Campaign Contests

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Abstract

I develop a formal model of political campaigns in which candidates choose how to distribute their resources over two different policy issues. I assume that campaigning on an issue has two simultaneous effects, both rooted in social and cognitive psychology: It increases the perceived quality of the advertising candidate in that issue and it makes the issue more salient, thereby increasing the issue's perceived importance to the voters. Whether a candidate can increase his vote share during the contest depends on the interplay of strategic issue selection, which depends on candidates' comparative advantages, and the aggregate resource allocation to the issues. The aggregate resource allocation—or campaign agenda—depends on an issue's importance, the firmness of voters' conviction regarding candidates' relative quality, and the divisiveness of this issue. A candidate increases his vote share during the campaign contest if he has a comparative advantage on the issue that receives more aggregate spending. Consequently, the contest may be biased in one candidate's favor and an a priori less popular candidate might be the actual odds on favorite. I show that a relatively unimportant issue might receive most aggregate spending and thus could decide the election.

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1 Introduction

There is an election between two candidates upcoming and Candidate 1 is currently more popular in the polls than Candidate 2, leading with 5 percentage points over his opponent. Both candidates have identical campaign budgets and employ their funds with equal efficiency. There are no shocks to voters' preferences and there is no randomness in the campaign. Can we then conclude that Candidate 1 is going to win the election? In this paper I show that the answer to that question is "no." The reason for this is that campaign contests are often biased in one candidate's favor; they benefit the candidate who has a *comparative advantage* on the issue that receives the greatest amount of campaign spending. If a candidate trails his opponent by not too great a margin at the outset of the campaign contest, he thus could be likely to come out ahead on Election Day.

Political campaigns in many western democracies are often best described as contests in which candidates and political parties spend significant amounts of time and money—or effort—in an attempt to influence voters' decisions at the ballot. The prime example is the US, where spending during these campaign contests by the two main candidates during presidential elections has experienced an average growth rate of 24.6 per cent between campaigns over the period from 1984 to 2016 and has reached a maximum of more than $1.2 billion in 2012.[1] Candidates allocate these funds over multiple policy issues and how issues are strategically targeted matters for electoral outcomes.[2] Nevertheless, the vast majority of the literature studying campaign contests focusses on one-dimensional campaigns in which campaign spending creates valence.[3] Another important strand of literature studies multi-dimensional campaign contests where candidates compete through issue strategic selection.[4] In this class of models, the function of campaigning is to prime issues, i.e., to strategically manipulate which issues the voters consider important on Election Day. Both of these approaches have led to a series of interesting results and have deepened our understanding of how campaign contests are fought and what consequences they have. But, taken in isolation, they also have significant shortcomings. For example, Kaplan et al. (2006) criticize the state of the theoretical literature studying strategic issue selection by stating that "*[i]ssue ownership theory clearly requires further development before it can systematically help us understand campaigns*" (p. 735).

In the current paper I combine features of these two approaches to political campaigns to further our understanding of their workings and consequences. There are two candidates competing in a campaign contest and who need to decide how to allocate their campaign resources to the different policy issues. Campaigning on an issue has two simultaneous effects: it *persuades* the voters of the issue specific quality of the advertising candidate, and it *primes* the issue, thereby manipulating voters' issue importance ranking. Persuasion is similar to creating issue specific valence and hence relates to the literature on

[1]Calculated using data from `https://www.fec.gov/data/`. Recent studies point to the importance of campaign contests, see for example Erikson and Palfrey (1998, 2000) or Franz and Ridout (2007, 2010).

[2]Kang et al. (2018), Arbour (2014), Bélanger and Meguid (2008), Kaplan et al. (2006), or Sigelman and Buell (2004) show that spending is distributed over a whole range of important issues in the US, while Wagner and Meyer (2014), Meyer and Wagner (2016), or Dolezal et al. (2014) show the same for campaigns in Europe.

[3]E.g. Snyder (1989), Erikson and Palfrey (2000), Klumpp and Polborn (2006), Ashworth and Bueno de Mesquita (2009), Meirowitz (2008), Iaryczower and Mattozzi (2012, 2013), Denter and Sisak (2015), or Balart et al. (2018).

[4]E.g. Petrocik (1996), Riker (1996), Amorós and Puy (2013), Aragonès et al. (2015), Egorov (2015), or Dragu and Fan (2016).

endogenous valence, while priming relates to the literature studying strategic issue selection. Voters are heterogeneous in their candidate evaluations and may also differ in their issue importance weights. Candidates choose an allocation of their budgets that maximizes their respective vote shares.

Combining the two existing approaches generates many testable predictions. In particular:

- The candidate with a comparative advantage spends more on an issue than his contender.
- An issue receives ceteris paribus more aggregate spending if it is more important, less divisive, or if voters have generally no strict opinion about candidates' relative qualities on the issue.
- A candidate increases his electoral support during the campaign contest, if he has a *comparative advantage* on the issue on which candidates campaign with greater intensity. As a consequence, campaign contests often *structurally* benefit one candidate over the other.
- An a priori weaker candidate could be the actual favourite on Election Day, once the campaign contest is taken into account.

The first result shows that results from Aragonès et al. (2015) and Amorós and Puy (2013) remain valid even though the framework was changed significantly by allowing for persuasion. However, as we will see later, the current model leads to a more nuanced version of this result as it may happen in interior pure strategy Nash equilibrium. Therefore, unlike in the literature so far, both candidates may campaign on all issues. The second result follows from a contest theoretic logic and while I am not aware of a similar result in the literature, the underlying intuitions are familiar from other contexts (see for example Konrad, 2009, for an overview). Finally, the two remaining results are, to the best of my knowledge, novel.

The paper is organized as follows. The remainder of this section places the paper in the context of the relevant literature. The next section discusses how campaign contests are likely to affect voters' attitudes towards candidates. Section 3 introduces a model of campaign contests, and Section 4 studies equilibrium campaigning. Section 5 derives implications of campaign contests for candidate selection on Election Day and for optimal candidate nomination. Section 6 concludes. All proofs are contained in the appendix.

Related Literature. As mentioned before, the paper combines features from two different literatures and thus contributes to both. First, the paper contributes to the extensive literature studying competitive vote buying/endogenous valence, for example Snyder (1989), Klumpp and Polborn (2006), Herrera et al. (2008), Dahm and Porteiro (2008), Ashworth and Bueno de Mesquita (2009), Denter and Sisak (2015), Iaryczower and Mattozzi (2012, 2013), Boyer et al. (2017), Balart et al. (2018), or Casas (2018). In contrast to these papers, I study the allocation of a campaign budget over different issues with the additional twist that campaigning primes issues. Thus, the paper also contributes to the literature studying strategic issue selection when campaign on an issue primes it, for example Petrocik (1996), Riker (1996), Amorós and Puy (2013), Aragonès et al. (2015), or Dragu and Fan (2016). The current paper innovates by introducing persuasion: the way voters evaluate candidates is determined endogenously during the campaign contest. In this literature candidates never campaign on the same set of issues in equilibrium.

Empirical research, however, refutes this conclusion, as some form of "convergence" on the issues is the norm rather than the exception:[5] "*[T]here is no shortage of explanations for why issue convergence is such a rare commodity in American campaigns. Perhaps surprisingly, though, there is a shortage of convincing evidence that issue convergence really is a rare commodity.*" (Sigelman and Buell, 2004, p. 651) The model presented in the current paper allows for imperfect convergence and is thus a step forward in reconciling theory and data.

The model I develop is a form of a Blotto game. A Blotto game is a situation in which players allocate resources to a number of different contests (here issues), and typically the player spending most on a certain contest wins it for sure. Papers contributing to this literature are the classical treatise of Borel (1953), Shubik and Weber (1981), Roberson (2006), Chowdhury et al. (2013), Kovenock and Roberson (2011), or Hortala-Vallve and Llorente-Saguer (2012). The current paper differs because the value of a battlefield is determined endogenously, as an issue's importance increase in aggregate spending directed to it. Moreover, unlike in these papers, in the current paper success on individual battle fields—or issues—is not modelled as all-pay auctions but as a smooth function of campaign spending.

While the above literature studied non-informative campaigns, some papers focus on candidates' incentives to provide information during campaign contests. Gul and Pesendorfer (2012) study how parties release information regarding a payoff relevant state variable over time and Alonso and Câmara (2016) or Denter et al. (2019) study how an incumbent politician may design policy experiments to influence voters' decision at the ballot. Polborn and Yi (2006) study informative positive and negative campaigning. In all these papers the policy space is one-dimensional and thus, unlike in the current paper, issue selection as well as issue priming cannot play a role. Egorov (2015) and Basu and Knowles (2018) study informative campaigning with two-dimensional policy spaces. Egorov (2015) studies the incentives of an incumbent and a challenger to campaign either on the first or on the second issue in a model in which campaigning directly reveals information about a candidate's competence and when issue selection also signals information regarding one's competence on the issue one does not campaign on. In contrast to his paper, in Basu and Knowles (2018) candidates can campaign on both issues at once, but drop they the assumption that voters may draw inference about a candidate's competence also from issue selection. As in the current paper, both Egorov (2015) and Basu and Knowles (2018) show that candidates may choose to campaign on the same issues in equilibrium. However, unlike in the current paper, in their papers campaigning does not prime policy issues, which creates the strict incentive found in the literature to campaign on different issues in the first place. Moreover, in contrast to these papers, in the current paper neither candidates nor voters are restricted in the sense that they can only campaign on or observe campaign spending on one policy issue. Finally, none of these papers studies the political consequences of the campaign contest for candidate selection on Election Day.

2 Effects of Campaigning: Priming and Persuasion

Given the multi-dimensionality of campaign contests, there are two distinct ways in which they may affect voters. First, campaigns could have an across-issues dimension and may change how voters view

[5] Other papers coming to similar conclusion include Kaplan et al. (2006), Green and Hobolt (2008), or Damore (2005).

the different issues. In particular, campaigns may change how voters prioritize issues or which weights voters attach to the different issues. Second, there may be a within-issue dimension as well. That is, candidates' campaigning on a given issue could change the way voters see candidates' qualities on that issue. This distinction between across- and within-issue effects is similar to the distinction used by Bartels (2006), who differentiates between *priming* and *persuasion*. We will follow Bartels by referring to the different effects of campaigning in the same way. In the remainder of this section I discuss how persuasion and priming are likely to change voters' attitudes.

Priming. The fact that priming an issue can raise this issue's importance relative to other issues is well known in political science, see for example Bartels (2006) or Aragonès et al. (2015) and the respective references provided therein. This effect has its roots in cognitive psychology. Priming is a cognitive process that activates accessible categories in the mind of a person. Exposure to a stimulus makes the related categories of the stimulus easier accessible and the categories become more important in the mind of individuals. Smith and Mackie (2007) put it like this: "[...] *anything that brings an idea to mind–even coincidental, irrelevant events–can make it accessible and influence our interpretation of behavior*" (p. 67). In the specific example of a political campaign, priming makes an issue more salient and thus individuals evaluate the issue as more relevant for making decisions (see Iyengar and Kinder, 1987, or Weaver, 2007). Priming is hence closely related to the theory of agenda setting (see for example the discussion in Willnat, 1997). In deciding between alternatives, the primed issue is still in the memory and becomes more important. Priming can therefore "*alter the standards by which people evaluate election candidates*" (Severin and Tankard, 1997). In the sequel I will assume that campaigning on an issue increases this issue's relative importance and decreases the importance of the other issues.

Persuasion. There are many reasons to suspect that campaigning changes how voters view candidates conditionally on an issue. One simple reason could be that campaigning provides information regarding policy platforms. If voters are risk averse, this will on average increase the advertising candidate's issue specific evaluation as uncertainty is reduced. Similarly, issue specific political persuasion tends to improve how voters esteem a certain candidate on that issue. Persuasion could take the form of providing costly evidence of a candidate's issue specific valence, for example by highlighting a candidate's professional background as a business leader or veteran. Skaperdas and Vaidya (2012) study this kind of persuasion. Similarly, persuasion may take the form of Bayesian persuasion as pioneered by Kamenica and Gentzkow (2011). An application of this model to political persuasion is for example Alonso and Câmara (2016). In both cases, campaigning on an issue will at least in expectation improve a candidate's assessment on that issue.

Finally, there is reason to expect a positive persuasion effect of campaigning based on what psychologists call the *mere-exposure effect*. According to this effect "*repeated exposure to an object results in greater attraction to that object*" (Hogg and Vaughan, 2008, p. 170), because it creates familiarity. The effect was first systematically described by Zajonc (1968) and there is ample evidence of its importance for human attitudes, see for example Bornstein (1989), Tom et al. (2007), Moon et al. (2009), or Fang et al.

(2007).[6] The importance of the mere-exposure effect for advertising is well-established, see for example Yoo (2008) or Lee et al. (2015). Moreover, Moorthy and Hawkins (2005) show that mere repetition of an ad increases a products perceived quality.

There are sufficient reasons to believe that persuasion effects are relevant and that voters esteem a candidate more if the candidate campaigns on the issue. In the following I will assume that by campaigning on an issue a candidate indeed increases his perceived quality.

3 Campaign Contests

In this section I introduce a theoretical model of campaign contests. Two politicians $j \in \{D, R\}$ compete in a campaign for a political office by exerting effort. While effort could mean many different things, for specificity I stick to the interpretation of buying TV advertising. There is a measure-one continuum of voters, indexed by v. Voters care about 2 policy issues indexed by i.[7] They assign to each candidate a relative quality belief $\theta^i_{v,j} \in (0,1)$, where relative quality is defined in a way such that $\theta^i_{v,D} + \theta^i_{v,R} = 1$. It is useful to define $\theta^i_{v,D} \equiv \theta^i_v$ and $\theta^i_{v,R} \equiv 1 - \theta^i_v$ and work with this convention in the following. To assess the overall relative quality of a politician, voters assign a weight $\varphi_v \in (0,1)$ to issue 1 and $1 - \varphi_v$ to issue 2. Voters' assessments of candidates' relative quality on issue i are distributed on $\Theta^i = [\underline{\theta}^i, \overline{\theta}^i] \subset (0,1)$. Similarly, issue importance assessments are distributed on $\Omega = [\underline{\varphi}, \overline{\varphi}] \subset (0,1)$. Every voter v is hence completely described by $s_v \in \mathcal{S} \equiv \Theta^1 \times \Theta^2 \times \Omega$. Voters' assessments of candidates and issues are uncorrelated with respective marginal distributions $\mathcal{I}^i(\varphi^i_v)$ and $\mathcal{C}^i(\theta^i_v)$.

