationally under pressure, or is better at securing pork projects for his district.

Voters care about both the ideology and quality of elected politicians. All voters share common preferences for higher-quality politicians over lower-quality politicians. However, voters differ in their preferences over ideology. A continuum of voters exists, with ideology continuously distributed on the real-line. Denote voter i's ideology by ρ_i. The distribution of voter ideologies is given by cumulative distribution function $G(\rho)$, with continuous density function $g(\rho)$. The median of the distribution of voter ideology is normalized to be $\rho = 0$. To simplify the exposition, we also assume that this distribution has continuous support on the entire real line, and that $E[|\rho|] < \infty$.

When a candidate with quality q_w and ideology ρ_w wins election, voter i with ideology ρ_i receives payoff $u_i = vq_w - |\rho_w - \rho_i|$, where v is the relative weight that voters place on quality relative to ideology. Because we focus on an electorate composed of a continuum of voters, no unilateral deviation can change the election outcome. However, in our setting, if there were any chance that a voter were pivotal, every voter's ballot would express his or her true preference; we therefore assume that all voters vote for the candidate they believe offers the highest expected value if elected.

The two parties, L and R, have ideology positions $\rho_L^P < 0$ and $\rho_R^P > 0$. Parties care about the ideology of the election winner, but do not care about quality. Given that a candidate with

[3] A large empirical literature analyzes campaigns, much of it focused on the link between voter information and other attributes of campaigns, for example spending (e.g., Partin 2001, Freedman, Franz and Goldstein 2004), debates (e.g., Miller and MacKuen 1979, Holbrook 1999) and media coverage (e.g., Chaffee, Zhao and Leshner 1994, Bartels 1993). Although no clear consensus exists in this literature about whether higher campaign spending increases the probability of a candidate winning election (e.g., Levitt 1994, Palda and Palda 1998, Milyo 1999, Moon 2006)), the link between campaign spending and voter information is clear (Partin 2001).

[4] This is consistent with Carrillo and Castanheira (2008), Ashworth and de Mesquita (2009) and Serra (2010). Carrillo and Castanheira (2008) argue that the assumption is a good approximatation for reality since there is much more uncertainty about candidate quality than about their ideology.

ideology ρ_w wins election, party R receives $u_j^P = -|\rho_w - \rho_j^P|$.

The parties choose the ideology of their nominated candidates, who then compete for election. We use superscript P to denote when a variable or function applies to a party, and leave off the superscript when referring to a party's candidate. A party never prefers to nominate a candidate more extreme than the party ideal or with ideology on the opposite side of the median voter. Party L will always prefer a candidate with ρ_L such that $\rho_L^P \leq \rho_L \leq 0$ and party R will always prefer a candidate with ρ_R such that $0 \leq \rho_R \leq \rho_R^P$. Define by $\delta_j^P \equiv |\rho_j^P|$ the distance between the ideology of party j and the median voter, and by $\delta_j \equiv |\rho_j|$ the distance between candidate j's ideology and the median voter. That is, δ_j corresponds to a candidate's level of extremism. Focusing on δ_j rather than ρ_j simplifies exposition.

We make the following assumption about party ideology:

A1 $\quad min\{\delta_L^P, \delta_R^P\} > \frac{v\sqrt{\pi}}{2}$.

This assumption guarantees that party ideology is always sufficiently extreme that parties choose to nominate candidates more moderate than the party ideal. Relaxing this assumption will not change the qualitative results. Because parties will never nominate candidates more extreme than the party ideology, the only consequence of relaxing the assumption is a potentially binding upper bound on policy divergence. When the upper bound binds, the welfare costs of improved information will be less, and the range of parameters for which more-informative campaigns will be detrimental to voters will be more restrictive.

Variable q_j denotes the quality of candidate $j \in \{L, R\}$. Each candidate's q_j is the independent realization of a random variable distributed according to $N(\mu, 1)$. This means that all candidates have the same expected quality, μ; therefore, the parties only make a choice over candidate ideology when choosing a nominee.

Following the nomination of candidates, but prior to voting, information about candidate quality is revealed through a campaign. During the campaign, candidates engage in debates, town hall meetings, and media interviews. Voters also observe how campaigns are managed, and investigative reporting may lead to voters learning more details about candidate background and past behavior. All of this may help voters assess candidate quality. For example, the more debates and interviews that candidates participate in, the more informed voters will be about candidate quality on election day. To incorporate this into the model, voters observe a public signal about candidate quality prior to voting. For each candidate j, voters observe a public draw s_j from a normal distribution centered around the candidate's true quality; specifically, s_j is the realization of a random variable S_j, distributed according to $N(q_j, \sigma_j^2)$. The higher is σ_j, the less informative the signal is about candidate j's quality; $\sigma_j \to \infty$ represents a perfectly uninformative signal which does not alter voters' posterior beliefs about candidate quality. Conversely, low values of σ_j, imply that the signal is very informative about candidate quality; indeed, if $\sigma_j = 0$ the signal perfectly reveals a candidate's quality. We focus primarily on a setting in which (σ_L, σ_R) are exogenous; however, in Section 5, we discuss an extension in which candidates choose campaign informativeness strategically.

We solve for the Perfect Bayesian Equilibrium of the game that takes place in the following sequence.

1. Parties each nominate a candidate. That is, they choose the ideology ρ_j of their candidate.
2. A campaign informs voters about the quality of each candidate. All voters observe the realizations of signals S_L and S_R about the quality of the candidates, where $S_i \sim N(q_i, \sigma_i^2)$.
3. Voters rationally update their beliefs about candidate quality and simultaneously cast ballots for their preferred candidate. The candidate who receives the majority of votes wins.

The model we present is highly stylized, incorporating assumptions about symmetry, preferences, and information which both emphasize our main results and make it most-straightforward to build intuition. Our results will continue to hold for at least some parameter cases in more-general settings, which we discuss in Section 5.

Focus on the median voter

Voters differ only in their ideology, which is defined along a one-dimensional policy space, and share common preferences over candidate quality. On election day every voter casts a ballot for the candidate that offers him the highest expected individual payoff if elected. Therefore, if the voter at position $\hat{\rho}$ is indifferent between the candidates, all voters to the right of $\hat{\rho}$ vote for one of the candidates, and all voters to the left of $\hat{\rho}$ vote for the other candidate. In light of this, the candidate preferred by the voter with the median ideology will win the election.[5]

Probability of election win

Candidate L defeats candidate R if he is preferred by the median voter following the campaign. That is, if

$$vE[q_L|s_L] - |\rho_L - \rho_M| > vE[q_R|s_R] - |\rho_R - \rho_M|,$$

where ρ_M is the ideology of the median voter. Because $\rho_M = 0$, this condition becomes

$$E[q_L|s_L] - E[q_R|s_R] > \frac{\delta_L - \delta_R}{v}. \tag{1}$$

The left hand side represents the quality difference, for which a positive value means that candidate L has higher expected quality than candidate R. The right hand side represents the expected difference in ideology, and positive values mean candidate L is more extreme than candidate R. For L to win, the quality benefit he provides must dominate any ideological disadvantage. Given that the signals, s_L and s_R are stochastic, neither candidate is able to guarantee that inequality (1) holds or fails to hold. We are therefore interested in the probability that (1) is satisfied given δ_L and δ_R.

[5] If the median voter is indifferent between the two candidates, each wins with equal probability. This can happen in equilibrium only when $\sigma_L = \sigma_R \to \infty$.

It is straightforward to calculate this probability given the known distributions of $q_j \sim N(\mu, 1)$ and $S_j|q_j \sim N(q_j, \sigma_j)$. The Appendix walks through each step of this calculation. If functions F and f represent the cdf and pdf of the standard normal distribution, $N(0,1)$, then the ex ante probability that each candidate wins election given δ_L and δ_R is

$$Pr(\text{L wins}|\delta_L, \delta_R) = 1 - F\left(\frac{\delta_L - \delta_R}{v\alpha}\right) = F\left(\frac{\delta_R - \delta_L}{v\alpha}\right)$$

$$Pr(\text{R wins}|\delta_L, \delta_R) = F\left(\frac{\delta_L - \delta_R}{v\alpha}\right) = 1 - F\left(\frac{\delta_R - \delta_L}{v\alpha}\right),$$

where

$$\alpha \equiv \sqrt{\frac{1}{1+\sigma_L^2} + \frac{1}{1+\sigma_R^2}}.$$

Parameter α is a measure of the overall level of campaign informativeness. It depends only on the standard deviation of the campaign signals, σ_L and σ_R, and is strictly increasing as voters observe more-accurate signals about either candidate's quality (i.e., as either σ_j decreases). When both campaigns are fully informative (i.e., when $\sigma_L = \sigma_R = 0$), α takes on its maximum value at $\alpha = \sqrt{2}$. When both campaigns are fully uninformative (i.e., when $\sigma_L = \sigma_R \to \infty$), α takes on its minimum value at $\alpha = 0$. When one campaign is fully informative and the other fully uninformative, $\alpha = 1$.

3 EFFECTS OF CAMPAIGNS ON CANDIDATE IDEOLOGY

In this section, we show our first main result: more-informative campaigns result in the nomination of more-extreme candidates.

