Campaign Contests*

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Abstract

I develop a formal model of contests in political campaigns. Voters are assumed to be impressionable and have beliefs about the quality of two candidates in the different policy issues and about the issues' relative importance. Candidates spend time/money in an effort to influence voters' decisions at the ballot. Influence has two simultaneous effects: (i) It increases the perceived relative quality of a candidate in an issue and (ii) it makes the issue more salient, thereby increasing the issue's perceived importance. I characterize equilibrium strategies and study conditions under which candidates choose divergent or convergent strategies. I also show that issues of secondary importance may dominate the campaign in terms of aggregate campaigning intensity, and hence may dominate decision making on Election Day. I then study the implications of campaign contests for candidate selection on Election Day and for optimal nomination of candidates for political office.

Keywords: political campaign, contest, advertising, priming, stochastic Blotto game, candidate selection
JEL Codes: D01, D72, P16

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1 Introduction

One of the main goals of political economy is to improve our understanding of democratic processes and government formation. In most models of political competition, parties or candidates for political office choose an ideology or policy platform and then voters decide whom to elect. However, this simple picture of political competition seems to be missing out a significant part of electoral competition: campaign contests. During campaign contests, candidates spend significant amounts of money and time to woo voters. And these efforts have important consequences. Campaign contests influence the identity of the winner of an election, and hence also which policy platform and ideological position is successful on Election Day. Moreover, campaign contests have strategic repercussions for candidate selection and platform determination, and therefore campaigns influence not only for whom voters cast their ballots, but also what politicians offer to constituents in the first place. However, despite their importance, campaign contests and their consequences are still poorly understood. In this paper I propose a theory of campaign contests to answer these questions. In particular, I first propose a theory of campaign contests with a focus on strategic issue selection by competing candidates. I then use the derived results to shed some light on the economic consequences of campaign contests, in particular how they influence candidate selection on Election Day, optimal candidate nomination prior to the campaign, and whether or not campaigns create electoral momentum.

The vast majority of the literature studying campaign contests focusses on pure priming (or agenda setting) contests, which has its roots in the issue ownership literature developed by Petrocik (1996). The central question this literature asks is whether candidates should be expected to converge or to diverge in their campaign strategies, i.e., whether they should select the same set of issues to campaign on or whether they are more likely to choose divergent strategies. A general conclusion in this literature is that competing politicians should never emphasize the same set of issues, see for example Riker (1996), Aragonès et al. (2015), or Dragu and Fan (2016). However, there is little empirical support for this claim, which is nicely epitomized by the following quote by Sigelman and Buell (2004): "*[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.*" (p. 651) Related papers coming to similar conclusions include, for instance, Kaplan et al. (2006), Green and Hobolt (2008), or Bélanger and Meguid (2008).

In this paper I derive a theoretical model that amends the standard framework and shows that candidates often have incentives to converge on a set of issues during their campaign. The policy space is multi-dimensional and candidates for political office have issue specific qualities, for example their innate characteristics, ideological positions, competence, or policy platforms. A candidate's quality may differ from issue to issue and candidates are likely to differ in some qualities and to be more similar in others. Some qualities are important to voters while others are not. Moreover, voters may or may not agree on candidates' qualities and issues' relative importance, reflecting the potential heterogeneity of the electorate. Taking all these things into account, candidates allocate campaign funds to the different issues in an effort to further their chances on Election Day. I assume that voters are impressionable and that campaign advertising is persuasive.[1] Voters care about the importance weighted quality of a candidate. I amend the standard agenda setting contest model by allowing for a second effect campaigns have on voters' evaluation of candidates: quality advertising. This implies that campaigning on an issues has two simultaneous effects. First, as in the existing literature, it primes the issue, which increases the issue's salience and thereby shifts voters' attention towards it. This increases the issue's perceived importance. At the same time, campaigning on an issue raises a voter's opinion of the issue specific quality of the advertising candidate. To fix ideas, I refer to these two effects as *issue priming* and *quality advertising*. I hence model the campaign as a series of intertwined contests with effort spillovers, in which candidates' relative quality in a given issue is determined in one contest, and the issues' relative importance in another. The game is thus a stochastic version of a Blotto game (Borel, 1953) with endogenous values of the different battle fields or issues.

I use the model to study a series of questions, pertaining both to equilibrium play in the campaign contest and the strategic implications of the campaign contest. In particular, when do candidates converge or diverge in their strategies? That is, under which conditions do candidates address an issue with similar emphasis and converge, or when are they more likely to diverge in their campaigning strategies by prioritizing different issues? Which issues will dominate the campaign contest in terms of aggregate attention devoted to them, and thus have the greatest impact on outcomes on Election Day? Related to the implications of a campaign contest, I study how the contest affects candidates' chances at the ballot and whether campaign contests lead to electoral momentum. Moreover, I study some implications of campaign contests for optimal candidate nomination and policy choice.

The main results are the following:

- Comparative advantages determine whether candidate converge or not on an issue. Absolute advantages are irrelevant for relative issue emphasis.
- Campaign contests may alter the political agenda in a way that issues of secondary importance may dominate the campaign and thereby receive a high priority on Election Day.
- Initial popularity is not causal for which candidate benefits during the campaign contest. Thus, the campaign may both create momentum and anti-momentum
- A candidate's popularity before the campaign contest starts is a bad predictor of eventual

[1] In this paper I interpret persuasive advertising as something different to informative advertising. Thus, persuasion is not related to Bayesian persuasion à la Kamenica and Gentzkow (2011). For a comparison and discussion of persuasive and informative advertising, see for example Bagwell (2007).

electoral success. Candidates who are significantly less popular than others might be the actual favorites, once the campaign contest's details are taken into account.

To get an intuition for the first result, consider a campaign between two candidates, D and R, with two issues, 1 and 2, and with one representative voter. Assume the voter believes both issues are equally important and that he believes Candidate D has greater quality in issue 1 than Candidate R, and much greater quality in the other issue. If D campaigns on issue 1, he increases his perceived quality in the issue and he increases the issue's relative importance. This means that issue 2's relative importance decreases. But because in this issue his advantage is greater, he shifts the voter's attention away from his best and to his worst issue, while improving his perceived quality in it. An analogous argument shows that Candidate R, by campaigning on issue 1, increases his perceived quality in this issue and shifts attention away from his worst issue. The effect of increasing perceived quality is beneficial for both, while the attention shifting affect works in favor of R. This latter effect thus creates stronger incentives for R to campaign on issue 1 than for D, although D's perceived *absolute* quality in the issue is greater. In this situation, Candidate D has a comparative advantage in issue 2, while Candidate R has a comparative advantage in issue 1, and this causes her to campaign with greater intensity on issue 2 than R. As I show in the sequel, this intuition holds generally.

The two effects, issue priming and policy advertising, differ significantly in the way they affect candidates' incentives. The degree of divergence depends on the relative importance of these two effects. Intuitively, the importance of policy advertising depends on an issue's importance and on the degree to which voters are impressionable. Voters who are undecided about which candidate has greater quality are more impressionable than voters who already have a clear idea about which candidate offers greater quality.[2] In the words of Festinger et al. (1956): "*A man with a conviction is a hard man to change*." Hence, if voters are undecided in one issue but have conviction in the other, this may lead both candidates to campaign with greater intensity on the undecided issue. This in turn implies that one of the two candidates focusses on his weakest issue. A similar argument also establishes that issues of secondary importance might dominate the campaign in terms of aggregate spending. If an issue is undecided, it may receive greater attention by both candidates than a more important issue in which the voter has a clear favorite. Depending on the effectiveness of priming, this may make these issues decisive for electoral outcomes. Thus, candidates' strategic considerations may trump voters' preferences during electoral competition and thus outcomes on Election Day generally may poorly reflect constituents' needs.

The paper is organized as follows: In the remainder of this section I discuss the related literature. In Section 2 I introduce the model and study the equilibrium of the campaign contest. In Section 3 I use the model to derive economic implications of campaign contests for candidate selection on Election Day, momentum, and optimal candidate nomination. Moreover, I show how a standard

[2]Freedman et al. (2004) show that voters who lack information are indeed those most susceptible to advertising.

Downsian model of electoral competition can be incorporated into the current model for applied work. Section 4 concludes. All proofs are relegated to Appendix A. In Appendix B I generalize the model from Section 2 and show that all main results are robust.

Related literature. The paper contributes to the literature studying strategic resource allocation in political campaigns or campaign contests. Brams and Davis (1973, 1974), Snyder (1989), Strömberg (2008), and Fletcher and Slutsky (2011) study candidates' allocation of campaign resources to different political markets or states. Denter and Sisak (2015) or Klumpp and Polborn (2006) study the dynamics of persuasive campaign spending. The current paper studies how candidates strategically channel campaign funds/time to the different issues, depending on voters' assessments of issue-specific candidate quality and voters' ex-ante beliefs of issues' relative importance.

Other papers have developed formal models of resource allocation to policy issues before. Two distinct modelling approaches emerged in the literature. The first one focuses on the effects of issue priming (e.g. Petrocik, 1996, Riker, 1996, Amorós and Puy, 2013, Aragonès et al., 2015, or Dragu and Fan, 2016). The second approach is closely related to the literature studying Blotto games and focuses on what we call policy advertising in the current paper. A Blotto game is a situation in which players allocate their resources to a certain number of different 'battlefields.' Typically, the player spending most on a certain battlefield wins it for sure and players' utility increases in the total number of battlefields won. Papers contributing to this literature are the classical treatises of Borel (1953) and Shubik and Weber (1981) as well as more recent papers due to Roberson (2006), Powell (2007), Roberson and Kvasov (2012), Chowdhury et al. (2013), Kovenock and Roberson (2011), and Hortala-Vallve and Llorente-Saguer (2012). Kovenock and Roberson (2012) survey the literature. In the current paper, I combine features of both literatures by allowing for simultaneous priming and issue advertising. This combination greatly matters for conclusions and gives more nuanced predictions about candidate behavior. Essentially, the simultaneity implies that the model studied is a probabilistic version of a Blotto game with endogenous prizes. To my knowledge, this is the first paper to develop such a model.

While the above literature studied non-informative campaigns, some recent papers focus on candidates' incentives to provide information. Egorov (2014) studies candidates' incentives to select issues when campaigning signals candidates' strengths and weaknesses to the populace. Voters are Bayesian and update their beliefs about candidates' qualities depending on candidates' strategic choices of which issue to campaign on. The relative importance of issues is assumed fixed and hence there is no priming. In a very recent paper, Basu and Knowles (2017) study the "clarity incentive" in campaigns, that is how releasing information about one's policies tends to align incentives so that candidates compete on the same issues. Their results stem from the assumption of ambiguity averse voters and they show that, similar to what happens in the model presented in the current paper, this might lead to aligned incentives of candidates to campaign on an issue. The dynamics of information revelation during a campaign are studied by Gul and Pesendorfer (2012) in what they call the 'war of information.' In contrast to those papers, I do not study information transmission in campaigns but study how simultaneous priming and quality advertising influence campaigning incentives.

Finally, the presented model is also a model of persuasion. Kamenica and Gentzkow (2011) develop a theory of Bayesian persuasion, in which a sender optimally selects a distribution of an unbiased signal with the aim to maximize the probability of changing a receiver's decision in the desired direction. Zhang and Zhou (2016) adapt their framework to study optimum Bayesian persuasion in a contest setting. Glazer and Rubinstein (2012) develop a model of persuasion with a boundedly rational sender. Most closely related to the current paper is Skaperdas and Vaidya (2012), who show that contest models of persuasion–like the one presented in the current paper–can be micro-founded using a Bayesian updating model, when the sender collects evidence to persuade the receiver and collecting more evidence has a greater effect on the posterior belief. Unlike in these papers, voters are not considered Bayesian in the current paper and persuasion is multi-dimensional. Moreover, the importance of the different dimensions is endogenous.

2 The Model

2.1 Setup

In the main part of this paper I only describe a simplified version of the game. A more general analysis can be found in Appendix B.

Two candidates, $j = D, R$, compete in two issues, $i = 1, 2$, by highlighting either the one or the other. There is a unique voter V who on Election Day casts a ballot for one of the two candidates (abstention is not possible). V wants to select the better of the two candidates, given his assessment of their qualities. His relative quality or competence estimate of D in issue i is $\theta^i \in [0, 1]$ and that of R is $1 - \theta^i \in [0, 1]$. Thus, both are identical in their ascribed competence in issue i if $\theta^i = \frac{1}{2}$. If $\theta^i > \frac{1}{2}$, D has an advantage and the advantage is on R's side when $\theta^i < \frac{1}{2}$. Issues may be of the same importance in the eyes of V, but they do not need to. Let $\varphi \in [0, 1]$ be the weight he puts on issue 1, such that $1 - \varphi \in [0, 1]$ is the weight he puts on issue 2. V has weighted issue preferences (e.g. Krasa and Polborn, 2010), meaning his quality assessment of a candidate is the issue-importance weighted relative quality of a candidate. In particular, his relative assessment of Candidate D before the outset of the campaign is

$$\tilde{u}(z) = \theta^1\varphi + \theta^2(1 - \varphi),$$

where $z = (\theta^1, \theta^2, \varphi)$, while the one of Candidate R is $1 - \tilde{u}(z)$.

The purpose of campaigning is to alter the voter's perception of one's relative quality. To keep the model as parsimonious as possible at this point, I assume both candidates are endowed with one indivisible unit of a use-it-or-lose-it budget, which they have to allocate to one of the two issues.[3] For example, they may use the budget to buy TV advertising for their policies in the different issues. Because $x_j^1 = 1 - x_j^2$, a strategy profile can be expressed as $\mathbf{x} = (x_D^1, x_D^2, x_R^1, x_R^2) = (x_D^1, 1 - x_D^1, x_R^1, 1 - x_R^1)$. Denote $w(\mathbf{x}; \varphi)$ and $c^i(\mathbf{x}; \theta^i) = c(\mathbf{x}; \theta^i)$ the after campaigning importance of issue 1 and the after campaigning relative quality in issue i respectively.

Deciding to spend the budget on a given issue has two *simultaneous* effects: First, by focussing attention on this issue, the candidate *primes* it, which (weakly) increases the perceived importance of the issue. Second, it *impresses* voters in the sense of Morton and Myerson (1992) or Klumpp (2014), meaning that V changes his assessment of the relative quality in the advertised issue in favor of the advertising candidate. To this latter effect I will refer as *persuasion* or *quality advertising* in the following.[4] For example, when Candidate D campaigns on *Healthcare*, the effect will be that this issue will be perceived more important than before and at the same time the voter changes the relative quality assessment in that issue in favor of D. Assumptions 1 and 2, which are explained in more detail below, specify how the campaign alters beliefs exactly:

Assumption 1 (Priming)**.** *$w(\mathbf{x}; \varphi)$ has the following properties: (i.) $\frac{\partial w(\mathbf{x};\varphi)}{\partial \varphi} > 0$ for all $\varphi \in [0,1]$ and for all $\mathbf{x}$, (ii.) if $x_D^i = x_R^k$, $i \neq k$, $w(\mathbf{x}; \varphi) = \varphi$, (iii.) if $x_D^1 = x_R^1 = 1$ and $\varphi \in (0,1)$, $w(\mathbf{x}; \varphi) = \overline{w}(\varphi) > \varphi$, (iv.) if $x_D^1 = x_R^1 = 0$ and $\varphi \in (0,1)$, $w(\mathbf{x}; \varphi) = \underline{w}(\varphi) < \varphi$, and (v.) $w(\mathbf{x}; \varphi) = 1 - w((1,1,1,1) - \mathbf{x}; 1 - \varphi)$. (vi.) $\frac{\partial^2 \underline{w}^i}{\partial \varphi^2} \geq 0$, and (vii.) $\frac{\partial^2 \overline{w}^i}{\partial \varphi^2} \leq 0$.*

Assumption 2 (Persuasion)**.** *$c(\mathbf{x}; \theta^i)$ has the following properties: (i.) $\frac{\partial c(\mathbf{x};\theta^i)}{\partial \theta^i} > 0$ for all $\theta^i \in [0,1]$ and for all $\mathbf{x}$, (ii.) $c(\mathbf{x}; \theta^i) = c^i = \theta^i$ if $x_D^i = x_R^i$, (iii.) $c(\mathbf{x}; \theta^i) = \overline{c}^i > \theta^i$ if $x_D^i > x_R^i$ and $\theta^i \in (0,1)$, (iv.) $c(\mathbf{x}; \theta^i) = \underline{c}^i < \theta^i$ if $x_D^i < x_R^i$ and $\theta^i \in (0,1)$, (v.) $c(\mathbf{x}; \theta^i) = 1 - c((1,1,1,1) - \mathbf{x}; 1 - \theta^i)$, and (vi.) $\frac{\partial^2 \underline{c}^i}{\partial (\theta^i)^2} \geq 0$, and (vii.) $\frac{\partial^2 \overline{c}^i}{\partial (\theta^i)^2} \leq 0$.*

The assumptions are quite similar, so I will explain them together. Parts (i.) say that post-campaigning assessments are monotonic in pre-campaigning assessments. Parts (ii.) state that the effect of D's campaign spending can be undone if R counters it in an appropriate way. For example, if candidates campaign on different issues, the issues' relative importance will not change. Parts (iii.) and (iv.) state that campaigning is effective in the sense that is alters the voter's assessment

[3]Not using the budget can never be the unique best strategy, so I assume candidate must use it.