Following the literature, voters are assumed to have *weighted issue preferences* (e.g. Krasa and Polborn, 2010) and evaluate candidates as follows:

$$\begin{aligned} u_D(\mathbf{x}, s_v) &= c(\mathbf{x}^1, \theta^1_v) w(\mathbf{x}, \varphi_v) + c(\mathbf{x}^2, \theta^2_v)(1 - w(\mathbf{x}, \varphi_v)), \\ u_R(\mathbf{x}, s_v) &= (1 - c(\mathbf{x}^1, \theta^1_v)) w(\mathbf{x}, \varphi_v) + (1 - c(\mathbf{x}^2, \theta^2_v))(1 - w(\mathbf{x}, \varphi_v)), \end{aligned} \tag{1}$$

where $c(\mathbf{x}^i, \theta^i_v) \in [0,1]$ is voter v's evaluation of Candidate D's relative quality on issue i, taking into account campaign spending $\mathbf{x}^i \equiv (x^i_D, x^i_R)$ and the initial evaluation θ^i_v. Similarly, $w(\mathbf{x}, \varphi_v) \in [0,1]$ is the voter's evaluation of the importance of issue 1, depending on campaign spending $\mathbf{x} \equiv (\mathbf{x}^1, \mathbf{x}^2)$ and the initial evaluation φ_v. It follows that when $u_D(\mathbf{x}, s_v) > \frac{1}{2}$, voter v prefers D over R, and vice versa if $u_D(\mathbf{x}, s_v) < \frac{1}{2}$. Moreover, $u_R(\mathbf{x}, s_v) = 1 - u_D(\mathbf{x}, s_v)$.

Campaigning has the two simultaneous effects described before, *persuasion* and *priming*. Persuasion implies that the assessment of a candidate's quality is improving in the number of published TV ads, x^i_j. Priming leads to a reassessment of issues' relative importance. We assume the following priming technology:

Assumption 1. *Campaigning changes a voter's beliefs about issues' relative importance in the following way:*

$$w(\mathbf{x}, \varphi_v) = \max\left\{\min\left\{\varphi_v + \eta\left(g\left(x^1_D + x^1_R\right) - g\left(x^2_D + x^2_R\right)\right), 1\right\}, 0\right\} \tag{2}$$

[6] Interestingly, the mere-exposure effect also has a significant impact on how researchers value the quality of different academic journals (Serenko and Bontis, 2011).

[7] Most of the analysis in Section 4 can be readily extended to any number of issues $n \geq 2$.

for $g(0) = 0$, $g'(x) > 0$, $g''(x) \leq 0$, *and* $\eta \geq 0$.

Spending on an issue increases that issue's relative importance and decreases the importance of all other issues. η is a parameter that measures the overall effectiveness of priming and will be useful for comparative statics.[8]

Voter v's after-campaigning assessment of candidates' relative quality on issue i is $c(\mathbf{x}^i, \theta_v^i)$. I assume the following persuasion technology:

Assumption 2. $c(\mathbf{x}^i, \theta_v^i) \in [0, 1]$ *is* C^2 *in all arguments and has the following properties:*

1. ***Concavity:*** $c(\mathbf{x}^i, \theta_v^i)$ *is strictly concave and increasing in* x_D^i *and strictly convex and decreasing in* x_R^i.

2. ***Symmetry:*** $c(x, y, \theta_v^i) = 1 - c(y, x, 1 - \theta_v^i)$.

3. ***Neutrality:*** $c(x, x, \theta_v^i) = \theta_v^i$.

As in the case of priming, the technology may differ from issue to issue. Assumption 2 is very similar to what Dixit (1987) or Hoffmann and Rota-Graziosi (2012) impose on contest success functions. Each player's effort has a positive but diminishing marginal effect on his issue specific relative evaluation. $c(\mathbf{x}^i, \theta^i)$ is symmetric in the sense that if we exchange candidates' efforts and initial evaluations, we also exchange their post campaigning evaluation. Moreover, if both choose the same level of effort on issue i, their relative evaluation is unchanged; efforts neutralize each other. Throughout most of the analysis, that is with the exception of Section 4.1 and some examples, I will impose another assumption, namely that the first unit of persuasive effort is very effective, $\lim_{x_j^i \to 0} \frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_j^i} = +\infty$. This assumption precludes the existence of corner equilibria, which are not the focus of this paper, and makes the analysis slightly more convenient.

Lemma 1 in Appendix A.4 shows that Assumption 2 implies that given a symmetric spending profile on issue i, $x_D^i = x_R^i$, the marginal impact of campaign spending on candidates' relative evaluation depends on voter v's initial assessment through $\theta_v^i(1 - \theta_v^i)$, which one can interpret as a measure of the voter's decidedness on issue i. Throughout the analysis I will assume that in such a situation it is weakly easier to influence a voter who is undecided than a voter who has a clear favorite on issue i:

Assumption 3. *The marginal impact of campaign spending on a voter's relative evaluation of candidates on issue i is weakly increasing in a voter's undecidedness* $\theta_v^i(1 - \theta_v^i)$. *Formally,* $\left.\frac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i \partial \theta_v^i}\right|_{x_D^i = x_R^i} \geq 0$ *if* $\theta_v^i \leq \frac{1}{2}$, *and* $\left.\frac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i \partial \theta_v^i}\right|_{x_D^i = x_R^i} \leq 0$ *else.*

Starting at $\theta_v^i = \frac{1}{2}$, when θ_v^i gets closer to zero or one, the effectiveness of campaigning does not increase. Thus, the assumption formalizes the words of Festinger et al. (1956): "*A man with a conviction is a hard man to change.*" A similar assumption is made explicit in a recent paper by Balart et al. (2018), where the effectiveness of campaign spending depends on and decreases in platform polarization.

[8] Voters usually care about all issues to some degree, as $\varphi_v^i \in (0, 1)$.

Similarly, Ashworth and Bueno de Mesquita (2009) show that if voters have concave policy utility, the marginal effectiveness of campaign spending decreases in policy divergence. $\theta_v^i(1-\theta_v^i)$ can be interpreted as a measure of policy divergence, where $\theta_v^i(1-\theta_v^i) = \frac{1}{4}$ implies candidates choose the same platforms on issue i and therefore candidates convergence completely.[9]

We need one final assumption to facilitate the analysis. Given Assumptions 2 and 3, it is not guaranteed that a unique pure strategy equilibrium exists even when $\eta = 0$, that is when the game becomes a standard contest with exogenous prizes or weights. The next assumption constrains the magnitude of the cross derivatives of c^i and is sufficient to guarantee this:

Assumption 4. *For all* $\mathbf{x}^i \in [0,B]^2$ *and for all* $\theta^i \in (0,1)$,

$$\frac{\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial (x_D^i)^2}\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_R^i}}{\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i}} > \frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i \partial x_R^i} > \frac{\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial (x_R^i)^2}\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i}}{\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_R^i}}.$$

Assumptions 2 to 4 define something that in other contexts is often called a *contest success function*, see for example Skaperdas (1996). Most standard contest success functions are special cases of $c(\mathbf{x}^i,\theta_v^i)$, for example the generalized logit, or Tullock, contest success function studied by Snyder (1989), Skaperdas and Grofman (1995), Klumpp and Polborn (2006), Balart et al. (2018), or Bouton et al. (2018), or the tournament model with potential head starts studied by Lazear and Rosen (1981), Herrera et al. (2008), or Denter and Sisak (2015).[10]

Voting is probabilistic and the probability that a voter casts her ballot for candidate j is $u_j(\mathbf{x}, s_v)$. Campaign spending has no immediate marginal costs but candidates are endowed with a use-it-or-lose-it budget $B > 0$ that they can distributed over the different issues. Since it is always beneficial to increase spending on one of the two issues, in equilibrium the budget constraint needs to hold with equality, and hence $x_j^2 = B - x_j^1$. Candidates maximize their vote share and their respective maximization problems are then as follows:

$$\begin{aligned}
\max_{x_D^1\in[0,B]} \pi_D(\mathbf{x}) &= \int\int\int_{\mathcal{S}} \left[c(\mathbf{x}^1,\theta_v^1)\,w(\mathbf{x},\varphi_v) + c(\mathbf{x}^2,\theta_v^2)\,(1-w(\mathbf{x},\varphi_v))\right] d\mathcal{C}^1(\theta_v^1)d\mathcal{C}^2(\theta_v^2)d\mathcal{I}(\varphi_v) \\
&= E\left[c(\mathbf{x}^1,\theta_v^1)\,w(\mathbf{x},\varphi_v) + c(\mathbf{x}^2,\theta_v^2)\,(1-w(\mathbf{x},\varphi_v))\right] \\
\max_{x_R^1\in[0,B]} \pi_R(\mathbf{x}) &= \int\int\int_{\mathcal{S}} \left[(1-c(\mathbf{x}^1,\theta_v^1))\,w(\mathbf{x},\varphi_v) + (1-c(\mathbf{x}^2,\theta_v^2))\,(1-w(\mathbf{x},\varphi_v))\right] d\mathcal{C}^1(\theta_v^1)d\mathcal{C}^2(\theta_v^2)d\mathcal{I}(\varphi_v) \\
&= E\left[(1-c(\mathbf{x}^1,\theta_v^1))\,w(\mathbf{x},\varphi_v) + (1-c(\mathbf{x}^2,\theta_v^2))\,(1-w(\mathbf{x},\varphi_v))\right]
\end{aligned}$$

$E[\cdot]$ is the expectation operator. The equilibrium concept is Nash equilibrium.

[9] For example, assume $\theta_v^i = \frac{1}{2}\left(1-(b_v^i-p_D^i)^2+(b_v^i-p_R^i)^2\right) \in [0,1]$, where the policy space is $[0,1]$, $b_v^i \in [0,1]$ is voter v's ideal point on issue i and $p_j^i \in [0,1]$ is candidate j's policy platform on that issue. Let $p_D^i = p^i + \epsilon$ and $p_R^i = p^i - \epsilon$ for appropriately chosen ϵ, which can be interpreted as a measure of platform convergence and when $\epsilon = 0$ candidates choose the same platforms and thus converge perfectly. Then $\theta_v^i(1-\theta_v^i)$ decreases in platform polarization ϵ.

[10] In tournament models Assumption 4 holds only when the variance of the additive noise variable is sufficiently large, as otherwise the marginal impact of campaign spending becomes zero at one point.

4 Equilibrium Campaigning

We now study equilibrium behavior by both candidates in the campaign contest. To derive intuitions for how the two main effects of campaigning influence candidates' incentives, I begin with an analysis of the two effects in isolation. That is, I first study behavior in a campaign contest when campaigning only persuades but leaves issues' relative importance unchanged, and then I continue by studying the other polar case, i.e., a campaign contest that only primes issues but does not persuade voters. As we will see, the two effects have very different consequences for equilibrium campaigning, and these differences relate to *comparative advantages*, which I define as follows:

Definition 1 (Comparative Advantage)**.** *Let*

$$\sigma^i \equiv E\left[\theta_v^i\right] - \bar{\theta},$$

where $\bar{\theta} \equiv \frac{1}{2}E\left[\theta_v^1 + \theta_v^2\right]$*. Candidate* D *has a comparative advantage on issue* i *if* $\sigma^i > 0$*. If* $\sigma^i < 0$*, Candidate* R *has a comparative advantage in* i *and if* $\sigma^i = 0$*, no candidate has a comparative advantage on that issue.*

By the nature of comparative advantages, it is not possible that one candidate has a comparative advantage on all issues. This follows directly from $\sigma^1 + \sigma^2 = 0$. In particular, either every candidate has exactly one comparative advantage or no candidate has a comparative advantage. For example, in the simplest case with a single voter comparative advantage boils down to a comparison of θ^1 and θ^2. For example, if $\theta^1 = 0.8$ and $\theta^2 = 0.6$, D has an absolute advantage on all issues and a comparative advantage on issue 1.

4.1 Two Polar Benchmarks

To motivate the study of an integrated model with both priming and persuasion, I now study both effects in isolation. Hence, I now study a campaign contest that either only primes or only persuades. This will deliver two important benchmarks and shows why an integrated model with both effects is necessary to generate the results of this paper.

First, consider a situation in which campaigning only persuades, i.e., where $\eta = 0$. Then:

Proposition 1. *Let* $\eta = 0$*. The campaign contest has a unique interior Nash equilibrium in pure strategies in which candidates converge completely, i.e., they spend the same amount on all issues* i*,* $x_D^i = x_R^i = x^i$*.*

Thus, without priming there is complete convergence in the campaign contest. In this case the game is a version of a Blotto, or divide-the-dollar, model. This kind of models has been used to model electoral competition before, for example by Myerson (1993), Laslier and Picard (2002), or Boyer et al. (2017). In this class of models pure strategy Nash equilibria typically do not exist.[11] To the contrary, Proposition 1 states that only a pure strategy equilibrium exists. The reason is that the current model is a stochastic version of a Blotto game, where the value of each 'battle field'—or issue—is not either zero or one but a

[11] An exception is Hortala-Vallve and Llorente-Saguer (2012).

continuously changing function of campaign spending. This produces the result that candidates converge completely by spending the exact same amount on all issues.

Next, consider a situation in which campaigning only primes issues:

Proposition 2. *Let $\eta > 0$ and $c(\mathbf{x}^i, \theta_v^i) = \theta_v^i$ for all $\mathbf{x}^i \in [0, B]^2$. If candidates have comparative advantages, the campaign contest has a unique Nash equilibrium in which each candidate spends all of his budget on the issue where he has the comparative advantage. Therefore, candidates diverge completely, i.e., they spend never campaign on the same issue i, $x_D^i \cdot x_R^i = 0$. When candidates have no comparative advantage, any spending profile $(x_D^1, x_R^1) \in [0, B]^2$ is an equilibrium.*

If campaigning does not persuade, the campaign contest is a version of the models studied by Amorós and Puy (2013), Aragonès et al. (2015), or Dragu and Fan (2016), and candidates behave similarly in equilibrium. For example, Proposition 2 is similar to Proposition 1 of Aragonès et al. (2015), which states that "*[...] each party concentrates all its campaigning time on the issue in which it has the largest quality advantage.*" In their paper, absolute advantages imply also comparative advantages, as every candidate has exactly one absolute advantage. Proposition 2 makes the importance of comparative advantage explicit, as does the analysis of for example Amorós and Puy (2013). Their conclusions and the conclusion of Proposition 2 are also in line with what Riker (1996) coined the *Dominance Principle* in political campaigns.[12] Generally, when there are comparative advantages candidates completely diverge in equilibrium. Hence, priming leads to the exact opposite incentives as persuasion.