We now determine the parties' equilibrium choices of candidate ideology. In equilibrium, a party chooses δ_j to maximize its expected payoff given the choice of δ_k by the other party. The expected payoff to party j given ideological divergences (δ_j, δ_k) is

$$\begin{aligned} Eu_j^P(\delta_j, \delta_k) &= -\delta_j^P - \left(1 - F\left(\tfrac{\delta_k - \delta_j}{v\alpha}\right)\right)\delta_k + F\left(\tfrac{\delta_k - \delta_j}{v\alpha}\right)\delta_j \\ &= -\delta_j^P + F\left(\tfrac{\delta_k - \delta_j}{v\alpha}\right)(\delta_j + \delta_k) - \delta_k \end{aligned}$$

The derivative of this function is given by the following:

$$\frac{\partial Eu_j^P}{\partial \delta_j} = F(\frac{\delta_k - \delta_j}{\alpha v}) - (\delta_j + \delta_k) f(\frac{\delta_k - \delta_j}{\alpha v})\frac{1}{\alpha v}$$

This expression illustrates the tradeoff inherent in a party's choice of ideology. If the party nominates a marginally more extreme candidate, then they experience a marginal benefit whenever their candidate wins election, reflected in the first term. However, by doing so, the party also reduces the probability of winning the election, a cost reflected in the second term. Therefore a critical point of a party's expected payoff (as a function of its level of ideological divergence) is defined by

the following equation:

$$F(\frac{\delta_k-\delta_j}{\alpha v})-(\delta_j+\delta_k)f(\frac{\delta_k-\delta_j}{\alpha v})\frac{1}{\alpha v}=0 \iff \frac{f(\frac{\delta_k-\delta_j}{\alpha v})}{F(\frac{\delta_k-\delta_j}{\alpha v})}=\frac{\alpha v}{\delta_k+\delta_j} \tag{2}$$

Consider the sign of the derivative at $\delta_j = 0$. For the standard Normal distribution, $x \geq 0 \Rightarrow \frac{f(x)}{F(x)} < \frac{1}{x}$.[6] Substituting $\delta_j = 0$ into equation (2) and applying this inequality gives:

$$\frac{f(\frac{\delta_k}{\alpha v})}{F(\frac{\delta_k}{\alpha v})} < \frac{\alpha v}{\delta_k} \Rightarrow \frac{\partial E u_j^P}{\partial \delta_j}\Big|_{\delta_j=0} > 0$$

Therefore, for values of δ_j near zero, the party's expected payoff is increasing in δ_j (for any δ_k). Because the Normal distribution is log-concave, $\frac{f(z)}{F(z)}$ is a decreasing function, and because the argument $\frac{\delta_k-\delta_j}{\alpha v}$ is itself decreasing in δ_j, the left hand side of this equation is increasing in δ_j. Meanwhile, the right hand side is decreasing, approaching a limit of zero as $\delta_j \to \infty$. Thus a unique value of δ_j satisfies equation (2). In addition, the unique critical value satisfying this equation always defines a maximum: the derivative at $\delta_j = 0$ is positive and changes sign (only once) at the critical point. Hence, a unique critical point always exists, and it is always the unique global maximum of the party's expected payoff. Therefore, party j's best response to δ_k is uniquely defined by the value of δ_j satisfying (2). Equilibrium party ideologies (δ_L, δ_R) are therefore defined by the following system of equations:

$$\frac{f(\frac{\delta_L-\delta_R}{\alpha v})}{F(\frac{\delta_L-\delta_R}{\alpha v})}=\frac{\alpha v}{\delta_L+\delta_R} \text{ and } \frac{f(\frac{\delta_R-\delta_L}{\alpha v})}{F(\frac{\delta_R-\delta_L}{\alpha v})}=\frac{\alpha v}{\delta_R+\delta_L}$$

These equations immediately imply the following:

$$\frac{f(\frac{\delta_L-\delta_R}{\alpha v})}{F(\frac{\delta_L-\delta_R}{\alpha v})}=\frac{f(\frac{\delta_R-\delta_L}{\alpha v})}{F(\frac{\delta_R-\delta_L}{\alpha v})} \iff F(\frac{\delta_R-\delta_L}{\alpha v})=F(-\frac{\delta_R-\delta_L}{\alpha v}) \iff \delta_L=\delta_R$$

Thus, equilibrium ideological extremism is symmetric: $\delta_L = \delta_R = \delta^*$.

Using these observations, we derive the unique equilibrium of the game. Suppose that $\delta_k = \delta^*$. The critical point in equation (2) is therefore defined by

$$\frac{f(\frac{\delta^*-\delta_j}{\alpha v})}{F(\frac{\delta^*-\delta_j}{\alpha v})}=\frac{\alpha v}{\delta^*+\delta_j}$$

[6] Let $R(x)=\frac{F(x)}{f(x)}$. Obviously $R(0) > 0$. Furthermore, $R'(x)=\frac{f(x)^2+xf(x)F(x)}{f(x)^2}=1+xR(x)>1$. Thus, $R(x) > x$ holds at $x = 0$, and for all $x > 0$, $R'(x) > 1$. Thus, $x > 0 \Rightarrow R(x) > x$. Inverting each side of this inequality gives the inequality given in the text.

In equilibrium, this critical point must be $\delta_j = \delta^*$. Therefore δ^* must satisfy the following:

$$\frac{f(0)}{F(0)} = \frac{\alpha v}{2\delta^*} \iff \frac{\frac{1}{\sqrt{2\pi}}}{\frac{1}{2}} = \frac{\alpha v}{2\delta^*} \iff \delta^* = \frac{v\sqrt{2\pi}}{4}\alpha$$

Henceforth, define $\delta^*(\alpha) \equiv \frac{v\sqrt{2\pi}}{4}\alpha$. We omit the argument α and write simply δ^* whenever doing so does not cause confusion.

Proposition 3.1 *The unique equilibrium of this game is $\delta_L = \delta_R = \delta^*(\alpha)$.*

The higher is $\delta^* = \frac{v\sqrt{2\pi}}{4}\alpha$, the more divergent are the ideologies of both candidates, and the more extreme they are compared to the preferences of the median voter. Unsurprisingly, equilibrium ideological divergence δ^* is increasing in v. Higher v means the voter cares less about candidate ideology relative to candidate quality. Thus, when v is high the marginal cost of increasing extremism—in terms of a reduction in the probability of being elected—is smaller, leading to greater ideological extremism in equilibrium.

Our first main result describes the relationship between equilibrium extremism and campaign informativeness: the divergence between candidate ideology and the median voter's ideology, δ^*, is strictly increasing in α. The more informative are campaigns, the more divergent are the ideologies of the nominated candidates.

Proposition 3.2 *(Informativeness and ideological extremism)*

- $\frac{\partial \delta^*}{\partial \alpha} > 0$. *Both candidates become more extreme as either campaign becomes more informative.*
- $\delta^* = 0$ *if and only if* $\sigma_L, \sigma_R \to \infty$. *Candidate ideology converges to the median voter only when campaigns are completely uninformative.*

When campaigns are completely uninformative, both candidates remain indistinguishable on the quality dimension following the campaign. In this case, the more-moderate candidate always wins, and party competition to nominate a more-moderate candidate than the other party results in nominees who share the same ideology as the median voter. On the other hand, when campaigns reveal information about candidate quality, then the more moderate candidate is not guaranteed to win the election. The parties recognize that campaigns will expose differences in expected candidate quality, and that a candidate with higher *ex post* expected quality can still win election when his ideology is moderately more extreme than his opponent. Parties react to the anticipated revelation of information about quality by nominating more-extreme candidates in the first stage. Thus, in equilibrium, informative campaign signals undermine the incentive for parties to moderate the ideology of their nominees, resulting in an equilibrium with a higher level of ideological extremism.

4 VOTER WELFARE

Since more-informative campaigns result in both more-extreme candidates and more-informed voters, it is not initially clear whether voters benefit from less informative campaigns. Continuing the

analysis from the previous section, we show that the downsides of more information may dominate the benefits, and voters may be better off when campaigns are less informative.

Total voter welfare is measured as the utilitarian sum of voter payoffs. Given that a politician with ideology ρ_w and quality q_w wins election, welfare equals

$$W(\rho_w, q_w) = vq_w - L(\rho_w),$$

where

$$L(\rho_w) = \int_{-\infty}^{\infty} g(\rho_i)|\rho_w - \rho_i| d\rho_i$$

is the average voter utility loss due to divergence between an election winner's ideology and the preferred ideologies of the individual voters. The expression for $L(\rho_w)$ may be rewritten:

$$L(\rho_w) = (2G(\rho_w) - 1)\rho_w - \int_{-\infty}^{\rho_w} g(\rho_i)\rho_i d\rho_i + \int_{\rho_w}^{\infty} g(\rho_i)\rho_i d\rho_i.$$

Therefore,

$$\frac{\partial L(\rho_w)}{\partial \rho_w} = 2G(\rho_w) - 1. \tag{3}$$

As is evident from equation (3), the voter welfare loss associated with election winner ideology is minimized when $G(\rho_w) = \frac{1}{2}$. That is, when the election winner ideology equals that of the median voter, $\rho_w = \rho_M = 0$. As the distance between ρ_w and $\rho_M = 0$ increases, the welfare loss associated with ideology increases.

Although the welfare cost of extremism is smallest when candidates share the ideology of the median voter, such candidates are not nominated in equilibrium. Only when $\alpha = 0$, i.e., when both campaigns are completely uninformative about candidate quality, do parties choose $\delta_R = \delta_L = 0$ (or equivalently $\rho_R = \rho_L = 0$). Whenever $\alpha > 0$, candidate ideology will diverge from the median voter's ideology, with this distance increasing as either campaign becomes more informative. Therefore, the policy divergence caused by informative campaigns imposes a cost on voters.