[4]Both priming and impressionability of voters have foundations 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 in the following way: "*[A]nything that brings an idea to mind–even coincidental, irrelevant events–can make it accessible and influence our interpretation of behavior*" (page 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 can thus "*alter the standards by which people evaluate election candidates*" (Severin and Tankard, 1997). Impressionability of voters relates to a phenomenon psychologists call the *mere-exposure effect*. It states that "*repeated exposure to an object results in greater attraction to that object*" (Hogg and Vaughan, 2008). The mere exposure effect may thus be interpreted as one justification for impressionability of voters and the effectiveness of persuasive advertising.

in all other cases.[5] Parts (v.) imply symmetry of the impression and priming functions in the sense that both candidates are equally affected by priors and campaign spending, which is slightly more general than the definition of symmetry in Dixit (1987). Parts (vi.) and (vii.) relate the curvature of the functions to the spending profile. Note that Assumptions 1 and 2 imply that campaigning works in a similar fashion as Bayesian updating (although information is not modelled explicitly). Functional forms fulfilling the assumptions include a standard Bayesian framework, where x is an informative signal, or a technology that is linear in x. Also the 'generalization' of the Bayesian model (see Skaperdas and Vaidya, 2012), which will be introduced in (B.3) and (B.4) in Section B, fulfills the assumptions. As a convention, in the following I write c, $\underline{c}$, and $\overline{c}$ when $\theta^1 = \theta^2 = \theta$, thus dropping the indices.

Candidate D's relative post-campaigning assessment is

$$u(\mathbf{x}; z) = c(\mathbf{x}; \theta^1) w(\mathbf{x}; \varphi) + c(\mathbf{x}; \theta^2)(1 - w(\mathbf{x}; \varphi)), \tag{1}$$

while that of R is $1 - u(\mathbf{x}; z)$.

I assume that voting is probabilistic as in Hinich (1977), Lindbeck and Weibull (1987), or Schofield (2007), and that the probability that V casts his vote in favor of D is simply $u(\mathbf{x}; z)$. Candidates maximize their relative assessment, which is then the same as maximizing the probability of getting elected. The game can thus be represented as follows:

	$x_R^1 = 1$	$x_R^1 = 0$
$x_D^1 = 1$	$c^1\overline{w} + c^2(1 - \overline{w})$	$\overline{c}^1 w + \underline{c}^2(1 - w)$
$x_D^1 = 0$	$\underline{c}^1 w + \overline{c}^2(1 - w)$	$c^1\underline{w} + c^2(1 - \underline{w})$

Table 1: Matrix representation of the game with payoffs of Candidate D. Candidate R's payoff follow immediately.

2.2 Equilibrium Campaigning

The model is now set up and we can start analyzing equilibrium campaigning. I start out with studying individual strategies. First I establish an important lemma:

Lemma 1. *A Nash equilibrium, possibly in mixed strategies, exists. If a strict Nash equilibrium exists, it is the unique Nash equilibrium of the game. If multiple pure strategy Nash equilibria exist, they are all outcome equivalent, i.e., winning probabilities are the same.*

The existence part is trivial and follows from Nash's theorem. Non-existence of pure strategy equilibrium can be seen as an artifact of the indivisible budget, because it tends to happen when

[5] Many studies have confirmed the effectiveness of campaigning, see for example Erikson and Palfrey (2000) or Franz and Ridout (2007).

candidates would like to target both issue with similar intensity. The rest is implied by the fact the the game is constant sum.

Before going on, two definitions have to be made:

Definition 1 (Comparative Advantage)**.** *A candidate j has a comparative advantage in issue i if his perceived relative quality in this issue is greater than his perceived relative quality in the other issue. When $\theta^1 = \theta^2$, each candidate's relative assessment is identical in both issues and no candidate has a comparative advantage.*

Definition 2 (Monotonicity)**.** *An equilibrium is monotonic in $k \in K = \{\theta^1, \theta^2, \varphi\}$ if, when all $K \setminus k$ are kept fixed, the set of values of parameter k such that the said equilibrium exists is convex.*

Comparative advantage will turn out to be important for determining equilibrium campaigning strategies.[6] Conceptually, it is the same as comparative advantages in a Ricardian sense in trade theory. For example, if $\theta^1 = 0.8$ and $\theta^2 = 0.6$, Candidate D has absolute quality advantages in all issues, but while D also has a comparative advantage in 1, R has a comparative advantage in issue 2. In the following I will restrict attention to cases such that $\theta^1 \geq \theta^2$. By symmetry, all the results would be similar for $\theta^1 < \theta^2$ and so I dispense with this part for brevity's sake.

Monotonicity relates to comparative statics. If an equilibrium is monotonic in a certain parameter k, a situation like the following is not possible: A given strategy profile is an equilibrium for all $k \in [0, 1/3] \cup [2/3, 1]$, but not for $k \in (1/3, 2/3)$.

2.2.1 Convergent Equilibria

Much of the literature on electoral competition has focussed attention on the question of whether policies are likely to converge or not in political equilibrium. The first manifestation of the strong gravitational forces of electoral competition is the celebrated Median Voter Theorem due to Black (1948), and his paper has sparked an immense literature studying the conditions under which convergence of policies to the electoral median, for example Whitman (1983) , Groseclose (2001), or Aragonès and Palfrey (2002). Hinich (1977) showed that the Median Voter Theorem is an artifact of the assumption of deterministic voting and showed that under probabilistic voting, we should still expect strong gravitational forces to be at work, but the point of convergence with quadratic preferences is not the electoral median but the electoral mean. Again, his paper sparked many follow up papers putting under scrutiny the conditions under which we should expect the Mean Voter Theorem to hold, see for example Coughlin (1992), McKelvey and Patty (2006), or Schofield (2007).

In all these papers, there is some form of convergence in equilibrium, even though convergence might be imperfect. Interestingly, while gravitational forces seem strong in the policy domain,

[6] In Definition 3 in Appendix B, I develop a generalization of comparative advantage that can deal with multiple issues and preference heterogeneity among multiple voters.

in another domain of political competition, issue selection during political campaigns, centrifugal forces seem to dominante according to theoretical research. The following quote due to Riker (1996) epitomizes this result: "*When one side has an advantage on an issue, the other side ignores it; but when neither side has an advantage, both seek new and advantageous issues*" (page 106). He named the former the *dominance principle* and the latter the *dispersion principle*. If candidates are to follow these principles, there will be a set of issues that nobody emphasizes and another set of issues that is emphasized by only one of the two candidates. The prediction of the theory is hence that there is an extreme form of divergence in strategies, because candidates will never address the same issues. Either the candidate with an advantage addresses an issue or, if no candidate has a significant advantage, the issue will be neglected. More recent papers, e.g. Amorós and Puy (2013), Dragu and Fan (2016), or Aragonès et al. (2015), confirm this: Centrifugal forces are strong in campaigns and candidates should not be expected to target the same set of issues. In particular, Proposition 1 in Aragonès et al. (2015) states the following: "*[...] each party concentrates all its campaigning time on the issue in which it has the largest quality advantage.*" The empirical record, however, seems to point towards the opposite: Candidates largely campaign on the same issues and with similar intensities, a manifestation of which is the quote due to Sigelman and Buell (2004) in the introduction of this paper. That is, while theory stresses the importance of centrifugal forces in issue selection during campaigns, the empirical record suggests that gravitational forces–just like in the policy domain–might be more important. The next proposition shows conditions under which convergence is indeed the equilibrium of the campaign contest:

Proposition 1 (Convergent Equilibria)**.** *Define* $\hat{\varphi} \equiv \max\left\{\frac{c-\underline{c}}{\overline{c}-\underline{c}}, \frac{\overline{c}-c}{\overline{c}-\underline{c}}\right\} \in (0,1)\, \forall\theta \in (0,1)$ *and* $\check{\varphi} \equiv \min\left\{\frac{c-\underline{c}}{\overline{c}-\underline{c}}, \frac{\overline{c}-c}{\overline{c}-\underline{c}}\right\} = 1 - \hat{\varphi} \in (0,1)\, \forall\theta \in (0,1)$. *The unique strict Nash equilibrium (SNE) is*

- *(1,1) if and only if*

$$w(\overline{c}^1 - \underline{c}^2) + (\underline{c}^2 - c^2) > \overline{w}(c^1 - c^2) > w(\underline{c}^1 - \overline{c}^2) + (\overline{c}^2 - c^2).$$

  A sufficient condition for this is $\theta^1 = \theta^2$ *and* $\varphi > \hat{\varphi}$.

- *(0,0) if and only if*

$$w(\underline{c}^1 - \overline{c}^2) + (\overline{c}^2 - c^2) > \underline{w}(c^1 - c^2) > w(\overline{c}^1 - \underline{c}^2) + (\underline{c}^2 - c^2).$$

  A sufficient condition for this is $\theta^1 = \theta^2$ *and* $\varphi < \check{\varphi}$.

A convergent SNE, in which both candidates campaign on issue i*, is monotonic in* θ^i *and* φ*, but not in* θ^{-i}.

Note that $\overline{c}^i = c^i = \underline{c}^i = \theta^i$ when there is no persuasion, and then the conditions stated in the proposition never hold. But why is convergence possible once there is persuasion? This is easiest seen when we assume that no comparative advantage exists initially, i.e., $\theta^1 = \theta^2$. Then, campaigning on a given issue, say 1, *endogenously* creates a comparative advantage, if the other candidate does not fight back. If the issue is sufficiently important, the other candidate has an incentive to fight back, because the value of persuasion is large in this issue. However, if the other candidate's optimal reaction is to not fight back, the reason must be that the value of campaigning on issue 2 is greater than the value of persuasion on issue 1. Campaigning on issue 2 means the comparative advantages are strengthened through persuasion, while on aggregate, priming does not change relative issue importance. However, if this is optimal from the perspective of the second candidate, the constant-sum nature of the game implies that the first candidate will optimally change his strategy as well to prevent his opponent from gaining too much. When issue 2 is sufficiently important, we will then have convergence on the other issue. If issues are more or less of the same importance, this jumping from issue to issue will go on and no pure strategy Nash equilibrium exists.[7]

Applied to real world campaigns, Proposition 1 implies that if a candidate's relative competence in some issues is well approximated by his average relative evaluation across all issues, in which case comparative advantages are small or do not exist at all (see also Section B), then we should expect candidates to converge on those issues. But note that this does not only happen when there are no comparative advantages. In fact, when either $\varphi \to 0$ or $\varphi \to 1$, candidates will converge independent of comparative advantages. The next proposition is then an immediate corollary. If convergent equilibria can exist when candidates have comparative advantages, candidates may, in fact, focus attention on their relatively weakest issue:

Proposition 2. *In SNE, a candidate might campaign hardest on the issue in which he has the greatest relative disadvantage.*

Note that the proposition contradicts the above mentioned result by Aragonès et al. (2015), where candidates *always* focus *all* attention on their strongest issue, defined as the issue in which they have the greatest competence advantage. The proposition states that candidates might find it in their best interest to focus attention on their weak issues, however. The reason is that a candidate has an interest to improve his standing with the voter relative to his opponent. And in certain situations, for example when the issue of one's disadvantage is highly important or highly competitive, a weak issue offers better chances to do so.

2.2.2 Divergent Equilibria

Now let us turn attention to divergent equilibria. As discussed before, divergence is more likely when there are 'significant' comparative advantages. The following lemma will be useful:

[7] This will be formalized in Lemma 3 below. Moreover, as we will see in Corollary 1 in Section B, the non-existence of a pure strategy equilibrium is an artifact of the indivisible budget. If the budget can be split continuously and if there are no comparative advantages, a completely convergent Nash equilibrium generally exists.

Lemma 2. *There cannot exist a divergent SNE in which both candidates campaign on their comparative disadvantage.*

In other words, given that $\theta^1 \geq \theta^2$, $(0,1)$ can never be a SNE. Thus, the lemma tells us that comparative advantage is an important driving force behind divergent equilibria in the sense that, if an equilibrium is divergent, candidates must focus on their comparative advantages. This becomes even clearer with the next lemma:

Lemma 3. *Absent comparative advantages, if a pure strategy Nash equilibrium exists, it is convergent. Formally, if $\theta^1 = \theta^2$ and $\varphi \in (\check{\varphi}, \hat{\varphi})$ as defined in Proposition 1, no pure strategy equilibrium exists.*

Thus, for a divergent SNE to exist there need to be comparative advantages. What is the intuition for this? For any candidate, campaigning on the issue of the comparative disadvantage means shifting attention *away* from his best issue towards his weakest issue. If the other candidate has an incentive to campaign on the comparative advantage of his rival, this implies persuasion dominates for him the disadvantage of priming his comparative disadvantage. But then it will be in the interest of the first candidate to also campaign on this issue, because than the original comparative advantage will be restored and the issue will be primed. Thus, comparative advantages are stable in the sense that whenever a candidate has a pre-campaigning comparative advantage, this advantage will be preserved in any SNE. Moreover, if no candidate had a comparative advantage at the outset of the campaign, no SNE exists in which candidates endogenously develop comparative advantages.

Under which conditions exists a divergent SNE? When φ is very close to either 0 or 1, persuasion dominates priming and the equilibrium is convergent. For intermediate φ, no pure strategy equilibrium exists when comparative advantages are small. Thus, for a divergent SNE to exist, φ cannot be too close to either 0 or 1 and comparative advantages must be sufficiently large. The next proposition states the exact conditions:

Proposition 3 (Divergent Equilibria)**.** *The unique SNE is (1,0) if and only if*

$$\overline{w}(c^1 - c^2) + (c^2 - \underline{c}^2) > w(\overline{c}^1 - \underline{c}^2) > \underline{w}(c^1 - c^2) + (c^2 - \underline{c}^2).$$

A sufficient condition for this is $\varphi = 1/2$, $\theta^2 = 1 - \theta^1$ and $\theta^1 > 1/2$. Divergent SNE are monotonic in φ but not in θ^1 and θ^2.

Note that the importance of comparative advantage for divergence contradicts issue ownership theory in the sense that owned issues may generally perform badly in predicting which candidate focusses on which issue during a campaign. In fact, this is exactly the conclusion of Kaplan et al. (2006): "*Issue ownership theory clearly requires further development before it can systematically help us understand campaigns. [...] When we define owned issues in a manner consistent with*

Petrocik (1996), we find that issue ownership has no statistically significant relationship with the extent of issue convergence." (page 735) Thus, I offer an explanation for this finding and an alternative to issue ownership to predict issue convergence: comparative advantage. Note that Amorós and Puy (2013) already stressed the importance of comparative advantage. However, they do not provide a meaningful definition of comparative advantage when the policy space has more than two dimensions. In Definition 3in the Appendix I provide a generalization of Definition 1 to an n-dimensional issue space with arbitrary voter beliefs that could be used in empirical research.

2.2.3 Campaign Agendas

Now let us look into campaign agendas. As a campaign agenda I interpret the joint allocation of campaign funds. In convergent equilibria some issue receives all the funds, while in divergent equilibria issues receive the same amount of attention. The purpose of this section is to shed light on the connection between what the voter deems important and what candidates do in the campaign. As we have discussed above, candidates' incentives to target an issue are increasing, ceteris paribus, in this issue's relative importance. The reason is that more important issues make it more valuable to persuade voters. Thus, it seems intuitive that when an issue is sufficiently important, that both candidates campaign on it in SNE. We might interpret this as candidates responding to the voter's preferences.