Persuasion leads candidates to adopt identical strategies and they will converge completely in any equilibrium. Priming has the opposite effect and in isolation leads candidates to diverge perfectly. Both are extreme predictions and fail to explain the empirical evidence that was mentioned in the introduction. In particular, Sigelman and Buell (2004) showed that imperfect convergence is the best description of observed campaigning behavior and that one candidate tends to spend more on a certain subset of issues and less on the remaining ones. As I will explore in the sequel, an integrated model with both priming and persuasion can rationalize such behavior.

4.2 An Integrated Model

In this section I now turn to study the integrated model that allows both effects to be present in a campaign contest. The following proposition establishes that an interior pure strategy Nash equilibrium exists:

Proposition 3. *The game has an interior pure strategy Nash equilibrium. Moreover, there exists $\bar{\eta} > 0$ such that for all $\eta \in [0, \bar{\eta}]$ the game has a unique Nash equilibrium.*

The proposition shows the existence of a pure strategy Nash equilibrium in the campaign contest, even interior equilibria. Thus, adding persuasion to a standard priming model may *qualitatively* change the campaign contest's equilibrium in an important way. Of course, the assumption of an infinite marginal product of persuasion is therefore not necessary; it suffices that the first unit of persuasion is sufficiently

[12] Riker (1996) defines it as follows: "*When one side has an advantage on an issue, the other side ignores it.*" (Riker, 1996, p. 106).

effective. If additionally η is sufficiently small, the campaign contest has a unique Nash equilibrium. The exact values η may take on depend on the details of the game. The following example shows that η need not be really close to zero and that priming can be quite effective:

Example 1: *Assume that $B = 1$ and that*

$$w(\mathbf{x}, \varphi) = \max\left\{\min\left\{\varphi + \eta\left(x_D^1 + x_R^1 - x_D^2 - x_R^2\right), 1\right\}, 0\right\}$$

as well as

$$c(\mathbf{x}^i, \theta^i) = \max\left\{\min\left\{\theta^i + \kappa\left((x_D^i - \frac{1}{2}(x_D^i)^2) - (x_R^i - \frac{1}{2}(x_R^i)^2)\right), 1\right\}, 0\right\}.$$

for some $\kappa > 0$ and $\eta > 0$. Moreover, let $\overline{\theta}^i + \frac{\kappa}{2} < 1$, $\underline{\theta}^i - \frac{\kappa}{2} > 0$, $\overline{\varphi} + 2\eta < 1$, $\underline{\varphi} - 2\eta > 0$.[13] *The individual decision problems of the candidates are strictly concave and the campaign contest has a unique Nash equilibrium in pure strategies. For large enough κ, the equilibrium is interior, i.e., $x_j^i \in (0, 1)$.*

The proofs to all the examples in the paper can be found in Appendix B. Note that the assumptions in the example define an upper boundary $\bar{\eta} = \min\left\{\frac{1-\overline{\varphi}}{2}, \frac{\underline{\varphi}}{2}\right\} \leq \frac{1}{4}$ for η. Whenever, $\eta < \bar{\eta}$, the campaign contest has a unique pure strategy Nash equilibrium.

4.2.1 Issue Selection: Convergence or Divergence?

I now begin with the analysis of equilibrium campaigning. In a first step I focus on strategic issue selection, that is with which intensity the two candidates campaign on an issue and which candidate outs greater emphasis on a given issue. As we will see in Section 5, strategic issue selection is an important determinant of candidate selection on Election Day. Therefore, it is important to understand what determines strategic issue selection by the candidates.

In an interior pure strategy Nash equilibrium behavior follows from the set of first order conditions (henceforth FOCs):

$$\begin{aligned}
\frac{\partial \pi_D(\mathbf{x})}{\partial x_D^1} &= E\left[\tfrac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1} w(\mathbf{x},\varphi_v) + \tfrac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2}\tfrac{dx_D^2}{dx_D^1}(1 - w(\mathbf{x},\varphi_v)) + \left(c(\mathbf{x}^1,\theta_v^1) - c(\mathbf{x}^2,\theta_v^2)\right)\tfrac{\partial w(\mathbf{x},\varphi_v)}{\partial x_D^1}\right] \\
&= E\left[\tfrac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1} w(\mathbf{x},\varphi_v) - \tfrac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2}(1 - w(\mathbf{x},\varphi_v)) + \left(c(\mathbf{x}^1,\theta_v^1) - c(\mathbf{x}^2,\theta_v^2)\right)\tfrac{\partial w(\mathbf{x},\varphi_v)}{\partial x_D^1}\right] \\
\frac{\partial \pi_R(\mathbf{x})}{\partial x_R^1} &= E\left[-\tfrac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_R^1} w(\mathbf{x},\varphi_v) - \tfrac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_R^2}\tfrac{dx_R^2}{dx_R^1}(1 - w(\mathbf{x},\varphi_v)) - \left(c(\mathbf{x}^1,\theta_v^1) - c(\mathbf{x}^2,\theta_v^2)\right)\tfrac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^1}\right] \\
&= E\left[-\tfrac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_R^1} w(\mathbf{x},\varphi_v) + \tfrac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_R^2}(1 - w(\mathbf{x},\varphi_v)) - \left(c(\mathbf{x}^1,\theta_v^1) - c(\mathbf{x}^2,\theta_v^2)\right)\tfrac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^1}\right]
\end{aligned}$$

The first two terms in both FOCs relate to the marginal effect of persuasion, and they enter both FOCs in a similar way. The third term relates to priming and comparative advantage and has a different sign for both candidates. Hence, priming creates incentives to diverge whenever $E\left[c(\mathbf{x}^1, \theta_v^1) - c(\mathbf{x}^2, \theta_v^2)\right] \neq 0$, which relates to comparative advantage. When a candidate has a comparative advantage on i, highlighting this issue has two beneficial effects: it persuades voters and it primes an issue, in which the candidate is

[13] These assumption guarantee that $c(\mathbf{x}^i, \theta^i) \in (0, 1)$ and $w(\mathbf{x}, \varphi_v) \in (0, 1)$ for all $\mathbf{x}$.

relatively strong. The contender, who has a comparative disadvantage on i, also benefits from persuasion, but suffers from priming the issue. This creates incentives to diverge at the margin, but also allows for some degree of convergence. Proposition 4 formalizes this intuition:

Proposition 4 (Issue Selection and Comparative Advantage)**.** *A candidate spends more on issue i than his opponent if and only if he has a comparative advantage on i. Both candidates spend the same on issue i if and only if nobody has a comparative advantage on i. Formally, $Sign[x_D^i - x_R^i] = Sign[\sigma^i]$, $i = 1, 2$.*

The proposition highlights the possibility of perfect convergence in the absence of comparative advantages, something that can be sustained also in pure priming campaigns (see Proposition 2). More importantly, Proposition 4 allows for *imperfect convergence* in *interior equilibrium*, where candidates have different focus in their campaign strategies. This may help explain previous empirical findings. As we saw earlier, a campaign that only primes or only persuades will never generate such a result. An integrated model, however, is able to generate such a result and may thus be valuable to foster our understanding of campaign contests.

In the setting of Example 1 this looks as follows:

Example 1 (Continued)**:** *Consider the campaign contest described in Example 1 above. In the unique interior Nash equilibrium spending on issue 1 is*

$$\begin{aligned} x_D^1 &= \tfrac{E[\varphi_v]}{1-4\eta} + \tfrac{2\eta\left(E[\theta_v^1]-E[\theta_v^2]-\kappa\right)}{\kappa(1-4\eta)}, \\ x_R^1 &= \tfrac{E[\varphi_v]}{1-4\eta} + \tfrac{2\eta\left(E[\theta_v^2]-E[\theta_v^1]-\kappa\right)}{\kappa(1-4\eta)}, \end{aligned}$$

and spending on issue 2 follows from $x_j^2 = 1 - x_j^1$, $j = D, R$. If $E[\theta_v^1] = E[\theta_v^2]$, and hence if no candidate has a comparative advantage, $x_D^1 = x_R^1$, and thus candidates converge perfectly. Otherwise $Sign[x_D^i - x_R^i] = Sign[\sigma^i]$ with imperfect convergence/divergence. If we measure issue convergence following Sigelman and Buell (2004) by $C \equiv 1 - \frac{1}{2}\left(Abs[x_D^1 - x_R^1] + Abs[x_D^2 - x_R^2]\right) = 1 - Abs[x_D^1 - x_R^1] = 1 - Abs\left[\frac{4\eta(E\left[\theta_v^1-\theta_v^2\right])}{\kappa(1-4\eta)}\right]$, the level of issue convergence decreases in $Abs\left[E\left[\theta_v^1 - \theta_v^2\right]\right]$.

What are the main takeaways of this section? We see that in a quite general setting it is comparative advantage that determines whether there is convergence or divergence. In contrast to earlier papers studying campaigning, this is the case in interior equilibrium, and hence the model is able to explain imperfect divergence as we observe it in real campaigns.

4.2.2 Campaign Agendas

Next I turn to candidates' "aggregate incentives" to address an issue and study which issues dominate the campaign contest in terms of aggregate campaign spending devoted to them. In real campaigns, voters often feel that candidates do not listen to their needs and talk about things that voters deem of secondary importance. A recent example is the 2016 presidential campaign between Donald Trump and Hillary Clinton. During the course of the year, the number of surveyed Americans stating that candidates actually talked about issues they really cared about hovered between 62 and 56 percent, and just a month before the election took place, in October, this number dropped to 48 percent.[14] Moreover, this perception that candidates focus on the "wrong" issues was similar for Democrats and Republicans. Another example of candidates not focussing on voters' priority issues can be found in the US 2008 presidential campaign. Both John McCain and Barrack Obama spent heavily on the issue *Taxes*, making it the most important issue in terms of aggregate campaign spending of this campaign.[15] But *Taxes* was not among the five most important issues at the time.[16] Hence, it appears that campaign contests often lead candidates to focus on issues that are not really important to voters.

Our model can help shed light on why candidates shape campaign agendas in such a way. And as we will see in Section 5, campaign agendas matter because together with strategic issue selection they determine which candidate tends to benefit from the campaign contest by increasing his popularity with the voters.

Define aggregate campaign spending on issue i as $X^i \equiv x_D^i + x_R^i$. To understand what determines campaign agendas we take another look at the first order conditions. From there it follows that in any interior equilibrium the following must hold:

$$E\left[\left(\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^1} - \frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_R^1}\right) w(\mathbf{x},\varphi_v)\right] = E\left[\left(\frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2} - \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_R^2}\right)(1 - w(\mathbf{x},\varphi_v))\right].$$

This is independent of priming and comparative advantages and hence, loosely speaking, in an interior equilibrium aggregate incentives to address an issue are mostly driven by candidates' desire to persuade. How strong persuasion incentives are depends on an issue's importance and potentially on $\theta_v^i(1-\theta_v^i)$ (see Assumption 3). Thus, ceteris paribus, an issue should receive a greater share of total campaign spending when its relative importance increases, when voters' assessment of candidates' competence on the issue becomes more similar ($\theta^i(1-\theta^i)$ increases), or when voters' assessment of candidates' competence on the other issue becomes less similar ($\theta^j(1-\theta^j)$ decreases).

Proposition 5. *Candidates may campaign hardest on the least important issue. In particular, if voters have strong convictions on an important issues and are undecided on an unimportant issue, the latter may dominate the campaign in terms of aggregate spending.*

As the proposition only states a possibility result, I prove it below by providing two examples where it holds. The proposition provides a rationale for *inverse campaign agendas*, i.e., for candidates directing their resources to the issues that voters do not consider very important. Incentives to persuade are important determinants for aggregate incentives to campaign on an issue. If voters are easily swayed on an issue, both candidates may have strong incentives to campaign on it, even if there are other and more important issues. Of course, this may lead candidates to campaign on the most important issues with the greatest intensity, but as Proposition 5 shows, also less intuitive equilibria with inverse agendas are possible:

[14] For sources of this data, see `https://news.gallup.com/poll/196607/sharp-drop-views-candidates-talk-key-issues.aspx?g_source=POLITICS&g_medium=topic&g_campaign=tiles` (last retrieved: June 5, 2019).

[15] See for example `https://www.nytimes.com/elections/2008/president/advertising/advertisers/8-john-mccain.html`.

[16] For sources of this data, see `https://news.gallup.com/poll/108331/obama-has-edge-key-election-issues.aspx` (last retrieved: June 5, 2019).

Example 2: *Consider the campaign contest defined in Example 1, but let* $E[\theta_v^1] = E[\theta_v^2]$ *and*

$$c(\mathbf{x}^i, \theta_v^i) = \max\left\{\min\left\{\theta^i + \kappa^i\left((x_D^i - \frac{1}{2}(x_D^i)^2) - (x_R^i - \frac{1}{2}(x_R^i)^2)\right), 1\right\}, 0\right\}$$

for some $\kappa^i > 0$. *Moreover, let* $\overline{\theta}^i + \frac{\kappa^i}{2} < 1$ *and* $\underline{\theta}^i - \frac{\kappa^i}{2} > 0$. *Then the campaign contest has a unique Nash equilibrium in pure strategies. Moreover,*

$$Sign[X^1 - X^2] = Sign\left[E[\varphi_v] - \frac{\kappa^2}{\kappa^1 + \kappa^2}\right] = Sign\left[E[\varphi_v] - \frac{1}{1+\nu}\right],$$

where $\nu \equiv \frac{\kappa^1}{\kappa^2}$. *Figure 1 shows how* ν *and* $E[\varphi_v]$ *influence aggregate spending on the issues.*

Example 2 showed how an issue's importance and the issue specific marginal effectiveness of persuasion together shape aggregate incentives to address an issue. The differences in marginal effectiveness were thereby assumed and it is not clear how they relate to the conditions candidates face during a campaign contest. By Assumption 4 the marginal effectiveness of persuasion depends on the distribution of θ_v^i. The next example, in which I study a specific but quite popular version of $c(\mathbf{x}^i, \theta_v^i)$, a generalized Tullock contest, shows how this affects campaign agendas:

Example 3: *Consider a campaign contest where*

$$c(\mathbf{x}^i, \theta_v^i) = \frac{\theta_v^i f(x_D^i)}{\theta_v^i f(x_D^i) + (1 - \theta_v^i) f(x_R^i)},$$

where $f(x)$ *is a concave and increasing function with* $f(0) > 0$ *and* $f'(0) = \infty$. *Moreover, let* $\mathcal{C}^1(\theta_v^1)$ *be a mean-preserving spread of* $\mathcal{C}^2(\theta_v^2)$, *implying* $E[\theta_v^1] = E[\theta_v^2]$ *and thus that no candidate has a comparative advantage, and* $E[(\theta_v^1)^2] > E[(\theta_v^2)^2]$. *Everything else is like in Example 1. Then there exists* $\bar{\eta} > 0$ *such that for all* $\eta \in [0, \bar{\eta}]$ *the campaign contest has a unique Nash equilibrium in pure strategies and that*

$$Sign[X^1 - X^2] = Sign\left[E[\varphi_v] - \frac{\rho^2}{\rho^1 + \rho^2}\right] = Sign\left[E[\varphi_v] - \frac{1}{1+\nu}\right],$$

where $\rho^i \equiv E[\theta_v^i(1 - \theta_v^i)]$ *and* $\nu \equiv \rho^1/\rho^2$. *Therefore, candidates campaign more intensely on issue 2 unless issue 1 is significantly more important. Figure 1 again shows how* ν *and* $E[\varphi_v]$ *influence aggregate spending on the issues.*

The example shows that more divisive issues tend to receive less attention, and the intuition is clear: ceteris paribus, as an issue becomes more divisive, voters have stronger opinions and are harder to persuade. Hence, it becomes less attractive to campaign on the issue.