At the same time that an informative campaign causes divergence in candidate ideology, damaging voter welfare, it also results in voters being more informed about candidate quality and more likely to elect the higher-quality candidate, improving welfare. Because in equilibrium both parties choose equally extreme candidates, i.e., $\delta_R^* = \delta_L^*$, voters in equilibrium elect the candidate who has the higher expected quality following the realization of the campaign signals. The election winner is the candidate who's posterior quality distribution has the higher posterior mean.

Given quality-signal realizations s_L and s_R, the expected quality of the election winner is given by

$$q_w|s_L, s_R = max\{\frac{\mu\sigma_L^2 + s_L}{\sigma_L^2 + 1}, \ \frac{\mu\sigma_R^2 + s_R}{\sigma_R^2 + 1}\}.$$

We have already shown that before the signal is realized, the posterior mean of quality $\frac{\mu\sigma_i^2 + s_i}{\sigma_i^2 + 1}$ is

distributed according to $N(\mu, \frac{1}{1+\sigma_i^2})$. Therefore, the expected quality of the election winner is given by

$$Eq_w = E[max\{Q_L, Q_R\}],$$

where $Q_j \sim N(\mu, \frac{1}{1+\sigma_j^2})$. Using a standard formula, this expectation evaluates to

$$Eq_w = \mu + \frac{\sqrt{\frac{1}{1+\sigma_L^2} + \frac{1}{1+\sigma_R^2}}}{\sqrt{2\pi}} = \mu + \frac{\alpha}{\sqrt{2\pi}}.$$

The expected quality of the election winner is strictly increasing in overall campaign informativeness, α, and therefore also increasing in the informativeness of the individual campaigns.

Increases in campaign informativeness therefore have two confounding effects: the expected quality of the election winner increases, benefitting voters, and parties nominate candidates with more-extreme ideologies, hurting voters. To understand the interaction of these effects, we consider expected aggregate equilibrium welfare as a function of α:

$$EW(\alpha) = v(\mu + \frac{\alpha}{\sqrt{2\pi}}) - \frac{1}{2}(L(\delta^*(\alpha)) + L(-\delta^*(\alpha))).$$

Differentiating this expression gives the derivative of social welfare with respect to α:

$$\begin{aligned}\frac{\partial EW(\alpha)}{\partial \alpha} &= \frac{v}{\sqrt{2\pi}} - \frac{1}{2}(2G(\delta^*(\alpha)) - 1 - (2G(-\delta^*(\alpha)) - 1))\frac{d\delta^*}{d\alpha} \\ &= \frac{v}{\sqrt{2\pi}} - (G(\delta^*(\alpha)) - G(-\delta^*(\alpha)))\frac{v\sqrt{2\pi}}{4}.\end{aligned}$$

From this expression for the derivative we conclude that voter welfare is increasing in informativeness when

$$\frac{\partial EW(\alpha)}{\partial \alpha} > 0 \iff G(\delta^*(\alpha)) - G(-\delta^*(\alpha)) < \frac{2}{\pi}.$$

That is, the electorate benefits from an *increase* in campaign informativeness when a sufficiently large portion of the voter population have ideologies which are more-extreme than the equilibrium ideology of the candidates. Conversely, $\frac{\partial EW(\alpha)}{\partial \alpha} < 0$ and the electorate benefits from a *decrease* in campaign informativeness when a sufficiently large portion of the voter population has more-moderate ideologies than the nominated candidates.

This result is quite intuitive. While a small increase in campaign informativeness increases extremism, the increased extremism does not impose a welfare cost on a voter with ideological preference outside of the interval $(-\delta^*(\alpha), \delta^*(\alpha))$. While one candidate moves further from the voter's ideal ideology, the other candidate moves toward the voter's preferred ideology. Because each candidate is equally likely to win election in equilibrium, these effects offset. Thus voters with relatively extreme ideologies only benefit from increased campaign informativeness, as it allows them to select higher-quality candidates. However, voters with ideological preference inside $(-\delta^*(\alpha), \delta^*(\alpha))$ are "doubly" hurt by extremism, as the ideological position of each candidate moves

away from their preferred position. If the mass of voters in this interval is relatively high, then the welfare cost of extremism on moderate voters dominates the informational benefits for all voters.

Momentarily ignoring the restriction that $\alpha \leq \sqrt{2}$, it is easy to see that aggregate voter welfare is maximized for the value $\tilde{\alpha}$ that solves

$$G(\delta^*(\tilde{\alpha})) - G(-\delta^*(\tilde{\alpha})) = \frac{2}{\pi}.$$

When both campaigns are fully informative about candidate quality, then $\alpha = \sqrt{2}$, and no higher α is possible. Therefore, if $\tilde{\alpha} \geq \sqrt{2}$, the welfare maximizing α is a corner solution at $\alpha = \sqrt{2}$. When $\tilde{\alpha} < \sqrt{2}$, then voters are best off when campaigns are less than fully informative. This is the case when

$$\left.\frac{\partial EW(\alpha)}{\partial \alpha}\right|_{\alpha=\sqrt{2}} < 0 \iff$$

$$G(v\frac{\sqrt{\pi}}{2}) - G(-v\frac{\sqrt{\pi}}{2}) > \frac{2}{\pi}. \tag{4}$$

That is, if a sufficient portion of the voter population is more moderate than the candidates who are nominated when campaigns are fully informative, then voter welfare is maximized by less-than-fully informative campaigns.

Proposition 4.1 *(Information and voter welfare) When inequality (4) holds, aggregate expected voter welfare is maximized by some $\tilde{\alpha} \in (0, \sqrt{2})$, that is, when campaigns are less-than-fully informative about candidate quality. Otherwise, aggregate expected voter welfare is maximized when campaigns are fully informative.*

In addition to α, two other factors affect the value of $G(\delta^*(\alpha)) - G(-\delta^*(\alpha))$, and therefore determine the welfare impact of increased informativeness. The first is how "condensed" the distribution of voter ideology is around the ideology of the median voter; the second is how much voters care about quality relative to ideology, v. The more condensed the distribution of voter ideology is around the ideology of the median voter, the larger is $G(\delta^*(\alpha)) - G(-\delta^*(\alpha))$. If voter ideology is normally distributed, for example, then a more-condensed (i.e., lower-variance) distribution corresponds to a larger share of the population with more moderate ideology than the candidates. In this case, (as described above) candidate extremism imposes a welfare cost on a larger portion of the electorate; if enough voters bear this cost, overall welfare is hurt (despite the benefits). Second, (as previously described) the more voters care about politician quality relative to ideology (i.e., the higher is v), the less a candidate's probability of winning depends on his or her ideology. Parties respond by nominating candidates with more-extreme ideologies. This means that given any α, a larger v leads to a larger portion of the population that is less extreme than the candidates, i.e., a larger value for $G(\delta^*(\alpha)) - G(-\delta^*(\alpha))$.

These considerations are important for two reasons. First, they imply that if v is sufficiently large or the ideology distribution is sufficiently concentrated around the median, then voter welfare

is maximized when campaigns are less-than-fully informative. For lower v and more spread out ideology distributions, voters strictly benefit from more informative campaigns. Second, they imply that for any $\alpha > 0$, there exists sufficiently high values of v and sufficiently concentrated ideology distributions such that voters would be made better off by a decrease in campaign informativeness.

An interesting related result involves the relationship between the welfare maximizing level of campaign informativeness and v, the parameter representing how much voters care about politician qualifications.

Proposition 4.2 *If inequality (4) holds, then* $\frac{\partial \tilde{\alpha}}{\partial v} < 0$. *The welfare maximizing level of campaign informativeness is decreasing how much voters care about candidate quality.*

We provide a formal proof in the appendix.

The result is paradoxical. When voters care more about electing high-quality candidates, they are better off when the campaign reveals less about candidate quality. As the intensity of voter preferences for quality increases, the optimal level of campaign informativeness decreases, even though less informative campaigns make it less likely that voters elect the more-qualified candidate. This is because any increase in α has a larger impact on δ^* when v is high compared to when v is low. Higher v means candidate ideology is more sensitive to changes in campaign informativeness. As a result, the welfare-maximizing level of campaign informativeness decreases as v increases.

Finally, it is important to point out that $\tilde{\alpha}$ never equals 0. That is, completely uninformative campaigns are never optimal for voter welfare. Under certain conditions, however, voters are better off under a completely uninformative campaign (i.e., $\alpha = 0$) compared to campaigns that are very informative (i.e., α sufficiently large).

5 ALTERNATIVE ASSUMPTIONS

The above analysis relies on a stylized model which focuses on developing intuition for our main result and highlighting our contribution to the literature. As always, a variety of alternative assumptions may have been used. Here, we discuss three of the more-interesting alternatives in an effort to further develop intuition regarding which assumptions are responsible for our results.

5.1 NON-LINEAR COST OF IDEOLOGICAL DIVERGENCE

In the Appendix, we reconsider the analysis under the assumption that voter and party preferences are concave in differences in ideology; that is, the costs associated with the distance between their own ideology and the ideology of the election winner are convex. The analysis considers separately voter and party preferences, in order to isolate whether the linearity of either group's utility drives our results.