While intuitive, this reasoning misses out an important part of the campaign. When V has a clear favorite in terms of quality in a given issue, but is more undecided in the other issue, campaigning on the first will not be very effective, because there is no room for persuasion. When comparative advantages are not too pronounced, a convergent equilibrium still exists, and in this equilibrium candidates may well focus on the less important issue. But how unimportant can an issue be such that still the unique equilibrium is convergence on that issue? To see this we focus on the SNE (0,0) and let $\underline{w} = \varphi - \eta(\eta)$ for some $\eta(\varphi) \in [0, \varphi]$. Then:

Proposition 4. *In SNE, candidates might focus all attention on an issue that the voter deems of secondary importance. (0,0) is SNE whenever*

$$\varphi < \min\left\{ \frac{(\overline{c}^2 - c^2) + \eta(\varphi)(c^1 - c^2)}{(\overline{c}^2 - c^2) + (c^1 - \underline{c}^1)}, \frac{(c^2 - \underline{c}^2) - \eta(\varphi)(c^1 - c^2)}{(c^2 - \underline{c}^2) + (\overline{c}^1 - c^1)} \right\} \leq 1.$$

As $\eta(\varphi) \to 0$, *(0,0) might be SNE for any* $\varphi < 1$.

The proposition gives us a condition under which a convergent equilibrium exists. It tells us that when priming is relatively ineffective and when advertising on issue 2 is more effective than advertising issue 1, then $(0,0)$ can be SNE even though φ is large and thus issue 1 more important. The condition for $(0,0)$ being SNE for any $\varphi < 1$ is of course restrictive, but note that, for example, in the "Bayesian" specification defined in (3) below this naturally holds as $\varphi \to 0$ or $\varphi \to 1$. That is, the condition might quite naturally hold exactly when a given issue is very important. Consequently,

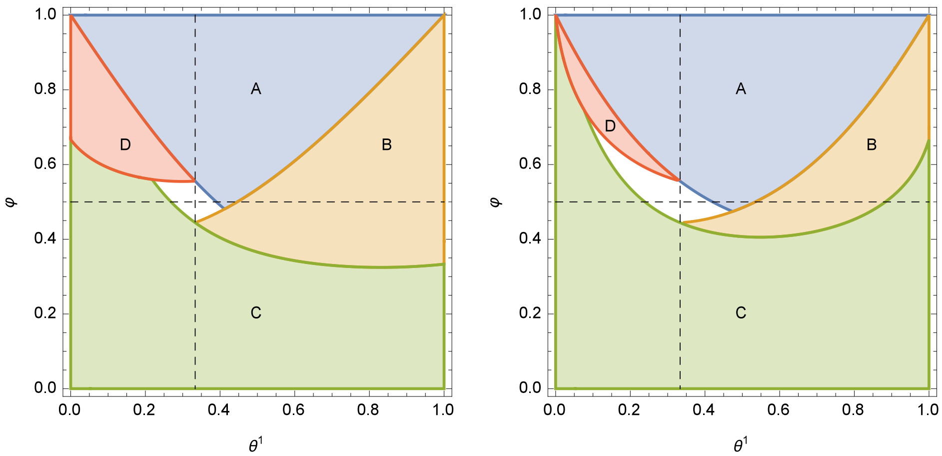

Figure 1: Different equilibria of the campaign contest. The campaign technology is the one defined in (B.3) and (B.4) below with $f(x) = \kappa + x$, $g(x) = \eta + x$, $\kappa = 1$, and $\theta^2 = \frac{1}{3}$. Left panel: $\eta = 2$. Right panel: $\eta = 6$. The vertical line marks $\theta^1 = \theta^2 = \frac{1}{3}$. The SNE are as follows: (1,1) in region A, (1,0) in region B, (0,0) in region C, (0,1) in region D. As $\theta^1 \to 0$, (0,0) is SNE even when issue 1 is significantly more important than issue 2, i.e., when φ gets large. In the region in which the two dashed lines cross no pure strategy Nash equilibrium exist (see Lemma 3).

candidates might devote all campaigning time and resources to an issue that the voter does not really care about.

The important take away is that campaign agendas may well misrepresent the electorate's preferences over issues. But this may also imply that elections are decided based on issues that voters did not care about at all when the campaign began. This may lead to a suboptimal election outcome, in particular if priming does not permanently alter constituents' issue preferences. On the other hand, campaigning may influence the political agenda also after Election Day. If campaign agendas turn out to be persistent, they might not only influence political selection but also which policies are actually implemented. Competitive pressure during the campaign may makes candidates focus on issues of secondary importance, which in turn could distort policy making.

To sum up, in Figure 1 the different types of equilibria are depicted for a parameterized campaigning technology. In region A both candidates converge on issue 1, in region C both converge on issue 2, and in regions B and D candidates diverge and each candidate focuses on the own comparative advantage.

3 Implications of Campaign Contests

So far the analysis was silent with respect to the implications of campaign contests. In this section I study some of them. In particular, I study the implications of campaign contests for candidates' chances to win the election, whether campaigns cause momentum, how campaign contests influence optimal candidate nomination, and how the model can be used to study equilibrium policy choices of office motivated candidates. To facilitate the analysis I focus on the simple model from Section

2, but the results are more general.

3.1 Candidate Selection on Election Day

A natural question to ask is whether one of the candidates can use the campaign contest to improve his electoral prospects. Note that if priming is not effective, i.e., if $\overline{w} = \omega = \underline{w}$, the campaign contest cannot have a divergent SNE. Moreover, in a convergent SNE, the contest has no influence on the outcome on Election Day in equilibrium.[8] The reason is that when candidates converge, their relative quality in no issue changes, and neither does the isues' relative importance. Similarly, without quality advertising, i.e., when $\overline{c}^i = \theta^i = \underline{c}^i$, the campaign contest cannot have a convergent SNE. In a divergent SNE the campaign does not alter candidates' chances, because, again, neither relative quality nor relative issue importance change. Hence, taken in isolation, both channels, through which the campaign influences voters' evaluations of candidates, have no effect for who wins the election in equilibrium. This is also in line with earlier research, see for example Propositions 1 and 2 in Denter and Sisak (2015) or Proposition 2 in Meirowitz (2008). However, if both priming and advertising are effective, this changes:

Proposition 5. *Let $\theta^1 \geq \theta^2$. If the equilibrium is*

- $(1,1)$*, D benefits if $\theta^1 > \theta^2$, while nobody benefits if $\theta^1 = \theta^2$.*
- $(0,0)$*, R benefits if $\theta^1 > \theta^2$, while nobody benefits if $\theta^1 = \theta^2$.*
- $(1,0)$*, then there exists $\tilde{\varphi}(\theta^1, \theta^2)$ such that if $\varphi > \tilde{\varphi}(\theta^1, \theta^2)$, D gains, if $\varphi = \tilde{\varphi}(\theta^1, \theta^2)$ nobody gains, and if $\varphi < \tilde{\varphi}(\theta^1, \theta^2)$, R gains during the campaign contest.*
- *in mixed strategies, then the ex ante weaker candidate benefits.*

Figure 2 shows the different equilibria and $\tilde{\varphi}(\theta^1, \theta^2)$ (left panel) and which candidate benefits during the campaign contest (right panel).

If candidates play a convergent equilibrium, say (1,1), the intuition for Proposition 5 is quite clear. In this case issue 1 becomes more important relative to issue 2, while relative perceived quality in the issues remain unchanged. If $\theta^1 > \theta^2$, candidate D benefits because his comparative advantage is put in the spotlight, while his weak issue's relative importance decreases. Hence, in any convergent equilibrium, the candidate with a comparative advantage in this issue benefits from campaigning. What about divergent equilibria? Consider (1,0), implying that issues' relative importance is unchanged by the contest, but candidates improve in the issues of their comparative advantages. Hence, each candidate benefits in one issue and loses in the other, and which effect dominates depends on φ, i.e., the relative importance of the issues. When φ is large enough, gaining in issue 1 dominates losing in issue 2 and thus D benefits during the campaign contest, while the opposite is true if φ is small. However, who benefits also depends on the voter's impressionability.

[8] Which does not mean that campaigning is irrelevant. Rather, candidates' strategic choices cancel each other out in terms of consequences for the election and hence no candidate can gain during the campaign.

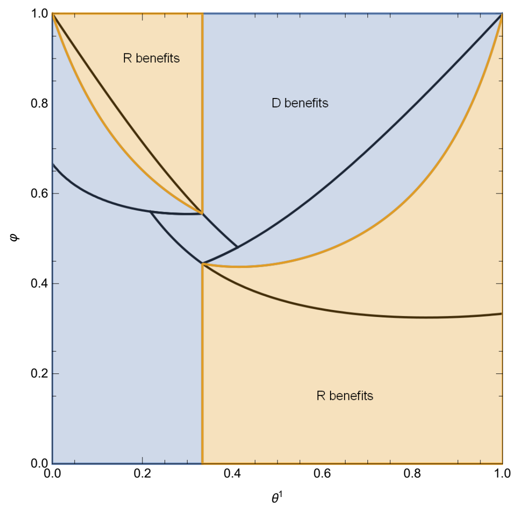

Figure 2: Beneficiary of campaign contest for varying θ^1 and φ and $\theta^2 = \frac{1}{3}$ in the example of the left panel of Figure 1. Solid black lines mark the different equilibria.

Note that candidates are equipped with an equal amount of campaign resources and hence, in a sense, the campaign contest is fair. Nevertheless, if $\theta^1 \neq \theta^2$ and $\varphi \neq \tilde{\varphi}$, one of the candidates benefits and increases his support during the campaign. Thus, campaign contests tend to favor a certain candidate. Moreover, this must be true also when the other candidate, who is disadvantaged, has a financial advantage, so long as this advantage is not too great. Greater financial means are helpful, but they do not immediately imply an increasing vote share. This conclusion is in stark contrast to the conclusions drawn from models in which campaigning creates valence, see for example Ashworth and Bueno de Mesquita (2009), Herrera et al. (2008), Iaryczower and Mattozzi (2012), or Denter and Sisak (2015). The reason is that in a pure valence campaign, greater financial means directly translate into greater valence and thus greater chances to win the election. Hence, a candidate with a financial advantage is likely to increase his expected vote share during the contest. The current model shows that this need not be the case and that by focussing on valence competition important strategic interactions cannot be uncovered.

3.2 Do Campaign Contests Cause Momentum?

Proposition 5 is useful to study other interesting phenomena. A question related to which candidate gains during the campaign and which has received a lot of attention by researchers in recent years is whether there is momentum or anti-momentum in electoral competition. In an electoral context, momentum is usually interpreted as a tendency of initial electoral advantages to further manifest themselves during a campaign, while anti-momentum means the opposite, i.e., that initial advantages tend to shrink. The literature has not reached a consensus as to whether momentum exists yet, and there seems to be evidence that both momentum and anti-momentum can happen. For example, Blais et al. (2006) conclude that there is neither significant momentum nor anti-momentum in electoral contests. But this comes as a sharp contradiction to theory, which usually concludes that there should be momentum in electoral competition (see for example Bikhchandani et al., 1992, Hong and Konrad, 1998, Callander, 2007, Knight and Schiff, 2010, or Ali and Kartik, 2012). The current model sheds some light on why conclusions are not so simple and why the identity of the candidate who mostly likely benefits in the campaign contest is unrelated to candidates' relative popularity.

Proposition 6. *A candidate with a given ex ante popularity may both increase and decrease his electoral support. Initial popularity is not causal for which candidate benefits during the campaign contest.*

The proposition follows from Proposition 5 and the intuition is most easily explained by considering convergent equilibria of the campaign contest. In a convergent equilibrium, the identity of the candidate who improves his electoral prospects during the campaign depends on who holds the comparative advantage in this issue. Comparative advantages, however, are unrelated to a candidates general popularity. Thus, both a more and a less popular candidate may gain support during the campaign. Figure 2 provides an example. The dashed line in the right panel represents combinations of θ^1 and φ such that $\varphi\theta^1 + (1-\varphi)\theta^2 = \frac{55}{100}$, given $\theta^2 = \frac{1}{3}$, implying on this line D is more popular at the campaign outset than R. The line goes through both the blue and the brown region, implying the stronger candidate may both benefit from the campaign contest and lose popularity because of it. Denter and Sisak (2015) also show that campaign contests neither create momentum nor anti-momentum, if the electoral system is proportional representation. Proposition 6 implies that this finding is more general.

3.3 Optimal Candidate Nomination

Intuitively, one of the most important determinants of electoral success is selecting the 'right' candidate. I show next that selecting a candidate optimally requires a good understanding of how a campaign contest plays out exactly.

Assume one of the two sides in the campaign, say, R has already decided on a candidate. How should D optimally select a candidate if the primary goal is to win the election? 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 Democrats. In the end, Hillary Clinton won the nomination, but she lost the election in November 2016. After this defeat, many Americans have questioned whether Hillary Clinton was the optimal candidate to challenge Donald Trump, or whether 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[9]: "*The RealClearPolitics average from May 6-June 5 had Sanders at 49.7% to Trump's 39.3%, a 10.4-point cushion. In*

[9] https://www.usatoday.com/story/news/politics/onpolitics/2016/11/09/bernie-sanders-donald-trump/93530352/ (last retrieved: October 10, 2017).

that same time frame, Trump was polling close to Clinton and was even ahead in multiple polls." While intuitive and tempting, using polling figures to judge candidates' chances to succeed, the model suggests that a comparison of poll results *before* the campaign starts may be a bad guide for optimal candidate selection. The next proposition, which is a corollary of Proposition 6, states this formally:

Proposition 7. *A candidate's pre-campaign popularity relative to an opponent candidate is not sufficient to judge the candidates' relative chances at the ballot after the campaign contest. A less popular candidate at the campaign outset might have better chances to win the election than a more popular candidate.*

A candidate's identity influences the campaign contest and thus also equilibrium play. A candidate may not only stand for issue specific qualities, but may just by his or her presence in the contest prime some issues. For example, because of the Benghazi affairs and Hillary Clinton being the candidate for presidential office, issues like *Trustworthiness*[10] and *Leadership* attracted attention. With Bernie Sanders as the running candidate, these issues might have been less important, while other would have been primed instead. Hence, a candidate's identity not only influences his or her current popularity with the electorate, but also the *potential to develop* during the campaign contest. This is exactly the content of Proposition 7: The currently most popular candidate might be a bad choice as a running candidate, if the goal is to maximize electoral prospects. The proposition also implies that judging Hillary Clinton's nomination as a bad decision, just because Bernie Sanders looked better in the polls, might be a mistake. Of course, a more popular candidate could be the better candidate, but a candidate's potential to develop during the contest, which is unrelated to his or her popularity, is also an important determinant for optimal candidate selection. In Figure 3 such a situation is depicted. Both A and B are available to run as candidate D. Ex ante, A appears stronger compared to B, because A has a 10 percentage point advantage compared to R, while B and R are equally popular with the electorate ex ante. However, an analysis of the campaign contest reveals that B is the better, more promising candidate, which can be seen in the right panel of Figure 3.

Note that Iaryczower and Mattozzi (2013) have already studied how campaigns affect optimal candidate selection in equilibrium, where candidate selection is modelled as in the citizen candidate model developed by Besley and Coate (1997) and Osborne and Slivinski (1996). However, in their model the campaign contest creates valence à la Stokes (1963) and along the equilibrium path campaign spending cancels out, implying the campaigning has no influence on the equilibrium outcome of the election once candidates are chosen (see Proposition 2 in their article). Without

[10]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/paulroderickgregory/2016/06/29/how-benghazi-can-still-hurt-hillary-clinton/#66d8c5a1599c` (last retrieved: October 9, 2017)

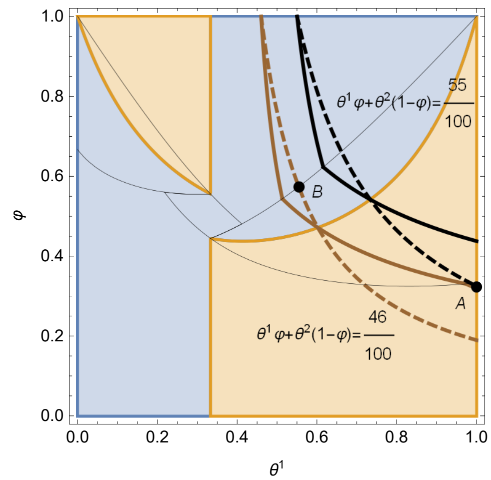

Figure 3: Ex ante (dashed) and ex post iso-probability lines. The black lines represent a probability of 55/100, the brown lines of 46/100. Ceteris paribus, the probability increases in the north east direction. This implies that A, while being on a higher ex-ante iso-probability curve than B, is in fact the weaker of the two candidates.

offering a complete equilibrium characterization of which candidates run for election, Proposition 7 suggests that in a campaign contest with multiple issues the effect a campaign has on candidate selection is likely to be more subtle.