Note that if both candidates campaign hardest on the same issue, a candidate may campaign with the greatest intensity on his *weakest* issue, the issue of the comparative disadvantage. The reason for this is, as before, that when an issue is important, persuasion is also important, and so independent of comparative advantages it may be worthwhile to campaign intensely on an important issue:

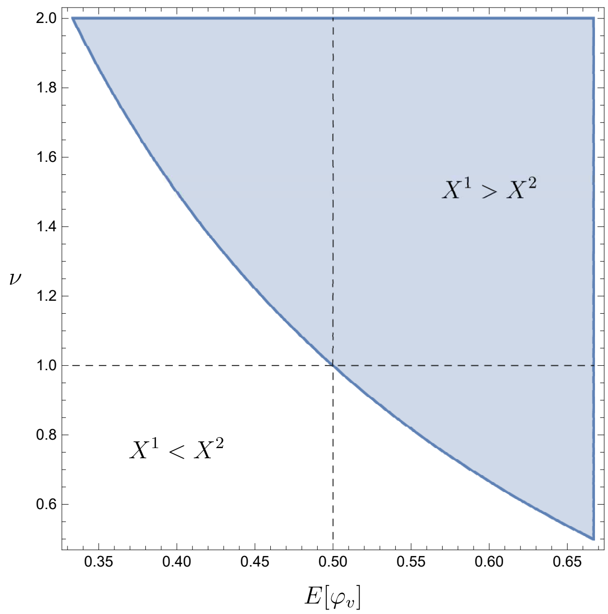

Figure 1: aggregate campaign agendas as a function of ν and $E[\varphi_v]$.

Example 1 (Continued)**:** *D spends more on issue 2 than on issue 1 if*

$$E[\varphi_v] < \frac{1}{2} - \frac{2\eta\left(E[\theta_v^1] - E[\theta_v^2]\right)}{\kappa}.$$

For example, if $\eta = \frac{1}{10}$, $\kappa = \frac{1}{4}$, $E[\theta_v^1] = \frac{55}{100}$, $E[\theta_v^2] = \frac{45}{100}$, *and* $E[\varphi_v] = \frac{2}{5}$, *then* $x_D^1 = \frac{7}{15} < \frac{8}{15} = x_D^2$, *and hence D spends most of his budget on his weakest issue.*

5 Implications: Candidate Selection and Nomination

So far the focus was on understanding candidate behavior in campaign contests, but not on the consequences campaign contests have for political outcomes. In this section I will shift focus on the implications of campaign contests.

5.1 Candidate Selection

An important question is how campaign contests influence candidates' equilibrium vote shares. Bartels (1992) hypothesizes that campaign contests are likely to have no consequences at all, and he provides the following intuition:

> "*In a world where most campaigners make reasonably effective use of reasonably similar resources and technologies most of the time, much of their effort will necessarily be without visible impact, simply because every campaigner's efforts are balanced against more or less equally effective efforts to produce the opposite effect.*"
>
> (Bartels, 1992, p. 267)

In fact, many studies have derived this result formally, see for example Proposition 2 in Meirowitz (2008), Proposition 2 in Iaryczower and Mattozzi (2013), or Propositions 1 and 2 in Denter and Sisak (2015). In the next Proposition I challenge this finding and show that campaign contests tend to structurally benefit one of the candidates:

Proposition 6. *In a neighborhood of $\eta = 0$, in any interior pure strategy Nash equilibrium Candidate D benefits during the campaign if*

$$\Psi \equiv (E[\theta_v^1] - E[\theta_v^2])(X^1 - X^2) > 0,$$

Candidate R benefits if $\Psi < 0$, and no candidate benefits when $\Psi = 0$.

Absent comparative advantages, no candidate benefits and the campaign contests remains neutral. This result makes intuitive sense, because in this case perceived competence does not change and since it is equal in both issues, shifting issue weights has no consequence for candidate selection. Similarly, if $X^1 = X^2$, relative issue importance does not change, and hence changes in issue specific candidate evaluation balance each other out. However, when candidates have comparative advantages agenda setting starts to become important. Having a comparative advantage on an issue means one further improves one's standing with the voters on that issue, but loses on the other issue. Whether or not this is beneficial depends on whether or not the issue of the comparative advantage becomes more important during the campaign contest or not. This way, the intuitions derived in Sections 4.2.1 for relative issue emphasis and 4.2.2 for campaign agendas *together* determine which candidate can use the campaign contest to the own advantage.

Proposition 6 shows who benefits from the campaign contest, but the formal analysis focussed on the case when $\eta \approx 0$. A relevant question is now whether the result stated in the proposition is robust. The following example shows that the underlying intuition is valid more generally, that is when η is strictly positive:

Example 1 (Continued)**:** *In an interior pure strategy Nash equilibrium Candidate D benefits during the campaign if*

$$\Psi \equiv (E[\theta_v^1] - E[\theta_v^2])(X^1 - X^2) > 0,$$

Candidate R benefits if $\Psi < 0$, and no candidate benefits when $\Psi = 0$.

At this moment it is useful to relate the implications of a campaign with both priming and persuasion to a campaign where one of the two effects is absent. Propositions 1 and 2 characterize equilibrium in these cases. A campaign that does not prime leads to perfect convergence and this implies that no candidate benefits from the campaign contest, as issues' weights remain unchanged and relative competence remains unchanged as an equilibrium outcome. A campaign that does not persuade but primes leads to perfect divergence, and again no candidate benefits from the campaign contest, as relative competence remains constant and issues' relative weights remain constant as well. The analysis in this section reveals that the campaign contest affects winning probabilities only if both effects play a role at the same time. Hence, the integrated model is necessary not only to derive the results on imperfect convergence, but also to

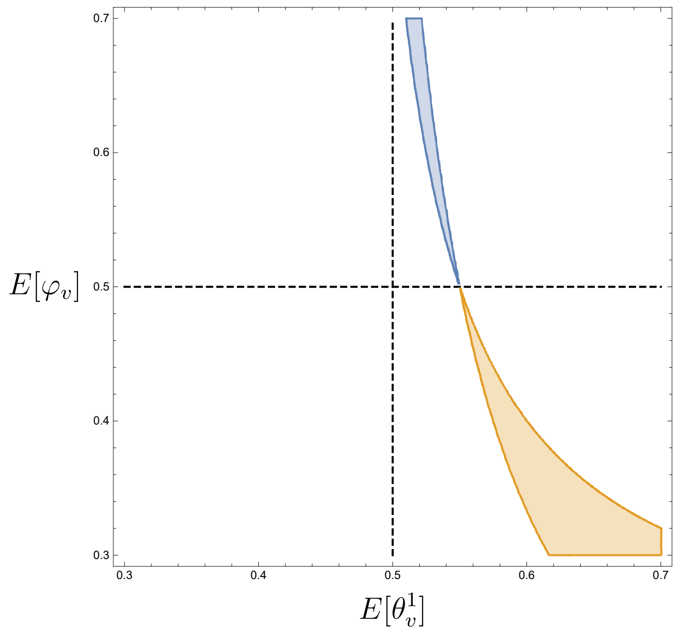

Figure 2: A campaign with $\eta = \frac{1}{10}$, $\kappa = \frac{1}{2}$, and $E[\theta_v^2] = \frac{45}{100}$. To the right of the solid line D's equilibrium vote share π_D^{EQ} is greater than 50 percent. To the right of the dashed line D's initial vote share π_D^0 is greater than 50 percent. In the upper, blue-shaded area below the solid and above the dashed line D loses the majority during the campaign contest, while in the lower, brown shaded area below the dashed and above the solid line D gains a majority.

understand the implications of campaign contests for candidate selection on Election Day.

5.2 Candidate Nomination

Understanding how campaign contests influence candidate selection on Election Day of course has important consequences for optimal candidate nomination. Assuming office motivation, the right candidate is the one that maximizes the chances of getting elected or the one maximizing the expected vote share of the party. The important question is, therefore, which candidate from a given candidate pool achieves this goal. Our above analysis reveals that the a priori popularity of a candidate is no sufficient reason to choose a candidate. Rather, the potential to develop in the campaign contest needs to be taken into account to make a good judgement. If this potential, captured by Ψ, is sufficiently large, an a priori less popular contender may in fact be the expected winner of an election. We show this by way of an example:

Example 1 (Continued)**:** *Assume $E[\theta_v^1] > E[\theta_v^2]$, $E[\varphi_v] > \frac{1}{2}$, and $u^0 < \frac{1}{2}$, i.e., that D is the less popular candidate at the campaign outset. Candidate D is able to turn this initial disadvantage into an advantage during the campaign contest if*

$$\eta > \frac{\frac{1}{2} - E\left[\theta_v^1\varphi_v + \theta_v^2(1-\varphi_v)\right]}{2(1 - E\left[\theta_v^1 + \theta_v^2\right]}.$$

The example shows that indeed the a priori weaker candidate might have better chances to win the election than his seemingly stronger contender. This leads us back to the question posed in the first paragraph of the introduction: is it possible that a candidate who initially trails his contender by 5 percentage points is the actually stronger candidate? Consider Example 1 and let $\omega^1 = \frac{1}{4}$, $\omega^2 = \frac{59}{100}$, $\varphi = \frac{1}{3}$, $\eta = \frac{85}{1000}$, and $\kappa = \frac{1}{2}$. Then the campaign contest has a unique interior pure strategy equilibrium and D's vote share increases from $\theta^1\varphi + \theta^2(1-\varphi) = 0.475$ before the campaign contest to 0.505 after. Hence, D turns a deficit of 5 percentage points into a victory.[17] Figure 2 shows combinations of parameter values for which the identity of the stronger candidate changes endogenously during the campaign contest of Example 1. Hence, selecting candidates based on poll results may be misguided.[18]

While it is tempting to use polling figures to judge a candidate's chances to succeed in an election, the model suggests that a comparison of before-nomination poll results may be a bad guide for candidate selection. Initial popularity does not say anything about a candidate's *potential to develop* during the campaign contest. This potential is captured by Ψ. Of course, all else equal, greater popularity is a good thing, but typically candidates are not identical and thus a candidates' potential to develop during the contest should be taken into account as well. A candidate's identity influences the campaign contest and therefore also equilibrium campaigning. Candidates' comparative advantages matter for their potential to develop during the campaign contest. Therefore, the currently more popular candidate could well be a bad choice as a running candidate, if the goal is to maximize electoral prospects.

A candidate may not only stand for issue specific qualities, but may just by her or his presence in the campaign contest prime some issues; that is, a candidate's identity may influence the distribution of φ_v^i. For example, because of the Benghazi affairs, Hillary Clinton being the candidate for presidential office 'primed' issues like *Trustworthiness* and *Leadership*, which turned out to be major obstacles in her campaign.[19] With Bernie Sanders as the running candidate, these issues might have been less important

[17] Prato and Wolton (2018) also show that under certain conditions the ex-ante less popular candidate might structurally benefit during a campaign contest. In their paper, which only has one policy dimension, this is the case if the race is imbalanced due to partisan preferences. In the current paper I uncover a new channel for such the a priori less popular candidate to benefit from the campaign contest. Moreover, in Prato and Wolton (2018) the a priori less popular candidate remains less popular, even though the gap may become smaller. To the contrary, the current model shows that in some campaigns the a priori less popular candidate can be actually the stronger candidate.

[18] Of course, the quality of a candidate is often judged based on poll results. For example, the Democratic Party in the US was faced with a similar question in 2016. Donald Trump was already selected as the candidate of the Republican Party, but both Hillary Clinton and Bernie Sanders were still in the race of the Democratic Party. In the end, Hillary Clinton won the nomination, but she lost the election on November 8, 2016. After this defeat, many have questioned that she was the optimal candidate to challenge Donald Trump, and that Bernie Sanders would have been a better choice. For example, USA Today cast doubt on the optimality of her nomination, citing polls that saw Bernie Sanders relatively stronger vis-á-vis Donald Trump: "*The RealClearPolitics average from May 6-June 5 had Sanders at 49.7% to Trump's 39.3%, a 10.4-point cushion. In that same time frame, Trump was polling close to Clinton and was even ahead in multiple polls.*" (source: `https://www.usatoday.com/story/news/politics/onpolitics/2016/11/09/bernie-sanders-donald-trump/93530352/` (last retrieved: June 6, 2019)). Similarly, early in 2017 Angela Merkel, the then sitting chancellor of Germany, announced to run again as her party's (CDU) candidate in the general election in Germany. The Social Democratic Party of Germany (SPD), the CDU's main contender, had not yet decided on a candidate, but soon after Angela Merkel's decision selected Martin Schulz, the president of the European Parliament at the time, over the then acting Federal Minister for Economic Affairs and Energy and vice chancellor of Germany, Sigmar Gabriel. The justification for this, it seems, was that according to public opinion polls Schulz had better chances to beat Merkel in an election. For example, Reuters wrote the following: "*Opinion polls suggest Schulz, 61, has a better chance than Gabriel – though still very small – of unseating the conservative Merkel, who has led Germany since 2005 and is Europe's most powerful leader.*" (source: `https://www.reuters.com/article/us-germany-election-spd/german-spd-chief-gabriel-makes-way-for-schulz-to-run-against-merkel-idUSKBN15824X` (last retrieved: June 6, 2019)).