When party utility is concave in the difference between its own ideal and the ideology of the election winner, the qualitative results from the earlier analysis continue to hold: increased campaign informativeness results in ideology divergence, and this has the potential to decrease voter welfare (when the distribution of voters is sufficiently concentrated around the median).

When voter utility is concave in policy, increased campaign informativeness results in ideology divergence. However, this divergence has the potential to decrease voter welfare only if voter payoffs are not too concave. If we want to maintain the same concavity for the preferences of both voters and parties, then the same logic applies. We show that more informative campaigns lead to greater divergence in candidate ideology, and that this divergence can decrease overall voter welfare only if preferences are not too concave.

5.2 ASYMMETRIC EXPECTED QUALITY

Our analysis focuses on the case in which parties and their potential pool of candidates are *ex ante* undifferentiated: the initial expected quality of the candidate nominated by either party is identical. This is a natural assumption, and we see no reason that the distribution of candidate quality should differ by party. Under an alternative interpretation of our model, however, the parties are actually two competing, policy-motivated candidates on opposite sides of the median voter commit to their own policy platforms at the beginning of their campaigns. In this case, it is perfectly reasonable to assume that the two candidates have *ex ante* differences in expected quality.

In the Appendix, we show that the results extend in a natural way when the difference in expected candidate quality is not too pronounced. In equilibrium, the party whose candidate is expected to be higher quality capitalizes on his advantage by selecting a more-extreme ideology than in the symmetric equilibrium, while the initially disadvantaged party chooses a more-moderate ideology. When the difference in prior qualities is not too large, even the (moderate) disadvantaged party does not converge to the ideology of the median voter, and in equilibrium each party is equally likely to win election. Just as in the symmetric case, if the distribution of voter tastes is sufficiently concentrated about the median, then increasing the informativeness of campaign signals decreases aggregate voter welfare.

5.3 ENDOGENOUS CAMPAIGN INFORMATIVENESS

Until now, the analysis assumes σ_L and σ_R are exogenous. However, it is reasonable to think that the informativeness of the signals observed by voters can be influenced by campaign strategy. By giving interviews, participating in debates and town hall meetings, and spending money on informative advertising, candidates improve the accuracy of voter perceptions about their quality, without knowing exactly what these perceptions will be.[7]

In the Appendix, we incorporate the strategic choice of individual campaign informativeness σ_i into the previous framework. Otherwise, the players, preferences and timing of the previous game are unchanged. In the second stage, once candidates have been nominated and ideologies set, each candidate simultaneously chooses the informativeness σ_j of his or her campaign signal. These

[7] At the time that the campaign chooses the informativeness of the signal, the campaign does not know the signal realization, as the signal realization is determined by the candidate's performance in the debates or interviews and the inferences voters draw from the candidate's ads.

signals are simultaneously realized, and the election is held. We allow for an exogenous limit on campaign informativeness, which can be loosely interpreted as a campaign spending limit.

The sequentially rational choice of campaign informativeness is straightforward: whenever the extremism of the parties is different, $\delta_L \neq \delta_R$, the candidate with more-moderate ideology chooses a completely uninformative campaign, while the candidate with more-extreme ideology chooses the most-informative campaign possible. Intuitively, the more-moderate candidate has an advantage and has no reason to run the risk of generating an unfavorable quality signal. The more-extreme candidate is disadvantaged, and must generate a campaign signal that strongly suggests high quality in order to have a chance to win election. If both candidates choose the same level of ideological extremism, then, regardless of the choice of campaign informativeness, then both have the same probability of winning election. In a symmetric equilibrium any choices of informativeness can arise on the equilibrium path.[8]

We demonstrate that when campaign informativeness is endogenous, qualitatively similar results hold. Allowing more informative campaigns (relaxing limits to campaign spending or fundraising) increases extremism. Furthermore, this increase in extremism decreases voter welfare if the electorate is sufficiently concentrated around the median voter.

6 RELATIONSHIP TO THE LITERATURE

The theoretical result with the most similar flavor to ours is found in the industrial organization literature. Moscarini and Ottaviani (2001) show how consumer access to pre-purchase product information can reduce price competition between firms and can lead consumers to be worse off. It is not appropriate, however, to view our model as simply an application of theirs in a political economy setting. Although the intuition is similar in both settings, the underlying models are substantially different.[9] Less directly, our analysis is related to the literature on transparency in decision making environments (e.g., Holmstrom 1979, Prat 2005, Mattozzi and Merlo 2007).[10]

Our paper is also related to a number of literatures in political economy. Most notable is its relationship with papers on probabilistic voting, where uncertainty about voter preferences causes

[8]Interpret campaign expenditures as a proxy for activities that improve the informativeness of the signal observed by voters. Then our results suggest that if the difference in the *ex ante* expected quality of candidates is small, then observed campaign expenditures do not affect the probability of winning the election. This is reminiscent of a strand of empirical research that finds little evidence linking campaign expenditures and election probabilities: Levitt (1994), Palda and Palda (1998); see also Milyo (1999) and Moon (2006)).

[9]In Moscarini and Ottaviani (2001), consumers can purchase either one of two products, or purchase neither product. In our election game, voters do not have the option to elect neither candidate. This seemingly benign difference in the agent action space considerably changes the analysis. Furthermore, the models incorporate different state spaces, signal structures, and restrictions on asymmetries involving the informativeness of signals and ex ante differences in expected quality. Additionally, we extend our framework to allow candidates to choose how informative to make their campaigns.

[10]Holmstrom (1979) shows that in classical principal agent problems, the principal can never be made worse off by observing additional signals about the agent. More recently, a number of papers illustrate how greater access to information, i.e., greater transparency, may make decision makers worse off (e.g., Holmstrom 1999, Dewatripont, Jewitt and Tirole 1999, Gavazza and Lizzeri 2009, Prat 2005, Levy 2007). Mattozzi and Merlo (2007) shows how the ability to observe the performance of politicians once in office can make it more difficult to keep high-quality elected officials from moving from public service careers to the private sector, and can make voters worse off.

policy-motivated candidates to adopt divergent policies (e.g. Wittman 1983, Hannson and Stuart 1984, Calvert 1985, Roemer 1994, Duggan 2008, Bernhardt, Duggan and Squintani 2009). Aragones and Palfrey (2002) model probabilistic voting when one candidate has a known quality advantage. Herrera, Levine and Martinelli (2008) show that both increased political polarization and increased campaign spending may result from increases in the volatility of voter preferences, which they model as aggregate shocks to voter bias in favor of one party or the other. These models assume the uncertainty about voter preferences is exogenous. Our paper provides a micro foundation for such uncertainty, showing how it may be driven by information that emerges as candidates campaign for election. This allows us to ask how changes in campaign informativeness affect the uncertainty about voters and thereby change the incentives to adopt more extreme policies. These considerations are absent in other papers.

The analysis is also related to other models of campaigns in which candidates are defined by both their policy choice and their valence. In Groseclose (2001) and Aragones and Palfrey (2002), candidates announce policy knowing that one candidate has a valence advantage. Other papers consider the choice of both policy and valence. Ashworth and de Mesquita (2009) and Carrillo and Castanheira (2008) assume that candidates commit to a policy position before choosing how much to invest in developing valence.[11] When candidates strategically invest in valence, Serra (2010) shows that candidates will be high-valence or policy will be moderate, not both. Campaign spending in Herrera, Levine and Martinelli (2008) and Meirowitz (2008) may also be interpreted as candidate investment in valence after committing to policy.[12] Rather than endogenize candidate valence, we take valence as fixed, but unknown. Our framework tells a story about the resolution of uncertainty concerning candidate quality, and how this expected resolution of uncertainty drives policy divergence in equilibrium. This is in contrast to the majority of the literature, where campaigns increase, rather than reveal information about, valence.

Our results show how information revealed during campaigns may hurt voters. A variety of other papers show how other aspects of campaigns may also hurt voters. These papers rely on arguments driven by factors such as interest groups, fundraising, or endorsements, which are not present in our analysis. For example, some papers consider the tradeoff between the informational benefits of political campaigns and the welfare costs of politicians needing to fundraise in order

[11] The choice of policy position affects the incentives for subsequent valence acquisition. Ashworth and de Mesquita (2009) show that candidates may choose divergent policy positions in order to soften valence competition in the second period. Eyster and Kittsteiner (2007) consider a similar tradeoff. Carrillo and Castanheira (2008) shows how candidates may choose policies away from the median voter's ideal in order to commit themselves to developing higher valence in the second period.

[12] Bernhardt, Camara and Squintani (2011) present a model of repeated elections, where voters have information about incumbent fixed valence and endogenous policy choices, but only know the party of challengers. There, higher-valence senior politicians are more likely to choose extreme policies. In another dynamic election setting, Camara (2008) considers the interaction between politician skill, policy choice and political advantage. He shows how even competent politician are unlikely to choose policy that decreases their political advantage. Sahuguet and Persico (2006) too show that valence differences cause policy divergence, but assume that candidates can engage in campaign spending to increase their valence. In equilibrium, campaign spending can reduce the valence gap between the candidates leading to more moderate policy. In this case, limits to campaign spending may increase policy divergence by reducing the ability of candidates to use spending to overcome initial valence differences.

to run their campaign. Coate (2004*a*,*b*) considers this tradeoff when political contributions fund directly-informative advertising, and Prat (2002*a*,*b*) considers the tradeoff when campaign spending is indirectly informative about candidate quality (since voters make inferences about candidate quality through their ability to fundraise). In Chakraborty and Ghosh (2011), candidates may pander to the media in order to gain endorsements.[13] In these models, political candidates pander to special interest groups in order to attract the contributions or endorsements which are needed to convey their quality (i.e., valence) to voters during a campaign. The presence of special interest groups, fundraising, and endorsements in these models lead to policy divergence, and can decrease voter welfare. Our analysis demonstrates that both of these conclusions are not necessarily driven by pandering or fundraising. While past models implicitly assume that accurate and neutral information revealed during a campaign (in the absence of special interest groups) strictly benefits voters, we illustrate that such information revelation alone can lead to policy divergence and lower voter welfare.