3.4 Policy Choice with Office Motivated Candidates

Next I show how the model can be incorporated in a standard Downsian framework of policy choice. For simplicity's sake, I focus on purely office motivated candidates.

Assume θ^i is determined by the candidates' policy positions, represented by $p^i_j \in \mathbb{R}$ in issue i, and the voter's preferred policy position in this issue, $b^i \in \mathbb{R}$. Assume the voter has standard spatial or Downsian preferences, i.e., he evaluates a policy p^i_j according to $u(|p^i_j - b^i|)$, where $u > 0$ is a decreasing function. Then we can define

$$\theta^i = \frac{u(|p^i_D - b^i|)}{u(|p^i_D - b^i|) + u(|p^i_R - b^i|)} \in (0, 1).$$

If both D and R choose identical policies in issue i, $p^i_D = p^i_R = p^i$, we get $\theta^i = \frac{u(|p^i - b^i|)}{u(|p^i - b^i|) + u(|p^i - b^i|)} = \frac{1}{2}$. Otherwise the candidate with a position closer to the voter's ideal point is considered better. Candidates have comparative advantages in the campaign contest if and only if

$$\frac{u(|p^1_D - b^1|)}{u(|p^1_D - b^1|) + u(|p^1_R - b^1|)} \neq \frac{u(|p^2_D - b^2|)}{u(|p^2_D - b^2|) + u(|p^2_R - b^2|)} \Leftrightarrow \frac{u(|p^1_D - b^1|)u(|p^2_D - b^2|)}{u(|p^1_R - b^1|)u(|p^2_R - b^2|)} \neq 1.$$

Whenever candidates choose identical policies (but not only then), none has a comparative advantage.

If candidates can freely choose policy platforms, that is if they are not bound by party ideologies or special interests, the outcome of the policy choice game is well known:

Proposition 8. *Let $\omega \in (0,1)$. If $\omega \neq \frac{1}{2}$, office motivated candidate choose identical platforms equal to the voter's preferred policy in each issue i in the unique subgame perfect equilibrium. If $\omega = \frac{1}{2}$, there is a continuum of outcome equivalent subgame perfect equilibria in which both candidates choose the voter's preferred policy in each issue.*

If $\omega = \frac{1}{2}$ and candidates converge in each issue, any strategy profile is an equilibrium in the campaign contest, and thus also any mixed strategy. Thus, in this case there is a continuum of equilibria. In all other cases, the equilibrium is unique. Hence, both candidates always cater completely to the voter's preferences. Admittedly, this is not really surprising. But the analysis shows how the campaign contest and platform choices can be linked and how they influence each other. In particular, if candidates converge in the platform choice game, convergence in the campaign contests is also a likely outcome.

4 Conclusion

In this paper I developed a model of multi-issue political competition in a campaign contests. Candidates compete for electoral success by spending time or money on the different issues. The novelty is that I allow for simultaneous issue priming and quality advertising, which cannot be disentangled. This allows us to develop a whole new set of interesting testable predictions about candidate behavior.

The main results are the following: While quality advertising aligns candidates' incentives in the campaign, issue priming drives a wedge between them. We develop a notion of comparative advantage that is important for determining whether and by how much candidates diverge in their strategies. Generally, a candidate who enjoys a comparative advantage in an issue has the tendency to address this issue with greater intensity than his competitor. Further, the model explains why oftentimes candidates campaign heavily on their weak(est) issues. In existing models this cannot be rationalized, because putting the own weakness in the spotlight must be detrimental. However, once we allow for quality advertising, things change drastically and a candidate may campaign hardest on an issue that he would have neglected completely otherwise.

This effect also engenders that campaign agendas depend on an intricate interplay of many forces. Most importantly, issues that are perceived marginal may receive the bulk of candidates' attention. This in turn may be welfare relevant for at least two reasons. First, as we show, this implies that who wins on Election Day may be decided by issues that are of only secondary importance to voters. Moreover, if agendas are persistent, it also may influence the policies that are given priority by the elected candidate in a way that is to the detriment of voters.

While most of the literature on issue selection and strategic campaign spending comes to the conclusion that centrifugal forces are very important and thus we should expect candidates to diverge in their strategies, the model shows that gravitational forces are also important and may dominate. As a conclusion, completely convergent equilibria are possible as we have seen in Proposition 1 and Corollary 1. As discussed earlier, this seems to be in line with the empirical record.

By explicitly modeling a multi issue campaign, the model can be used to study strategic repercussions for both policy choices and entry decisions. I show in an application of the model that campaign contests have important implications for election outcomes and that optimal candidate nomination should not be based on candidates' popularity before the outset of the campaign contest, but that a candidates potential to develop during the contest should be taken into account as well. The result implies that locally moving away from the preferred policy of the median voter, if one exists, may increase electoral prospects.

From a technical perspective, the model is a probabilistic version of a Blotto game (e.g. Borel, 1953, Roberson, 2006 or Kovenock and Roberson, 2012) with endogenous prizes. The model is well suited to analyze other interesting questions as well, for example advertising competition on goods markets when goods have multiple attributes, as described by Lancaster (1966). The model suggests that companies focus on attributes in which their goods are perceived to be *relatively* good, not necessarily better than their opponents. An interesting implication is that firms focussing on their respective relative strengths might thus be able to differentiate products–or the perception thereof–which then allows them to influence the perceived substitutability of products and thus grants them price-setting power.

A Mathematical Appendix

A.1 Proof of Lemma 1

Existence. Follows trivially from Nash's theorem.

Uniqueness of SNE. Assume Candidate D's payoffs are as follows:

	$x_R^1 = 1$	$x_R^1 = 0$
$x_D^1 = 1$	a	b
$x_D^1 = 0$	c	d

Table 2: Payoff matrix.

Without loss of generality focus on SNE (1,1). Then $a > c$ and $a < b$, because $1 - a > 1 - b$, imply $b > c$. This immediately implies that both (1,0) and (0,1) cannot be equilibria. But what about $(0, 0)$? This would be a Nash equilibrium iff $d \geq b$ and $d \leq c$, thus necessitating $c \geq d \geq b$, or $c \geq b$. But this contradicts $b > c$. Thus, if a SNE exists, no other Nash equilibrium exists.

Payoff Equivalence. Consider the payoff matrix depicted in Table 2 above. Assume there are multiple equilibria. If they are adjacent, e.g. (1,1) and (1,0), they trivially must be payoff equivalent. So assume two equilibria are non adjacent, e.g. (1,1) and (0,0). Then $a \geq c$ and $a \leq b$ for (1,1) and $d \geq b$ as well as $d \leq c$ for (0,0). The first implies $b \geq a \geq c$, the latter $c \geq d \geq b$. Hence, $b = c$, which then also implies $a = b = c = d$. Therefore, if multiple pure strategy equilibria exist, they all must imply the same winning probabilities and are thus payoff equivalent.

A.2 Proof of Proposition 1

Equilibrium condition. The payoff matrix is

	$x_R^1 = 1$	$x_R^1 = 0$
$x_D^1 = 1$	$c^1\overline{w} + c^2(1-\overline{w})$	$\overline{c}^1 w + \underline{c}^2(1-w)$
$x_D^1 = 0$	$\underline{c}^1 w + \overline{c}^2(1-w)$	$c^1\underline{w} + c^2(1-\underline{w})$

and the conditions follow simply from comparing the matrix' entries in the appropriate way.

Sufficiency. The proposition states that without comparative advantages, $\theta^1 = \theta^2 = \theta$, and if one issue is sufficiently important, then a convergent SNE exists. I prove this only for the case of SNE (1,1). The case for (0,0) follows from an analogous argument.

Without comparative advantages, payoffs are as follows:

	$x_R^1 = 1$	$x_R^1 = 0$
$x_D^1 = 1$	c	$\overline{c}w + \underline{c}(1-w)$
$x_D^1 = 0$	$\underline{c}w + \overline{c}(1-w)$	c

Table 3: Matrix of Candidate D's payoff, absent comparative advantages.

Then, (1,1) is SNE if $c > \underline{c}w + \overline{c}(1-w) \Leftrightarrow \frac{\overline{c}-c}{\overline{c}-\underline{c}} < w = \varphi$ and $c < \overline{c}w + \underline{c}(1-w) \Leftrightarrow \frac{c-\underline{c}}{\overline{c}-\underline{c}} < w = \varphi$. Thus, if $\varphi > \hat{\varphi} = \max\left\{\frac{c-\underline{c}}{\overline{c}-\underline{c}}, \frac{\overline{c}-c}{\overline{c}-\underline{c}}\right\} \in (0,1)$ for all $\theta \in (0,1)$, (1,1) is the unique SNE.

φ-monotonicity Recall the condition for the (1,1) equilibrium:

$$w(\overline{c}^1 - \underline{c}^2) + (\underline{c}^2 - c^2) > \overline{w}(c^1 - c^2) > w(\underline{c}^1 - \overline{c}^2) + (\overline{c}^2 - c^2)$$

Consider the three parts separately:

$$\begin{aligned} W^1(\varphi) &= w(\overline{c}^1 - \underline{c}^2) + (\underline{c}^2 - c^2) \\ W^2(\varphi) &= \overline{w}(c^1 - c^2) \\ W^3(\varphi) &= w(\underline{c}^1 - \overline{c}^2) + (\overline{c}^2 - c^2) \end{aligned}$$

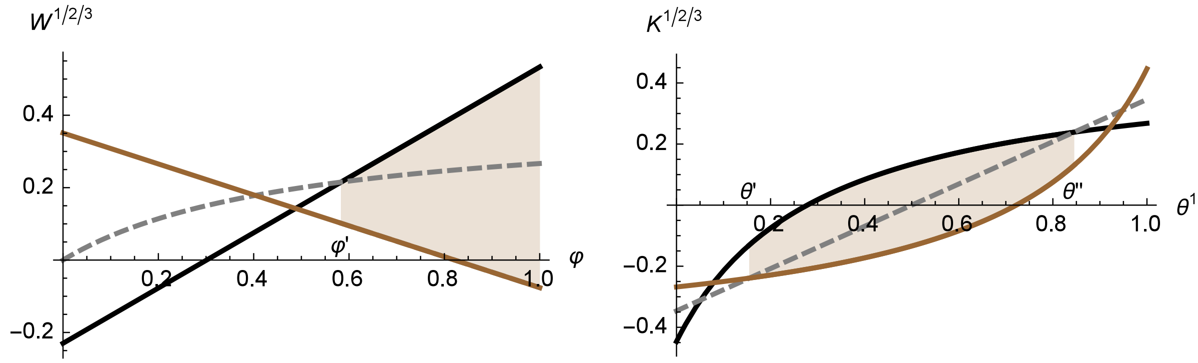

Figure 4: Left panel: $W^1(\varphi)$ (black and solid, linear), $W^2(\varphi)$ (gray and dashed, concave), $W^3(\varphi)$ (brown and solid, linear). $(1,1)$ is SNE if and only if $\varphi \in (\varphi', 1]$ (shaded region). Right panel: $K^1(\theta^1)$ (black and solid, concave), $K^2(\theta^1)$ (gray and dashed, linear), $K^3(\theta^1)$ (brown and solid, convex). (1,1) is SNE if and only if $\theta^1 \in (\theta', \theta'')$ (shaded region).

At $\varphi = 0$ we get

$$\begin{aligned} W^1(0) &= \underline{c}^2 - c^2 < 0 \\ W^2(0) &= \overline{w}(c^1 - c^2) \\ W^3(0) &= \overline{c}^2 - c^2 > 0 \end{aligned}$$

and thus $W^3(0) > W^1(0)$, implying at this point there cannot be a convergent SNE. At $\varphi = 1$ we get

$$\begin{aligned} W^1(1) &= \overline{c}^1 - c^2 \\ W^2(1) &= c^1 - c^2 \\ W^3(1) &= \underline{c}^1 - c^2 \end{aligned}$$

and thus $W^1(1) > W^2(1) > W^3(1)$, implying here (1,1) is a SNE for all $\theta^1 \in (0,1)$. Now note that $W^1(\varphi)$ and $W^3(\varphi)$ are both linear in φ and intersect exactly once on $[0,1]$. $W^2(\varphi)$ is weakly concave in φ, implying once it lies between W^1 and W^3 it stays there. See the left panel in Figure 4 for an illustration. Consequently, the set of values of φ for which (1,1) is SNE is convex.

θ^1-monotonicity Consider the three parts separately:

$$\begin{aligned} K^1(\theta^1) &= w(\overline{c}^1 - \underline{c}^2) + (\underline{c}^2 - c^2) \\ K^2(\theta^1) &= \overline{w}(c^1 - c^2) \\ K^3(\theta^1) &= w(\underline{c}^1 - \overline{c}^2) + (\overline{c}^2 - c^2) \end{aligned}$$

$K^1(\theta^1)$ is concave in θ^1, $K^3(\theta^1)$ is convex, and $K^2(\theta^1)$ is linear by Assumption 2. This implies that whenever $K^1(\theta^1) > K^3(\theta^1)$, which is necessary for (1,1) to be SNE, both functions span a convex lense. If, then, $K^2(\theta^1)$ ever cuts through this lense, the set of values such that the equilibrium exists must be convex, thus proving this part of the proposition. See the right panel in Figure 4 for an illustration.

θ^{-i}-monotonicity To show that the equilibrium is not always monotonic in θ^{-i}, an example suffices. In the right panel of Figure 1 such an example can be found. There, (0,0) is not monotonic in θ^1.

A.3 Proof of Lemma 2

Assume $\theta^1 > \theta^2$. We need to show that (0,1) cannot be SNE. Assume it was SNE. Because $\theta^1 > \theta^2$, $\overline{c}^1 > \overline{c}^2$ and $\underline{c}^1 > \underline{c}^2$. Thus,

$$\overline{w}c^1 + (1-\overline{w})c^2 > \underline{w}c^1 + (1-\underline{w})c^2, \tag{A.1}$$

implying Candidate D prefers (1,1) over (0,0) and Candidate R vice versa. For (0,1) to be equilibrium, we need that

$$w\underline{c}^1 + (1-w)\overline{c}^2 > \overline{w}c^1 + (1-\overline{w})c^2$$

and

$$1 - \left(w\underline{c}^1 + (1-w)\overline{c}^2\right) > 1 - \left(\underline{w}c^1 + (1-\underline{w})c^2\right) \Leftrightarrow w\underline{c}^1 + (1-w)\overline{c}^2 < \underline{w}c^1 + (1-\underline{w})c^2.$$

Thus,

$$\underline{w}c^1 + (1-\underline{w})c^2 > w\underline{c}^1 + (1-w)\overline{c}^2 > \overline{w}c^1 + (1-\overline{w})c^2,$$

contradicting (A.1). Consequently, (0,1) cannot be SNE if $\theta^1 > \theta^2$.

A.4 Proof of Lemma 3

Let $\theta^1 = \theta^2 = \theta \in (0,1)$. Moreover, let $\varphi = \lambda\check{\varphi} + (1-\lambda)\hat{\varphi}$, $\lambda \in (0,1)$. The payoff matrix then looks as follows:

	$x_R^1 = 1$	$x_R^1 = 0$
$x_D^1 = 1$	c	$c(1-2\lambda) + \lambda(\overline{c} + \underline{c})$
$x_D^1 = 0$	$c(2\lambda - 1) + (1-\lambda)(\overline{c} + \underline{c})$	c

Table 4: Matrix of Candidate D's payoff, absent comparative advantages and for $\varphi \in (\check{w}, \hat{w})$.

Denote the best response of player j by $BR_j(x)$ if player $-j$ chose $x \in \{0,1\}$. Then,

$$BR_D(1) = \begin{cases} 1 & \text{if } c > \frac{\overline{c}+\underline{c}}{2} \\ 0 & \text{if } c < \frac{\overline{c}+\underline{c}}{2} \end{cases} \quad \text{and} \quad BR_D(0) = \begin{cases} 0 & \text{if } c > \frac{\overline{c}+\underline{c}}{2} \\ 1 & \text{if } c < \frac{\overline{c}+\underline{c}}{2} \end{cases}$$

The best response of 2 is $BR_R(x) = 1 - BR_D(x)$. Thus, one of the two candidates always tries to match the strategy of the other, while the other has an incentive to choose differently. A pure strategy equilibrium cannot exist as a consequence. Note that if $c = \frac{\overline{c}+\underline{c}}{2}$ it must be the case that either c is linear and both $\overline{c}$ and $\underline{c}$ are strictly between 0 and 1, or that $\theta = 1/2$.