[19] For example, Forbes reported the following: "*Days after the massacre, Clinton told a father, mother, sister and uncle before the flag-draped coffins of the four victims that an errant video maker caused their loved-ones' deaths and that she would make sure that he was brought to justice. The tearful relatives related to the press Clinton's words almost immediately and expressed their outrage that she would lie to them on such an occasion." Source:* `https://www.forbes.com/sites/`

and others would have been considered more important instead. Of course, this form of issue priming is another important determinant for optimal candidate nomination. In particular, optimal nomination should be such that the selected candidate primes the own strength rather then the own weakness.

6 Conclusion

In this paper I have developed a model of campaign contests, in which candidates compete for electoral success by spending time or money on different policy issues. The novelty is that I allow for simultaneous issue priming and persuasion. This allows me to develop a whole new set of testable predictions about candidate behavior, which have important consequences for candidate selection on Election Day and optimal candidate nomination.

The main results are the following: While persuasion aligns candidates' incentives in the campaign to campaign on a certain issue, priming drives a wedge between them. I develop a notion of comparative advantage that determines the size of this wedge and determines whether or not candidates campaign with similar intensities on an issue or not. Generally, a candidate who enjoys a comparative advantage on an issue addresses this issue with greater intensity than his competitor. I show that this relative issue emphasis together with the aggregate emphasis issues receive determines which candidate cna use the campaign to the own advantage. In particular, having comparative advantage on an issue on which candidates campaign with great intensity is beneficial and allows a candidate to increase his electoral support during the campaign contest. This may even go so far that an a priori less popular candidate might actually be stronger than his contender, once equilibrium campaigning is taken into account. This has important implication for optimal candidate nomination, as a candidate's potential to develop and thrive during the campaign contest matters.

A Mathematical Appendix

A.1 Proof of Proposition 1

Candidates' strategy spaces are convex and compact, as $x_j^1 \in [0, B]$. Also note that individual payoff functions are continuous in all variables by Assumptions 1 and 2. To ensure existence of a pure strategy Nash equilibrium, it hence suffices to show that payoff functions are strictly quasi-concave in x_j^1, because this allows us to apply standard results (see for example Theorem 1.2 in Fudenberg and Tirole, 1991).

When $\eta = 0$, the first derivative of j's payoff function is

$$\begin{aligned}
\left.\frac{\partial \pi_D(\mathbf{x})}{\partial x_D^1}\right|_{\eta=0} &= E\left[\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1}\varphi_v + \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2}\frac{dx_D^2}{dx_D^1}(1-\varphi_v)\right] \\
&= E\left[\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1}\varphi_v - \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2}(1-\varphi_v)\right] \\
\left.\frac{\partial \pi_R(\mathbf{x})}{\partial x_R^1}\right|_{\eta=0} &= E\left[-\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_R^1}\varphi_v - \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_R^2}\frac{dx_R^2}{dx_R^1}(1-\varphi_v)\right] \\
&= E\left[-\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_R^1}\varphi_v + \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_R^2}(1-\varphi_v)\right]
\end{aligned}$$

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and

$$\begin{aligned}
\left.\frac{\partial^2 \pi_D(\mathbf{x})}{\partial (x_D^1)^2}\right|_{\eta=0} &= E\left[\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial (x_D^1)^2}\varphi_v - \frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial (x_D^2)^2}\frac{dx_D^2}{dx_D^1}(1-\varphi_v)\right] \\
&= E\left[\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial (x_D^1)^2}\varphi_v + \frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial (x_D^2)^2}(1-\varphi_v)\right] < 0, \\
\left.\frac{\partial^2 \pi_R(\mathbf{x})}{\partial (x_R^1)^2}\right|_{\eta=0} &= E\left[-\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial (x_R^1)^2}\varphi_v + \frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial (x_R^2)^2}\frac{dx_R^2}{dx_R^1}(1-\varphi_v)\right] \\
&= E\left[-\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial (x_R^1)^2}\varphi_v - \frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial (x_R^2)^2}(1-\varphi_v)\right] < 0,
\end{aligned}$$

implying individual payoffs are strictly concave and thus also quasi-concave. Hence, equilibrium exists.

Next turn to the second part of the proposition. The following lemma is very useful:

Lemma 1.

$$\left.\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i}\right|_{x_D^i=x_R^i} = -\left.\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_R^i}\right|_{x_D^i=x_R^i} = \left.\frac{\partial c(\mathbf{x}^i,1-\theta_v^i)}{\partial x_D^i}\right|_{x_D^i=x_R^i} = -\left.\frac{\partial c(\mathbf{x}^i,1-\theta_v^i)}{\partial x_R^i}\right|_{x_D^i=x_R^i}$$

Proof. By Assumption 2, $c(x,x,\theta_v^i)=\theta_v^i$. Thus,

$$\left.\frac{\partial c(x_D^i,x_R^i,\theta_v^i)}{\partial x_D^i}\right|_{x_D^i=x_R^i} + \left.\frac{\partial c(x_D^i,x_R^i,\theta_v^i)}{\partial x_R^i}\right|_{x_D^i=x_R^i} = 0 \Leftrightarrow \left.\frac{\partial c(x_D^i,x_R^i,\theta_v^i)}{\partial x_D^i}\right|_{x_D^i=x_R^i} = -\left.\frac{\partial c(x_D^i,x_R^i,\theta_v^i)}{\partial x_R^i}\right|_{x_D^i=x_R^i}$$

and of course as well

$$\left.\frac{\partial c(x_D^i,x_R^i,1-\theta_v^i)}{\partial x_D^i}\right|_{x_D^i=x_R^i} = -\left.\frac{\partial c(x_D^i,x_R^i,1-\theta_v^i)}{\partial x_R^i}\right|_{x_D^i=x_R^i}.$$

Moreover, also by Assumption 2, $c(x,y,\theta_v^i)=1-c(y,x,1-\theta_v^i)$ and thus $\frac{\partial c(x,y,\theta_v^i)}{\partial x} = -\frac{\partial c(y,x,1-\theta_v^i)}{\partial x}$ and of course as well

$$\left.\frac{\partial c(x,y,\theta_v^i)}{\partial x}\right|_{x=y} = -\left.\frac{\partial c(y,x,1-\theta_v^i)}{\partial x}\right|_{x=y}.$$

Therefore,

$$-\left.\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_R^i}\right|_{x_D^i=x_R^i} = \left.\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i}\right|_{x_D^i=x_R^i} = -\left.\frac{\partial c(\mathbf{x}^i,1-\theta_v^i)}{\partial x_R^i}\right|_{x_D^i=x_R^i} = \left.\frac{\partial c(\mathbf{x}^i,1-\theta_v^i)}{\partial x_D^i}\right|_{x_D^i=x_R^i},$$

which proves the lemma. □

When candidates choose identical spending profiles, they have the same marginal utility of campaigning on the different issues. An implication is that if the current spending profile is either $(x_D^1,x_R^1)=(0,0)$ or $(x_D^1,x_R^1)=(B,B)$, if D has no incentive to deviate neither has R and vice versa.

To proceed we need one more lemma:

Lemma 2. *If* $c(\mathbf{x}^i, \theta_v^i) \in (0,1)$,

$$-\frac{\dfrac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i}}{\dfrac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i}} \left\{\begin{array}{c} > \\ = \\ < \end{array}\right\} 1 \quad \textit{if} \quad x_D^i - x_R^i \left\{\begin{array}{c} < \\ = \\ > \end{array}\right\} 0.$$

Proof. First note that by Lemma 1

$$\left.\frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i}\right|_{x_D^i = x_R^i} + \left.\frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i}\right|_{x_D^i = x_R^i} = 0 \Leftrightarrow \rho^i(\mathbf{x}^i, \theta_v^i) \equiv -\frac{\left.\frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i}\right|_{x_D^i = x_R^i}}{\left.\frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i}\right|_{x_D^i = x_R^i}} = 1.$$

Now take the derivative of $\rho^i(\mathbf{x}^i, \theta_v^i)$ with respect to x_D^i:

$$\frac{\partial \rho^i(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i} = -\frac{\dfrac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial (x_D^i)^2}\dfrac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i} - \dfrac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i}\dfrac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i \partial x_D^i}}{\left(\dfrac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i}\right)^2}.$$

This is negative if and only if

$$\begin{aligned}
&-\left(\frac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial (x_D^i)^2}\frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i} - \frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i}\frac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i \partial x_D^i}\right) < 0 \\
&\Leftrightarrow \frac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial (x_D^i)^2}\frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i} - \frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i}\frac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i \partial x_D^i} > 0 \\
&\Leftrightarrow \frac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial (x_D^i)^2}\frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i} > \frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i}\frac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i \partial x_D^i} \Leftrightarrow \frac{\dfrac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial (x_D^i)^2}\dfrac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i}}{\dfrac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i}} > \frac{\partial^2 c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i \partial x_D^i}
\end{aligned}$$

This is the case by Assumption 4 and hence $\rho^i(\mathbf{x}^i, \theta_v^i)$ is monotone decreasing in x_D^i. In a similar way we can prove that $\rho^i(\mathbf{x}^i, \theta_v^i)$ monotonically increases in x_R^i. Thus,

$$\rho^i(\mathbf{x}^i, \theta_v^i) \left\{\begin{array}{c} > \\ = \\ < \end{array}\right\} 1 \quad \text{if} \quad x_D^i - x_R^i \left\{\begin{array}{c} < \\ = \\ > \end{array}\right\} 0,$$

which proves the lemma. ∎

Note that the lemma implies that when $x_D^i > x_R^i$, $\frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i} < \frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i}$ and vice versa:

Corollary 1.

$$\frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_D^i} + \frac{\partial c(\mathbf{x}^i, \theta_v^i)}{\partial x_R^i} \left\{\begin{array}{c} > \\ = \\ < \end{array}\right\} 0 \quad \textit{if} \quad x_D^i - x_R^i \left\{\begin{array}{c} < \\ = \\ > \end{array}\right\} 0.$$

The marginal product of persuasion of Candidate D relative to Candidate R depends on who spends more on the issue so far, independent of θ_v^i. Hence, an equilibrium in which only one candidate campaigns on issue i and the other chooses zero effort cannot exist. When equilibrium is not interior, both candidates choose the same level of effort on issue 1 and hence converge completely.

Next consider the first order conditions. In an interior equilibrium, both FOCs need to hold simultaneously. Thus,

$$\begin{aligned} E\left[\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1}\varphi_v - \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2}(1-\varphi_v)\right] = 0 = E\left[-\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_R^1}\varphi_v + \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_R^2}(1-\varphi_v)\right] \\ \Leftrightarrow E\left[\left(\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1} + \frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_R^1}\right)\varphi_v\right] = E\left[\left(\frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2} + \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_R^2}\right)(1-\varphi_v)\right] \end{aligned} \tag{A.1}$$

By Lemma 1, (A.1) holds if $x_D^1 = x_R^1$, as both the LHS and RHS are zero. Now assume $x_D^1 \neq x_R^1$, for example $x_D^1 > x_R^1$. Then the LHS of (A.1) is negative, while the RHS is positive, because $x_D^1 > x_R^1 \Leftrightarrow x_D^2 < x_R^2$. Hence, this cannot be the case in interior equilibrium. Similarly, $x_D^1 < x_R^1$ is not possible either. Hence, in any interior equilibrium, both candidates campaign with identical intensity on all issues, $x_D^i = x_R^i$ for $i = 1, 2$, and thus they converge completely.

To prove uniqueness, evaluate the first order condition given $x_D^1 = x_R^1 = x^1$ and reorganize:

$$E\left[\frac{\left.\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1}\right|_{x_j^1=x^1}}{\left.\frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2}\right|_{x_j^1=x^1}}\right] = E\left[\frac{1-\varphi_v}{\varphi_v}\right].$$

If we can show that this is monotone in x^1 equilibrium must be unique. Taking the derivative with respect to x^1 yields

$$E\left[\frac{\left.\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1}\right|_{x_j^1=x^1}\left(\left.\frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^1\partial x_R^1}\right|_{x_j^1=x^1} + \left.\frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial (x_D^1)^2}\right|_{x_j^1=x^1}\right) + \left.\frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^1}\right|_{x_j^1=x^1}\left(\left.\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1\partial x_R^1}\right|_{x_j^1=x^1} + \left.\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial (x_D^1)^2}\right|_{x_j^1=x^1}\right)}{\left(\left.\frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^1}\right|_{x_j^1=x^1}\right)^2}\right], \tag{A.2}$$

where we already used that $dx_j^2/dx_j^1 = -1$. If this is strictly positive or strictly negative equilibrium is unique. To determine the sign of this we need a last lemma:

Lemma 3.

$$\left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i \partial x_R^i}\right|_{x_j^1=x^1} = -\frac{1}{2}\left(\left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial (x_D^i)^2}\right|_{x_j^1=x^1} + \left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial (x_R^i)^2}\right|_{x_j^1=x^1}\right).$$

Proof. We know from Lemma 1 that $\left.\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i}\right|_{x_D^i=x_R^i=x^i} + \left.\frac{\partial c(\mathbf{x}^i,\theta_v^i)}{\partial x_R^i}\right|_{x_D^i=x_R^i=x^i} = 0$. Totally differentiating with respect to x^i yields

$$\left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial (x_D^i)^2}\right|_{x_D^i=x_R^i=x^i} + \left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i \partial x_R^i}\right|_{x_D^i=x_R^i=x^i} + \left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial (x_R^i)^2}\right|_{x_D^i=x_R^i=x^i} + \left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i \partial x_R^i}\right|_{x_D^i=x_R^i=x^i} = 0$$
$$\Leftrightarrow \left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial x_D^i \partial x_R^i}\right|_{x_D^i=x_R^i=x^i} = -\frac{1}{2}\left(\left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial (x_D^i)^2}\right|_{x_D^i=x_R^i=x^i} + \left.\frac{\partial^2 c(\mathbf{x}^i,\theta_v^i)}{\partial (x_R^i)^2}\right|_{x_D^i=x_R^i=x^i}\right),$$

which is the condition stated in the lemma. □

Using the lemma condition (A.2) simplifies to

$$E\left[\frac{\left.\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1}\right|_{x_j^i=x^i}\left(\left.\frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial (x_D^1)^2}\right|_{x_j^i=x^i} - \left.\frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial (x_R^1)^2}\right|_{x_j^i=x^i}\right) + \left.\frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^1}\right|_{x_j^i=x^i}\left(\left.\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial (x_D^1)^2}\right|_{x_j^i=x^i} - \left.\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial (x_R^1)^2}\right|_{x_j^i=x^i}\right)}{2\left(\left.\frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^1}\right|_{x_j^i=x_i}\right)^2}\right] < 0.$$