7 DISCUSSION

First, we show that policy divergence between candidates increases as campaigns become more informative about candidate quality. More-informative campaigns lead to elected officials being both higher expected quality and more extreme. Second, we show that the costs of policy divergence may be sufficiently large to offset the benefits of a more-informed electorate. Unbiased, undistorted information revealed during campaigns can hurt voters.

In recent discussion in the popular press, experts consider whether presidential debates are beneficial for voters.

> The debates have probably diminished voters' chances of choosing an effective president.
> – H.W. Brands, presidential biographer

> Presidential debates, both in primaries and in the general elections, have proved fairly reliable indicators of how presidents go on to perform the duties of their office.
> – Jon Meacham, presidential biographer[14]

Some argue that debates decrease voter ability to choose an effective president, an argument based on the idea that debates reward characteristics, like television theatrics or a willingness to pander to popular opinion, that may be detrimental in a president. Others argue that the debates are beneficial because they provide insight into how candidates perform in unscripted environments. Our analysis shows how debates may simultaneously provide valuable information to voters, and lead to lower voter wellbeing, but for reasons that have not previously been recognized. Our

[13] Prat (2008) provides an overview of this literature, including related papers by Ashworth (2006), Gerber (1998), and Potters, Sloof and van Winden (1997). Alesina and Holden (2008) consider a setting in which candidates may choose to be strategically ambiguous in their announcement of policy, as they attempt to appeal to both interest groups and voters.

[14] Both quotes come from the authors' columns in the NYTimes.com October 28, 2011 *Room for Debate* feature.

results suggest that debates can hurt voters precisely because they provide valuable information, which incentivizes candidates to run on less-moderate platforms. Similar conclusions may be made regarding increases in media coverage. Where others argue that media bias may distort election outcomes and hurt voters, our results suggest that even increases in unbiased media coverage may hurt voters.

Finally, our results have implications regarding campaign finance reform, including contribution limits, spending limits, and replacing private contributions with public funding. One contribution to this debate is to highlight another potential benefit of campaign finance reform policies that has not previously been recognized. Specifically, any campaign finance reform that reduces the amount of informative campaigning (e.g., informative advertising) may lead to less-informed voters, but also more-moderate policies and improved voter wellbeing. This is true even we ignore other potential detrimental effects that arise when candidates engage in fundraising (e.g., Prat 2002*a*,*b*, Coate 2004*a*,*b*). Our results suggest that campaign contribution or spending limits may benefit voters if they result in less spending on informative campaigning. A second contribution to this debate is to show that replacing private contributions with a system of public campaign spending does not guarantee that candidates adopt policies in line with voter preferences. We show that eliminating private funding in no way guarantees that candidates act to maximize constituent welfare. If campaigns reveal information about candidate quality, then even in the absence of special interest groups and fundraising, candidate ideology diverges from the median voter.

The results also provide insight into policy debate. Consider two parties with different preferences over fiscal policy, who each make an alternative budget proposal. The "ideology" reflected in a budget proposal—for example the total size of government proposed—may be easily observed. Nonetheless, details concerning the "quality" of a budget—the merits of the particular allocation of funds—may only be learned by debating, analyzing, and scrutinizing the budgets after they are proposed. Similarly, political parties may propose competing reforms on education, health care, tax policy, or military operations. Although the ideological stance inherent in these reform proposals may be obvious to the legislators, the overall social benefits of the policy reforms may only be revealed through debate or legislative hearings. In these settings, our analysis suggests that legislative hearings and extensive debate about the merits of alternative policies could have unintended adverse consequences as they lead to more-extreme proposals. We do not suggest that policy makers should cast votes without first becoming informed; only that policy makers and the electorate should recognize this tendency for extensive debate to lead to the proposal of more-extreme policies.

The analysis suggests that any aspect of a campaign that leads to better informed voters may also lead to more extreme policies. Seemingly beneficial changes in the number or format of debates, media coverage, and campaign finance laws may lead to more extreme policy and may have unintended welfare consequences.

8 APPENDIX

8.1 PROBABILITY OF WINNING ELECTION GIVEN POLICY CHOICES

Candidate L wins the election if following the campaign, $E[q_L|s_L] - E[q_R|s_R] > (\delta_L - \delta_R)/v$. Here, we determine the probability that this condition holds, given the first period choices of δ_j.

First consider $E[q_j|s_j]$. Given that $q_j \sim N(\mu, 1)$ and $S_j|q_j \sim N(q_j, \sigma_j^2)$, the posterior belief regarding q_j given a particular signal realization s_j is as follows:

$$q_j|S_j = s_j \sim N\left(\frac{s_j + \mu\sigma_j^2}{1+\sigma_j^2}, \frac{\sigma_j^2}{1+\sigma_j^2}\right).$$

Therefore, expected candidate quality given signal realization s_i is just the mean of this distribution.

$$E[q_j|s_j] = \frac{s_j + \mu\sigma_j^2}{1+\sigma_j^2},$$

and $E[q_L|s_L] - E[q_R|s_R] > (\delta_L - \delta_R)/v$ may be rewritten

$$\frac{s_L + \mu\sigma_L^2}{1+\sigma_L^2} - \frac{s_R + \mu\sigma_R^2}{1+\sigma_R^2} > \frac{\delta_L - \delta_R}{v}. \tag{5}$$

Given the information structure, it is simple to calculate the unconditional distribution of the campaign signal S_j.

$$q_j \sim N(\mu, 1) \text{ and } S_j|q_j \sim N(q_j, \sigma_j^2) \Rightarrow S_j \sim N(\mu, 1+\sigma_j^2)$$

We use this to find the distribution of the posterior mean of candidate quality:

$$S_j \sim N(\mu, 1+\sigma_j^2) \Rightarrow \frac{S_j + \mu\sigma_j^2}{1+\sigma_j^2} \sim N(\mu, \frac{1}{1+\sigma_j^2})$$

From here we find the distribution of the left hand side of (5):

$$\frac{s_L + \mu\sigma_L^2}{1+\sigma_L^2} - \frac{s_R + \mu\sigma_R^2}{1+\sigma_R^2} \sim N(0, \alpha^2)$$

where

$$\alpha \equiv \sqrt{\frac{1}{1+\sigma_L^2} + \frac{1}{1+\sigma_R^2}}.$$

Therefore, if F is the cdf of the $N(0,1)$ distribution, then $E[q_L|s_L] - E[q_R|s_R] > (\delta_L - \delta_R)/v$ is satisfied with probability $F((\delta_L - \delta_R)/(v\alpha))$.

8.2 ASSUMING NON-LINEAR PREFERENCES

This section determines if and how the results depend on our assumption that voters and parties have linear preferences, as opposed to preferences that are concave in the difference between one's ideal policy and the policy implemented by the election winner. To do this, we incorporate concave preferences into the analysis. We consider separately concave voter and concave party preferences, in order to isolate the impact of voter versus party concavity on our results.

The following analysis assumes that voter ideology is distributed around the median voter according to $N(0, r^2)$. The variance r represents how concentrated the population is around the median, with large r denoting a wide range of popular opinion, and $r \to 0$ representing a special case where the entire voter population shares the same ideology.

Voter concavity

For voters, we assume power utility over policy outcomes, where

$$u_i = vq_w - (|\rho_w - \rho_i|)^\beta.$$

The parameter $\beta \geq 1$ represents how concave voter preferences are with respect to policy. The body of the paper considers $\beta = 1$; here we do not constrain the parameter to either value. To win election, a candidate must still be preferred by the median voter, who has $\rho_M = 0$. Therefore, candidate L wins election if

$$vE(q_L|s_L) - \delta_L^\beta > vE(q_R|s_R) - \delta_R^\beta \iff$$

$$E(q_L|s_L) - E(q_R|s_R) > \frac{\delta_L^\beta - \delta_R^\beta}{v}.$$

Given the distribution of q_j and s_j, we can rewrite the condition

$$\frac{s_L + \mu\sigma_L^2}{1+\sigma_L^2} - \frac{s_R + \mu\sigma_R^2}{1+\sigma_R^2} > \frac{\delta_L^\beta - \delta_R^\beta}{v}, \tag{6}$$

Where the left hand side is distributed according to $N(0, \alpha^2)$, where $\alpha^2 = \frac{1}{1+\sigma_L^2} + \frac{1}{1+\sigma_R^2}$ is our measure of campaign informativeness. The only difference between equations (6) and (5) is that the right hand side now has general β rather than $\beta = 1$. Candidate L wins the election with probability $1 - F(\frac{\delta_L^\beta - \delta_R^\beta}{v})$, and candidate R wins with probability $F(\frac{\delta_L^\beta - \delta_R^\beta}{v})$. Solving for the equilibrium value of $\delta_L^* = \delta_R^* = \delta^*$ using the same procedure as in the body of the paper gives

$$\delta^* = \left(\frac{v\sqrt{2\pi}}{4\beta}\alpha\right)^{\frac{1}{\beta}}.$$

Notice that the ideology of both candidates becomes more extreme as either campaign becomes more informative (increasing α).