Thus, if $c > \frac{\overline{c}+\underline{c}}{2}$, Candidate D's best response against Candidate R's strategy is always to choose a different one. Keep in mind that Candidate R's payoff is just 1 minus that of Candidate D. Thus, for Candidate R it is then the opposite: he always wants to match 1's choice. If to the contrary $c < \frac{\overline{c}+\underline{c}}{2}$, player switch roles. Thus, in either situation, no pure strategy equilibrium exists, and thus no SNE either. If $c = \frac{\overline{c}+\underline{c}}{2}$ we must have that $\theta = 1/2$ and that $\check{\varphi} = \hat{\varphi}$. Therefore, for no $\varphi \in (\check{\varphi}, \hat{\varphi})$ a pure strategy equilibrium exists as long as $\check{\varphi} \neq \hat{\varphi}$.

A.5 Proof of Proposition 3

Equilibrium condition. As in the last proposition, the conditions immediately follow from comparing the entries of the payoff matrix.

Sufficiency. Let $\varphi = 1/2$ and $\theta^2 = 1 - \theta^1$ (keeping $\theta^1 > \theta^2$, thus $\theta^1 > 1/2$). This implies $\overline{c}^2 = 1 - \underline{c}^1$, $\underline{c}^2 = 1 - \overline{c}^1$, and $\overline{w} = 1 - \underline{w}$. Then, the payoff matrix looks as follows:

	$x_R^1 = 1$	$x_R^1 = 0$
$x_D^1 = 1$	$c^1(2\overline{w} - 1) + (1 - \overline{w})$	$\frac{1}{2}$
$x_D^1 = 0$	$\frac{1}{2}$	$c^1(2\underline{w} - 1) + (1 - \underline{w})$

Table 5: Matrix of Candidate D's payoff, absent comparative advantages.

For (1,0) to be SNE we need that $\frac{1}{2} > c^1(2\underline{w} - 1) + (1 - \underline{w}) \Leftrightarrow c^1 = \theta^1 > \frac{1}{2}$. Moreover, we need that $\frac{1}{2} < 1 - (c^1(2\overline{w} - 1) + (1 - \overline{w})) \Leftrightarrow c^1(2\overline{w} - 1) + (1 - \overline{w}) < 1/2 \Leftrightarrow c^1 = \theta^1 > \frac{1}{2}$. Thus, the stated condition is sufficient for (1,0) to be SNE.

φ-monotonicity Recall the condition for (1,0) to be SNE:

$$\overline{w}(c^1 - c^2) + (c^2 - \underline{c}^2) > w(\overline{c}^1 - \underline{c}^2) > \underline{w}(c^1 - c^2) + (c^2 - \underline{c}^2).$$

Consider the three parts separately:

$$\begin{aligned} L^1(\varphi) &= \overline{w}(c^1 - c^2) + (c^2 - \underline{c}^2) \\ L^2(\varphi) &= w(\overline{c}^1 - \underline{c}^2) \\ L^3(\varphi) &= \underline{w}(c^1 - c^2) + (c^2 - \underline{c}^2) \end{aligned}$$

$L^1(\varphi)$ is concave in φ, $L^2(\varphi)$ linear, and $L^3(\varphi)$ convex by Assumption 1. This implies that whenever $L^1(\varphi) > L^3(\varphi)$, which is necessary for (1,0) to be SNE, both functions span a convex lense. If, $L^2(\varphi)$ ever cuts through this lense, the set of values such that the equilibrium exists must be convex, thus proving this part of the proposition. See the right panel in Figure 5 for an illustration.

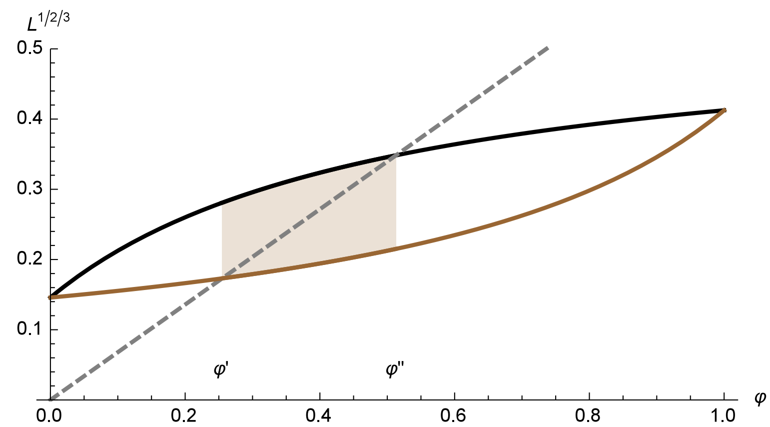

Figure 5: $L^1(\varphi)$ (black and solid, concave), $L^2(\varphi)$ (gray and dashed, linear), $L^3(\varphi)$ (brown and solid, convex). $(1,0)$ is SNE if and only if $\varphi \in (\varphi', \varphi'']$ (shaded region).

θ^1-monotonicity To show that the equilibrium is not monotonic in θ^1, an example suffices. Let

$$\begin{aligned} c(\mathbf{x};\theta^i) &= \frac{\theta^i(\frac{1}{5}+x_D^i)}{\theta^i(\frac{1}{5}+x_D^i)+(1-\theta^i)(\frac{1}{5}+x_R^i)} \\ w(\mathbf{x};\varphi) &= \frac{\varphi(1+x_D^1+x_R^1)}{\varphi(1+x_D^1+x_R^1)+(1-\varphi)(1+x_D^2+x_R^2)} \end{aligned} \tag{A.2}$$

If $\varphi = \frac{1}{10}$ and $\theta^2 = \frac{2}{100}$, (1,0) is SNE for $0 < \frac{7981-\sqrt{60531601}}{5900} < \theta^1 < \frac{685-7\sqrt{2785}}{5900}$ or $\frac{685+7\sqrt{2785}}{5900} < \theta^1 < 1$.

θ^2-monotonicity To show that the equilibrium is not monotonic in θ^2, an example suffices. Assume as above (A.2). If $\varphi = \frac{9}{10}$ and $\theta^1 = \frac{98}{100}$, (1,0) is SNE for $0 < \theta^2 < \frac{7(745-\sqrt{2785})}{5900}$ or $\frac{7(745+\sqrt{2785})}{5900} < \theta^2 < \frac{\sqrt{60531601}-2081}{5900} < 1$.

A.6 Proof of Proposition 4

Take the condition for a convergent SNE (0,0) and let $\underline{w} = \varphi - \eta(\varphi)$:

$$\varphi(\underline{c}^1 - \overline{c}^2) + (\overline{c}^2 - c^2) > (\varphi - \eta)(c^1 - c^2) > \varphi(\overline{c}^1 - \underline{c}^2) + (\underline{c}^2 - c^2)$$

There are two inequalities that need to hold at the same time,

$$\varphi(\underline{c}^1 - \overline{c}^2) + (\overline{c}^2 - c^2) > (\varphi - \eta(\varphi))(c^1 - c^2) \Leftrightarrow \varphi < \frac{(\overline{c}^2 - c^2) + \eta(\varphi)(c^1 - c^2))}{(\overline{c}^2 - c^2) + (c^1 - \underline{c}^1)}$$

and

$$(\varphi - \eta(\varphi))(c^1 - c^2) > \varphi(\overline{c}^1 - \underline{c}^2) + (\underline{c}^2 - c^2) \Leftrightarrow \varphi < \frac{(c^2 - \underline{c}^2) - \eta(\varphi)(c^1 - c^2)}{(c^2 - \underline{c}^2) + (\overline{c}^1 - c^1)}.$$

Thus, for (0,0) to be SNE we need that

$$\varphi < \min\left\{\frac{(\overline{c}^2 - c^2) + \eta(\varphi)(c^1 - c^2))}{(\overline{c}^2 - c^2) + (c^1 - \underline{c}^1)}, \frac{(c^2 - \underline{c}^2) - \eta(\varphi)(c^1 - c^2)}{(c^2 - \underline{c}^2) + (\overline{c}^1 - c^1)}\right\} \leq 1.$$

If $\eta(\varphi) \to 0$ and $\overline{c}^1 \approx \underline{c}^1$, (0,0) is SNE for any $\varphi < 1$.

A.7 Proof of Proposition 5

Without loss of generality assume $\theta^2 < \frac{1}{2}$. To prove the first part, define

$$\Delta^{(1,1)} \equiv \theta^1\overline{w} + \theta^2(1-\overline{w}) - \big(\theta^1\varphi + \theta^2(1-\varphi)\big) = (\theta^1 - \theta^2)(\overline{w} - \varphi).$$

By Assumption 4

$$\text{Sign}\left[\Delta^{(1,1)}\right] = \text{Sign}\left[\theta^1 - \theta^2\right] \; \forall\varphi \in (0,1).$$

Similarly, if

$$\Delta^{(0,0)} \equiv \theta^1\underline{w} + \theta^2(1-\underline{w}) - \big(\theta^1\varphi + \theta^2(1-\varphi)\big) = (\theta^1 - \theta^2)(\underline{w} - \varphi),$$

then

$$\text{Sign}\left[\Delta^{(0,0)}\right] = -\text{Sign}\left[\theta^1 - \theta^2\right] \; \forall\varphi \in (0,1).$$

Finally, let

$$\Delta^{(1,0)} \equiv \overline{c}^1\varphi + \underline{c}^2(1-\varphi) - \big(\theta^1\varphi + \theta^2(1-\varphi)\big) = (\overline{c}^1 - \theta^1)\varphi + (\underline{c}^2 - \theta^2)(1-\varphi).$$

Note that as $\theta^1 \to 1$, $\Delta^{(1,0)}$ must be negative for all $\theta^2 \in (0,1)$ and $\varphi \in (0,1)$. Further note that when $\theta^1 = \theta^2$ and $\varphi = \check{\varphi}$, because $\theta^2 < \frac{1}{2}$, $(1,0)$ is a pure strategy Nash equilibrium and that exactly at this point $\Delta^{(1,0)} = 0$. Similarly, when $\theta^1 = 1$ and $\varphi = 1$, $(1,0)$ is a pure strategy Nash equilibrium and also at this point $\Delta^{(1,0)} = 0$. Because for $\theta^2 > \theta^1$ (1,0) cannot be an equilibrium, these two equilibria are at the polar ends of the θ^1 spectrum allowing for (1,0). Finally, note that within a pure strategy equilibrium, candidates' expected utilities must be continuous in the parameters and they cannot be constant as long as $(\theta^1, \theta^2, \varphi) \in (0,1)^3$. Hence, there must be a unique continuous sequence $\tilde{\varphi}(\theta^1, \theta^2)$, or a line, connecting these two Nash equilibria such that on this line $\Delta^{(1,0)} = 0$. The slope of this line can be determined by totally differentiating $\Delta^{(1,0)}$:

$$\left.\frac{d\varphi}{d\theta^1}\right|_{\Delta^{(1,0)}=0} = -\frac{\varphi(\frac{\partial \overline{c}^1}{\partial \theta^1} - 1)}{(\overline{c}^1 - \theta^1) - (\underline{c}^2 - \theta^2)}.$$

As $\theta^1 \to 1$, this must be positive. For low values of θ^1 it may be both positive and negative.

To finish the proof note that $\Delta^{(1,0)}$ is increasing in φ as

$$\frac{\partial \Delta^{(1,0)}}{\partial \varphi} = (\overline{c}^1 - \theta^1) - (\underline{c}^2 - \theta^2) > 0.$$

Hence, when $\varphi > \tilde{\varphi}$, D benefits from the campaign and R loses, while the opposite is true when $\varphi < \tilde{\varphi}$.

A.8 Proof of Proposition 8

Lemma 4. *If $\theta^1 = \theta^2 = \frac{1}{2}$, no candidate can improve his position during the campaign.*

Proof. From Proposition 1 it follows that when $\omega > \frac{1}{2}$, the unique campaigning equilibrium is (1,1). Hence,

$$\Delta^{(1,1)}\left(\frac{1}{2},\frac{1}{2}\right) = \left(\frac{1}{2} - \frac{1}{2}\right)(\overline{w} - \varphi) = 0.$$

Similarly, when $\varphi < \frac{1}{2}$, by Proposition 3 the unique equilibrium is (0,0). Hence,

$$\Delta^{(0,0)}\left(\frac{1}{2},\frac{1}{2}\right) = \left(\frac{1}{2} - \frac{1}{2}\right)(\underline{w} - \varphi) = 0.$$

Finally, if $\varphi = \frac{1}{2}$, any strategy combination is a pure strategy Nash equilibrium and hence also any mixed strategy. In a convergent equilibrium with no comparative advantages, nobody benefits from the campaign, as I have just established. If candidates diverge, for example (1,0), we get

$$\Delta^{(1,0)}\left(\frac{1}{2},\frac{1}{2}\right) = \left(\overline{c} - \frac{1}{2}\right)\frac{1}{2} + \left(\underline{c} - \frac{1}{2}\right)\frac{1}{2} = \frac{1}{2}\left(\overline{c} + \underline{c} - 1\right).$$

By Assumption 2, $\overline{c}^i = 1 - \underline{c}^i$ when $\theta^i = \frac{1}{2}$. Thus,

$$\Delta^{(1,0)}\left(\frac{1}{2},\frac{1}{2}\right) = \frac{1}{2}\left(1 - \underline{c} + \underline{c} - 1\right) = 0$$

Hence, when $\theta^1 = \theta^2 = \frac{1}{2}$, no candidate gains support during the campaign contest, independent of the strategy combination that is played. □

Lemma 5. *Independent of the policy positions of the other candidate, a candidates electoral chances are maximized when he chooses $p^i_j = b^i$, $i = 1, 2$.*

Proof. Consider first a convergent equilibrium, say (1,1). Then equilibrium utility of D is $\theta^1\overline{w} + \theta^2(1 - \overline{w})$. This is increasing in both θ^1 and θ^2. An analogous argument establishes the same result for equilibrium (0,0). Next consider a divergent equilibrium. Equilibrium utility of D is $\overline{c}^1\varphi + \underline{c}^2(1 - \varphi)$. This is also weakly increasing in θ^1 and strictly so in θ^2. An analogous argument establishes the same result for equilibrium (0,1). Thus, choosing $p^i_j = b^i$, $i = 1, 2$, maximizes utility in all equilibria, and thus is also globally optimal. □

Note that Lemma 4 implies that any candidate can enforce himself a minimum payoff of $\frac{1}{2}$ by choosing $p^i_j = b^i$, $i = 1, 2$. This is true for both candidates, and thus no candidate can have equilibrium utility different from $\frac{1}{2}$. Moreover, Lemma 5 implies that the only strategy combination, which leads to payoffs of $\frac{1}{2}$, and given which no candidate has an incentive to deviate, is $p^i_j = b^i$, $i = 1, 2$. Hence, candidates must choose $p^i_j = b^i$, $i = 1, 2$ in subgame perfect equilibrium, and thus $\theta^1 = \theta^2 = \frac{1}{2}$ in equilibrium. Equilibrium play in the contest follows from Propositions 1 and 3.

B A General Model

In this section I now look at a more general model of electoral competition. In particular, there are n different policy issues, there is a continuum of voters who may hold arbitrary beliefs with respect to politicians' qualities and issues' relative importance, and candidates can allocate funds or time in a continuous way over the different issues. As we will see, all results established in the discrete model above hold generally.

B.1 Setup

Two politicians $j = D, R$ compete in a campaign for a political office by exerting effort. While effort can 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 n policy issues, $i \in \{1, 2, \dots, n\}$. 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 $\theta^i_{v,D} + \theta^i_{v,R} = 1$ as in the discrete model above. 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 $\varphi^i_v \in (0, 1)$ to issue i where $\sum_{i=1}^n \varphi^i_v = 1$.