In a similar fashion we can establish the result using the first order condition of candidate R. Thus, equilibrium is unique, which proves the proposition. □

A.2 Proof of Proposition 2

If campaigning only primes issues, the first derivative of j's payoff function is

$$\begin{aligned}
\left.\frac{\partial \pi_D(\mathbf{x})}{\partial x_D^1}\right|_{c(\mathbf{x}^i,\theta_v^i)=\theta_v^i \forall i,v} &= E\left[\left(\theta_v^1-\theta_v^2\right)\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_D^1} + \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_D^2}\frac{dx_D^2}{dx_D^1}\right)\right] \\
&= E\left[\left(\theta_v^1-\theta_v^2\right)\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_D^1} - \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_D^2}\right)\right] \\
&= E\left[\left(\theta_v^1-\theta_v^2\right)\right] E\left[\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_D^1} - \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_D^2}\right)\right] \\
\left.\frac{\partial \pi_R(\mathbf{x})}{\partial x_R^1}\right|_{c(\mathbf{x}^i,\theta_v^i)=\theta_v^i \forall i,v} &= -E\left[\left(\theta_v^1-\theta_v^2\right)\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^1} + \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^2}\frac{dx_R^2}{dx_R^1}\right)\right] \\
&= -E\left[\left(\theta_v^1-\theta_v^2\right)\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^1} - \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^2}\right)\right] \\
&= -E\left[\left(\theta_v^1-\theta_v^2\right)\right] E\left[\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^1} - \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^2}\right)\right]
\end{aligned}$$

Note that $\text{Sign}\left[E\left[\left(\theta_v^1-\theta_v^2\right)\right]\right] = \text{Sign}[\sigma^1]$, as

$$\text{Sign}\left[\sigma^1\right] = \text{Sign}\left[E[\theta_v^1] - \frac{1}{2}\left(\theta_v^1+\theta_v^2\right)\right] = \text{Sign}\left[E\left[\theta_v^1-\theta_v^2\right]\right].$$

Therefore, if $\sigma^1 = \sigma^2 = 0$, any combination of strategies is a Nash equilibrium, as campaigning has no effect whatsoever. Otherwise, i.e., when $\sigma^1 > 0$ and $\sigma^2 < 0$, D spends all of his budget on issue 1 and R spends all of his budget on issue 2, because $E\left[\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^1} - \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x_R^2}\right)\right] > 0$, and the opposite is true when $\sigma^1 < 0$ and $\sigma^2 > 0$. In other words, candidates never campaign on the same issue and thus they diverge completely. □

A.3 Proof of Proposition 3

When η is small the proof follows by a continuity argument from the proof of Proposition 1 and implies also uniqueness. However, for larger η it is not clear that utilities are quasi-concave. Baye et al. (1993) provide sufficient conditions for existence of a pure strategy Nash equilibrium when payoffs may fail to be quasi-concave. In particular, (i) strategy spaces eed to be convex and compact and the aggregator function $U^{agg}(\mathbf{x}) \equiv u_D(\mathbf{x}) + u_R(\mathbf{x})$ needs to be (ii) diagonally transfer continuous and (iii) diagonally transfer quasi-concave. (i) clearly holds by assumption. (ii) follows from Proposition 2 of Baye et al. (1993), as both u_D and u_R are continuous, which is a weaker condition than diagonal transfer continuity. Finally, U^{agg} is constant $(= 1)$ and thus quasi-concave, which by Proposition 1 of Baye et al. (1993) is sufficient for diagonal transfer quasi-concavity. Thus, a pure strategy Nash equilibrium exists. Moreover, a corner equilibrium cannot exists as the marginal product of x_j^i would be either plus $(x_j^i = 0)$ or minus infinity $(x_j^i = B)$. Consequently, each payoff function has an interior maximum and at this maximum the payoff functions must be concave. Hence, Nash equilibria are determined by the respective first-order conditions.

A.4 Proof of Proposition 4

The candidates' respective objective is to maximize

$$\begin{aligned}
\pi_D(\mathbf{x}) &= E\left[c(\mathbf{x}^1, \theta_v^1) w(\mathbf{x}, \varphi_v) + c(\mathbf{x}^2, \theta_v^2)\left(1 - w(\mathbf{x}, \varphi_v)\right)\right] \;\; s.t.\; x_D^1 + x_D^2 = B \\
\pi_R(\mathbf{x}) &= E\left[\left(1 - c(\mathbf{x}^1, \theta_v^1)\right) w(\mathbf{x}, \varphi_v) + \left(1 - c(\mathbf{x}^2, \theta_v^2)\right)\left(1 - w(\mathbf{x}, \varphi_v)\right)\right] \;\; s.t.\; x_R^1 + x_R^2 = B
\end{aligned} \tag{A.3}$$

If an interior equilibrium exists, it is determined by the system of first order conditions, which are

$$\begin{aligned}
\frac{\partial \pi_D(\mathbf{x})}{\partial x_D^1} &= E\left[\frac{\partial c(\mathbf{x}^1, \theta_v^1)}{\partial x_D^1} w(\mathbf{x}, \varphi_v^1) + \frac{\partial c(\mathbf{x}^2, \theta_v^2)}{\partial x_D^2} \frac{dx_D^2}{dx_D^1}\left(1 - w(\mathbf{x}, \varphi_v^1)\right)\right] \\
&+ E\left[\left(c(\mathbf{x}^1, \theta_v^1) - c(\mathbf{x}^2, \theta_v^2)\right)\left(\frac{\partial w(\mathbf{x}, \varphi_v)}{\partial x_D^1} + \frac{\partial w(\mathbf{x}, \varphi_v)}{\partial x_D^2}\frac{dx_D^2}{dx_D^1}\right)\right] \\
&= E\left[\frac{\partial c(\mathbf{x}^1, \theta_v^1)}{\partial x_D^1} w(\mathbf{x}, \varphi_v^1) - \frac{\partial c(\mathbf{x}^2, \theta_v^2)}{\partial x_D^2}\left(1 - w(\mathbf{x}, \varphi_v^1)\right)\right] \\
&+ E\left[\left(c(\mathbf{x}^1, \theta_v^1) - c(\mathbf{x}^2, \theta_v^2)\right)\left(\frac{\partial w(\mathbf{x}, \varphi_v)}{\partial x_D^1} - \frac{\partial w(\mathbf{x}, \varphi_v)}{\partial x_D^2}\right)\right] \\
\frac{\partial \pi_R(\mathbf{x})}{\partial x_R^1} &= E\left[-\frac{\partial c(\mathbf{x}^1, \theta_v^1)}{\partial x_R^1} w(\mathbf{x}, \varphi_v^1) - \frac{\partial c(\mathbf{x}^2, \theta_v^2)}{\partial x_R^2} \frac{dx_R^2}{dx_R^1}\left(1 - w(\mathbf{x}, \varphi_v^1)\right)\right] \\
&- E\left[\left(c(\mathbf{x}^1, \theta_v^1) - c(\mathbf{x}^2, \theta_v^2)\right)\left(\frac{\partial w(\mathbf{x}, \varphi_v)}{\partial x_R^1} + \frac{\partial w(\mathbf{x}, \varphi_v)}{\partial x_R^2}\frac{dx_R^2}{dx_R^1}\right)\right] \\
&= E\left[-\frac{\partial c(\mathbf{x}^1, \theta_v^1)}{\partial x_R^1} w(\mathbf{x}, \varphi_v^1) + \frac{\partial c(\mathbf{x}^2, \theta_v^2)}{\partial x_R^2}\left(1 - w(\mathbf{x}, \varphi_v^1)\right)\right] \\
&- E\left[\left(c(\mathbf{x}^1, \theta_v^1) - c(\mathbf{x}^2, \theta_v^2)\right)\left(\frac{\partial w(\mathbf{x}, \varphi_v)}{\partial x_R^1} - \frac{\partial w(\mathbf{x}, \varphi_v)}{\partial x_R^2}\right)\right]
\end{aligned} \tag{A.4}$$

Note that $\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x^i_R} = \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x^i_D} = \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x^i}$. In any interior equilibrium it needs to hold that:

$$
\begin{aligned}
& E\left[\left(\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1} + \frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_R^1}\right) w(\mathbf{x},\varphi_v^1) - \left(\frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2} + \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_R^2}\right)\left(1 - w(\mathbf{x},\varphi_v^1)\right)\right] \\
= \; & -2E\left[\left(c(\mathbf{x}^1,\theta_v^1) - c(\mathbf{x}^2,\theta_v^2)\right)\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x^1} - \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x^2}\right)\right] \\
= \; & -2E\left[\left(c(\mathbf{x}^1,\theta_v^1) - c(\mathbf{x}^2,\theta_v^2)\right)\right] E\left[\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x^1} - \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x^2}\right)\right]
\end{aligned}
$$

Note that when $x_D^1 > x_R^1$ we also have $x_D^2 < x_R^2$. By Corollary 1 this means that

$$
\begin{aligned}
\text{Sign}\left[E\left[\left(\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1} + \frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_R^1}\right) w(\mathbf{x},\varphi_v^1) - \left(\frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^2} + \frac{\partial c(\mathbf{x}^2,\theta_v^2)}{\partial x_R^2}\right)\left(1 - w(\mathbf{x},\varphi_v^1)\right)\right]\right] \\
= -\text{Sign}[x_D^1 - x_R^1].
\end{aligned}
$$

Consequently, in any interior equilibrium

$$
\begin{aligned}
-\text{Sign}[x_D^1 - x_R^1] = \text{Sign}\left[-2E\left[\left(c(\mathbf{x}^1,\theta_v^1) - c(\mathbf{x}^2,\theta_v^2)\right)\right] E\left[\left(\frac{\partial w(\mathbf{x},\varphi_v)}{\partial x^1} - \frac{\partial w(\mathbf{x},\varphi_v)}{\partial x^2}\right)\right]\right] \\
\Leftrightarrow \text{Sign}[x_D^1 - x_R^1] = \text{Sign}\left[E\left[\left(c(\mathbf{x}^1,\theta_v^1) - c(\mathbf{x}^2,\theta_v^2)\right)\right]\right].
\end{aligned}
$$

To see that this also implies that $\text{Sign}[x_D^1 - x_R^1] = \text{Sign}\left[E\left[\theta_v^1 - \theta_v^2\right]\right]$, we prove the following lemma:

Lemma 4.

$$
Sign\left[\left.\frac{\partial x_D^1}{\partial \eta}\right|_{\eta=0} - \left.\frac{\partial x_R^1}{\partial \eta}\right|_{\eta=0}\right] = Sign\left[E\left[\theta_v^1 - \theta_v^2\right]\right].
$$

Proof. To derive comparative statics of spending with respect to η we totally differentiate the system of first-order conditions and evaluate the result at $\eta = 0$. Totally differentiating the FOCs and evaluating the result at $\eta = 0$ yields

$$
\begin{aligned}
\left.\frac{\partial^2 \pi_D(\mathbf{x})}{\partial (x_D^1)^2}\right|_{\eta=0} &= E[\varphi_v] E\left[\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial (x_D^1)^2}\right] + (1 - E[\varphi_v]) E\left[\frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial (x_D^1)^2}\right] \\
\left.\frac{\partial^2 \pi_D(\mathbf{x})}{\partial x_D^1 \partial x_R^1}\right|_{\eta=0} &= E[\varphi_v] E\left[\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1 \partial x_R^1}\right] + (1 - E[\varphi_v]) E\left[\frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^1 \partial x_R^1}\right] \\
\left.\frac{\partial^2 \pi_D(\mathbf{x})}{\partial x_D^1 \partial \eta}\right|_{\eta=0} &= -2(g(X^1) - g(X^2)) E\left[\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1}\right] - E\left[\theta_v^1 - \theta_v^2\right]\left(g'(X^1) + g'(X^2)\right) \\
\left.\frac{\partial^2 \pi_R(\mathbf{x})}{\partial x_D^1 \partial x_R^1}\right|_{\eta=0} &= -E[\varphi_v] E\left[\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial x_D^1 \partial x_R^1}\right] - (1 - E[\varphi_v]) E\left[\frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial x_D^1 \partial x_R^1}\right] \\
\left.\frac{\partial^2 \pi_R(\mathbf{x})}{\partial (x_R^1)^2}\right|_{\eta=0} &= -E[\varphi_v] E\left[\frac{\partial^2 c(\mathbf{x}^1,\theta_v^1)}{\partial (x_R^1)^2}\right] - (1 - E[\varphi_v]) E\left[\frac{\partial^2 c(\mathbf{x}^2,\theta_v^2)}{\partial (x_R^1)^2}\right] \\
\left.\frac{\partial^2 \pi_R(\mathbf{x})}{\partial x_R^1 \partial \eta}\right|_{\eta=0} &= 2(g(X^1) - g(X^2)) E\left[\frac{\partial c(\mathbf{x}^1,\theta_v^1)}{\partial x_R^1}\right] + E\left[\theta_v^1 - \theta_v^2\right]\left(g'(X^1) + g'(X^2)\right)
\end{aligned}
$$

Define

$$
M = \begin{pmatrix} \frac{\partial^2 \pi_D}{\partial (x_D^1)^2} & \frac{\partial^2 \pi_D}{\partial x_D^1 \partial x_R^1} \\ \frac{\partial^2 \pi_R}{\partial x_D^1 \partial x_R^1} & \frac{\partial^2 \pi_R}{\partial (x_R^1)^2} \end{pmatrix}, \quad M_D = \begin{pmatrix} -\frac{\partial^2 \pi_D}{\partial x_D^1 \partial \eta} & \frac{\partial^2 \pi_D}{\partial x_D^1 \partial x_R^1} \\ -\frac{\partial^2 \pi_R}{\partial x_R^1 \partial \eta} & \frac{\partial^2 \pi_R}{\partial (x_R^1)^2} \end{pmatrix}, \quad \text{and} \quad M_R = \begin{pmatrix} \frac{\partial^2 \pi_D}{\partial (x_D^1)^2} & -\frac{\partial^2 \pi_D}{\partial x_D^1 \partial \eta} \\ \frac{\partial^2 \pi_R}{\partial x_D^1 \partial x_R^1} & -\frac{\partial^2 \pi_R}{\partial x_R^1 \partial \eta} \end{pmatrix}.
$$