To determine the impact of campaign informativeness on voter welfare, we rewrite the ideology loss function L from the earlier analysis:

$$L(\rho_w) = \int_{-\infty}^{\infty} g(\rho)(|\rho_w - \rho|)^{\beta} d\rho.$$

The loss is minimized when the ideology of the election winner equals the ideology of the median voter, $\rho_w = \rho_M = 0$, and is strictly increasing as ρ_w diverges from 0. Writing the loss L as a function of δ^* gives

$$L(\delta^*) = \int_{-\infty}^{\delta^*} g(\rho)(\delta^* - \rho)^{\beta} d\rho + \int_{\delta^*}^{\infty} g(\rho)(\rho - \delta^*)^{\beta} d\rho.$$

Expected voter welfare equals

$$EW = v\mu + \frac{v}{\sqrt{2\pi}}\alpha - L(\delta^*).$$

The impact that campaign informativeness has on voter welfare depends on the concavity of the voter payoff function.

$$\frac{\partial EW}{\partial \alpha} = \frac{v}{\sqrt{2\pi}} - \left(\int_{-\infty}^{\delta^*} g(\rho)(\delta^* - \rho)^{\beta-1} d\rho - \int_{\delta^*}^{\infty} g(\rho)(\rho - \delta^*)^{\beta-1} d\rho \right) \beta \frac{\partial \delta^*}{\partial \alpha}.$$

Plugging in to $\frac{\partial \delta^*}{\partial \alpha}$, this becomes

$$\frac{\partial EW}{\partial \alpha} = \frac{v}{\sqrt{2\pi}} - \left(\int_{-\infty}^{\delta^*} g(\rho)(\delta^* - \rho)^{\beta-1} d\rho - \int_{\delta^*}^{\infty} g(\rho)(\rho - \delta^*)^{\beta-1} d\rho \right) \left(\frac{v\sqrt{2\pi}}{4\beta} \right)^{\frac{1}{\beta}} \alpha^{\frac{1}{\beta}-1}.$$

When voter payoffs are linear, as they are in the body paper, there always exists sufficiently large v or sufficiently concentrated distribution of voters (as indicated by our parameter r) such that $\frac{\partial EW}{\partial \alpha} < 0$; that is, such that increasing α decreases voter welfare. Assuming quadratic voter policy utility (i.e., assuming $\beta = 2$) is already sufficiently concave that increasing campaign informativeness strictly increases voter welfare. When $\beta = 2$, there does not exist parameters such that $\frac{\partial EW}{\partial \alpha} < 0$, and as such the voters always benefit from an increase in campaign informativeness. To

see this,

$$\begin{aligned}
\tfrac{\partial EW}{\partial \alpha}\big|_{\beta=2} &= \tfrac{v}{\sqrt{2\pi}} - \left(\int_{-\infty}^{\delta^*} g(\rho)(\delta^* - \rho)d\rho - \int_{\delta^*}^{\infty} g(\rho)(\rho - \delta^*)d\rho\right)\left(\tfrac{v\sqrt{2\pi}}{8}\right)^{\frac{1}{2}}\alpha^{-\frac{1}{2}} \\
&= \tfrac{v}{\sqrt{2\pi}} - \left(\delta^* - \int_{-\infty}^{\infty} g(\rho)\rho d\rho\right)\left(\tfrac{v\sqrt{2\pi}}{8}\right)^{\frac{1}{2}}\alpha^{-\frac{1}{2}} \\
&= \tfrac{v}{\sqrt{2\pi}} - \delta^*\left(\tfrac{v\sqrt{2\pi}}{8}\right)^{\frac{1}{2}}\alpha^{-\frac{1}{2}} \\
&= \tfrac{v}{\sqrt{2\pi}} - \left(\tfrac{v\sqrt{2\pi}}{8}\alpha\right)^{\frac{1}{2}}\left(\tfrac{v\sqrt{2\pi}}{8}\right)^{\frac{1}{2}}\alpha^{-\frac{1}{2}} \\
&= \tfrac{v}{\sqrt{2\pi}} - \tfrac{v\sqrt{2\pi}}{8},
\end{aligned}$$

an expression which is always positive given $v > 0$.

This implies that there exists a value of β between 1 and 2 such that with lower β there exists parameters under which more informative campaigns decrease voter welfare.

We can explicitly calculate β for the limit case where $r \to 0$, and voters are extremely concentrated. As $r \to 0$, EW approaches the welfare of the median voter,

$$\begin{aligned}
Ew_M &= v\mu + \tfrac{v}{\sqrt{2\pi}}\alpha - \delta^{*\beta} \\
&= v\mu + \tfrac{v}{\sqrt{2\pi}}\alpha - \tfrac{v\sqrt{2\pi}}{4\beta}\alpha.
\end{aligned}$$

Therefore,

$$\frac{\partial Ew_M}{\partial \alpha} = \frac{v}{\sqrt{2\pi}} - \frac{v\sqrt{2\pi}}{4\beta}.$$

Let $\bar{\beta}$ define the value of β for which $\frac{\partial Ew_M}{\partial \alpha} = 0$. That is, $\bar{\beta} = \frac{\pi}{2}$. Note that $EW < Ew_M$, and $\lim_{r\to 0} EW = Ew_M$. Therefore, for any $\beta < \bar{\beta}$ and for any v, there exists a value r such that vote welfare is decreasing in campaign informativeness.

Party concavity

Assuming power utility on behalf of the parties does not allow for a tractable analysis. We therefore introduce concavity of party preferences by assuming that they are quadratic in the difference between their ideology and the ideology of the winning candidate. Under quadratic party preferences, and linear voter preferences, the qualitative results from the body of the paper continue to hold: there exists parameter cases under which increased campaign informativeness decreases voter welfare.

When parties have concave preferences over policy outcomes, the analysis from the body of the paper is unchanged up until we get to the party expected payoff functions given δ_L and δ_R. For any δ_L and δ_R between 0 and δ^P,

$$Eu_L^P(\delta_L, \delta_R) = -F\left(\frac{\delta_L - \delta_R}{v\alpha}\right)(\delta^P + \delta_R)^2 + \left(1 - F\left(\frac{\delta_L - \delta_R}{v\alpha}\right)\right)(\delta^P - \delta_L)^2$$

$$Eu_R^P(\delta_L, \delta_R) = F\left(\frac{\delta_L - \delta_R}{v\alpha}\right)(\delta^P - \delta_R)^2 + \left(1 - F\left(\frac{\delta_L - \delta_R}{v\alpha}\right)\right)(\delta^P + \delta_L)^2$$

The first order conditions of these functions with respect to the party's own candidate ideology are

$$\frac{\partial Eu_L^P}{\partial \delta_L} = f\left(\frac{\delta_L - \delta_R}{v\alpha}\right)\frac{1}{v\alpha}\left((\delta^P - \delta_L)^2 - (\delta^P + \delta_R)^2\right) + \left(1 - F\left(\frac{\delta_L - \delta_R}{v\alpha}\right)\right)2(\delta^P - \delta_L) = 0.$$

$$\frac{\partial Eu_R^P}{\partial \delta_R} = f\left(\frac{\delta_L - \delta_R}{v\alpha}\right)\frac{1}{v\alpha}\left((\delta^P - \delta_R)^2 - (\delta^P + \delta_L)^2\right) + \left(1 - F\left(\frac{\delta_L - \delta_R}{v\alpha}\right)\right)2(\delta^P - \delta_R) = 0.$$

Solving these equations for δ_L and δ_R give the equilibrium solution

$$\delta^* = \delta_L^* = \delta_R^* = \frac{\alpha v \delta^P \sqrt{2\pi}}{4\delta^P + \alpha v\sqrt{2\pi}}.$$

The ideology of both candidates is strictly increasing in α. That is, both candidates become more extreme as either campaign becomes more informative.

Voter welfare is decreasing in campaign informativeness if

$$\begin{array}{rcl} \frac{\partial EW}{\partial \alpha} = & \frac{v}{\sqrt{2\pi}} - \left(\int_{-\infty}^{\delta^*} g(\rho)d\rho - \int_{\delta^*}^{\infty} g(\rho)d\rho\right)\frac{\partial \delta^*}{\partial \alpha} < 0 \\ \iff & \frac{v}{\sqrt{2\pi}} < (2G(\delta^*) - 1)\frac{\partial \delta^*}{\partial \alpha} \\ \iff & \frac{v}{\sqrt{2\pi}} < (2G(\delta^*) - 1)\frac{4{\delta^P}^2 v\sqrt{2\pi}}{(4\delta^P + \alpha v\sqrt{2\pi})^2} \\ \iff & \frac{(4\delta^P + \alpha v\sqrt{2\pi})^2}{8{\delta^P}^2\pi} < 2G(\delta^*) - 1. \end{array}$$

In the limit, as voters become concentrated (i.e., $r \to 1$) and voters , $G(\delta^*) \to 1$ and this condition becomes

$$\frac{(4\delta^P + \alpha v\sqrt{2\pi})^2}{8\pi{\delta^P}^2\sqrt{2\pi}} < 1, \tag{7}$$

which holds for low enough v, since $(4\delta^P)^2 < 8\pi{\delta^P}^2\sqrt{2\pi} \iff 2 < \pi\sqrt{2\pi}$. Similarly, for any $v > 0$ such that inequality (7) holds, there exists a range of r small enough such that $\frac{\partial EW}{\partial \alpha} < 0$.