Voters' beliefs about candidates' relative quality in issue i are distributed on $\Theta^i = [\underline{\theta}^i, \overline{\theta}^i] \subseteq (0, 1)$ with distribution $\mathcal{C}^i(\theta^i_v)$. Similarly, the issue importance beliefs are distributed on $\Omega^i = [\underline{\varphi}^i, \overline{\varphi}^i] \subseteq (0, 1)$ with distribution $\mathcal{I}^i(\varphi^i_v)$. Hence, voters' quality belief space is $\Theta = \Theta^1 \times \Theta^2 \times \cdots \times \Theta^n$ and voters' importance belief space is $\Omega = \Omega^1 \times \Omega^2 \times \cdots \times \Omega^n$. Accordingly, every voter v is completely described by $s_v \in \mathcal{S} \equiv \Theta \times \Omega$. Beliefs are independent draws from $\mathcal{S}$.

Voters have *weighted-issue preferences* as before and a candidate's relative evaluation by a voter is

$$u_{v,D}(\mathbf{x}; s_v) = \sum_{i=1}^n c^i_v(\mathbf{x}; s_v) w^i_v(\mathbf{x}; s_v), \tag{B.1}$$

$$u_{v,R}(\mathbf{x}; s_v) = \sum_{i=1}^n (1 - c^i_v(\mathbf{x}; s_v)) w^i_v(\mathbf{x}; s_v), \tag{B.2}$$

where $c^i_v(\mathbf{x}; s_v) \in [0, 1]$ is voter v's evaluation of Candidate D's quality in issue i, taking into account campaign spending $\mathbf{x} = (x^1_D, x^2_D, \dots, x^n_D, x^1_R, x^2_R, \dots, x^n_R)$ and the prior evaluation θ^i_v. Similarly, $w^i_v(\mathbf{x}; s_v) \in [0, 1]$ is the voter's evaluation of the importance of issue i, depending on campaign spending $\mathbf{x}$ and the prior evaluation φ^i_v, and where $\sum_{i=1}^n w^i_v(\mathbf{x}; s_v) = 1$. It follows that when $u_{v,D} > \frac{1}{2}$, voter v prefers D over R, and vice versa if $u_{v,D} < \frac{1}{2}$. Moreover, $u_{v,R}(\mathbf{x}; s_v) = 1 - u_{v,D}(\mathbf{x}; s_v)$.

Campaigning has the two simultaneous effects I described before: *policy advertising* and *issue priming*. Policy advertising implies that the assessment of a candidate's quality is improving in the number of published TV ads, x^i_k. Issue priming alters an issue's relative importance. Denote voter v's after-campaigning assessment of candidates' relative quality by $c^i_{v,D} \equiv c^i_v$ and $c^i_{v,R} \equiv 1 - c^i_v$. I assume the following policy advertising technology:

$$c_v^i(\mathbf{x}; s_v) = \frac{\theta_v^i f(x_D^i)}{\theta_v^i f(x_D^i) + (1 - \theta_v^i) f(x_R^i)} \tag{B.3}$$

$f(x) > 0$ determines the impact of campaigning and is an increasing function. If both candidates spend an equal amount on TV advertising on some issue, a candidate's relative quality is not altered, $c_v^i(x, x, \theta_v^i) = \theta_v^i$. The functional form described in (B.3) has been employed frequently to model campaigning, e.g. Snyder (1989), Klumpp and Polborn (2006), or Skaperdas and Vaidya (2012). I make the following assumptions:

Assumption 3. *(i) $f(x)$ is $\mathcal{C}^2$, (ii) $f(0) > 0$, (iii) $f'(x) > 0$, (iv) $f'(0) = \mu > 0$, and (v) $f''(x) \leq 0$.*

(ii) means that even if a candidate does not spend anything in the campaign his perceived quality remains positive. A direct implication is that perceived quality is a continuous function of candidates' efforts and voters' pre-campaigning beliefs. (iii) reflects that advertising is effective. (iv) restricts the second derivative of $f(x)$, which is necessary to guarantee existence of equilibrium. Note that (B.3) is an example of a persuasion technology fulfilling Assumption 2.

Next I describe priming. With φ_v^i being a voter's importance belief of issue i, priming leads to a reassessment of issues' relative importance. I assume the following functional form that has been used in earlier work on priming contests as well (see for example Dragu and Fan, 2016):

$$w_v^i(\mathbf{x}; s_v) = \frac{\varphi_v^i g(x_D^i + x_R^i; \zeta)}{\sum_{j=1}^n \varphi_v^j g(x_D^j + x_R^j; \zeta)} \tag{B.4}$$

ζ is a parameter that governs the magnitude of g and its derivatives. I make the following assumptions:

Assumption 4. *(i) $g(x; \zeta)$ is $\mathcal{C}^2$ in all arguments, (ii) $g(0; \zeta) > 0$, (iii) $\frac{\partial g(x;\zeta)}{\partial x} > 0 \, \forall \zeta < \bar{\zeta}$, (iv) $\frac{\partial^2 g(x;\zeta)}{\partial x \partial \zeta} < 0 \, \forall \zeta < \bar{\zeta}$, and (v) $\frac{\partial g(x;\zeta)}{\partial x} = 0 \forall \zeta \geq \bar{\zeta}$.*

Part (ii) implies that the importance of an issue can never drop to zero (but of course may approach it). Together with Assumption 3, (ii) also assures continuity of the payoff functions. Part (iii) states that priming increases the importance of an issue whenever $\zeta < \bar{\zeta}$. (iv) and (v) will be used to prove existence of a pure strategy Nash equilibrium. Indeed, this is the only use of ζ and hence I will abuse notation a bit throughout the main body of the paper and let $g(x; \zeta) = g(x)$ as well as $\frac{\partial g(x;\zeta)}{\partial x} = g'(x)$. Note that I do not restrict the curvature of g and it might be convex or concave. An intuitive property of this technology is that whenever two issues receive an identical amount of attention, their relative weights remain unchanged. Note that (B.4) is a special case of the class of the priming functions defined in Assumption 1.

Voting is probabilistic and the probability that a voter casts her ballot for a candidate is $u_{v,j}(\mathbf{x}; s_v)$. Candidates maximize their vote share subject to the costs of campaigning, with constant marginal cost equal to one for both. The candidates' respective maximization problem is

$$\begin{aligned}
\max_{\mathbf{x}_D} \pi_D(\mathbf{x};s) &= \int \cdots \int \sum_{i=1}^n c_v^i(\mathbf{x};s)\, w_v^i(\mathbf{x};s) \prod_{i=1}^n d\mathcal{C}^i(\theta_v^i)\, d\mathcal{I}^i(\varphi_v^i) - \sum_{i=1}^n x_D^i \\
&= E\left[\sum_{i=1}^n c_v^i(\mathbf{x};s)\, w_v^i(\mathbf{x};s)\right] - \sum_{i=1}^n x_D^i \\
\max_{\mathbf{x}_R} \pi_R(\mathbf{x};s) &= \int \cdots \int \sum_{i=1}^n (1-c_v^i(\mathbf{x};s))\, w_v^i(\mathbf{x};s) \prod_{i=1}^n d\mathcal{C}^i(\theta_v^i)\, d\mathcal{I}^i(\varphi_v^i) - \sum_{i=1}^n x_R^i \\
&= E\left[\sum_{i=1}^n (1-c_v^i(\mathbf{x};s))\, w_v^i(\mathbf{x};s)\right] - \sum_{i=1}^n x_R^i
\end{aligned}$$

where $E[\cdot]$ is the expectation operator. A strategy is an allocation of campaign funds to the different issues. The equilibrium concept we employ is Nash equilibrium. The following proposition establishes sufficient conditions for existence of pure strategy Nash equilibrium:

Proposition 9. *Under Assumptions 3 and 4 there always exists $\zeta^* < \bar{\zeta}$ such that if $\zeta > \zeta^*$, the game has a pure strategy Nash equilibrium. For sufficiently large μ, all equilibria are interior.*

The proof of this is quite standard and hence I do not delve into its details here. Throughout most of the paper the focus will be on interior equilibria, which is the most interesting case. A discussion of corner equilibria can be found in Section B.2.4.

B.2 Equilibrium Campaigning

B.2.1 Convergence or Divergence?

We saw in Section 2 that comparative advantages rather than absolute advantages determine whether candidates converge or diverge on an issue. However, Definition 1 is not very useful when there are $n > 2$ issues and thus it needs to be generalized:

Definition 3 (Comparative Advantage)**.** *Candidate D has an after-campaigning comparative advantage in issue i if*

$$\sigma^i(\mathbf{x};s) := E\left[w_v^i(\mathbf{x};s)\left(c_v^i(\mathbf{x};s) - \bar{c}(\mathbf{x};s)\right)\right] > 0.$$

where $\bar{c}(\mathbf{x};s) = E\left[\sum_{k=1}^n c_v^k(\mathbf{x};s)\, w_v^k(\mathbf{x};s)\right]$ is the weighted average of Candidate D's relative quality evaluation. If $\sigma^i < 0$, Candidate R has a comparative advantage in i and if $\sigma^i = 0$, no candidate has a comparative advantage in that issue. When $\mathbf{x} = (0,\ldots 0, 0,\ldots, 0)$ we write $\tilde{\sigma}^i$ and refer to this as the ex ante comparative advantage.

The definition of comparative advantage has some intuitive appeal.[11] To see this consider voter-specific comparative advantages first. A candidate has a voter-specific comparative advantage in an issue i exactly when his perceived relative quality in that issue is greater than his average

[11] To get an intuitive understanding of why this definition is meaningful for our purpose, consider a single voter type v. We might say that a candidate has a voter-specific comparative advantage when $c_v^i(\mathbf{x};s) - \bar{c}_v(\mathbf{x};s) > 0$. Hence, a candidate has a voter-specific comparative advantage in an issue i exactly when his perceived relative quality in that issue is greater than the voter's weighted average evaluation of the candidate. However, we cannot just aggregate over voter-specific comparative advantages to calculate overall comparative advantages. The reason is that we need to take into account the intensity of voters' assessments. Therefore, we need to weight voter-specific comparative advantages by the weight that voters assign to these issues, $w_v^i(\mathbf{x};s_v)$.

evaluation as seen by that voter. For example, in the case of three issues $i \in \{1,2,3\}$ which all have equal weights $w^i = 1/3$ for a voter, and Candidate D's perceived quality in the issues is given by $(c^1, c^2, c^3) = (\frac{3}{6}, \frac{4}{6}, \frac{5}{6})$, such that Candidate D is weakly better than his opponent in all issues, we get $\sigma^1 = -\frac{1}{18}$, $\sigma^2 = 0$, and $\sigma^3 = \frac{1}{18}$: Candidate 1 has a comparative advantage in issue 3, 2 has a comparative advantage in issue 1, and no candidate has a voter-specific comparative advantage in issue 2. Note that, unlike in previous papers on campaigning like Amorós and Puy (2013) and **?**, comparative advantages are not based solely on quality measures but issues' weights play an important role as well. This becomes apparent when changing the issue weights also impacts comparative advantages. For example, in the above example with three issues, if weights were $w = (\frac{1}{5}, \frac{1}{2}, \frac{3}{10})$ instead, D keeps his comparative advantage in issue 3 but R now has a comparative advantage in the other two issues since $\sigma^1 = -\frac{22}{600}$, $\sigma^2 = -\frac{5}{600}$, and $\sigma^3 = \frac{27}{600}$. The reason is that changing issues' weights changes both the weighted average evaluation of a candidate and it also changes the intensity of voter-specific comparative advantages.

By the nature of comparative advantages, it is not possible that one candidate has a comparative advantage in all issues. In particular, whenever there is at least one $\sigma^i \neq 0$, each candidate has a comparative advantage:

Fact 1. *Each candidate always has at least one comparative advantage unless $\sigma^i(\mathbf{x}; s) = 0$ for all i, in which case there are no comparative advantages at all.*

In an interior pure strategy Nash equilibrium behavior can be determined by appealing to the first order conditions of the candidates. Hence, consider the first order conditions of both candidates in issue i. After simple manipulations they can be shown to be as follows:

$$\begin{aligned} \frac{\partial \pi_D(\mathbf{x}; s)}{\partial x_D^i} &= E\left[c_v^i(\mathbf{x}; s)(1 - c_v^i(\mathbf{x}; s)) w_v^i(\mathbf{x}; s)\right] \frac{f'(x_D^i)}{f(x_D^i)} + \sigma^i(\mathbf{x}; s) \frac{g'(x_D^i + x_R^i)}{g(x_D^i + x_R^i)} - 1 \stackrel{!}{=} 0 \\ \frac{\partial \pi_R(\mathbf{x}; s)}{\partial x_R^i} &= E\left[c_v^i(\mathbf{x}; s)(1 - c_v^i(\mathbf{x}; s)) w_v^i(\mathbf{x}; s)\right] \frac{f'(x_R^i)}{f(x_R^i)} - \sigma^i(\mathbf{x}; s) \frac{g'(x_D^i + x_R^i)}{g(x_D^i + x_R^i)} - 1 \stackrel{!}{=} 0 \end{aligned} \tag{B.5}$$

As we can see, comparative advantage enters both candidates' FOC with a different sign, hence driving a wedge between incentives whenever $\sigma^i(\mathbf{x}; s) \neq 0$. This is due to issue priming, as we have discussed earlier. The next proposition generalizes Propositions 1 and 3:

Proposition 10 (Comparative Advantage and Convergence)**.** *In any interior Nash equilibrium, a candidate spends more on issue i than his opponent if and only if he has a comparative advantage in i. Both candidates spend the same on issue i if and only if nobody has a comparative advantage in i. Formally, Sign$[x_D^i - x_R^i]$ = Sign$[\sigma^i(\mathbf{x}; s)]$.*

What are the main takeaways of this proposition? First, we see that in a quite general setting it is indeed comparative advantage that determines whether there is convergence or divergence in an issue. In contrast to earlier papers studying campaigning this is the case in interior equilibria and hence the model is able to explain imperfect divergence as we observe in real campaigns, which other theories could not yet account for.[12] In fact, if there are no comparative advantages, even a completely convergent equilibrium, in which candidates choose exactly the same spending profile, exists:

Corollary 1. *When there are no comparative advantages, $\sigma^i(\mathbf{x}, s) = 0\,\forall i$, there exists a completely convergent equilibrium in which both candidates advertise each issue with identical intensity, $x_D^i = x_R^i \forall i$.*

The corollary has an immediate implication. If θ_v^i is determined by a candidate's policy position as in the Downsian model and the Median Voter Theorem or Mean Voter Theorem hold, i.e., there is convergence in policies, then we should expect candidates to also convergence in the campaign contest.

Comparative advantages determine which candidate spends more on an issue in the campaign. This comparative advantage is defined *in equilibrium*, i.e. taking into account strategies. A natural question that arises now is how before and after-campaigning comparative advantages are related. It is easy to show that when comparative advantages are 'large' they are also persistent.[13] That is, the same candidate has a comparative advantage in an issue before and after the campaign. But can we generally say that ex-ante and ex-post comparative advantages are identical? The following example illustrates that the answer is no.

Example 1. *Assume $n = 3$ and that there is just one voter type with $\theta^1 = \frac{85}{100}$, $\theta^2 = \frac{1}{2}$, $\theta^3 = \frac{2}{3}$, $\varphi^1 = \frac{2}{5}$, and $\varphi^2 = \frac{2}{5}$. Thus, $\left(\tilde{\sigma}^1, \tilde{\sigma}^2, \tilde{\sigma}^3\right) = \left(\frac{53}{750}, -\frac{52}{750}, -\frac{1}{750}\right)$. Assume $f(x) = (\frac{1}{300} + x)^{\frac{2}{3}}$ and $g(x) = (\frac{1}{2} + x)^{\frac{2}{3}}$. Then $\left(x_D^1, x_D^2, x_D^3\right) = (0.0321, 0.0634, 0.0275)$ and $\left(x_R^1, x_R^2, x_R^3\right) = (0.0265, 0.0751, 0.0274)$, implying $\left(c^1(\mathbf{x}; s), c^2(\mathbf{x}; s), c^3(\mathbf{x}; s)\right) = (0.8651, 0.4724, 0.6671)$, $\left(w^1(\mathbf{x}; s), w^2(\mathbf{x}; s)\right) = (0.3859, 0.4219)$, and thus $\left(\sigma^1(\mathbf{x}; s), \sigma^2(\mathbf{x}; s), \sigma^3(\mathbf{x}; s)\right) = (0.0786, -0.0797, 0.0011)$. Hence, the comparative advantage in issue 3 changed.*

B.2.2 Individual Agendas

Next I study individual campaign agendas, focussing on a generalization of Proposition 2, which stated that candidates might campaign hardest on their weakest issues. First, I establish the following lemma:

Lemma 6. *Let $\zeta = \bar{\zeta}$, such that $g'(x) = 0$. The campaign contest has a unique Nash equilibrium in which candidates converge perfectly, i.e., they spend the same amount on any issue i, $x_D^i = x_R^i = x^i$. Moreover, spending on issue i weakly increases in $E[\theta_v(1 - \theta_v)\varphi_v]$.*

[12] Note, however, that the prediction that comparative advantage drives whether or not converge does not depend on interiority of equilibrium. Interiority is guaranteed by making advertising sufficiently effective at the margin. If this fails to hold the issue priming effect still causes candidates to follow their comparative advantages. However, a subset of issues may be neglected, see also the discussion in Section B.2.4.