Equilibrium comparative statics are $\frac{\partial x_D^1(\eta)}{\partial \eta} = \frac{|M_D|}{|M|}$ and $\frac{\partial x_R^1(\eta)}{\partial \eta} = \frac{|M_R|}{|M|}$. Using Lemmas 1 and 3 together with $\eta = 0$ and $x^i_R = x^i_D$ yields

$$\left.\frac{\partial x^1_D}{\partial \eta}\right|_{\eta=0} - \left.\frac{\partial x^1_R}{\partial \eta}\right|_{\eta=0} = \frac{4E[\theta^1_v - \theta^2_v]\left(g'(X^1) + g'(X^2)\right)}{E\left[\varphi_v\left(\frac{\partial^2 c(\mathbf{x}^1,\theta^1_v)}{\partial (x^1_R)^2} - \frac{\partial^2 c(\mathbf{x}^1,\theta^1_v)}{\partial (x^1_D)^2}\right) + (1-\varphi_v)\left(\frac{\partial^2 c(\mathbf{x}^2,\theta^2_v)}{\partial (x^2_R)^2} - \frac{\partial^2 c(\mathbf{x}^2,\theta^2_v)}{\partial (x^2_D)^2}\right)\right]}$$

As the sign of the denominator is clearly positive, the sign of the whole expression depends on the sign of the numerator, and hence on $E[\theta^1_v - \theta^2_v]$. □

Hence, when η small but positive, the candidate with the a priori comparative advantage spends more on an issue. Say D has comparative advantage on 1. Could R spend more on this issue when η increases further? Note that spending is a continuous function of all parameters. For R to spend more on 1, continuity implies that first there must be η such that both spend the same. But that is not possible, as when both spend the same comparative advantage remains unchanged, and thus D needs to spend more on it. Moreover, could it be true that one candidate spends more than another on an issue absent comparative advantages? The answer is no again. To see this note that if $E[\theta^1_v] = E[\theta^2_v] + \epsilon$ for any $\epsilon > 0$, $x^1_D > x^1_R$. Moreover, for any $\epsilon < 0$, $x^1_D < x^1_R$. By continuity (along this sequence of equilibria), when $\epsilon = 0$, $x^1_D = x^1_R$. This implies that $\text{Sign}\left[x^1_D - x^1_R\right] = \text{Sign}\left[\theta^1_v - \theta^2_v\right]$ is generally true. □

A.5 Proof of Proposition 6

To prove the proposition, I study equilibrium when $\eta = 0$ and then totally differentiate the system of FOCs at the symmetric equilibrium:

$$E\left[\left.\frac{\partial c(\mathbf{x}^1,\theta^1_v)}{\partial x^1_j}\right|_{x^1_D = x^1_R = x^1}\right] = \frac{E[1-\varphi_v]}{E[\varphi_v]} E\left[\left.\frac{\partial c(\mathbf{x}^2,\theta^2_v)}{\partial x^2_j}\right|_{x^2_D = x^2_R = B - x^1}\right]. \tag{A.5}$$

This is the FOC for both candidates at the symmetric equilibrium.

The vote share of D as a function of η is

$$\begin{aligned}\Upsilon(\eta) = E&\left[c(\mathbf{x}^1(\eta),\theta^1_v)\left(\varphi_v + \eta\left(g(x^1_D(\eta) + x^1_R(\eta)) - g(2B - x^1_D(\eta) - x^1_R(\eta))\right)\right)\right.\\ &\left.+ c(\mathbf{x}^2(\eta),\theta^2_v)\left(1 - \left(\varphi_v + \eta\left(g(x_D(\eta)^1 + x^1_R(\eta)) - g(2B - x^1_D(\eta) - x^1_R(\eta))\right)\right)\right)\right]\end{aligned}$$

Note that $\Upsilon(0) = E[\theta^1_v\varphi_v + \theta^2_v(1-\varphi_v)]$. When η now increases, the vote shares changes in the following way:

$$\begin{aligned}\Upsilon'(\eta)|_{\eta=0 \wedge x^1_D = x^1_R = x^1} &= E[\varphi_v]\left(\left.\frac{\partial x^1_D(\eta)}{\partial \eta}\right|_{\eta=0}\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta^1_v)}{\partial x^1_D}\right|_{\eta=0} + \left.\frac{\partial x^1_R(\eta)}{\partial \eta}\right|_{\eta=0}\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta^1_v)}{\partial x^1_R}\right|_{\eta=0}\right)\\ &- (1-E[\varphi_v])\left(\left.\frac{\partial x^1_D(\eta)}{\partial \eta}\right|_{\eta=0}\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta^1_v)}{\partial x^2_D}\right|_{\eta=0} + \left.\frac{\partial x^1_R(\eta)}{\partial \eta}\right|_{\eta=0}\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta^1_v)}{\partial x^2_R}\right|_{\eta=0}\right)\\ &+ \left(E[\theta^1_v] - E[\theta^2_v]\right)\left(g(X^1) - g(X^2)\right)\end{aligned}$$

It follows from Lemma 1 that $\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta^1_v)}{\partial x^1_D}\right|_{\eta=0} = \left.\frac{\partial c(\mathbf{x}^1(\eta),\theta^1_v)}{\partial x^1_R}\right|_{\eta=0}$ and $\left.\frac{\partial c(\mathbf{x}^2(\eta),\theta^2_v)}{\partial x^2_D}\right|_{\eta=0} = \left.\frac{\partial c(\mathbf{x}^2(\eta),\theta^2_v)}{\partial x^2_R}\right|_{\eta=0}$.

Thus,

$$\begin{aligned}
\Upsilon'(\eta)\big|_{\eta=0\wedge x_D^1=x_R^1=x^1} &= E[\varphi_v]\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta_v^1)}{\partial x_D^1}\right|_{\eta=0}\left(\left.\frac{\partial x_D^1(\eta)}{\partial\eta}\right|_{\eta=0}+\left.\frac{\partial x_R^1(\eta)}{\partial\eta}\right|_{\eta=0}\right)\\
&- (1-E[\varphi_v])\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta_v^1)}{\partial x_D^2}\right|_{\eta=0}\left(\left.\frac{\partial x_D^1(\eta)}{\partial\eta}\right|_{\eta=0}+\left.\frac{\partial x_R^1(\eta)}{\partial\eta}\right|_{\eta=0}\right)\\
&+ \left(E[\theta_v^1]-E[\theta_v^2]\right)\left(g(X^1)-g(X^2)\right)\\
&= \left(E[\varphi_v]\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta_v^1)}{\partial x_D^1}\right|_{\eta=0}-(1-E[\varphi_v])\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta_v^1)}{\partial x_D^2}\right|_{\eta=0}\right)\left(\left.\frac{\partial x_D^1(\eta)}{\partial\eta}\right|_{\eta=0}+\left.\frac{\partial x_R^1(\eta)}{\partial\eta}\right|_{\eta=0}\right)\\
&+ \left(E[\theta_v^1]-E[\theta_v^2]\right)\left(g(X^1)-g(X^2)\right)
\end{aligned}$$

Finally, using (A.5) it becomes apparent that $\left(E[\varphi_v]E\left[\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta_v^1)}{\partial x_D^1}\right|_{\eta=0}\right]-(1-E[\varphi_v])E\left[\left.\frac{\partial c(\mathbf{x}^1(\eta),\theta_v^1)}{\partial x_D^2}\right|_{\eta=0}\right]\right)=0$, and hence the condition boils down to

$$\Upsilon'(\eta)\big|_{\eta=0\wedge x_D^1=x_R^1=x^1} = \left(E[\theta_v^1]-E[\theta_v^2]\right)\left(g(X^1)-g(X^2)\right).$$

When $\Upsilon'(0)>0$, for sufficiently small but positive η, D benefits from the campaign contest, while R can use the contest to his advantage if $\Upsilon'(0)<0$. If $\Upsilon'(0)=0$ the candidates' vote shares remain constant. As $g'(x)>0$, $\mathrm{Sign}[g(X^1)-g(X^2)]=\mathrm{Sign}[X^1-X^2]$, and thus I can rephrase the condition for D to benefit as

$$\Psi = \left(E[\theta_v^1]-E[\theta_v^2]\right)\left(X^1-X^2\right)>0.$$

This proves the proposition. □

B The Examples

B.1 Example 1:

Given the assumptions, $c(\mathbf{x}^i,\theta_v^i)\in(0,1)$ and $w(\mathbf{x},\varphi_v)\in(0,1)$ for all $[x_D^1,x_R^1]\in[0,B]^2$. The FOCs are

$$\begin{aligned}
\frac{\partial\pi_D}{\partial x_D^1} &= 2\eta(E[\theta_v^1]-E[\theta_v^2]-\kappa+2\kappa\cdot x_D^1)+\kappa(E[\varphi_v]-x_D^1)=0,\\
\frac{\partial\pi_R}{\partial x_R^1} &= 2\eta(E[\theta_v^2]-E[\theta_v^1]-\kappa+2\kappa\cdot x_R^1)+\kappa(E[\varphi_v]-x_R^1)=0,
\end{aligned}$$

while the SOCs are

$$\frac{\partial^2\pi_j}{\partial(x_j^1)^2}=\kappa(4\eta-1)<0\Leftrightarrow\eta<\frac{1}{4}.$$

The SOCs hold whenever $\eta<\frac{1}{4}$, which is the case by assumption, as $\overline{\varphi}+2\eta<1$ and $\underline{\varphi}-2\eta>0$. Hence, the candidates' decision problems are concave and strategy spaces are compact and convex, implying that a pure strategy Nash equilibrium exists. Moreover, the FOCs are linear and independent of the other candidate's effort choice. Thus, there is a unique pure strategy Nash equilibrium, and if κ sufficiently large this equilibrium must be interior. In this case we find

$$\begin{aligned} x_D^1 &= \frac{E[\varphi_v]}{1-4\eta} + \frac{2\eta\left(E[\theta_v^1] - E[\theta_v^2] - \kappa\right)}{\kappa(1-4\eta)} = \frac{E[\varphi_v]}{1-4\eta} + \frac{2\eta\left(E[\theta_v^1] - E[\theta_v^2]\right)}{\kappa(1-4\eta)} - \frac{2\eta}{1-4\eta}, \\ x_R^1 &= \frac{E[\varphi_v]}{1-4\eta} + \frac{2\eta\left(E[\theta_v^2] - E[\theta_v^1] - \kappa\right)}{\kappa(1-4\eta)} = \frac{E[\varphi_v]}{1-4\eta} + \frac{2\eta\left(E[\theta_v^2] - E[\theta_v^1]\right)}{\kappa(1-4\eta)} - \frac{2\eta}{1-4\eta}. \end{aligned} \tag{B.1}$$

This implies

$$X^1 = \frac{2(E[\varphi_v] - 2\eta)}{1-4\eta} \text{ and } X^2 = \frac{2\left((1-E[\varphi_v]) - 2\eta\right)}{1-4\eta}.$$

Given (B.1), equilibrium vote shares are

$$\begin{aligned} S_D &= \frac{E\left[\theta_v^1\varphi_v + \theta_v^2(1-\varphi_v)\right] - 2\eta\left(E[\theta_v^1 + \theta_v^2]\right)}{1-4\eta}, \\ S_R &= 1 - S_D. \end{aligned} \tag{B.2}$$

Note that when $\eta = 0$ the vote shares remain unchanged, as

$$S_D|_{\eta=0} = S_D^0 = E\left[\theta_v^1\varphi_v + \theta_v^2(1-\varphi_v)\right].$$

Given the above, candidate D benefits during the campaign contest if and only if

$$\begin{aligned} S_D > S_D^0 &\Leftrightarrow \tfrac{S_D^0 - 2\eta\left(E[\theta_v^1+\theta_v^2]\right)}{1-4\eta} > S_D^0 \\ &\Leftrightarrow E[\theta_v^2](\tfrac{1}{2} - E[\varphi_v]) > E[\theta_v^1](\tfrac{1}{2} - E[\varphi_v]) \\ &\Leftrightarrow E[\theta_v^1](E[\varphi_v] - \tfrac{1}{2}) > E[\theta_v^2](E[\varphi_v] - \tfrac{1}{2}). \end{aligned}$$

If $E[\varphi_v] > \frac{1}{2}$, this is the case when $E[\theta_v^1] > E[\theta_v^2]$, otherwise if $E[\theta_v^1] < E[\theta_v^2]$. Thus, the candidate having the comparative advantage in the more important issue benefits during the campaign contest.

If $S_D^0 < \frac{1}{2}$, Candidate D is a priori weaker than Candidate R. If $S_D > \frac{1}{2}$, Candidate D is a posteriori stronger than Candidate R. If both are true at the same time, D is able to turn an initial disadvantage into an advantage. Simple manipulations show that $S_D > \frac{1}{2} \Leftrightarrow S_D^0 > \frac{1}{2} + 2\eta\left(E[\theta_v^1 + \theta_v^2] - 1\right)$. Note that when $E[\varphi_v] > \frac{1}{2}$, $S_D^0 < \frac{1}{2}$ implies that $E[\theta_v^1 + \theta_v^2] < 1$. Thus, we can further reformulate to get

$$\eta > \frac{\frac{1}{2} - S_D^0}{2(1 - E\left[\theta_v^1 + \theta_v^2\right]} = \frac{\frac{1}{2} - E\left[\theta_v^1\varphi_v + \theta_v^2(1-\varphi_v)\right]}{2(1 - E\left[\theta_v^1 + \theta_v^2\right]},$$

which is the condition from the example. □

B.2 Example 2:

Given the assumptions, $c(\mathbf{x}^i, \theta_v^i) \in (0,1)$ and $w(\mathbf{x}, \varphi_v) \in (0,1)$ for all $[x_D^1, x_R^1] \in [0, B]^2$. A proof analogous to the one in Example 1 establishes existence of a unique pure strategy Nash equilibrium.