From this, we conclude that with quadratic party preferences, there exists a range of values for v and r such that voter welfare is decreasing in campaign informativeness.

Preference concavity for both voters and parties

Assuming power utility for both voters and parties, means any player with ideology ρ_i (regardless of whether they are a party or a voter) experiences policy disutility $-(|\rho_w - \rho_i|)^\beta$ from the election of a candidate with ideology ρ_w.

As we have already claimed, such an assumption over party preferences does not allow for a closed form derivation of δ^*, making the analysis of voter welfare intractable. Despite this, the above analysis allows us to conclude that there exists a range of $\beta \geq 1$ such that (when both voters and parties have power utility) voter welfare is decreasing in campaign informativeness as long as the distribution of voters is sufficiently concentrated around the median (i.e., as long as r is sufficiently small). This follows from the fact that result holds at $\beta = 1$ (as seen in the body of the

paper), that the result holds for a range of $\beta \geq 1$ when voter utility is concave and party utility is linear, that the result holds for $\beta = 2$ when party utility is concave and voter utility is linear, and the continuity of the problem.

8.3 EX ANTE ASYMMETRY

This section shows that the qualitative results from Sections 4 and 5 continue to hold when the party candidates differ in their ex ante expected quality. The following analysis assumes that voter ideology is distributed around the median voter according to $N(0, r^2)$. The variance r represents how concentrated the population is around the median, with large r denoting a wide range of popular opinion, and $r \to 0$ representing a special case where the entire voter population shares the same ideology.

Suppose that the prior belief about the quality of the party L candidate is $q_L \sim N(\mu_L, 1)$, while the prior belief about quality for party R candidate is $q_R \sim N(\mu_R, 1)$. The analysis is unchanged, up to the calculation of the distribution of the terms on the left hand side of equation (5). In the text,

$$\frac{s_L + \mu\sigma_L^2}{1+\sigma_L^2} - \frac{s_R + \mu\sigma_R^2}{1+\sigma_R^2} \sim N(0, \alpha^2)$$

When the prior means are different, the distribution of this term is different:

$$\frac{s_L + \mu_L\sigma_L^2}{1+\sigma_L^2} - \frac{s_R + \mu_R\sigma_R^2}{1+\sigma_R^2} \sim N(m, \alpha^2)$$

where $m = \mu_L - \mu_R$. Following the analysis in the text, we find that t he expected payoff to the parties given their choices of δ are

$$\begin{aligned} Eu_L^P(\delta_L, \delta_R) &= -\delta_L^P + \left(1 - F\left(\tfrac{\delta_L - \delta_R - m}{v\alpha}\right)\right)(\delta_L + \delta_R) - \delta_R \\ &= -\delta_L^P + F\left(\tfrac{\delta_R - \delta_L + m}{v\alpha}\right)(\delta_L + \delta_R) - \delta_R \end{aligned}$$

$$\begin{aligned} Eu_R^P(\delta_L, \delta_R) &= \delta_R^P + F\left(\tfrac{\delta_L - \delta_R - m}{v\alpha}\right)\delta_R - \left(1 - F\left(\tfrac{\delta_L - \delta_R}{v\alpha}\right)\right)\delta_L \\ &= \delta_R^P + F\left(\tfrac{\delta_L - \delta_R - m}{v\alpha}\right)(\delta_L + \delta_R) - \delta_L \end{aligned}$$

Thus the first order conditions characterizing best-responses are

$$F(\frac{\delta_R - \delta_L + m}{\alpha v}) - (\delta_R + \delta_L) f(\frac{\delta_R - \delta_L + m}{\alpha v})\frac{1}{\alpha v} = 0$$

$$F(\frac{\delta_L - \delta_R - m}{\alpha v}) - (\delta_R + \delta_L) f(\frac{\delta_L - \delta_R - m}{\alpha v})\frac{1}{\alpha v} = 0.$$

Because the standard normal density is symmetric around zero,

$$(\delta_R + \delta_L) f(\frac{\delta_L - \delta_R - m}{\alpha v})\frac{1}{\alpha v} = (\delta_R + \delta_L) f(\frac{\delta_R - \delta_L + m}{\alpha v})\frac{1}{\alpha v}.$$

Thus, a Nash equilibrium with an interior optimum for each party (rather than a corner solution) requires:

$$F(\frac{\delta_L - \delta_R - m}{\alpha v}) = F(-\frac{\delta_L - \delta_R - m}{\alpha v}).$$

For the standard normal cdf, $F(x) = F(-x) \iff x = 0$. Thus it must be that at interior optimum,

$$\frac{\delta_L - \delta_R - m}{\alpha v} = 0 \iff \delta_L = \delta_R + m.$$

Observe that these equations also imply that at a Nash equilibrium with interior optimality, both parties are equally likely to win election. Combining this equation with either first order condition for party R gives the following:

$$\frac{1}{2} - \frac{m + 2\delta_R}{v\alpha\sqrt{2\pi}} = 0.$$

This equation immediately implies that

$$\delta_R = \frac{v\sqrt{2\pi}}{4}\alpha - \frac{m}{2} \text{ and } \delta_L = \frac{v\sqrt{2\pi}}{4}\alpha + \frac{m}{2}.$$

Compared with the symmetric case, the party with the greater expected quality chooses a more-extreme position, while the other party adopts a more-moderate position. As long as the difference in the means, m, is less than $\frac{v\sqrt{2\pi}}{2}\alpha$ both solutions are interior and constitute an equilibrium. If m is greater than this threshold, then the disadvantaged party perfectly moderates, running a candidate with the median voter's ideology. For subsequent welfare analysis, we focus on the case of small differences in *ex ante* means.

Unlike the case considered in the body, because the party positions are asymmetric, the election winner is not the candidate who generates the higher realized quality. Rather, the election winner is the candidate who generates a higher expected surplus for the median voter. Let Q_j represent the ex ante distribution of the posterior mean of quality:

$$Q_j = \frac{s_j + \mu_j\sigma_i^2}{1 + \sigma_j^2}$$

The expected surplus offered to the median voter at the interim stage is therefore

$$U_j = vQ_j - \delta_j$$

As discussed in text, $Q_j \sim N(\mu_j, \frac{1}{1+\sigma_j^2})$, and hence, $U_j \sim N(v\mu_j - \delta_j, \frac{v^2}{1+\sigma_j^2})$. As $r \to 0$ the expected utility of the electorate approaches the expected utility of the median voter, which is simply $E[max\{U_L, U_R\}]$. According to a standard formula, the expected value of the maximum order statistic drawn from two independent normals, $N(\nu_j, \theta_j^2)$ is given by

$$\nu_2 + (\nu_1 - \nu_2)F(\frac{\nu_1 - \nu_2}{\sqrt{\theta_1^2 + \theta_2^2}}) + \sqrt{\theta_1^2 + \theta_2^2}f(\frac{\nu_1 - \nu_2}{\sqrt{\theta_1^2 + \theta_2^2}})$$

In this formula the two critical quantities are the difference in means, and the sum of the variances. In our case, these evaluate as follows:

$$\nu_1 - \nu_2 = v\mu_L - \delta_L - v\mu_R + \delta_R = m(v-1)$$

$$\sqrt{\theta_1^2 + \theta_2^2} = \sqrt{\frac{v^2}{1+\sigma_L^2} + \frac{v^2}{1+\sigma_R^2}} = v\alpha.$$

Thus, this formula evaluates to

$$v\mu_R - \delta_R + m(v-1)F(\frac{m(v-1)}{v\alpha}) + v\alpha f(\frac{m(v-1)}{v\alpha}).$$

The derivative of this expression with respect to α is given by

$$-\frac{v\sqrt{2\pi}}{4} + \frac{m^2(v-1)^2}{v\alpha^2} f(\frac{m(v-1)}{v\alpha}) + vf(\frac{m(v-1)}{v\alpha}) - \frac{m^2(v-1)^2}{v\alpha^2} f(\frac{m(v-1)}{v\alpha}),$$

which becomes just

$$-\frac{v\sqrt{2\pi}}{4} + vf(\frac{m(v-1)}{v\alpha}).$$

Because the largest value for the Normal pdf is $\frac{1}{\sqrt{2\pi}}$ and $\frac{1}{\sqrt{2\pi}} - \frac{\sqrt{2\pi}}{4} < 0$, our result that voter welfare is decreasing in campaign informativeness when voters are sufficiently concentrated around the mean continues to hold. Our main result is robust to ex ante differentiation among candidates, provided this differentiation is not too large.

8.4 ENDOGENOUS CAMPAIGN INFORMATIVENESS

We incorporate the strategic choice of individual campaign informativeness σ_i into the previous framework. Otherwise, the players, preferences and timing of the previous game are unchanged. In the second stage, once candidates have been nominated and ideologies set, each candidate simultaneously chooses the σ_j associated with its campaign. We allow for an exogenous limit on the informativeness of campaigns, in that each σ_j cannot be less than some lower bound $\bar{\sigma} \geq 0$. That is, the candidates cannot make their signals more informative than the limit. The limit can be interpreted as a maximum campaign expenditure.