[13] Details are available upon request.

All else equal, spending on i increases in φ_v^i, the issue's weight. $\theta_v^i(1-\theta_v^i)$ can be interpreted as a measure of how decided v is in issue i. If he has a clear favorite, $\theta_v^i(1-\theta_v^i)$ is close to zero. If he is completely undecided, $\theta_v^i(1-\theta_v^i) = \frac{1}{2}(1-\frac{1}{2}) = \frac{1}{4}$. Hence, all else equal, undecided issues tend to be addressed with greater intensity. A direct implication of Lemma 6 is that a candidate might focus attention on issues in which he is considered weak:

Proposition 11. *A candidate may campaign hardest on issues in which he is considered weak, even on his weakest.*

Why does Proposition 11 follow from Lemma 6? Assume $n = 2$ and that candidates have comparative advantages. Moreover, let $g'(x) = 0$ and $E[\theta_v^1(1-\theta_v^1)\varphi_v^1] > E[\theta_v^2(1-\theta_v^2)\varphi_v^2]$. Then candidates converge in the two issues and both spend more on issue 1 than on issue 2. Now assume ζ changes slowly such that $g'(x)$ increases from zero. Because candidates have comparative advantages, they now spend different amount on the different issues. But for $g'(x)$ sufficiently small, still both candidates spend more on issue 1. The candidate with the comparative disadvantage in issue 1 thus spends more on issue 1 than on issue 2, although issue 1 is his worst issue. Hence, candidates might campaign hardest on their weakest issues.

B.2.3 Campaign Agendas

Next let us check how Proposition 4 generalizes. This proposition told us that issues may dominate the campaign although voters don't really care about them. Proposition 12 establishes that this is indeed the case:

Proposition 12 (Inverse Campaign Agenda)**.** *Candidates might campaign hardest on the least important issue, and thus there may be a negative correlation between the intensity with which an issue is addressed and issues' ex-ante importance.*

Note that this proposition follows from Lemma 6. For some $\zeta < \bar{\zeta}$ such that $g'(x) > 0$ but not too large, aggregate spending on an issue increases in $E[\theta_v^i(1-\theta_v^i)\varphi_v^i]$, and hence less important issues may receive greater attention in the campaign contest than more important issues. An example of a campaign in which the least important issue dominates can be seen in Figure 6. While the result follows from Lemma 6, the conclusion is more general and extends beyond the case of $g'(x) \approx 0$. Consider for example a campaign contest in the spirit of **?** or Dragu and Fan (2016), i.e. a campaign in which $f'(x) = 0$ and $g'(x) > 0$. Let there be three issues and assume $(\tilde{\sigma}^1, \tilde{\sigma}^2, \tilde{\sigma}^3) = (\epsilon, 0, -\epsilon)$ for some $\epsilon > 0$.[14] For *any* $\varphi^2 \in (0,1)$ and $\varphi^1 = \varphi^3 = \frac{1-\varphi^2}{2} > 0$, issue 2 will be neglected, no matter which issue is deemed most important. If $\varphi^2 > 1/3$, issue 2 is the most important issue. If $g'(x)$ is sufficiently large, however, the other two issues will be addressed by the respective candidate enjoying a comparative advantage, and thus again the least important issues may dominate the campaign agenda, if in a corner equilibrium.

[14] For example, if $\theta^1 = \theta^2 + \epsilon \in (0,1)$ and $\theta^3 = \theta^2 - \epsilon \in (0,1)$, such a situation would be given.

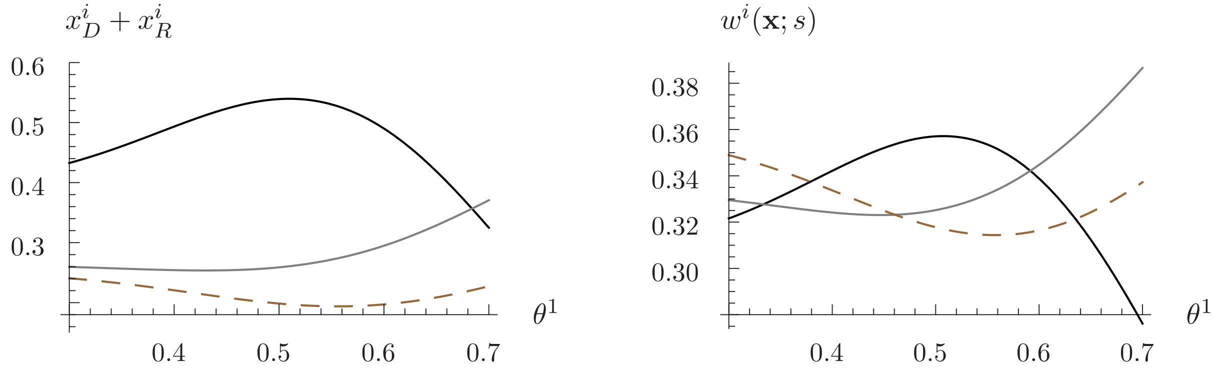

Figure 6: Aggregate spending on the issues (left panel) and after-campaigning issue importance (right panel), respectively as a function of $\theta^1 \in [\frac{3}{10}, \frac{7}{10}]$. $f(x) = (\frac{1}{100} + 4x)^{\frac{2}{3}}$, $g(x) = (\frac{1}{8} + 4x)^{\frac{2}{3}}$, $\theta^2 = \frac{3}{4}$, $\theta^3 = \frac{4}{5}$, $\varphi^1 = \frac{8}{30}$, $\varphi^2 = \frac{10.5}{30}$, and $\varphi^3 = \frac{11.5}{30}$. The solid black curves represent issue 1, the gray curves issue 2, and the dashed and brown curves issue 3, respectively. We can see that although issue 3 is the most important one from an ex-ante perspective, candidates spend the most on the least important one, issue 1, for a large range of parameters, and issue 3 never receives the greatest share of total spending. Moreover, for intermediate values of θ^1, issue 1 becomes the most important issue on Election Day, although the voter valued both other issues significantly higher at the campaign outset, and issue 3, the formerly most important one, becomes the least important.

Proposition 12 shows that relatively unimportant issues may receive the greatest attention in the campaign contest. As we saw the reason for this finding is that spending on issue i tends to increase in $E[\theta_v^i(1-\theta_v^i)\varphi_v^i]$. This seems to imply that more important issues are targeted with greater intensity, if no comparative advantages exist, because, in this case, loosely speaking, the most important differences between the issues relate to the issues' relative importance, φ_v^i. Unfortunately, because of the complexity of the game a general result relating to this is not available.[15] Hence, I turn to a simplified version of the game. In this case the model offers a crisp result. To wit:[16]

Proposition 13. *Assume $f(x) = x$, $g(x) = \eta + x$, $\eta > 0$, and that there is a representative voter. If there are no comparative advantages, in a convergent equilibrium a more important issue is targeted with greater intensity than a less important issue. Formally, if $\theta^i = \theta \forall i$, in any convergent equilibrium with $x_D^i = x_R^i = x^i$, $\varphi^i > \varphi^k \Leftrightarrow x^i > x^k$.*

B.2.4 Dispersion Equilibria

So far I have assumed all equilibria are interior, that is both candidates spend positive amounts on all issues. However, in the end of the last section I mentioned that, if advertising is not effective, there might be equilibria in which only a subset of issues is targeted by candidates and that candidates

[15]The reason is that those conditions, which guarantee that effort in a convergent equilibrium decreases in an issue's importance, seem to violate the second order conditions, such that the symmetric equilibrium does not exist in the first place.

[16]In the simplified model I assume $f(x) = x$, which violates Assumption 3 because now $f(0) = 0$, implying candidates' utilities are not continuous anymore, and thus we cannot use standard proofs to guarantee existence of equilibrium. However, we can show explicitly that equilibrium exists.

may diverge by selectively campaigning on issues. This is in line with Riker's (1996) predictions regarding how candidates should select issues: "*When one side has an advantage on an issue, the other side ignores it; but when neither side has an advantage, both seek new and advantageous issues*" (page 106). He coined the former the *dominance principle* and the latter the *dispersion principle*. The theoretical literature on campaign contests so far has mostly focussed on models in which the dominance principle holds, see for example Amorós and Puy (2013), **?**, or Dragu and Fan (2016). In this section I provide a sufficient condition for such 'dispersion equilibria.'

Let us start with an example. There is one representative voter and two issues, 1 and 2, with $\theta^1 = \theta^2 = \frac{4}{5}$. Thus there are no comparative advantages and Candidate D has a significant absolute advantage in both issues. Moreover, let $\varphi = \frac{4}{5}$. Then the marginal benefit of spending on 1 is significantly higher than the one from spending on 2. If $\frac{16}{125} \geq \frac{f(0)}{f'(0)} \geq \frac{4}{125}$, concavity of payoffs implies that both candidates will spend effort only on 1 and neglect 2. If $\frac{16}{125} < \frac{f(0)}{f'(0)}$ there will be no campaigning whatsoever. This holds more generally:

Proposition 14 (Riker's Dispersion Principle)**.** *Let $\tilde{\sigma}^i = 0 \forall i$ such that a symmetric equilibrium exists. A sufficient condition for issue i being neglected, $x^i = 0$, is*

$$E\left[\theta_v^i(1-\theta_v^i)\,\varphi_v^i\right] \leq \frac{f(0)}{f'(0)}.$$

Under this condition the dispersion principle due to Riker holds.

Note that this is only a sufficient condition for the dispersion principle to hold in issue i. An issue's importance is determined endogenously and thus, when candidates spend on some issue $k \neq i$ but not on i, $w^i(\mathbf{x}; s) < \varphi^i$. This implies that also when the condition in the proposition is violated, the dispersion principle will hold for some parameter values because spending on other issues decreases issue i's importance.

How does this change if candidates have comparative advantages? The candidate with the comparative advantage is more likely to campaign on an issue, while the candidate without a comparative advantage is more likely to mute an issue. This is straightforward and follows the intuitions derived earlier. Hence, there are situation in which just one candidate campaigns on a certain issue, while the other neglects it. In such situations Riker's dominance principle holds.

B.3 Discussion

B.3.1 Uniqueness of Equilibrium

So far we have not discussed the issue of potential multiplicity of equilibria. But in contest games like the one presented here, that is with endogenous prizes–here $w^i(\mathbf{x})$ depends on $\mathbf{x}$–multiplicity is often an issue, in particular when prices increase in spending. For example, Denter and Sisak (2015) show that if campaigning is very effective, there might be multiple equilibria in dynamic campaigning models and a candidate's strength may change endogenously. Chowdhury and Sheremeta (2011) study sufficient conditions guaranteeing multiplicity of equilibria in symmetric one-shot contest games. In the current model, this might be the case as well, depending on campaigning technologies and the electorate's priors. This is easiest seen when $f(x) = a + x$ and $g(x) = 2a + x$. Then, if $\theta^i = \frac{1}{2}$ for all i and $\varphi^i = \frac{1}{n}$, all spending profiles fulfilling $\sum_{i=1}^n x^i_j = 1/4 - na$, $x^i_j \geq 0$, are equilibria of this game. However, note that for large enough ζ (the parameter governing the derivatives of $g(x)$ discussed in Assumption 4) but $\zeta < \bar{\zeta}$, the equilibrium must be unique. Loosely speaking, the reason is that the equilibrium is in fact unique when $\zeta \geq \bar{\zeta}$, which follows for example from Lemma 1 in Hoffmann and Rota-Graziosi (2012), and continuity of the first-order conditions implies that this property must be preserved when ζ decreases slightly, starting at $\bar{\zeta}$. Intuitively, if best-responses only intersect once when $\zeta \geq \bar{\zeta}$, for some ζ slightly lower than $\bar{\zeta}$ this must remain true. However, independent of the number of equilibria, the content of the results derived in this paper remains valid.

B.3.2 Differences in Campaign Funds

Throughout the analysis we have assumed that candidates have identical financial means, that is that their marginal costs of campaigning are identical. How important is this for our results? First, note that whether or not a candidate campaigns heavily on her weak issue does not directly depend on marginal costs differences, and the same is true for campaign agendas. However, for convergence those differences matter. With asymmetric costs of campaign funds, no perfectly converging equilibrium can exist, at least when convergence is measured as differences in *absolute* spending on an issue. Of course, it is then the question whether absolute differences in spending can be interpreted as differences in emphasis. Sigelman and Buell (2004) and Kaplan et al. (2006) argue that in this case other measures for convergence, that take into account for example differences in the fractions of campaign budgets devoted to the different issues, are more meaningful. And relative convergence is still possible. For example, if there is a single voter, if there are no comparative advantages, and if $\varphi^i = 1/n$, then complete convergence in relative spending is again equilibrium.

C Mathematical Appendix to the general model

C.1 Proof of Proposition 9

Note that candidates' strategy spaces are compact, although candidates might choose any spending profile from $\mathbb{R}^n_+$. The reason is that spending more than one unit of effort on any issue is always strictly dominated by spending zero, such that the relevant strategy space is $[0, 1]^n$, which is convex and compact. Also note that individual payoff functions are continuous in all variables by Assumptions 3 and 4. To ensure existence of a pure strategy Nash equilibrium, it hence suffices to show that payoff functions are strictly concave in the own actions.

To show concavity, we assume first $\zeta = \bar{\zeta}$, implying $\frac{\partial g(x;\bar{\zeta})}{\partial x} = 0$, and show that the proposition holds. A continuity argument then proves that the proposition must also hold for some $\zeta < \bar{\zeta}$.

A candidate's payoff function is strictly concave, if the Hessian is negative definite, i.e. if the leading principal minors d^k of the Hessian alternate in sign and $d^1 < 0$. Consider the first derivative of a candidate's payoff function with respect to x_j^i:

$$\begin{aligned}\frac{\partial \pi_j(\mathbf{x};s)}{\partial x_j^i} &= E\left[\frac{\partial c_v^i(\mathbf{x};s)}{\partial x_j^i} w_v^i\right] - 1 \\ &= E\left[\frac{\theta_v^i(1-\theta_v^i) f'(x_j^i) f(x_{-j}^i)}{(\theta_v^i f(x_D^i) + (1-\theta_v^i) f(x_R^i))^2} w_v^i\right] - 1\end{aligned}$$

This is independent of all x_j^{-i} and hence all

$$\frac{\partial^2 \pi_j(\mathbf{x};s)}{\partial x_j^i \partial x_j^k} = 0 \;\forall k \neq i$$

Therefore, all entries except those on the main diagonal are zero and the Hessian is a diagonal Matrix. The determinant of a diagonal matrix equals the product of the elements on the diagonal. To determine the sign of the second derivatives we hence only need to check

$$\begin{aligned}\frac{\partial^2 \pi_j(\mathbf{x};s)}{\partial (x_j^i)^2} &= E\left[\frac{\partial^2 c_v^i(\mathbf{x};s)}{\partial (x_j^i)^2} w_v^i\right] \\ &= E\left[\frac{\theta_v^i(1-\theta_v^i) f(x_{-j}^i)\left\{f''(x_j^i) - 2\left[\theta_v^i f(x_D^i) + (1-\theta_v^i) f(x_R^i)\right] f'(x_j^i)^2\right\}}{(\theta_v^i f(x_D^i) + (1-\theta_v^i) f(x_R^i))^3}\right].\end{aligned} \tag{C.1}$$

By Assumption 3, (C.1) is strictly negative, implying each candidate's payoff function is strictly concave in his own strategy when $\zeta = \bar{\zeta}$. Each entry on the main diagonal of the Hessian is negative and the leading principal minors alternate in sign. Since the determinant of a square matrix is a continuous function of its entries and all entries are continuous in ζ, the determinant must also be continuous in ζ. Hence, the candidates' payoff functions must be strictly concave in their own efforts also for some $\zeta \in [\tilde{\zeta}, \bar{\zeta}]$. This assures existence of pure strategy equilibrium in this intervall by the Debreu, Glicksberg, and Fan (1952) theorem (see for example Theorem 1.2 in Fudenberg and Tirole (1991)). If $f'(0) = \mu$ sufficiently large, an interior pure strategy equilibrium exists, which can easily be seen from the first order conditions, $E\left[\theta_v^i(1-\theta_v^i)\varphi_v^i\right] = 0$ is excluded by assumption.