Take the derivatives of candidates' payoff functions with respect to their respective effort in issue 1:

$$\begin{aligned}
\frac{\partial \pi_D}{\partial x_D^1} &= \kappa^1 E[\varphi_v] + \eta\kappa^2 \left(3{x_D^1}^2 + 2x_D^1(x_R^1 - 1) - {x_R^1}^2\right) - \kappa^1 x_D^1 E[\varphi_v] + \kappa^2 x_D^1 (E[\varphi_v] - 1) \\
&+ \eta\kappa^1 \left(-2x_D^1 x_R^1 - 3(x_D^1 - 2)x_D^1 + {x_R^1}^2 - 2\right) = 0, \\
\frac{\partial \pi_R}{\partial x_R^1} &= \kappa^1 E[\varphi_v] + \eta\kappa^1((x_D^1 - 3x_R^1)(x_D^1 + x_R^1) + 6x_R^1 - 2) - \kappa^1 E[\varphi_v] x_R^1 + \kappa^2 x_R^1 (E[\varphi_v] - 1) \\
&- \eta\kappa^2((x_D^1 - 3x_R^1)(x_D^1 + x_R^1) + 2x_R^1) = 0,
\end{aligned}$$

This system of equations has no simple solution, but I can use the fact that $\frac{\partial \pi_D}{\partial x_D^1} + \frac{\partial \pi_R}{\partial x_R^1} = 0$ in any interior equilibrium. Letting $X^1 \equiv x_D^1 + x_R^1$,

$$\frac{\partial \pi_D}{\partial x_D^1} + \frac{\partial \pi_R}{\partial x_R^1} = 0 \Leftrightarrow 2\kappa^1 E[\varphi_v] - 2\eta(X^1 - 1)(\kappa^1(X^1 - 2) - \kappa^2 X^1) - X^1(\kappa^2(1 - E[\varphi_v]) + \kappa^1 E[\varphi_v]) = 0$$

This has one meaningful solution, which is

$$X^1 = \frac{\sqrt{(E[\varphi_v]\Delta\kappa - \eta(6\kappa^1 - 2\kappa^2) + \kappa^2)^2 + 16\eta\kappa^1(E[\varphi_v] - 2\eta)\Delta\kappa} + \eta(6\kappa^1 - 2\kappa^2) - E[\varphi_v]\Delta\kappa - \kappa^2}{4\eta\Delta\kappa}.$$

where $\Delta\kappa \equiv \kappa^1 - \kappa^2$. Note that X^1 increases in $E[\varphi_v]$. For issue 1 to receive more total spending than issue 2, we need $X^1 > 1$, and otherwise issue 2 receives more spending. Thus, there is a threshold value $\tilde{\varphi}$ that solves $X^1(E[\varphi_v]) = 1$ and such that if $E[\varphi_v] > \tilde{\varphi}$ issue 1 dominates the campaign, and issue 2 dominates if $E[\varphi_v] < \tilde{\varphi}$. This value is defined by

$$\frac{\sqrt{(\tilde{\varphi}\Delta\kappa - \eta(6\kappa^1 - 2\kappa^2) + \kappa^2)^2 + 16\eta\kappa^1(\tilde{\varphi} - 2\eta)\Delta\kappa} + \eta(6\kappa^1 - 2\kappa^2) - \tilde{\varphi}\Delta\kappa - \kappa^2}{4\eta\Delta\kappa} = 1 \Leftrightarrow \tilde{\varphi} = \frac{\kappa^2}{\kappa^1 + \kappa^2}.$$

If $\kappa^1 = \kappa^2$, $\tilde{\varphi} = \frac{1}{2}$ as before in Example 1. □

B.3 Example 3:

Under the assumption that

$$c(\mathbf{x}^i, \theta_v^i) = \frac{\theta_v^i f(x_D^i)}{\theta_v^i f(x_D^i) + (1 - \theta_v^i) f(x_R^i)},$$

expected utility of candidates are

$$\begin{aligned}
\pi_D(\mathbf{x}) &= E\left[\tfrac{\theta_v^1 f(x_D^1)}{\theta_v^1 f(x_D^1) + (1-\theta_v^1) f(x_R^1)} \left(\varphi_v + \eta\left(2x_D^1 + 2x_R^1 - 2B\right)\right)\right. \\
&+ \left.\tfrac{\theta_v^2 f(B - x_D^1)}{\theta_v^2 f(B - x_D^1) + (1-\theta_v^2) f(B - x_R^1)} \left(1 - \left(\varphi_v + \eta\left(2x_D^1 + 2x_R^1 - 2B\right)\right)\right)\right] \\
\pi_R(\mathbf{x}) &= E\left[\tfrac{(1-\theta_v^1) f(x_R^1)}{\theta_v^1 f(x_D^1) + (1-\theta_v^1) f(x_R^1)} \left(\varphi_v + \eta\left(2x_D^1 + 2x_R^1 - 2B\right)\right)\right. \\
&+ \left.\tfrac{(1-\theta_v^2) f(B - x_R^1)}{\theta_v^2 f(B - x_D^1) + (1-\theta_v^2) f(B - x_R^1)} \left(1 - \left(\varphi_v + \eta\left(2x_D^1 + 2x_R^1 - 2B\right)\right)\right)\right]
\end{aligned}$$

From here I can calculate the first-order conditions:

$$\begin{aligned}
\frac{\partial \pi_D(\mathbf{x})}{\partial x_D^1} &= E\Big[\tfrac{\theta_v^1(1-\theta_v^1)f'(x_D^1)f(x_R^1)}{(\theta_v^1 f(x_D^1)+(1-\theta_v^1)f(x_R^1))^2}\left(\varphi_v+\eta\left(2x_D^1+2x_R^1-2B\right)\right)\\
&- \tfrac{\theta_v^2(1-\theta_v^2)f'(B-x_D^1)f(B-x_R^1)}{(\theta_v^2 f(B-x_D^1)+(1-\theta_v^2)f(B-x_R^1))^2}\left(1-\left(\varphi_v+\eta\left(2x_D^1+2x_R^1-2B\right)\right)\right)\\
&+ \eta\left(\tfrac{\theta_v^1 f(x_D^1)}{\theta_v^1 f(x_D^1)+(1-\theta_v^1)f(x_R^1)}-\tfrac{\theta_v^2 f(B-x_D^1)}{\theta_v^2 f(B-x_D^1)+(1-\theta_v^2)f(B-x_R^1)}\right)\Big]\\
\frac{\partial \pi_R(\mathbf{x})}{\partial x_R^1} &= E\Big[\tfrac{\theta_v^1(1-\theta_v^1)f'(x_R^1)f(x_D^1)}{(\theta_v^1 f(x_D^1)+(1-\theta_v^1)f(x_R^1))^2}\left(\varphi_v+\eta\left(2x_D^1+2x_R^1-2B\right)\right)\\
&- \tfrac{\theta_v^2(1-\theta_v^2)f'(B-x_R^1)f(B-x_D^1)}{(\theta_v^2 f(B-x_D^1)+(1-\theta_v^2)f(B-x_R^1))^2}\left(1-\left(\varphi_v+\eta\left(2x_D^1+2x_R^1-2B\right)\right)\right)\\
&- \eta\left(\tfrac{\theta_v^1 f(x_D^1)}{\theta_v^1 f(x_D^1)+(1-\theta_v^1)f(x_R^1)}-\tfrac{\theta_v^2 f(B-x_D^1)}{\theta_v^2 f(B-x_D^1)+(1-\theta_v^2)f(B-x_R^1)}\right)\Big]
\end{aligned}$$

We know from Proposition 4 that absent comparative advantages candidates spend the same on any given issue, $x_D^i = x_R^i$. Using this and that $E[\theta_v^1] = E[\theta_v^2]$, first-order conditions simplify to

$$\begin{aligned}
\left.\frac{\partial \pi_D(\mathbf{x})}{\partial x_D^1}\right|_{x_D^i=x_R^i=x^i\wedge E[\theta_v^1]=E[\theta_v^2]} &= E\Big[\theta_v^1(1-\theta_v^1)\tfrac{f'(x^1)}{f(x^1)}\left(\varphi_v+\eta\left(4x^1-2B\right)\right)\\
&- \theta_v^2(1-\theta_v^2)\tfrac{f'(B-x^1)}{f(B-x^1)}\left(1-\left(\varphi_v+\eta\left(4x^1-2B\right)\right)\right)+\eta\left(\theta_v^1-\theta_v^2\right)\Big]\\
&= E\Big[\theta_v^1(1-\theta_v^1)\tfrac{f'(x^1)}{f(x^1)}\left(\varphi_v+\eta\left(4x^1-2B\right)\right)\\
&- \theta_v^2(1-\theta_v^2)\tfrac{f'(B-x^1)}{f(B-x^1)}\left(1-\left(\varphi_v+\eta\left(4x^1-2B\right)\right)\right)\Big]\\
\left.\frac{\partial \pi_R(\mathbf{x})}{\partial x_R^1}\right|_{x_D^i=x_R^i=x^i\wedge E[\theta_v^1]=E[\theta_v^2]} &= E\Big[\theta_v^1(1-\theta_v^1)\tfrac{f'(x^1)}{f(x^1)}\left(\varphi_v+\eta\left(4x^1-2B\right)\right)\\
&- \theta_v^2(1-\theta_v^2)\tfrac{f'(B-x^1)}{f(B-x^1)}\left(1-\left(\varphi_v+\eta\left(4x^1-2B\right)\right)\right)-\eta\left(\theta_v^1-\theta_v^2\right)\Big]\\
&= E\Big[\theta_v^1(1-\theta_v^1)\tfrac{f'(x^1)}{f(x^1)}\left(\varphi_v+\eta\left(4x^1-2B\right)\right)\\
&- \theta_v^2(1-\theta_v^2)\tfrac{f'(B-x^1)}{f(B-x^1)}\left(1-\left(\varphi_v+\eta\left(4x^1-2B\right)\right)\right)\Big]
\end{aligned}$$

When η is sufficiently 'small,' it follows from the proof of Proposition 1 that $\pi_j(\mathbf{x})$ is concave, and hence there exists $\bar{x}_j^i \in (0, B)$ such that $\pi_j(\mathbf{x})$ increases in x_j^i for all $x_j^i \in [0, \bar{x}_j^i)$ and such that $\pi_j(\mathbf{x})$ decreases in x_j^i for all $x_j^i \in (\bar{x}_j^i, B]$. Hence, when

$$\left.\frac{\partial \pi_D(\mathbf{x})}{\partial x_D^1}\right|_{x_D^i=x_R^i=x^i=\frac{B}{2}\wedge E[\theta_v^1]=E[\theta_v^2]} > 0,$$

in equilibrium we must have that $x^1 > \frac{B}{2}$, while $x^1 < \frac{B}{2}$ if

$$\left.\frac{\partial \pi_D(\mathbf{x})}{\partial x_D^1}\right|_{x_D^i=x_R^i=x^i=\frac{B}{2}\wedge E[\theta_v^1]=E[\theta_v^2]} < 0.$$

Using $x^1 = \frac{B}{2}$ in the simplified first-order condition, we find

$$\begin{gathered}
\left.\frac{\partial \pi_D(\mathbf{x})}{\partial x_D^1}\right|_{x_D^i = x_R^i = x^i = \frac{B}{2} \wedge E[\theta_v^1] = E[\theta_v^2]} > 0 \\
\Leftrightarrow E\left[\theta_v^1(1-\theta_v^1)\frac{f'(\frac{B}{2})}{f(\frac{B}{2})}\left(\varphi_v + \eta\left(4\frac{B}{2} - 2B\right)\right) - \theta_v^2(1-\theta_v^2)\frac{f'(B-\frac{B}{2})}{f(B-\frac{B}{2})}\left(1 - \left(\varphi_v + \eta\left(4\frac{B}{2} - 2B\right)\right)\right)\right] > 0 \\
\Leftrightarrow E\left[\theta_v^1(1-\theta_v^1)(\varphi_v) - \theta_v^2(1-\theta_v^2)(1-\varphi_v)\right] > 0 \Leftrightarrow E\left[\theta_v^1(1-\theta_v^1)(\varphi_v)\right] > E\left[\theta_v^2(1-\theta_v^2)(1-\varphi_v)\right] \\
\Leftrightarrow E\left[\theta_v^1(1-\theta_v^1)\right] E\left[(\varphi_v)\right] > E\left[\theta_v^2(1-\theta_v^2)\right](1 - E\left[\varphi_v\right]) \\
\Leftrightarrow E\left[\varphi_v\right] > \frac{E\left[\theta_v^2(1-\theta_v^2)\right]}{E[\theta_v^1(1-\theta_v^1)] + E[\theta_v^2(1-\theta_v^2)]}
\end{gathered}$$

When this is the case, in equilibrium it must be that $x^1 > \frac{B}{2} \Leftrightarrow 2x^1 > B \Leftrightarrow X^1 > B$, and thus also $X^1 > B > 2B - X^1 = X^2$. Similarly, when $E\left[\varphi_v\right] < \frac{E\left[\theta_v^2(1-\theta_v^2)\right]}{E[\theta_v^1(1-\theta_v^1)] + E[\theta_v^2(1-\theta_v^2)]}$ it must be that $X^1 < B < X^2$, and when $E\left[\varphi_v\right] = \frac{E\left[\theta_v^2(1-\theta_v^2)\right]}{E[\theta_v^1(1-\theta_v^1)] + E[\theta_v^2(1-\theta_v^2)]}$ we have $X^1 = X^2 = B$. Moreover, as $\mathcal{C}^1(\theta_v^1)$ is a mean-preserving spread of $\mathcal{C}^2(\theta_v^2)$,

$$\frac{E\left[\theta_v^2(1-\theta_v^2)\right]}{E\left[\theta_v^1(1-\theta_v^1)\right] + E\left[\theta_v^2(1-\theta_v^2)\right]} > \frac{1}{2},$$

as

$$E\left[\theta_v^2(1-\theta_v^2)\right] = E\left[\theta_v^2\right] - E\left[(\theta_v^2)^2\right] = E\left[\theta_v^1\right] - E\left[(\theta_v^2)^2\right] > E\left[\theta_v^1\right] - E\left[(\theta_v^1)^2\right] = E\left[\theta_v^1(1-\theta_v^1)\right].$$

Thus, persuasion is more effective on issue 2 and hence candidates have an incentive to campaign more heavily on this issue unless issue 1 can compensate by being sufficiently more important. This proves the statement from the example. □

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