We consider Subgame Perfect equilibria of the following game:

1. Each party simultaneously nominates a candidate. That is, they choose the ideology ρ_j of their candidate.

2. Candidates simultaneously choose how informative to make their campaigns. Each candidate $j \in \{L, R\}$ selects the standard deviation of the signal observed by voters about his true quality, $\sigma_j \geq \bar{\sigma}$.

3. Voters observe the signals about the quality of the candidates, then cast ballots for their

preferred candidate. The candidate who receives the majority of votes wins.

Subject to the constraint that $\sigma_j \geq \bar{\sigma}$, each candidate chooses their σ_j to maximize the probability they win election. This is consistent with each candidate caring about either (or both) holding office or the ideology of the election winner. Because of this, the model is unchanged if we assume that parties choose the σ_j of their candidates.[15]

Equilibrium behavior

All voters cast ballots for the candidate that provide them with the highest expected payoff. Therefore, (as in the previous section) the median voter casting the deciding vote will elect candidate L if inequality (5) holds. Anticipating voters' responses, the candidates simultaneously choose σ_L and σ_R to maximize their expected payoffs. Because the parties choose candidate ideology in the first stage, in the second stage maximizing expected payoff is equivalent to choose the campaign strategy σ_j that maximizes the probability of winning the election. To fully characterize candidate strategy, we must determine the choice of σ_L and σ_R for any combination of ρ_L and ρ_R selected in the first period.

Once ideology is set, candidate j chooses σ_j to maximize the probability of winning election: $F\left(\frac{\delta_k - \delta_j}{v\alpha}\right)$, where α (as previously defined) is a function of both σ_L and σ_R. The derivative of this probability with respect to σ_j is

$$\frac{\partial}{\partial \sigma_j} F\left(\frac{\delta_k - \delta_j}{v\alpha}\right) = -f\left(\frac{\delta_k - \delta_j}{v\alpha}\right)\frac{\delta_k - \delta_j}{v\alpha^2}\frac{\partial \alpha}{\partial \sigma_j}$$

where

$$\frac{\partial \alpha}{\partial \sigma_j} = \frac{1}{2\alpha}\frac{-2\sigma_j}{(1+\sigma_j^2)^2} < 0.$$

Combining the above, it is simple to see that if $\delta_k > \delta_j$, then candidate j's payoff is strictly increasing in σ_j, but if $\delta_k < \delta_j$ then candidate j payoff is strictly decreasing in σ_j. Thus, if candidate j is more moderate than candidate k, then candidate j prefers the least informative campaign possible (associated with largest value of σ_j), but if candidate j is more extreme than candidate k then j prefers the most informative campaign possible (smallest value of σ_j). Also notice that if $\delta_k = \delta_j$ then the choice of campaign accuracy does not alter the election outcome, and therefore any combination (σ_j, σ_k) is consistent with sequential rationality.

$$\begin{aligned}
&\delta_k > \delta_j \rightarrow \sigma_j = \infty \text{ and } \sigma_k = \bar{\sigma} \\
&\delta_k = \delta_j \rightarrow \text{ any feasible } \sigma_k \text{ and } \sigma_j \text{ are sequentially rational}
\end{aligned}$$

Because any $\sigma_L, \sigma_R \geq \bar{\sigma}$ are sequentially rational when $\delta_L = \delta_R$, in equilibrium the measure of campaign informativeness, α, may take on any value between $\alpha|_{\sigma_L=\sigma_R\rightarrow\infty} = 0$ and $\alpha|_{\sigma_j=0,\sigma_k\rightarrow\infty} =$

[15] What we do not formally consider is the realistic possibility that candidates also care about the quality of the elected politician. Allowing such preferences will not affect the qualitative results if the candidates (or the parties, for that matter) care enough about ideology and office relative to winner quality.

$\frac{2}{1+\bar{\sigma}^2}$. The more-restrictive the limit $\bar{\sigma}$, the lower the maximum campaign informativeness that may be observed in equilibrium. When $\delta_L \neq \delta_R$, the measure of campaign informativeness, α simplifies to

$$\alpha|_{\sigma_j=\bar{\sigma},\sigma_k=\infty} = \sqrt{\frac{1}{1+\bar{\sigma}^2}} \equiv \bar{\alpha}.$$

We use the variable $\bar{\alpha}$ to define this value of α that results from the sequentially-rational campaign strategies in any sub-game given $\delta_L \neq \delta_R$.

We derive an equilibrium in which parties choose candidates with symmetric ideology, $\delta_L = \delta_R = \delta^*$. No party can have an incentive to deviate from $\delta_j = \delta^*$ in the first stage of the game.

If party i anticipates that $\delta_j = \delta^*$ in period one, and chooses $\delta_i = \delta^*$, it expects a payoff 0. If it deviates by choosing $\delta_i \neq \delta^*$, then party i anticipates that in the campaign stage $\alpha = \bar{\alpha}$. Therefore, the expected payoff of party i from choosing $\delta_j \neq \delta^*$ is

$$Eu_j^P(\delta_j, \delta^*) = \rho_j^P + F\left(\frac{\delta^* - \delta_j}{\bar{\alpha}v}\right)(\delta_j + \delta^*) - \delta^*, \tag{8}$$

where $\rho_R^P = \delta_R$ and $\rho_L^P = -\delta_L$. In order for no deviation to exist, the maximum value of this function must be equal to 0. However, notice that substituting $\delta_i = \delta^*$ into equation gives value 0. Thus, if $\delta_i = \delta^*$ maximizes (8) then no beneficial deviation exists. The rest of the derivation is analogous to the case of exogenous variances:

$$\frac{\partial Eu_j^P}{\partial \delta_j} = F(\frac{\delta^* - \delta_j}{\bar{\alpha}v}) - (\delta_j + \delta^*)f(\frac{\delta^* - \delta_j}{\bar{\alpha}v})\frac{1}{\bar{\alpha}v} = 0$$

This derivative must equal 0 at $\delta_i = \delta^*$, and thus:

$$F(0) = 2\delta^* f(0)\frac{1}{\bar{\alpha}v} \iff \delta^* = \frac{v\sqrt{2\pi}}{4}\bar{\alpha}.$$

In addition, the second order is satisfied at the critical point. To see this observe that the second derivative of (8) is given by

$$-f(\frac{\delta^* - \delta_j}{\bar{\alpha}v})\frac{1}{\bar{\alpha}v} - f(\frac{\delta^* - \delta_j}{\bar{\alpha}v})\frac{1}{\bar{\alpha}v} - (\delta_j + \delta^*)\frac{\delta^* - \delta_j}{\bar{\alpha}v}f(\frac{\delta^* - \delta_j}{\bar{\alpha}v})\frac{1}{\bar{\alpha}v}$$

Evaluated at $\delta_j = \delta^*$ gives

$$-2f(0)\frac{1}{\bar{\alpha}v} < 0$$

Therefore, given $\delta_k = \delta^*$, the best response is $\delta_j = \delta^*$.

As in the case with exogenous informativeness, an increase in the maximum permitted informativeness $\bar{\sigma}$ (which can be interpreted as an increase in the campaign spending limit) causes greater ideological extremism. Therefore, the same tradeoff is present in this case as in the model with exogenous informativeness. The only real difference in the results is driven by the result that with endogenous informativeness, any feasible level of informativeness can be selected on the equilibrium

path. However, even if we assume that on the equilibrium path both campaigns are maximally informative, $\sigma_j = \sigma_k = \bar{\sigma}$, we still find that if the electorate is sufficiently concentrated about the median, an increase in maximal permitted informativeness can damage aggregate voter welfare.

To see this, imagine that equilibrium path, campaign signals are maximally informative, $\sigma_j = \sigma_k = \bar{\sigma}$. In this case, the expected quality on the equilibrium path is given by $\sqrt{\frac{2}{1+\bar{\sigma}^2}} = \bar{\alpha}\sqrt{2}$. Thus, the benefits of campaign informativeness are higher in this case, because on the equilibrium path campaign informativeness is higher than off of the equilibrium path.

Given this differences, it is straightforward to derive aggregate voter welfare as a function of $\bar{\alpha}$:

$$EW(\bar{\alpha}) = v(\mu + \frac{\bar{\alpha}}{\sqrt{\pi}}) - \frac{1}{2}(L(\delta^*(\bar{\alpha})) + L(-\delta^*(\bar{\alpha})))$$

Here $\delta^*(\bar{\alpha}) = \frac{v\sqrt{2\pi}}{4}\bar{\alpha}$ represents the equilibrium level of ideological divergence chosen by each party. Following a similar argument to the one when α was exogenous, one can show that for any $\bar{\alpha}$, voter welfare is increasing with a more restrictive limit when

$$G(\frac{v\sqrt{2\pi}}{4}\bar{\alpha}) - G(-\frac{v\sqrt{2\pi}}{4}\bar{\alpha}) > \frac{2}{\pi}\sqrt{2}. \tag{9}$$

Note that $\frac{2}{\pi}\sqrt{2} < 1$. As in the earlier analysis, this implies that for any $\bar{\alpha}$, voters benefit from a more restrictive limit on campaign information if they care enough about quality relative to ideology, or if the distribution of voter ideology is sufficiently concentrated around the median. When equation (9) holds with equality, then $\bar{\alpha}$ maximizes welfare, and when the left hand side is less than the right hand side, a less restrictive limit is preferred.

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