C.2 Proof of Fact 1

Assume to the contrary that one candidate has no comparative advantage, say Candidate R, but that Candidate D has at least one comparative advantage. Then, $\sum_{i=1}^n \sigma^i(\mathbf{x};s) > 0$, where

$$\begin{aligned}\textstyle\sum_{i=1}^n \sigma^i(\mathbf{x};s) &= \textstyle\sum_{i=1}^n E\left[w_v^i(\mathbf{x};s)\left(c_v^i(\mathbf{x};s) - \bar{c}(\mathbf{x};s)\right)\right] \\ &= E\left[\textstyle\sum_{i=1}^n w_v^i(\mathbf{x};s) c_v^i(\mathbf{x};s) - \sum_{i=1}^n w_v^i(\mathbf{x};s)\bar{c}(\mathbf{x};s)\right] \\ &= E\left[\bar{c}(\mathbf{x};s) - \bar{c}(\mathbf{x};s)\textstyle\sum_{i=1}^n w_v^i(\mathbf{x};s)\right] = E\left[\bar{c}(\mathbf{x};s) - \bar{c}(\mathbf{x};s)\right] = 0.\end{aligned}$$

That contradicts $\sum_{i=1}^{n} \sigma^i(\mathbf{x}; s) > 0$. Hence, There are either no comparative advantages or each candidate has at least one.

C.3 Proof of Proposition 10

Remember from (B.5) that the first order conditions in issue i, which have to hold in an interior equilibrium, can be written as

$$\begin{aligned} \frac{\partial \pi_D(\mathbf{x}; s)}{\partial x_D^i} &= E\left[\frac{\partial c_v^i(\mathbf{x}; s)}{\partial x_D^i} w_v^i(\mathbf{x}; s) + \sum_{k \neq i} \left(c_v^k(\mathbf{x}; s) - c_v^i(\mathbf{x}; s)\right) \frac{\partial w_v^k(\mathbf{x}; s)}{\partial x_D^i}\right] - 1 \overset{!}{=} 0, \\ \frac{\partial \pi_R(\mathbf{x}; s)}{\partial x_R^i} &= E\left[-\frac{\partial c_v^i(\mathbf{x}; s)}{\partial x_R^i} w_v^i(\mathbf{x}; s) - \sum_{k \neq i} \left(c_v^k(\mathbf{x}; s) - c_v^i(\mathbf{x}; s)\right) \frac{\partial w_v^k(\mathbf{x}; s)}{\partial x_D^i}\right] - 1 \overset{!}{=} 0, \end{aligned}$$

since $\frac{\partial w_v^k(\mathbf{x}; s)}{\partial x_R^i} = \frac{\partial w_v^k(\mathbf{x}; s)}{\partial x_D^i}$. After simple manipulations we can rewrite this as

$$E\left[\left(\frac{\partial c_v^i(\mathbf{x}; s)}{\partial x_D^i} + \frac{\partial c_v^i(\mathbf{x}; s)}{\partial x_R^i}\right) w_v^i(\mathbf{x}; s)\right] = -2E\left[\sum_{k \neq i} \left(c_v^k(\mathbf{x}; s) - c_v^i(\mathbf{x}; s)\right) \frac{\partial w_v^k(\mathbf{x}; s)}{\partial x_D^i}\right]. \tag{C.2}$$

The RHS relates to comparative advantages, the LHS to differences in spending, as we will show now.

Take a look at the LHS first:

$$\begin{aligned} &E\left[\left(\frac{\partial c_v^i(\mathbf{x}; s)}{\partial x_D^i} + \frac{\partial c_v^i(\mathbf{x}; s)}{\partial x_R^i}\right) w_v^i(\mathbf{x}; s)\right] = E\left[\frac{\theta_v^i(1-\theta_v^i)\left\{f'(x_D^i) f(x_R^i) - f(x_D^i) f'(x_R^i)\right\}}{\left(\theta_v^i f(x_D^i) + (1-\theta_v^i) f(x_R^i)\right)^2} w_v^i(\mathbf{x}; s)\right] \\ &= E\left[\frac{\theta_v^i(1-\theta_v^i)}{\left(\theta_v^i f(x_D^i) + (1-\theta_v^i) f(x_R^i)\right)^2} w_v^i(\mathbf{x}; s)\right] \left\{f'(x_D^i) f(x_R^i) - f(x_D^i) f'(x_R^i)\right\} \end{aligned}$$

The expected value in the first term is strictly positive and hence the sign of the whole expression depends solely on the second term. The second term is positive (negative/zero) whenever $x_D^i < x_R^i$ ($>$/$=$). This follows from

$$\frac{d\frac{f'(x)}{f(x)}}{dx} = \frac{f''(x) f(x) - f'(x)^2}{f(x)^2} < 0 \tag{C.3}$$

whenever $f(x)$ is log-concave, which follows from Assumption 3. Hence, to prove the proposition it remains to be shown that the RHS of (C.2) is negative whenever

$$\sigma^i(\mathbf{x}; s) = E\left[w_v^i(\mathbf{x}; s)\left(c_v^i(\mathbf{x}; s) - \sum_{k=1}^{n} w_v^k(\mathbf{x}; s) c_v^k(\mathbf{x}; s)\right)\right] > 0.$$

Trivially,

$$-2E\left[\sum_{k\neq i}\left(c_v^k(\mathbf{x};s)-c_v^i(\mathbf{x};s)\right)\frac{\partial w_v^k(\mathbf{x};s)}{\partial x_D^i}\right]<0\Leftrightarrow E\left[\sum_{k\neq i}\left(c_v^k(\mathbf{x};s)-c_v^i(\mathbf{x};s)\right)\frac{\partial w_v^k(\mathbf{x};s)}{\partial x_D^i}\right]>0.$$

Moreover,

$$\frac{\partial w_v^k(\mathbf{x};s)}{\partial x_D^i}=-\frac{\varphi_v^i\varphi_v^k g'(x_D^i+x_R^i)g(x_D^k+x_R^k)}{\left(\sum_{k=1}^n\varphi_v^k g(x_D^k+x_R^k)\right)^2}=-\frac{g'(x_D^i+x_R^i)}{g(x_D^i+x_R^i)}\,w_v^i(\mathbf{x};s)\,w_v^k(\mathbf{x};s).$$

Hence,

$$\begin{gathered}E\left[\textstyle\sum_{k\neq i}\left(c_v^k(\mathbf{x};s)-c_v^i(\mathbf{x};s)\right)\frac{\partial w_v^k(\mathbf{x};s)}{\partial x_D^i}\right]>0\\
\Leftrightarrow E\left[\textstyle\sum_{k\neq i}\left(c_v^i(\mathbf{x};s)-c_v^k(\mathbf{x};s)\right)w_v^i(\mathbf{x};s)w_v^k(\mathbf{x};s)\right]>0\\
\Leftrightarrow E\left[\textstyle\sum_{k\neq i}c_v^i(\mathbf{x};s)w_v^i(\mathbf{x};s)w_v^k(\mathbf{x};s)-\sum_{k\neq i}c_v^k(\mathbf{x};s)w_v^i(\mathbf{x};s)w_v^k(\mathbf{x};s)\right]>0\\
\Leftrightarrow E\left[c_v^i(\mathbf{x};s)w_v^i(\mathbf{x};s)\textstyle\sum_{k\neq i}w_v^k(\mathbf{x};s)-w_v^i(\mathbf{x};s)\sum_{k\neq i}c_v^k(\mathbf{x};s)w_v^k(\mathbf{x};s)\right]>0\\
\Leftrightarrow E\left[c_v^i(\mathbf{x};s)w_v^i(\mathbf{x};s)(1-w_v^i(\mathbf{x};s))-w_v^i(\mathbf{x};s)\textstyle\sum_{k\neq i}c_v^k(\mathbf{x};s)w_v^k(\mathbf{x};s)\right]>0\\
\Leftrightarrow E\left[c_v^i(\mathbf{x};s)w_v^i(\mathbf{x};s)-w_v^i(\mathbf{x};s)\textstyle\sum_{k=1}^n c_v^k(\mathbf{x};s)w_v^k(\mathbf{x};s)\right]>0\\
\Leftrightarrow E\left[w_v^i(\mathbf{x};s)\left(c_v^i(\mathbf{x};s)-\textstyle\sum_{k=1}^n c_v^k(\mathbf{x};s)w_v^k(\mathbf{x};s)\right)\right]>0\Leftrightarrow\sigma^i(\mathbf{x})>0\end{gathered}$$

Consequently, in any interior equilibrium we have

$$\text{Sign}\left[x_D^i-x_R^i\right]=\text{Sign}\left[\sigma^i(\mathbf{x})\right],$$

and Candidate D spends more on an issue i than 2 if he has a comparative advantage, less if he has a comparative disadvantage, and both spend the same amount on i else.

C.4 Proof of Lemma 6

First-order conditions in issue i are

$$\begin{aligned}\frac{\partial\pi_D(\mathbf{x};s)}{\partial x_D^i}&=E\left[\frac{\partial c_v^i(\mathbf{x};s)}{\partial x_D^i}w_v^i(\mathbf{x};s)+\textstyle\sum_{k\neq i}\left(c_v^k(\mathbf{x};s)-c_v^i(\mathbf{x};s)\right)\frac{\partial w_v^k(\mathbf{x};s)}{\partial x_D^i}\right]-1=0\\
&\Leftrightarrow E\left[\frac{\partial c_v^i(\mathbf{x};s)}{\partial x_D^i}w_v^i(\mathbf{x};s)\right]=1\Leftrightarrow f'(x_D^i)f(x_R^i)E\left[\frac{\theta_v^i(1-\theta_v^i)\varphi_v^i}{(\theta_v^i f(x_D^i)+(1-\theta_v^i)f(x_R^i))^2}\right]=1,\\
\frac{\partial\pi_R(\mathbf{x};s)}{\partial x_R^i}&=E\left[-\frac{\partial c_v^i(\mathbf{x};s)}{\partial x_R^i}w_v^i(\mathbf{x};s)-\textstyle\sum_{k\neq i}\left(c_v^k(\mathbf{x};s)-c_v^i(\mathbf{x};s)\right)\frac{\partial w_v^k(\mathbf{x};s)}{\partial x_D^i}\right]-1=0\\
&\Leftrightarrow E\left[\frac{\partial c_v^i(\mathbf{x};s)}{\partial x_R^i}w_v^i(\mathbf{x};s)\right]=1\Leftrightarrow f'(x_R^i)f(x_D^i)E\left[\frac{\theta_v^i(1-\theta_v^i)\varphi_v^i}{(\theta_v^i f(x_D^i)+(1-\theta_v^i)f(x_R^i))^2}\right]=1.\end{aligned}$$

Note that

$$f'(x_D^i)f(x_R^i)E\left[\frac{\theta_v^i(1-\theta_v^i)\varphi_v^i}{(\theta_v^i f(x_D^i)+(1-\theta_v^i)f(x_R^i))^2}\right]=1=f'(x_R^i)f(x_D^i)E\left[\frac{\theta_v^i(1-\theta_v^i)\varphi_v^i}{(\theta_v^i f(x_D^i)+(1-\theta_v^i)f(x_R^i))^2}\right]$$
$$\Leftrightarrow f'(x_D^i)f(x_R^i)=f'(x_R^i)f(x_D^i)\Leftrightarrow x_D^i=x_R^i=x^i.$$

Hence, spending is determined by

$$\frac{f'(x^i)f(x^i)}{f(x^i)^2}E\left[\theta_v^i(1-\theta_v^i)\varphi_v^i\right]=1\Leftrightarrow\frac{f(x^i)}{f'(x^i)}=E\left[\theta_v^i(1-\theta_v^i)\varphi_v^i\right],$$

and therefore the greater is $E\left[\theta_v^i(1-\theta_v^i)\varphi_v^i\right]$, the greater is x^i (this follows immediately from (C.3)). Moreover, since $\frac{f(x^i)}{f'(x^i)}$ is monotonic, the equilibrium is unique.

C.5 Proof of Proposition 13

From the FOC in (B.5) it follows than in an interior convergent equilibrium, that is when $x_D^i=x_R^i=x^i>0$, the following must hold:

$$c^i(\mathbf{x};s)(1-c^i(\mathbf{x};s))w^i(\mathbf{x};s)\tfrac{f'(x^i)}{f(x^i)}-1=0\Leftrightarrow\theta(1-\theta)\tfrac{\varphi^i(\eta+2x^i)}{\sum_{k=1}^n\varphi^k(\eta+2x^k)}\tfrac{1}{x^i}=1$$
$$\Leftrightarrow x^i=\theta(1-\theta)\tfrac{\varphi^i(\eta+2x^i)}{\sum_{k=1}^n\varphi^k(\eta+2x^k)}$$

Summing over all i yields

$$\sum_{i=1}^n x^i=\sum_{i=1}^n\theta(1-\theta)\frac{\varphi^i(\eta+2x^i)}{\sum_{k=1}^n\varphi^k(\eta+2x^k)}=\theta(1-\theta)\sum_{i=1}^n\frac{\varphi^i(\eta+2x^i)}{\sum_{k=1}^n\varphi^k(\eta+2x^k)}=\theta(1-\theta).$$

We can use this to simplify the above expression:

$$x^i=\theta(1-\theta)\frac{\varphi^i(\eta+2x^i)}{\sum_{k=1}^n\varphi^k(\eta+2x^k)}=\theta(1-\theta)\frac{\varphi^i(\eta+2x^i)}{\eta+2\sum_{k=1}^n x^k}=\theta(1-\theta)\frac{\varphi^i(\eta+2x^i)}{\eta+2\theta(1-\theta)},$$

where the second equality sign follows from $\sum_{i=1}^n\varphi^i=1$. Solving for x^i reveals the equilibrium spending on issue i in a convergent equilibrium (that is, assuming second order conditions hold, which is guaranteed for sufficiently large η):

$$x^{i*}=\frac{\theta(1-\theta)\varphi^i\eta}{2\theta(1-\theta)(1-\varphi^i)+\eta}>0$$

This is the equilibrium spending in *any* convergent equilibrium. To prove the proposition take the derivative of x^{i*} with respect to φ^i:

$$\frac{\partial x^{i*}}{\partial\varphi^i}=\frac{\eta(1-\theta)\theta(\eta+2(1-\theta)\theta)}{(2\theta(1-\theta)(1-\varphi^i)+\eta)^2}>0$$

Thus, in a convergent equilibrium, a more important issue receives greater attention during the campaign contest. Note that for η or $\theta(1-\theta)$ too small, the second order conditions are violated. In that case the convergent equilibrium does not exist. If $\eta \to \infty$, the equilibrium converges to the standard Tullock contest equilibrium without endogenous prices (see for example Konrad, 2009).

C.6 Proof of Proposition 14

Without comparative advantages, a symmetric equilibrium exists, $x_D^i = x_R^i = x^i$. Then $\sigma^i(\mathbf{x}) = 0$ for all i and thus the first derivative of the payoff function of candidate j with respect to campaigning on issue i is

$$\frac{\partial \pi_j(\mathbf{x}; s)}{\partial x_j^i} = E\left[\theta_v^i(1-\theta_v^i)\, w_v^i(\mathbf{x})\right] \frac{f'(x_j^i)}{f(x_j^i)} - 1.$$

Note that the ratio $\frac{f'(x_j^i)}{f(x_j^i)}$ is strictly decreasing in x^i (see (C.3)). Further note that $w^i(\mathbf{x})$ decreases in x^{-i}. Hence, a sufficient condition for a corner equilibrium is found by letting $w^i(\mathbf{x}) = \varphi^i$ and $x_j^i = 0$. If

$$\frac{\partial \pi_j(\mathbf{x}; s)}{\partial x_j^i} = E\left[\theta_v^i(1-\theta_v^i)\, \varphi_v^i\right] \frac{f'(0)}{f(0)} - 1 < 0 \Leftrightarrow E\left[\theta_v^i(1-\theta_v^i)\, \varphi_v^i\right] < \frac{f(0)}{f'(0)},$$

candidates have no incentive to campaign on issue i and therefore $x_D^i = x_R^i = 0$, implying the dispersion principle holds.

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